
8th Annual Trauma Anesthesia and Critical Care Symposium

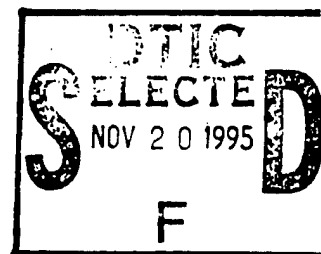
May 11-13, 1995

*The Yearly International Scientific Meeting on the
Perioperative Anesthetic and Critical Care Management of Trauma Patients*

BALTIMORE

1995

8th ATACCS

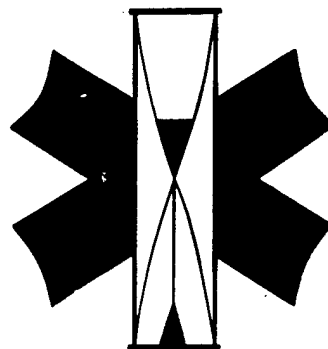


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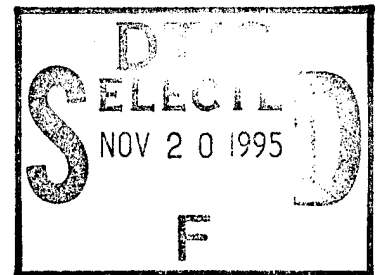
TITLE: 8th Annual Trauma Anesthesia and Critical Care Symposium

PRINCIPAL INVESTIGATOR: Christopher M. Grande

CONTRACTING ORGANIZATION: International Trauma Anesthesia and
Critical Care Society
Baltimore, MD 21211

REPORT DATE: October 1995

TYPE OF REPORT: Final Proceedings



PREPARED FOR: U.S. Army Medical Research and Materiel Command
Fort Detrick, Frederick, Maryland 21702-5012

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REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank) 2. REPORT DATE October 1995 3. REPORT TYPE AND DATES COVERED Final Proceedings (1 May 95 - 30 Sep 95)

4. TITLE AND SUBTITLE
8th Annual Trauma Anesthesia and Critical Care Symposium

5. FUNDING NUMBERS
DAMD17-95-1-5034

6. AUTHOR(S)
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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
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Baltimore, MD 21211

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Commander
U.S. Army Medical Research and Materiel Command,
Fort Detrick, Frederick, MD 21702-5012

10. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for public release;
distribution unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

Accession For	
NTIS CRA&I	☒
DTIC TAB	☐
Unannounced	☐
Justification _____	
By _____	
Distribution / _____	
Availability Codes	
Dist	Avail and/or Special
A-1	

DTIC QUALITY INSPECTED 5

14. SUBJECT TERMS
8th Annual Symposium, Anesthesia, Critical Care

15. NUMBER OF PAGES
270

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT
Unclassified

18. SECURITY CLASSIFICATION OF THIS PAGE
Unclassified

19. SECURITY CLASSIFICATION OF ABSTRACT
Unclassified

20. LIMITATION OF ABSTRACT
Unlimited

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8th Annual Trauma Anesthesia and Critical Care Symposium

May 11-13, 1995 • Baltimore, Maryland

THURSDAY, MAY 11, 1995

General Activities

- 07:00 - 08:00 Registration/Continental Breakfast
- 08:00 - 09:15 **GENERAL PLENARY SESSION**
- 08:00 - 08:25 Welcome and Introduction
Christopher M. Grande, MD, MPH
Adolph H. Giesecke, MD, President, ITACCS
John K. Stene, MD, PhD, President, ASTA
- 08:25 - 09:00 Keynote Address:
Norig Ellison, MD, President-Elect, ASA
The Role of the Anesthesiologist in Trauma Care: Past, Present, and Future
- 09:00 - 09:30 **BREAK** - Refreshments
- 09:30 - 12:15 **THURSDAY MORNING
SIMULTANEOUS SESSIONS**
- 12:15 - 13:30 **LUNCH/EXHIBITS OPEN**

SESSION A: Cutting Edge in Trauma Anesthesia *Chair: John K. Stene, MD, PhD*

- 09:30 - 10:00 Alternate Modes of Oxygen Delivery in Trauma Patients
John K. Stene, MD, PhD
- 10:00 - 10:30 Does Supranormal Oxygen Delivery Improve Trauma Critical Care?
Vladimir Kvetan, MD, FCCM
- 10:30 - 11:00 Immediate versus Delayed Fluid Resuscitation in Penetrating Trauma
Yves Lambert, MD
- 11:00 - 11:30 Update and Review of Shed Blood Reutilization
Colleen E. O'Leary, MD
- 11:30 - 12:00 In Whom Should We Economically Offer Cutting Edge Therapy: Cost Containment, Mediocrity and the Loss of the Salvageable
Michael A. Rie, MD, FACP
- 12:00 - 12:15 Discussion/Question and Answers

SESSION B: Prehospital Trauma Care: Maximum versus Optimum *Chair: John Schou, MD*

- 09:30 - 10:00 When is Prehospital Endotracheal Intubation Mandatory? When Advantageous?
Pierre A. Carli, MD
- 10:00 - 10:30 Primary Care of Amputation Injury
Sindre Mellesmo, MD
- 10:30 - 11:00 Antagonism versus Ventilation in Drug Overdose
John Schou, MD

11:00 - 11:30 Prospects of Prehospital Stabilization in Developing Countries
K. Chockalingam, MD, FRCS (Ed.)

11:30 - 12:00 Field Stabilization versus Scoop and Run: Different Priorities for Different Injuries
Charles D. Deakin, MA, MRCP, FRCA

12:00 - 12:15 Discussion/Questions and Answers

SESSION C: Recent Advances in Anesthetic Agents and Techniques for Trauma *Chair: Peter J.F. Baskett, MB, ChB, FFARCS*

- 09:30 - 09:55 Propofol in Trauma Anesthesia
David Coates, MB, ChB, FRCA
- 09:55 - 10:20 Benzodiazepines and Flumazenil in Trauma Anesthesia
Markus Lipp, MD
- 10:20 - 10:45 Lazaroids in Trauma Anesthesia
Pierre A. Carli, MD
- 10:45 - 11:10 Desflurane in Trauma Anesthesia
Brian G. McAlary, MD
- 11:10 - 11:35 Mivacurium in Trauma Anesthesia
Louis M. Guzzi, MD, MAJ, MC
- 11:35 - 12:00 Rocuronium in Trauma Anesthesia
Kenneth J. Abrams, MD
- 12:00 - 12:15 Discussion/Questions and Answers

SESSION D: Trauma Anesthesia Research Forum: Overview and Sources of Funding *Chair: Enrico M. Camporesi, MD*

- 09:30 - 09:55 ITACCS Research Program
Enrico M. Camporesi, MD
- 09:55 - 10:20 Clinical Research in Trauma Anesthesia
Bruce F. Cullen, MD
- 10:20 - 10:45 Basic Science Research in Trauma Anesthesia
Ronald G. Pearl, MD, PhD
- 10:45 - 11:10 Biotechnology Research in Trauma Anesthesia
Vladimir Kvetan, MD
- 11:10 - 11:35 Update on 1993 ITACCS Prospective Research Grant Award (Diaphragmatic Failure and Ventilatory Weaning)
Massimo Ferrigno, MD
- 11:35 - 12:00 Research Opportunities for Trauma in the Emerging World
Nguyen D. Kien, PhD
- 12:00 - 12:15 Discussion/Questions and Answers

DID YOU KNOW THAT MANY EMS SYSTEMS REQUIRE THAT PROFESSIONALS WHO MANAGE TRAUMA OBTAIN AS MANY AS 20 CREDIT HOURS ANNUALLY AND SPECIFICALLY IN TRAUMA?

MAY 11, 1995 • THURSDAY AFTERNOON SIMULTANEOUS SESSIONS

General Activities

- 13:30 All Sessions Commence
- 15:15 - 15:45 ALL SESSIONS BREAK
Visit Exhibits, Refreshments
- 17:30 All Sessions Adjourn
- 17:30 - 19:00 **WELCOME RECEPTION IN EXHIBITION AREA**
- 19:30 - 21:30 ITACCS Annual Board of Directors Meeting

SESSION A: Difficult Airway Management for Trauma Part I: Didactic Discussions *Chairs: Kenneth J. Abrams, MD Elizabeth C. Behringer, MD*

- 13:30 - 13:55 Airway Evaluation in Trauma
Steven J. Tryfus, MD
- 13:55 - 14:15 Bullard Laryngoscope and Retraction Blades
Kenneth J. Abrams, MD
- 14:15 - 14:35 Laryngeal Mask Airway/Bougies/Stylets in Trauma
Jerry P. Nolan, MB, ChB, FFARCS
- 14:35 - 14:55 Augustine Guide in Trauma
Anthony L. Kovac, MD
- 14:55 - 15:15 Retrograde Intubations/Surgical Airways
Anthony Sanchez, MD
- 15:45 - 16:15 Lung Separation in Trauma
Elizabeth C. Behringer, MD
- 16:15 - 16:40 Esophageal Detectors in Trauma
Mohammed Ramez Salem, MD
- 16:40 - 17:05 Esophageal Tracheal Combitude
Markus Lipp, MD
- 17:05 - 17:30 McCoy Laryngoscope in Trauma
Eamon P. McCoy, MB, FFARCSI

SESSION B: Pain Management and Regional Anesthesia for Trauma *Chair: Andrew D. Rosenberg, MD*

- 13:30 - 14:00 Prehospital Techniques
Pierre A. Carli, MD
- 14:00 - 14:20 Upper Extremity Regional Anesthesia
David B. Albert, MD
- 14:20 - 14:40 Lower Extremity Regional Anesthesia
Andrew D. Rosenberg, MD
- 14:40 - 15:00 Post Operative Pain Management
Mitchell H. Marshall, MD
- 15:00 - 15:15 Reflex Sympathetic Dystrophy
Ralph L. Bernstein, MD
- 15:45 - 17:30 **SPECIAL HANDS-ON WORKSHOP**
ATACCS Delegates will be divided into subgroups and have the opportunity to rotate through intensive hands-on skills stations featuring applications of the principles and techniques discussed during the didactic portion to the trauma setting.

SESSION C: Military Medicine and Trauma Anesthesia *Chair: Louis M. Guzzi, MD, MAJ, MC*

- 13:30 - 13:45 Introduction: Military Roles for Anesthetists
Louis M. Guzzi, MD, MAJ, MC
- 13:45 - 14:30 The Somalia Experience
*Michael Matson, MD, LTC, MC
Doug J. Rutkowski, CRNA, CPT, ANC*
- 14:30 - 15:00 Advanced Work and Development on Field Anesthesia Machine Systems
Stephen Janny, MHS, CRNA, LTC, ANC
- 15:00 - 15:15 Current Role in Anesthesia Trauma Research: USAMRMC
Dean E. Calcagni, MD, LTC, MC
- 15:45 - 16:00 Brief Overview of Efforts on Establishment of Training on Field Anesthesia in CONUS
Douglas Anderson, MD, LTC, MC
- 16:00 - 17:30 Hands-On Workshop: Army Field Anesthesia Machine (885A FAM)
*Paul C. Reynolds, MD, LTC, MC
Michael E. Lenczyk, MD, MAJ, MC
Stephen Janny, CRNA, LTC, ANC
William Clayton Petty, MD, CPT, MC, USN
Denver Perkins, MD, COL, MC
Vance Gainor, CRNA, CDR, NC, USN*

SESSION D: Special CRNA Session: Trauma Anesthesia BY CRNA's - FOR CRNA's *Chair: Charles R. Barton, CRNA, MEd*

- 13:30 - 14:00 Management of Complications Related to Invasive Monitoring in the Trauma Patient
Patricia G. Taub, CRNA, BS
- 14:00 - 15:15 Anesthetic Management of the Traumatized Pediatric Patient
Charles R. Barton, CRNA, MEd
- 15:45 - 16:15 Pain Management for the Patient with Orthopedic Trauma
Steven J. Zito, CRNA, MS
- 16:15 - 17:00 Anesthetic Management of Thoracic Trauma
Charles R. Barton, CRNA, MEd
- 17:00 - 17:30 Anesthetic Management of Abdominal Trauma
Charles R. Barton, CRNA, MEd

SESSION E: Scientific Free Papers and Posters I *Chair: Enrico M. Camporesi, MD*

- Moderators: Free Papers
*Colin F. Mackenzie, MD
Bruce F. Cullen, MD*
- Moderators: Posters
*Ronald G. Pearl, MD, PhD
John K. Stene, MD, PhD*

SESSION F: Satellite Seminar

- 13:30 - 15:15 Issues in Perioperative Hypothermia in the Trauma Patient
Sponsored by an unrestricted educational grant from Level One Technologies.

MAY 12, 1995 • FRIDAY MORNING SIMULTANEOUS SESSIONS

General Activities

- 07:30 - 08:00 Continental Breakfast
- 08:00 All Sessions Commence
- 09:45 - 10:15 ALL SESSIONS BREAK
Visit Exhibits, Refreshments
- 12:15 - 13:30 LUNCH/EXHIBITS OPEN

SESSION A: Special Equipment and Techniques for Trauma *Chair: Louis M. Guzzi, MD, MAJ, MC*

- 08:00 - 08:05 Introduction to Special Techniques and Equipment for Trauma
Louis M. Guzzi, MD, MAJ, MC
- 08:05 - 08:35 Research and Development of Ultra-Long Acting Local Anesthetics: Potential Utilization in Field Anesthesia
Benjamin H. Boedecker, MD, MAJ, MC
- 08:35 - 09:05 Implementation of Target-Controlled Anesthesia and Analgesia in the Austere Situation and Forward Casualty Care
W. Bosseau Murray, M.D.
- 09:05 - 09:45 Portable Ventilators and Monitors for Trauma Anesthesia
Rusty T. Reid, RCP, RRT
- 10:15 - 11:00 LSTAT™: Life Support for Trauma and Transport: Innovative Role in Forward Casualty Care
William P. Weismunn, MD, COL, MC
- 11:00 - 12:15 SPECIAL HANDS-ON WORKSHOP: Equipment Review and Demonstrations – Portable Ventilators, Portable Monitors, Cricothyroidotomy Sets, Needle Thoracostomy Sets, LSTAT™, Emergency Medical Manager™, TCCM™, Portable Capnography

SESSION B: Trauma, Anesthesia, Critical Care: Interfaces *Chairs: David T. Porembka, DO, FCCM Thomas M. Fuhrman, MD, FCCM, FCCP*

- 08:00 - 08:35 New Insights in CPR: Have we Reached the Limits?
Nicholas G. Bircher, MD
- 08:35 - 09:10 Traumatic Brain Injury: Innovative Monitoring and Therapy
Donald S. Prough, MD
- 09:10 - 09:45 Analgesia and Sedation: Modification of the Injury Response?
Thomas M. Fuhrman, MD, FCCM, FCCP

10:15 - 10:50 Transesophageal Echocardiography in the Critically Ill and Injured
David T. Porembka, DO, FCCM, FCCP

10:50 - 11:25 The Critical Role of Nutrition and Immune Function in the Critically Ill and Injured
Gary P. Zaloga, MD, FCCM

11:25 - 12:00 Nitric Oxide and Innovative Therapy in ARDS
Ronald G. Pearl, MD, PhD

12:00 - 12:15 Discussion/Questions and Answers

SESSION C: LOTAS: Level One Trauma Anesthesia Simulations/Human Factors in Emergencies *Chair: Colin F. Mackenzie, MD*

- 08:00 - 08:10 Introduction
Colin F. Mackenzie, MD
- 08:10 - 08:40 Communication During Management of Trauma Patients
Richard L. Horst, PhD
- 08:40 - 09:15 Videoanalysis of Tracheal Intubation for Trauma Patients
Colin F. Mackenzie, MD
- 09:15 - 09:45 Decision-Making Models in Trauma Anesthesia
Yan Xiao, PhD
- 10:15 - 10:45 Human Factors in Crisis Management
Matthew B. Weinger, MD
- 10:45 - 11:15 Panel Discussion
*Yoel Donchin, MD
Stefano Badiali, MD
Marzio G. Mezzetti, MD, PhD
LOTAS Faculty*
- 11:15 - 12:15 Special Demonstration: Opportunities on Simulators – Be the “Attending Trauma Anesthesiologist” for a Real Case from the Shock Trauma Center. Featuring: LORAL and CAE-Link Simulators and Technology
*Colin F. Mackenzie, MD
Kenneth J. Abrams, MD
Christopher M. Greene, MD*

SESSION D: Scientific Free Papers and Posters II *Chair: Enrico M. Camporesi, MD*

- Moderators: Free Papers
*Enrico M. Camporesi, MD
Bruce F. Cullen, MD*
- Moderators: Posters
*Adolph H. Giesecke, MD
John K. Stene, MD, PhD*

WHAT ROLES DO ANESTHETISTS HAVE TO PLAY IN THIS PROBLEM?

MAY 12, 1995 • FRIDAY AFTERNOON SIMULTANEOUS SESSIONS

General Activities

- 13:30 All Sessions Commence
- 15:15 - 15:45 ALL SESSIONS BREAK
Visit Exhibits, Refreshments
- 17:30 All Sessions Adjourn
- 17:45 - 18:30 ITACCS Annual General Meeting

SESSION A: Multi-Trauma: Problem-Based Learning Discussion and Case Presentations

Chair: Adolph H. Giesecke, MD

This session will take a multi-format approach including problem-based case presentations and round-table discussion of various important aspects of triage, resuscitation, choice of anesthesia, fluid therapy and post-operative care.

ATACCS delegates will receive the case material in advance and thus have an opportunity to actively participate in an interactive format.

Panelists: *Elizabeth A.M. Frost, MD*
Thomas E. Knuth, MD, MPH
Mark Murphy, MD
Joseph M. Rustick, MD
Vance E. Shearer, MD

SESSION B: Difficult Airway Management for the Trauma Patient, Part II: Round-Table Discussions and Hands-On Workshop

Chairs: Kenneth J. Abrams, MD
Elizabeth C. Behringer, MD

SPECIAL HANDS-ON WORKSHOP:

This session will begin with representative case presentations of controversial clinical issues and the use of special management techniques. Audience participation is emphasized in the form of questions and answers and commentary dialogue. The second portion of the session will feature "hands-on" skill stations such as fiberoptic intubation procedures, protection of cervical spine injury and performing cricothyroidotomy and other techniques covered during Part I of the Workshop.

SESSION C: Pediatric Trauma Anesthesia, Part I: Didactic Discussion

Chair: Jeffrey M. Berman, MD

- 13:30 - 14:05 Airway Management of the Pediatric Trauma Patient
Timothy W. Martin, MD
- 14:05 - 14:40 Vascular Access in the Pediatric Trauma Patient
John K. Hall, MD, FRCPC
- 14:40 - 15:15 Transfusion Guidelines for Pediatric Trauma: When? Why? How Much?
Gail E. Rasmussen, MD
- 15:45 - 16:20 Anesthetic Management of Pediatric Head Injury
Phillipe G. Meyer, MD
- 16:20 - 16:55 Pain Management in the Pediatric Trauma Patients
Joseph D. Tobias, MD
- 16:55 - 17:30 Discussion/Questions and Answers

SESSION D: Trauma Anesthesia Simulators

The LOTAS Faculty

SPECIAL HANDS-ON WORKSHOP:

Opportunities on Simulators – Be the "Attending Trauma Anesthesiologist" for a Real Case from the Shock Trauma Center. Featuring: LORAL and CAE-Link Simulators and Technology. A limited number of delegates will have the opportunity for an extended experience with current simulator technology and scenarios adapted especially for trauma anesthesia. The group will be divided into sections and rotate between the different simulators.

SESSION E: Satellite Seminars

- 08:00 - 09:45 Perioperative Use of Muscle Relaxants in the Trauma Patient
Sponsored by an unrestricted educational grant from Organon Pharmaceuticals
- 10:15 - 12:45 Perioperative Use of Propofol in the Trauma Patient
Sponsored by an unrestricted educational grant from Zeneca Pharmaceuticals
- 13:30 - 15:15 Perioperative Use of Midazolam and Flumazenil in the Trauma Patient
Sponsored by an unrestricted educational grant from Roche Pharmaceuticals
- 15:45 - 17:30 Perioperative Use of Etomidate in the Trauma Patient
Sponsored by an unrestricted grant from Abbott Pharmaceuticals

MAY 13, 1995 • SATURDAY MORNING SIMULTANEOUS SESSIONS

General Activities

- 07:30 - 08:00 Continental Breakfast
 08:00 All Sessions Commence
 09:45 - 10:15 ALL SESSIONS BREAK
Visit Exhibits, Refreshments
 12:15 Conference Adjournment
 14:20 Tour of the R Adams Cowley
 Shock Trauma Center (Optional, see page 11)

SESSION A:

International Trauma Systems

Panelists: *Kenneth J. Abrams, MD*
Christopher M. Grande, MD, MPH
Louis M. Guzzi, MD, MAJ, MC
Nyugen D. Kien, PhD
Charles P. Kingsley, MD
Thomas E. Knuth, MD, MPH
Debra J. Newman, MD, MS

In roundtable format, officers and committee chairpersons of ITACCS will address the various components of a multi-faceted program currently in development, designed to fuse civilian and military trauma management systems, and be flexible enough to address the needs of the developed, developing and underdeveloped worlds, with respect to the burgeoning global trauma epidemic. In addition, representatives from notable national and international government and private agencies such as ASA, WFSA, SCCM, WHO, WAEDM, CDC, USAID, UN, US Army, ATS, AAST, AAAM, International Red Cross, PAHO, and DHHS will be invited to participate and join the development of the project.

SESSION B:

Neurotrauma: Problem-Based Learning

Discussion: Case Presentations

Chair: *Elizabeth A.M. Frost, MD*

This session will take a multi-format approach including problem-based case presentations and round-table discussion of various important aspects of triage, resuscitation, choice of anesthesia, fluid therapy and post-operative care. ATACCS Delegates will receive the case material in advance, and thus have an opportunity to actively participate in an interactive format.

- 08:00 - 08:10 Introduction
 08:10 - 08:45 Resuscitation: The Golden Hour
Kenneth J. Abrams, MD
 08:45 - 09:15 Anesthetic Management of Neurodiagnosis
Irene Osborne, MD
 09:15 - 09:45 Anesthesia for Head Injury
Elizabeth A.M. Frost, MD
 10:15 - 10:45 Post-Operative and Intensive Care of Neuro Trauma
Elizabeth C. Behringer, MD
 10:45 - 11:15 The Patient with Spinal Cord Injury
Mariano Pimental, Jr., MD
 11:15 - 11:45 Pediatric Neurotrauma
Arno H. Fried, MD
 11:45 - 12:15 Conclusions

SESSION C:

Pediatric Trauma Anesthesia, Part II: Round-Table Discussion and Hands-On Workshops

Chair: *Jeffrey M. Berman, MD*

Faculty: *A. Mazurek G. Rasmussen*
P. Meyer J. Hall
J. Berman T. Martin

SPECIAL HANDS-ON WORKSHOP:

08:00 - 09:45 Case Presentations/Panel

A roundtable panel discussion will address several case presentations of pediatric trauma. Case materials will be made available to session participants in advance to facilitate faculty-audience interaction. Following the panel the program will shift to a hands-on format in which session participants will have the opportunity to participate in three (3) special skills stations.

10:15 - 12:15 Hands-On Skills Stations

Pediatric Airway Management and C-Spine Immobilization
Aleksandra J. Mazurek, MD and
Phillipe Meyer, MD

Interosseous Infusion and Vascular Access
Jeffrey M. Berman, MD and
Gail E. Rasmussen, MD

X-Ray Interpretation: C-Spine;
 CT; Abdomen, Chest, Head
John K. Hall, MD and *Timothy N. Martin, MD*

SESSION D:

Trauma Anesthesia and Critical Care for Disasters: Multi-Media Interactive Simulation

Chair: *Vladimir Kvetan, MD*

Special Speaker: *Peter J.F. Baskett, MB, BCh, FRCA, MRCP*

Panelists: *Yoel Donchin, MD*

Derek Angus, MB, ChB, MPH, MRCP
Joseph Barbera, MD
Michael A. Olds, PA-C, NREMT-P
Lee Brent, MD
Marzio G. Mezzetti, MD, PhD
T. Michael Moles, MBBS, FFARCS, DTMH

This session will begin with a short didactic presentation on comparison of natural and manmade disasters by the special speaker titled "A Visit to Sarajevo in July 1994." Then, beginning with the explanation of the rules of engagement, moderators and members of the audience will be assigned various roles that they will assume during the simulation. The simulation will consist of a scenario of a major earthquake in an urban area complicated by HAZMAT incident involving mass toxic inhalation designed as a tabletop management mock-up model. The learning process will include problem solving of specific sequential parts of the disaster management by participants under the guidance of a panel of experts. Round-table format will also be used for regular review of the progress and final summary by the expert panel.

LET ITACCS HELP YOU MEET YOUR COMMITMENT!!!

THURSDAY, MAY 11, 1995

08:00 - 09:15 GENERAL PLENARY SESSION

08:00 - 08:25 Welcome and Introduction
Christopher M. Grande, MD, MPH
Adolph H. Giesecke, MD, President, ITACCS
John K. Stene, MD, PhD, President, ASTA

08:25 - 09:00 Keynote Address:
Norig Ellison, MD, President-Elect, ASA
The Role of the Anesthesiologist in
Trauma Care: Past, Present, and Future

UPDATE AND REVIEW OF SHED BLOOD REUTILIZATION

Colleen E. O'Leary, M.D.
Assistant Professor of Anesthesiology
SUNY Health Science Center at Syracuse
Syracuse, New York

SESSION A - 8th ATACCS - THURSDAY, 11 MAY 1995 - 11:00 a.m.

- I. History of Autologous Transfusion
- II. Overview of Current Technology
 - A. Unwashed Blood
 - 1. equipment
 - 2. product
 - 3. cost
 - B. Washed Blood
 - 1. equipment
 - 2. product
 - 3. cost
- III. Use of Shed Blood in Trauma Patients - Literature Review
 - A. Preoperative Autotransfusion
 - B. Intraoperative Autotransfusion
 - C. Postoperative Autotransfusion
- IV. Advantages to Reuse of Shed Blood in Trauma Victims
 - A. Time
 - B. Supply
 - C. Avoidance/Limitation of Risks Associated with Allogeneic Blood
 - D. Blood Quality
 - 1. 2,3 DPG levels
 - 2. temperature
 - 3. pH, K⁺

V. Problems/Controversies Associated with Utilization of Shed Blood

- A. Inadequate Blood Retrieval
- B. Infusion of Potentially Contaminated Blood
- C. Infection
- D. Coagulopathy
- E. Air Embolization

VI. Current Applications - Literature Review

- A. Traumatic Hemothorax
 - 1. use in children
- B. Intra-abdominal Trauma
- C. Spine Trauma

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Prehospital Antagonization vs. Ventilation in Drug Overdose

J. Schou, J. Deklerk, M. Scherb, J. Kübler

Dept. of Anaesthesia, County Hospital, D-79539 Lörrach, Germany

Since 1986 [1], we have utilized prehospital antagonization as an alternative to intubation and ventilation in a total of 159 patients with suspected drug- and/or alcohol-overdose. The most important results are presented in Table 1. Major complications consisted in generalized convulsions in two patients with overdose of tricyclic antidepressants who then needed anticonvulsive therapy and intubation. A potential complication was the development of a subdural haematoma in a patient who had been successfully awoken with physostigmine after an accident caused by alcohol overdose. He developed secondary coma in the hospital but it is easy to imagine that to occur after end of surveillance. Also after physostigmine, vomiting was frequently observed but, under the circumstances, not really considered a complication.

During this period, the causative agent for intoxication has changed considerably in our region, with narcotic overdose becoming the 2nd most important agent (while alcohol intoxication still dominates). While this practice initially was criticized as a violation against the guideline [2] to intubate and ventilate all comatose patients lacking protective reflexes, this practice has become mandatory for lack of capacity for admission of ventilated patients to the intensive care units. In the last two years, it was thus possible to avoid 30% of the otherwise necessary prehospital intubations and many admissions of drug addicts. This is an economic aspect to be considered with this principle.

The aim of antagonization differs with the cause of intoxication. In suicidal attempts, the antagonist, e.g. flumazenil, is titrated to enable responsiveness but not complete reversal since accept of necessary admission could be endangered. Alcohol intoxication associated

with even the slightest suspicion of cranial trauma must also lead to admission. On the contrary, the admission of drug addicts seems irrational when it is possible to avoid it, which was the fact in 53% of the patients antagonized with nalbuphine. Contrary to naloxone, nalbuphine usually causes only mild or no withdrawal symptoms (we only experienced one such strong reaction) and protects the patient against relapse for at least 5 hours.

Results/Antagonist	F	P ¹	N	Total
Intubation avoided ²	13	48	40	101
Other improval	3	30	13	46
Success:	16	78	53	147
Intubated	2	6	2	10
Intubation declined ³	1	1	—	2
Failure:	3	7	2	12
Total:	19	85	55	159

Table 1: Results related to the different antagonists. ¹ 7 patients received physostigmine (P) after flumazenil (F) or nalbuphine (N) and are here listed under the other antagonists. ² One drug addict immediately extubated himself upon awakening and disappeared. ³ Intubation not carried out due to serious disease after diagnostic use of flumazenil.

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2. Schou J. Guidelines for the use of guidelines (editorial). Prehosp Emerg Med 1993;8:19-20.

THURSDAY, MAY 11, 1995

SESSION B: Prehospital Trauma Care:
Maximum versus Optimum
Chair: John Schou, MD

09:30 - 10:00 When is Prehospital Endotracheal Intubation Mandatory?
When Advantageous?
Pierre A. Carli, MD

10:00 - 10:30 Primary Care of Amputation Injury
Sindre Mellesmo, MD

10:30 - 11:00 Antagonism versus Ventilation in Drug Overdose
John Schou, MD

11:00 - 11:30 Prospects of Prehospital Stabilization in
Developing Countries
K. Chockalingam, MD, FRCS (Ed.)

11:30 - 12:00 Field Stabilization versus Scoop and Run:
Different Priorities for Different Injuries
Charles D. Deakin, MA, MRCP, FRCA

12:00 - 12:15 Discussion/Questions and Answers

Abstract on Prospects of Prehospital Stabilization in Developing Countries

- Dr. K. Chockalingam
Devaki Hospital, Madras.

The medical care in the developing countries is fighting to keep up with the improvements of the industrialised countries. While lack of money in the former and the rapid and sophisticated development of hospital care in the latter tend to make a gap between them larger than it was before. Widened under these circumstances, talk about improving the prehospital stabilization leaves so many questions open. Raising this question relieves that it was asked by someone who think that anything occurring in the ambulance is secondary to what can be done in the hospital. In fact, a minimum or even a lack of prehospital care makes a gap between developed and industrial countries even more. In addition, much irreparable miseries which turns out are preventable had there been an improved prehospital care.

It should be very clear from the beginning that it cannot be the aim to copy the ambulance services in the industrialised countries. A fragile economy does not permit the establishment of a good ambulance service just like in the West. For instance, cardio pulmonary resuscitation, one of the major activities in the pre-hospital services in the industrialised countries may be comfortably overlooked in the first stage of the establishing prehospital emergency service. Here the priority will be to transfer the injured victim to the hospital at the earliest avoiding the second accidents that can occur.

What advise can be given to the developing countries about the prehospital stabilization? It is very important to realise that accidents are preventable and methods by which they can be prevented should be given priority. (1) The first factor is the education of the lay people to safeguard against the accidents, (2) to legislate suitable measures of safety precautions like wearing helmet, seat belt, (3) severe penalty against drunken driving should be imposed, (4) (a) Education of the lay people the first aid measures that should be taken in case of accidents like prevention of aspiration in an unconscious patient, turning the patient to one side, (b) proper splinting and proper transportation of an injured patient to the hospital, (c) prevention of active bleeding can be taught to the lay people. Here comes the necessity gradually for a proper development of an Emergency Medical Tech-

nician as they are called EMT in the West. Here it should be pointed out that with all the televisions of the world beaming on countries like India even rural people are slowly learning from reference that if an accident occurs, patient should be transported quickly by an ambulance (Golden Hour Hypothesis). A demand is coming from below to authorities for consideration of a suitable project.

Let us take the example of Madras, one of the metropolis of India. There is no suitable alarming signal to take care of the receiving calls and sending the ambulances. Though there are recent efforts by the traffic police to arrange for the Golden Hour Ambulance System with the help of hospitals both private and public, we are yet to see a viable result.

The ambulances used are merely transport vehicles and they don't contain any life saving equipments whatsoever to help the patients. So, there is a definite need that we should establish ambulance service, establish central control and the basic resuscitating equipments in each of these ambulances along with basically trained para medical personnel that go out to the patient at the spot of emergency. This should be available round the clock. The important criteria is to create ambulance crew force who are educated in basic techniques of resuscitation and use of the basic equipments.

Organisation like International Trauma Anaesthesia and Critical Care Society to formulate a list of demands that are necessary for developing the prehospital services. It should follow the following demands:-

Preventive measures

Advices for layman in trauma

Standard alarm phone number

Regional rescue Centrals

Ambulance urban reaction time

Radio communication to ambulances

Other minimal equipment demands

Content of EMT educational programmes

Defining an emergency room and stressing its accessibility

This summary will give us an impression that makes sense to develop pre-hospital care in developing countries. A better prehospital care will encourage a better intra-hospital care.

**8th INTERNATIONAL TRAUMA ANESTHESIA
AND CRITICAL CARE SOCIETY ANNUAL CONFERENCE**

Baltimore May 1995

PREHOSPITAL SESSION

Field Stabilization vs. 'Scoop and Run' - Different priorities for different injuries.

Dr. Charles D. Deakin MA MRCP FRCA,
Helicopter Emergency Medical Service,
Royal London Hospital,
London U.K.

- 1.1** Introduction.
Historical perspective.
- 2.1** Current approach to prehospital management of major trauma.
Summary and criticisms of prehospital studies.
- 2.2** Should blunt and penetrating injuries both be treated by the same approach?
Spectrum of injury.
- 3.1** Penetrating Injuries.
Historical.
- 3.2** Theoretical considerations.
- 3.3** Clinical studies.
No benefit from prehospital fluids.
Detrimental effects of prehospital fluids.
- 3.4** Animal studies.
- 4.1** Isolated head injury.
Secondary damage preventable by on scene ALS.

4.2 Results of prehospital studies.

5.1 Blunt trauma.
Encompasses both types of injury.
Approach may depend upon which injury is the most significant.

6.1 An optimum approach to prehospital ALS?

6.2 On scene scoring and its use.

7.1 Summary.

THURSDAY, MAY 11, 1995

SESSION C: Recent Advances in Anesthetic Agents
and Techniques for Trauma
Chair: Peter J.F. Baskett, MB, ChB, FFARCS

09:30 - 09:55 Propofol in Trauma Anesthesia
David Coates, MB, ChB, FRCA

09:55 - 10:20 Benzodiazepines and Flumazenil
in Trauma Anesthesia
Markus Lipp, MD

10:20 - 10:45 Lazaroids in Trauma Anesthesia
Pierre A. Carli, MD

10:45 - 11:10 Desflurane in Trauma Anesthesia
Brian G. McAlary, MD

11:10 - 11:35 Mivacurium in Trauma Anesthesia
Louis M. Guzzi, MD, MAJ, MC

11:35 - 12:00 Rocuronium in Trauma Anesthesia
Kenneth J. Abrams, MD

12:00 - 12:15 Discussion/Questions and Answers

DESFLURANE IN TRAUMA ANESTHESIA

Brian G. McAlary, M.D.

I. Introduction

A. Overview of General Anesthesia

1. Apparent advantages

- a. Secured airway/mechanical ventilation
including PEEP, deliberate hyperventilation
- b. Reduced metabolic O₂ demand
- c. Reduced likelihood of unwanted movement
- d. Greater comfort in prolonged procedure and/or
non-supine positioning
- e. Increased ease of frank dialogue
- f. Technically easier placement of invasive monitors
including IVC
- g. Better quality CT/MRI studies

2. Apparent disadvantages

- a. Inability to assess neurologic status except ICP
- b. Inability to verbalize pressure or discomfort in positioning
- c. Aspiration on induction
- d. Less effective pre and post operative pain management
- e. Incomplete block of unwanted stress responses

II. Role of Inhalation Agents in Various Settings

Isoflurane as the "Gold Standard"

A new look at an old friend

A. Pre-hospital care

1. Practical problems with delivery systems
2. Increased likelihood of hypotension
3. Requirement for specially trained personnel
4. Potential for aggravating ICP

B. Intra-operative care

1. Trauma Center

- a. Minimal decrease in cardiac function
- b. Decrease in SVR without decreased perfusion
(reduced hepatic lactate; indirect volume indicator)
- c. Minimal dysrhythmic potential in face of increased
intrinsic and extrinsic sympathomimetic agents
- d. Greater dose predictability

- e. Ability to rapidly change levels
- f. Ability to monitor levels
 - 1) fewer surprises
 - 2) more planned emergence
 - 3) differential diagnosis of delayed emergence
- g. Predictable amnesia
- h. Cost effective
 - 1) no waste
 - 2) reduced requirement for adjunctive agents
 - 3) compatible with low flow techniques
- i. Compatible with virtually all drugs
- j. Reduced probability of substance abuse
 - 1) greater availability
 - 2) greater access
- k. International familiarity
- l. Virtually non-toxic/non-allergenic
- 2. Use in Field Facility/Mass Casualty
 - a. Non-flammable
 - b. Eliminate need for N₂O
 - c. Can be used without vaporizer
 - d. Does not require scavenging
 - e. Ability to function with minimal adjustive drugs
 - f. Can be used in diverse climates

C. Post-operative Care

- 1. Predictable emergence
 - a. Independent of hepatic/renal clearance
 - b. Virtually no delayed organ failure, even with multiple repetitive administrations
 - c. No tolerance problems
 - d. Lower incidence of nausea and vomiting
 - e. Minimal probability of prolonged mechanical ventilation

D. Area of Controversy

- 1. Coronary steal

III. Potential for Desflurane (I-653)

A. Chemical Structure

fully substituted methyl ethyl ether versus alpha ethyl chlorine

B. Low solubility

- 1. Blood gas coefficient 0.42
- 2. Fa/Fi 0.82 in 5 minutes
- 3. Response to command 2.7 minutes

C. Extreme stability

1. Chemical
2. Biochemical

D. Low Potency

1. Effect on FiO_2

E. High Vapor Pressure

1. New vaporizer technology

IV. Summary

"INTRODUCTION OF THE NEW MUSCLE RELAXANTS: POTENTIAL ROLE IN TRAUMA."

Louis Guzzi, M.D.
Chief, Combat Trauma Research
Walter Reed Army Hospital
Washington, D. C.

I. INTRODUCTION

The recent release of both Mivacurium (Mivacron) and Rocuronium (Zemuron) as "rapid onset neuromuscular blockers" have expanded the role of paralytics in the field. These rapid onset and brief duration paralytics allow for the short term paralyzation of the intubated patient and potential dissipation of effect prior to arrival and evaluation in the trauma bay. This "tailoring" of neuromuscular blockade should enhance the care provided in the field and in the long run decrease cost.

II. HISTORY OF PARALYTICS

HISTORY

- 1494 - Tales of travelers killed by poison darts
- 1554 - "Ourari" or "cururu" meaning "bird-killer"
- 1812 - Curarized cat kept alive by artificial respiration
- 1912 - Lawen used curare for abdominal closure
- 1940 - Curare used to prevent fractures during ECT
- 1941 - Initial use by Griffith, Cullen, and Rovenstine
- 1951 - Succinylcholine chloride first used in Stockholm

INTRODUCTION OF NEW DRUGS

- | | |
|-------------|--|
| 1494- 1942 | Curare |
| 1947 - 1951 | Succinylcholine chloride, Gallamine
Metocurine, Decamethonium |
| 1960's | Alcuronium |
| 1970's | pancuronium bromide, Fazadinium |
| 1980's | Vecuronium bromide, Atracurium
besylate |
| 1990 | Pipecuronium bromide |
| 1991 | Doxacurium chloride |
| 1992 | Mivacurium chloride |
| 1944 | Rocuronium bromide |

III. THE IDEAL RELAXANT

THE IDEAL RELAXANT

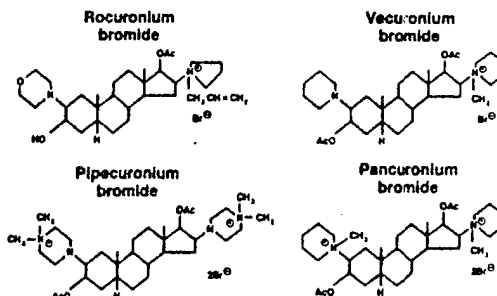
- Nondepolarizing
- Rapid onset
- Dose-dependent duration
- No side-effects
- Elimination independent of organ function
- No active or toxic metabolites

IV. STRUCTURAL CLASSES OF RELAXANTS

STRUCTURAL CLASSES OF NONDEPOLARIZING RELAXANTS

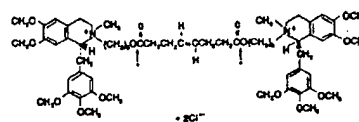
- Steroids: Rocuronium bromide, Vecuronium bromide, Pancuronium bromide, Pipecuronium bromide
- Isoquinolones: curare, metocurine
- Benzylisoquinoliniums: Atracurium besylate, Mivacurium chloride, Doxacurium chloride

MOLECULAR STRUCTURES



Adapted from: Poole, et al. Anesthesiology 75:151-158, 1991

MIVACURIUM CHLORIDE: CHEMICAL FORMULA



*Site of hydrolysis by plasma cholinesterases.

V. Mivacurium Chloride

A. Onset Of Block

ONSET OF BLOCK		
Adult Patients (Narcotic Anesthesia)		
Time from Injection to		
Dose (mg/kg)	Maximum Block (min)	$T_{95\%}$ (min)
Mivacurium 0.15	2.5 (0.9)	15.6 (3.4)
Atracurium 0.50	2.5 (0.5)	40.0 (6.9)
Succinylcholine 1.0	1.1 (0.2)	7.7 (1.4)

Values are mean (± SE).
Caldwell et al. Br J Anaesth. 1988;61:383.

B. Train Of Four Recovery

MIVACURIUM: SINGLE TWITCH AND TRAIN-OF-FOUR (T_1/T_4) RECOVERY			
Adult Patients (Narcotic Anesthesia)			
Dose (mg/kg)	Mean Time to 95% Recovery (min ± SE)	Mean Time to $T_1/T_4 \geq 70\%$ (min ± SE)	Mean Time from T_4 to $T_1/T_4 \geq 70\%$ (min ± SE)
0.10	25 ± 2	29 ± 3	3 ± 1
0.15	25 ± 2	29 ± 2	4 ± 1
0.20*	28 ± 1	31 ± 1	3 ± 1
0.25*	30 ± 2	32 ± 2	2 ± 1
0.30*	30 ± 3	32 ± 3	2 ± 1

Values manufacturer's recommended dose.
From Severance et al. Anesthesiology. 1988;68:723.

C. Pharmacodynamic Dose Response

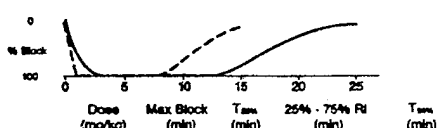
PHARMACODYNAMIC DOSE RESPONSE					
Adult Patients (Narcotic Anesthesia)					
Initial Mivacurium Dose (mg/kg)	Time to Maximum Block (min)	Time to Spontaneous Recovery (min) †			
		5% Recovery	25% Recovery	95% Recovery	T_1/T_4 Ratio $\geq 75\%$
0.07 to 0.10	4.9 (2.0 - 7.6)	11 (7-18)	13 (8-24)	21 (10-38)	21 (10-38)
0.15	3.3 (1.5 - 6.6)	13 (6-31)	16 (9-36)	26 (14-41)	26 (15-46)
0.20*	2.5 (1.2 - 6.0)	16 (10-29)	20 (10-36)	31 (18-51)	34 (18-58)
0.25*	2.3 (1.0 - 4.4)	19 (11-29)	23 (14-38)	34 (22-54)	43 (25-73)

† Values shown are medians of the means from individual studies (range of individual patient values).
* Agent manufacturer's recommended dose.

D. Intubation

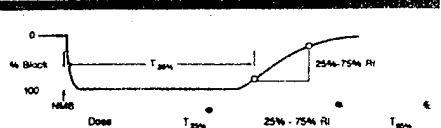
MIVACURIUM INTUBATION STUDIES	
Study Design	Results
Fentanyl: 0.001-0.008 mg/kg	Generally good-to-excellent intubation conditions at 2.5 min after 0.15 mg/kg mivacurium
Thiopental: 4-7 mg/kg	
Mivacurium: 0.15 mg/kg (5-15 sec injection)	
Attempt intubation at 2, 2.5, or 3 min after mivacurium dose and score intubation conditions	

E. Mivacurium vs. Succinylcholine

MIVACURIUM vs SUCCINYLCHOLINE					
					
	Dose (mg/kg)	Max Block (min)	$T_{25\%}$ (min)	25% - 75% Rt (min)	$T_{95\%}$ (min)
Mivacurium	0.15 (2 x ED ₅₀)	3.3	16	6	26
Succinylcholine	1.0 (4 x ED ₅₀)	1-1.5	9-12	3-6	12-15

Adapted from manufacturers' package inserts.

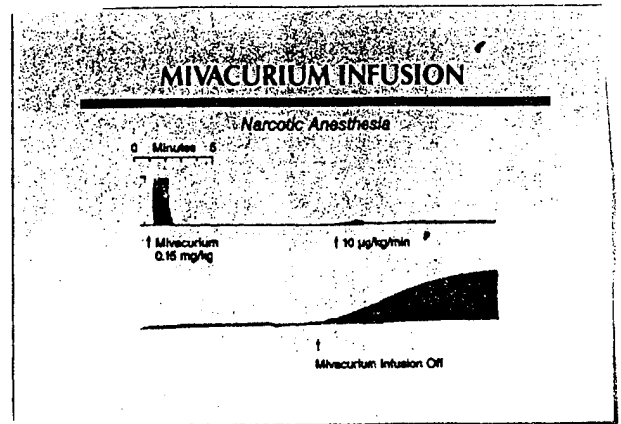
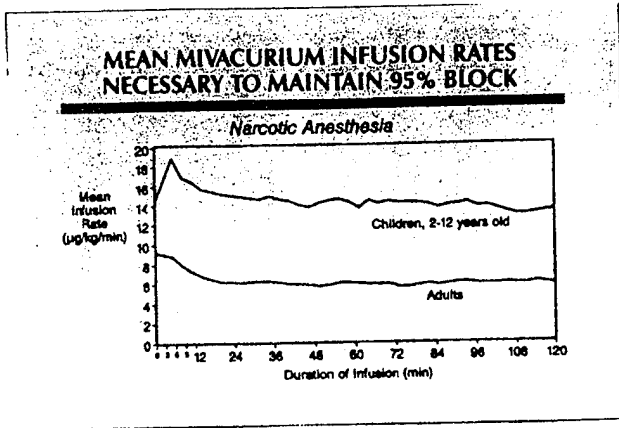
F. Mivacurium vs. Intermediate Agents

MIVACURIUM vs INTERMEDIATE-ACTING AGENTS: DURATION AND RECOVERY				
				
	Dose (mg/kg)	$T_{95\%}$ (min)	25% - 75% Rt (min)	$T_{95\%}$ (min)
Mivacurium	0.15	15-20	5-7	25-30
Atracurium	0.50	35-40	10-12	60-70
Vacuronium	0.06-0.10	25-40	15-25	45-55

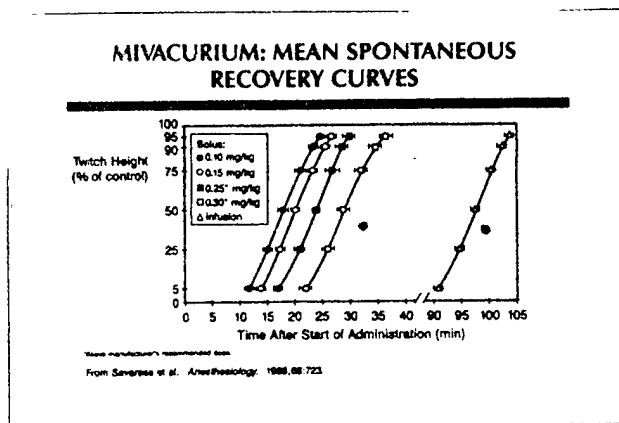
Adapted from manufacturers' package inserts.

V. Mivacurium Chloride (cont.)

G. Infusion



H. Spontaneous Recovery

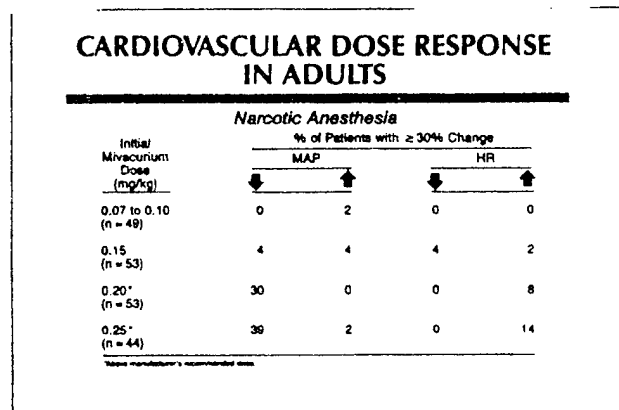


I. Reversal

MIVACURIUM REVERSAL: HIGH-DOSE NEOSTIGMINE (0.046 - 0.064 mg/kg)

N	Spontaneous Recovery at Reversal (%)	Elapsed Time from	
		Reversal to 95% Recovery (min)	Reversal to T ₁ /T ₀ Ratio ≥ 75% (min)
35	9 ± 0.7	7 ± 0.5 (4-16)	9 ± 0.5 (5-16)
23	23 ± 0.8	6 ± 0.6 (3-16)	6 ± 0.5 (3-12)
25	43 ± 2	5 ± 0.4 (3-10)	5 ± 0.4 (3-11)
8	73 ± 4	3 ± 0.6 (1-9)	2 ± 0.4 (1-4)

J. Cardiovascular Response



K. Adverse Events

ADVERSE EXPERIENCES MIVACRON® PACKAGE INSERT

The following adverse experiences were reported in patients administered Mivacron (all events judged by investigators during the clinical trials to have a possible causal relationship).

Incidence > 1%	Flushing (16%)		
Incidence < 1%			
Cardiovascular	Hypotension, tachycardia, bradycardia, cardiac arrhythmias, phlebitis	Non-specific:	Prolonged drug effect
Respiratory	Bronchospasm, wheezing, hypoxemia	Neurologic:	Dizziness
Dermatologic:	Rash, urticaria, erythema, injection site reaction	Musculoskeletal:	Muscle spasms

V. Mivacurium Chloride (cont.)

L. Special Populations

MIVACURIUM: SPECIAL POPULATIONS — pChE ACTIVITY

- At or slightly below lower limit of normal range
 - No reduction necessary
 - Expect more variability in duration
- Heterozygotes for atypical pChE gene (1:40)
 - No reduction necessary
 - Expect ~ 10 min longer duration
 - Lower infusion rates are recommended
- Homozygotes for atypical pChE gene (1:2500)
 - Not recommended

MIVACURIUM: SPECIAL POPULATIONS — INITIAL DOSE

- Elderly
 - No reduction necessary
 - Expect slightly longer (3 min) duration of block
- Renal Disease
 - No reduction necessary
 - With end-stage disease, clinical duration is prolonged (~1.5 times longer than in healthy patients)
- Hepatic Disease
 - No reduction necessary
 - With end-stage disease, clinical duration is markedly prolonged (~3 times longer than in healthy patients)
- Obesity
 - Base on ideal not actual body weight to decrease risk of changes in MAP
 - No change in clinical duration
- Significant CV Disease
 - No reduction necessary
 - Administer dose over 60 seconds

M. Summary and Conclusions

MIVACURIUM: SUMMARY AND CONCLUSIONS

- Short-acting, fast-recovery nondepolarizer
- Elimination by plasma cholinesterase hydrolysis
- Noncumulative
- Duration of action and recovery is $\frac{1}{3}$ to $\frac{1}{2}$ that of intermediate-acting agents
- Onset time similar to intermediate agents
- Minimal cardiovascular effects at recommended dose and rates of administration

MIVACURIUM: SUMMARY AND CONCLUSIONS (Cont'd)

- Appropriate for use as continuous infusion
- Children require higher doses
- Profile well suited for ambulatory surgery or procedures of unpredictable duration

THURSDAY, MAY 11, 1995

SESSION D: Trauma Anesthesia Research Forum:
Overview and Sources of Funding
Chair: Enrico M. Camporesi, MD

09:30 - 09:55 ITACCS Research Program
Enrico M. Camporesi, MD

09:55 - 10:20 Clinical Research in Trauma Anesthesia
Bruce F. Cullen, MD

10:20 - 10:45 Basic Science Research in Trauma Anesthesia
Ronald G. Pearl, MD, PhD

10:45 - 11:10 Biotechnology Research in Trauma Anesthesia
Vladimir Kvetan, MD

11:10 - 11:35 Update on 1993 ITACCS Prospective Research Grant Award
(Diaphragmatic Failure and Ventilatory Weaning)
Massimo Ferrigno, MD

11:35 - 12:00 Research Opportunities for Trauma in the Emerging World
Nguyen D. Kien, PhD

12:00 - 12:15 Discussion/Questions and Answers

CLINICAL RESEARCH IN TRAUMA ANESTHESIA

Bruce F. Cullen, M.D.

1. Introduction.
2. Current clinical research topics.
3. Recent controversial issues.
4. Areas of interest for new investigations.
5. Conclusion.

THURSDAY, MAY 11, 1995

SESSION A: Difficult Airway Management for Trauma Part I:
Didactic Discussions

Chairs: Kenneth J. Abrams, MD
Elizabeth C. Behringer, MD

13:30 - 13:55 Airway Evaluation in Trauma
Steven J. Tryfus, MD

13:55 - 14:15 Bullard Laryngoscope and Retraction Blades
Kenneth J. Abrams, MD

14:15 - 14:35 Laryngeal Mask Airway/Bougies/Stylets in Trauma
Jerry P. Nolan, MB, ChB, FFARCS

14:35 - 14:55 Augustine Guide in Trauma
Anthony L. Kovac, MD

14:55 - 15:15 Retrograde Intubations/Surgical Airways
Anthony Sanchez, MD

15:45 - 16:15 Lung Separation in Trauma
Elizabeth C. Behringer, MD

16:15 - 16:40 Esophageal Detectors in Trauma
Mohammed Ramez Salem, MD

16:40 - 17:05 Esophageal Tracheal Combitube
Markus Lipp, MD

17:05 - 17:30 McCoy Laryngoscope in Trauma
Eamon P. McCoy, MB, FFARCSI

AUGUSTINE GUIDE IN TRAUMA

Anthony L. Kovac, MD

I. Introduction

A. Augustine Guide: simple device for performing rapid, blind orotracheal intubation on adult patients.

B. Used to intubate difficult airways

1. Awake or unconscious patients
2. Apneic or spontaneously breathing
3. Supine, upright, trapped with access to head difficult
4. Immobilized or head and neck must be in neutral position
5. Blood or vomitous in mouth
6. Airway anatomy that makes direct visualization difficult
 - a. anterior larynx
 - b. large tongue
 - c. protruding incisors

II. Important Laryngeal Anatomy

A. Hyoid bone

1. Main external supporting structure of larynx
2. Landmark for orienting device blindly within larynx
3. U-shaped; sits high in neck at $\approx$ C-5 level
4. Palpation of hyoid bone movement can verify proper guide placement

B. Epiglottis

1. Upper-most cartilage of larynx
2. Anterior to opening between vocal cords
3. Semi-circular shape in cross-section, surrounded by hyoid bone
4. Held in midline by hyoepiglottic ligament

C. Hyoepiglottic Ligament

1. Centers epiglottis in midline of hyoid bone
2. Helps elevate epiglottis during Augustine Guide intubation procedure.
3. When tensed by Augustine Guide, elevates epiglottis

III. Augustine Guide Intubation Components

A. Intubation Guide

1. Proper engagement of leading edge can be verified with one hand while moving leading edge side-to-side laterally with the other hand
2. If leading edge is properly engaged under hyoid bone, movement of hyoid bone will be palpable
3. If properly engaged, elevation anteriorly will tense hyoepiglottic ligament and expose opening between vocal cords
4. Guide channel holds tube (7.8-8.0 mmID) and stylet

B. Stylet

1. Two main functions
 - a. A probe-to find the opening between the vocal cords
 - b. A tracheal tube introducer over which tube is advanced into the trachea

H. Perform esophageal detector test. Aspirate 30 cc of air; observe syringe plunger for recoil

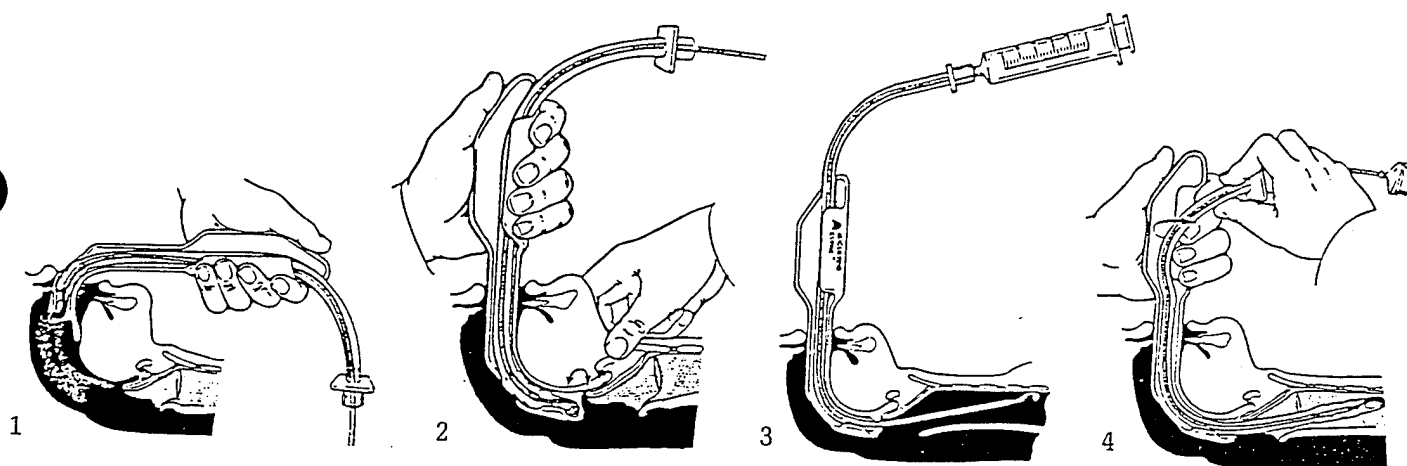
1. No plunger recoil indicates tracheal intubation

2. Plunger recoil indicates esophageal intubation

J. Advance tracheal tube; inflate tracheal tube cuff (Figure 4)

K. Stabilize tube; remove intubation guide, stylet and bite block

L. Confirm proper placement of tracheal tube using auscultation or CO₂ detection



Figures 1-4: Intubation sequence for the Augustine Guide (see text above)

Techniques of Lung Isolation in the Management of Thoracic Trauma Patients

Elizabeth C. Behringer, M.D.

Case History:

A 27 year-old previously healthy black male is admitted to the Emergency Room (ER) thirty minutes following a gunshot to the left chest. At the scene, he was alert and responsive, complaining of shortness of breath and severe left chest pain. Initial signs: BP 100/60, P:110 reg, R:30 labored. 100% face mask O₂ saturation 92%. CXR reveals a large left hemopneumothorax. His entire left lung field is opacified. The thoracic surgeons place a chest tube which drains 1500 cc of bright red blood. The patient is scheduled for an emergency left exploratory thoracotomy.

Guidelines for Discussion:

1. Indications for one-lung ventilation
2. Isolation techniques
 - a. Bronchial blockers
 - i. Univent tube
 - b. Single-lumen endobronchial tubes
 - c. Double-lumen endobronchial tubes
3. Complications of lung isolation techniques
4. Lung isolation techniques in trauma patients

References:

1. Wilson RS. Endobronchial Intubation in Thoracic Anesthesia. Second edition. Kaplan JA (ed) Churchill Livingstone, New York, 1991, pp 371-388.
2. Gottlieb LS, Hillberg R. Endobronchial tamponade therapy for intractable hemoptysis. Chest 1991;67:482.
3. Gourin A, Garzon AA. Control of hemorrhage in emergency pulmonary resection for massive hemoptysis. Chest 1975;68:120.
4. Garzon AA, Cerruti MM, Golding ME. Exsanguinating hemoptysis. J Thorac Cardiovasc Surg 1982;84:829.
5. Inoue H, Shohtsu A, Ogawa J, et al. Endotracheal tube with movable blocker to prevent aspiration of intratracheal bleeding. Ann Thorac Surg 1984;37:497.

6. Kamaya H, Kirshna PR. New endotracheal tube (Univent Tube) for selective blockade of one lung. *Anesthesiology* 1985;63:342.
7. Herenstein R, Russo JR, Moonka N, Capan LV. Management of one-lung anesthesia in an anticoagulated patient. *Anesth Analg* 1988;67:1120.
8. Heiser M, Steinberg JJ, Macvaugh H, et al. Bronchial rupture, a complication of use of the Robertshaw double-lumen tube. *Anesthesiology* 1979;51:88.
9. Burton NA, Fall SM, Lyons T, et al. Rupture of the left main-stem bronchus with a polyvinylchloride double-lumen tube. *Chest* 1983;83:928.
10. Wagner DL, Gammage GW, Wong ML. Tracheal rupture following the insertion of a disposable double-lumen endotracheal tube. *Anesthesiology* 1985;63:698.
11. Slinger PD. Fiberoptic bronchoscopic positioning of double-lumen tubes. *J Cardiothorac Anesth* 1989;3:486.
12. Hurford WE, Alfille PH, Bailin MT, Behringer EC, et al. Placement and complications of double-lumen endotracheal tubes. *Anesth Analg* 1992;74:S141.
13. Gayes JM. One-lung ventilation is best accomplished with the Univent Endotracheal tube. *J Cardiothorac Vasc Anesth* 1993;7:103.
14. Slinger P. The Univent tube is not the best method for providing one-lung ventilation. *J Cardiothorac Vasc Anesth* 1993;7:108.

ESOPHAGEAL DETECTORS IN TRAUMA

M. Ramez Salem, M.D.

I. Introduction

- A. Magnitude of the problem of esophageal intubation
- B. Is there an ideal test for confirmation of tracheal tube placement?
- C. Methods of verification of tracheal tube placement

II. The esophageal detector device (EDD)

- A. Principle of EDD -- Wee's syringe
- B. Modification of EDD -- the self-inflating bulb (SIB)
- C. Factors affecting performance of SIB
- D. Techniques of using SIB
- E. Demography and etiology of false negative & false positive results
- F. Comparison of EDD/SIB with other methods
- G. Use of EDD/SIB in trauma patients

III. Other uses of SIB

- A. Proper placement of the laryngeal mask airway
- B. Intubating the difficult airway
- C. Facilitating proper placement of the esophageal tracheal combitube

IV. Conclusions

- ## **II Design and development of the McCoy Laryngoscope**

[III] Conduct of Laryngoscopy with the McCoy laryngoscope

- (1) In normal situations
- (2) In trauma

[IV] Further modifications to the design

[V] Laryngeal visualization with the McCoy laryngoscope

- (1) With the experienced laryngoscopist
- (2) With the less inexperienced hand

[VI] The Stress response to laryngoscopy with the McCoy Laryngoscopy

- (1) Introduction and principles
- (2) Method
- (3) Results
- (4) Conclusions

[VII] The forces exerted at laryngoscopy

- (1) Principles of force assessment
- (1) Development of a force measuring device
- (2) Forces with the Macintosh Laryngoscope and patients parameters
- (3) A comparison of the forces at laryngoscopy with different blade designs
- (4) Conclusions

[VIII] Cervical spine movement with the McCoy Laryngoscope

- (1) Introduction
- (2) Methods
- (3) Results
- (4) Conclusions

[IX] Summary and Conclusions

THURSDAY, MAY 11, 1995

SESSION B: Pain Management and Regional Anesthesia for Trauma
Chair: Andrew D. Rosenberg, MD

13:30 - 14:00 Prehospital Techniques
Pierre A. Carli, MD

14:00 - 14:20 Upper Extremity Regional Anesthesia
David B. Albert, MD

14:20 - 14:40 Lower Extremity Regional Anesthesia
Andrew D. Rosenberg, MD

14:40 - 15:00 Post Operative Pain Management
Mitchell H. Marshall, MD

15:00 - 15:15 Reflex Sympathetic Dystrophy
Ralph L. Bernstein, MD

15:45 - 17:30 SPECIAL HANDS-ON WORKSHOP
ATACCS Delegates will be divided into subgroups and have the opportunity to rotate through intensive hands-on skills stations featuring applications of the principles and techniques discussed during the didactic portion to the trauma setting.

Regional Anesthesia for Upper Extremity

David B. Albert, M.D.

1. Success Rate/Options
2. Interscalene
3. Perivascular subclavian

Landmarks

Technique

Complication

4. Infraclavicular nerve block

Landmarks

Technique

Complication

5. Axillary

Landmarks

Technique

Complication

Regional Anesthesia for Lower Extremity

Andrew D. Rosenberg, M.D.

Experience in War Zones

Epidural

Spinal

Regional Anesthesia for Fractured Hip

Factors affecting mortality

Spinal vs General

Lumbar plexus block

Landmarks

Technique

Use of Nerve Stimulator

Nerve blocks

Landmarks

Technique

Hypobaric spinal

Femoral nerve block

Landmarks

Technique

Femoral-Sciatic nerve block

Anterior approach

Landmarks

Technique

Supine approach

Landmarks

Technique

Ankle blocks

Landmarks

Technique

Post-Operative Pain Management

Mitchell H. Marshall, M.D.

I. Opiates

A. Benefits, Risks

B. Route of Administration

1. Parenteral, Transdermal, Epidural and Spinal, Oral, misc.
2. Patient Controlled Analgesia (PCA)
 - a. The technology
 - b. Advantages/Disadvantages
 - c. Protocols: Bolus, Basal infusion, PCA dose, Lockout, Max dosing

C. Combination Therapy

II. Non-Opiate Analgesics

A. Non-steroidal agents

1. Ketorolac-prototype

B. Miscellaneous agents

III. Spinal/Epidural Techniques

A. Local anesthetics

B. Opiates

C. Infusions

1. Continuous

2. PCA method

IV. Regional Techniques

A. Wound Infiltration

B. Specific Blocks

1. One-shot, Catheter techniques

V. Specific Clinical Situations

A. Orthopedic injury in setting of multi-trauma

1. Head

2. Chest

Reflex Sympathetic Dystrophy
a.k.a. Sympathetically Mediated Pain

Ralph L. Bernstein, M.D.

Definition

Reflex Sympathetic Dystrophy (RSD) is a syndrome of pain, hyperthermia, vasomotor disturbances, and dystrophic changes that may improve with sympathetic denervation. Causalgia is a type of RSD caused by nerve injury.

Etiology

May be caused by trauma, surgery, neurologic disorders, medical conditions and immobilization after trauma.

Physical Examination

Pain, vasomotor disturbances, and trophic changes.

Vasomotor and trophic changes such as erythema, pallor, warmth or cold, cyanosis, discoloration and sweating.

Diagnosis

Early diagnosis is important since early treatment may prevent irreversible changes.

Stages

1. Acute Stage

Several weeks to a few months

Pain, burning, aching

Increased temperature, hair and nail growth

2. Dystrophic Stage

Lasts between 3 to 6 months

Pain constant

Skin edematous

Tenderness at wrist and metacarpal joints

Flexion deformities may begin to occur

3. Atrophic Stage

Pain may spread proximally

Limitation of motion

Contractures may develop

Radiographic Findings

May show diffuse demineralization

Scintigraphy

Technitium 99 in bone scan may show increased uptake in third stage of a three stage bone scan.

Thermography

Positive if there is 1° increase or decrease in temperature in the affected extremity.

Treatment

Sympathetic Ganglion Blockade

Stellate Ganglion Block for upper extremity

Lumbar Sympathetic Block for lower extremity

Intravenous Regional Bretylium Block

Continuous Epidural Infusion

Physical Therapy

Pain medication after physical therapy

Antidepressants for sleep

THURSDAY, MAY 11, 1995

SESSION C: Military Medicine and Trauma Anesthesia
Chair: Louis M. Guzzi, MD, MAJ, MC

13:30 - 13:45 Introduction: Military Roles for Anesthetists
Louis M. Guzzi, MD, MAJ, MC

13:45 - 14:30 The Somalia Experience
Michael Matson, MD, LTC, MC
Doug J. Rutkowski, CRNA, CPT, ANC

14:30 - 15:00 Advanced Work and Development on Field Anesthesia
Machine Systems
Stephen Janny, MHS, CRNA, LTC, ANC

15:00 - 15:15 Current Role in Anesthesia Trauma Research: USAMRMC
Dean E. Calcagni, MD, LTC, MC

15:45 - 16:00 Brief Overview of Efforts on Establishment of Training
on Field Anesthesia in CONUS
Douglas Anderson, MD, LTC, MC

16:00 - 17:30 Hands-On Workshop: Army Field
Anesthesia Machine (885A FAM)
Paul C. Reynolds, MD, LTC, MC
Michael E. Lenczyk, MD, MAJ, MC
Stephen Janny, CRNA, LTC, ANC
William Clayton Petty, MD, CPT, MC, USN
Denver Perkins, MD, COL, MC
Vance Gainor, CRNA, CDR, NC, USN

The Somalia Experience

1. Overview of Somalia
 - a. History
 - b. Culture
 - c. Politics
 - d. Disintegration
2. The relief efforts
 - a. Humanitarian groups
 - b. U.S. military
 - c. United Nations
3. The operational environment
 - a. Factions
 - b. Weapons
 - c. Climate
 - d. Diseases
 - e. Other risks
4. The U.N. medical assets
 - a. The U.S. military hospital
 - b. The Swedish military hospital
 - c. Other military hospitals
 - d. The U.S.A.F. staging facility
 - e. The Med-Evac group
 - f. The U.N. coordination group
5. The U.S. Army field hospital
 - a. Mission
 - b. Location
 - c. Physical structure

- d. Assets
- e. Philosophy
- 6. Anesthesia team care
 - a. Airway management
 - b. Resuscitation
 - c. Triage
 - d. Mass casualty response
 - e. Preoperative evaluation
 - f. Intraoperative care
 - g. Postoperative care
 - h. Intensive care
 - i. Patient transport
 - j. Respirator therapy supervision
 - k. Ventilator management
 - l. Vascular access
 - m. Invasive line placement
 - n. Invasive monitoring
- 7. Specific case examples
 - a. Types of injuries
 - b. Selected cases
 - c. Mass casualty episodes
- 8. Problem areas
 - a. Lab support
 - b. Blood bank support
 - c. Ventilators
 - d. Anesthesia delivery systems
 - e. Fluid warming

- f. Patient warming
- g. Infection control
- h. Area medical support
- i. Communications
- j. Supply issues
- k. Public relations

9. Present and future U.N. missions

- a. Over 50,000 troops worldwide
- b. A dozen or more missions
- c. Dozens of wars to stop
- d. Millions of refugees
- e. Tens of millions "internally displaced"
- f. Expanding U.N. roles with no end in sight
- g. Each mission needs medical support

Hands on Workshop for the Army Field Anesthesia Machine

Paul Reynolds, M.D.

A portion of the Hands-on Workshop will deal with Draw-over Anesthesia.

1. Display the Ohmeda Universal Portable Anesthesia Complete
 - a. As issued to Army units for battlefield use.
 - b As used presently for training in conventional operating rooms of Army Medical Centers.
2. Display a review of published information relevant to the use of the drawover technique in battlefield/austere conditions and in training conditions.

(This workshop will allow a close look by interested parties at the Army's primary field anesthesia apparatus - the Ohmeda PAC.)

THURSDAY, MAY 11, 1995

SESSION D: Special CRNA Session: Trauma Anesthesia BY CRNA's -
FOR CRNA's

Chair: Charles R. Barton, CRNA, MEd

13:30 - 14:00 Management of Complications Related to Invasive
Monitoring in the Trauma Patient
Patricia G. Taub, CRNA, BS

14:00 - 15:15 Anesthetic Management of the Traumatized
Pediatric Patient
Charles R. Barton, CRNA, MEd

15:45 - 16:15 Pain Management for the Patient with
Orthopedic Trauma
Steven J. Zito, CRNA, MS

16:15 - 17:00 Anesthetic Management of Thoracic Trauma
Charles R. Barton, CRNA, MEd

17:00 - 17:30 Anesthetic Management of Abdominal Trauma
Charles R. Barton, CRNA, MEd

COMPLICATIONS IN ANESTHESIA: INVASIVE MONITORING ARTERIAL TOURNIQUET

Patricia G. Taub, CRNA, BS

I. Introduction

A. *Types of Complications*

- 1. Occurring as a Result of Monitor Placement*
- 2. Resulting From Decisions Based on "Bad Data"*
- 3. Other*

II. Intra-Arterial Pressure Monitoring

A. *Introduction*

B. *Acute Placement Complications*

- 1. Pain*
- 2. Hematoma Formation*
- 3. Hemorrhage*
- 4. Retro- or Antegrade Embolization*
- 5. Nerve Injury*
- 6. Ischemic changes*

C. *Delayed Placement Complications*

(All of the above plus...)

- 1. Thrombosis*
- 2. Infection*

D. *Problems Related to Data Acquisition*

- 1. Equipment Related*
- 2. Aortic-Radial Pressure Gradient*

III. Central Venous Catheters

A. *Introduction*

B. *Acute Complications*

- 1. Arterial Puncture*
- 2. Pneumothorax*

3. *Hemothorax*
3. *Dysrhythmias*
4. *Malposition*
6. *Air/Foreign Body Embolus*
7. *Nerve Injury*
9. *Perforation of Heart/Vessels*

C. *Femoral/Anitcubital Vein Approach Specifics*

D. *Delayed Complications*

1. *Sepsis*
2. *Thrombosis/Thrombophelbitis*

E. *Problems Relating to Data*

1. *Causes and Consequences*
2. *Recommendations*

III. *Pulmonary Artery Catheters*

A. *Introduction*

B. *Acute Complications*

1. *Air Embolism*
2. *Arterial Puncture*
3. *Dyssrhythmias*
4. *Pulmonary Artery Perforation*
5. *Miscellaneous*

C. *Delayed Complications*

1. *Perforation*
2. *Infarction*
3. *Thrombosis*
4. *Infection*

D. *Problems Related To Data*

1. *Criteria to Assess Validity of Data*

IV. *Arterial Tourniqueting*

A. *Causes and Consequences*

B. *Recommendations*

ANESTHETIC MANAGEMENT OF THE TRAUMATIZED PEDIATRIC PATIENT

Charles R. Barton, CRNA, M.ED.

I. Introduction

A. History of Pediatric Trauma

1. Trauma has been a source of pain and suffering through the ages
2. Rural farm injuries and industrial injuries
3. High speed MVAs and violence today

B. Pediatric Trauma Statistics

1. In 1986, 22,000 deaths, 600,000 hospitalized, and 16 million E.R. visits
2. Homicide, neglect, and abuse causes 2,000 deaths annually up to 19 y.o.

C. Motor Vehicular Accidents

1. "The automobile is the most lethal component of a child's environment"
2. Most common cause of death in pediatrics
3. Most common cause for head injury in child

D. Tragic Outcomes of Pediatric Trauma

1. Entire families are severely affected by injury of a member
2. Of 54 pediatrics involved in multiple trauma, 68% had persistent handicaps, 60% had personality changes, 50% had cognitive, social, effective, or learning disabilities at one year following accident

C. Injury Prevention and Control - Goals of U.S. Public Health Policy

1. Target high risk-behavior
2. Prevent trauma and minimize permanent injury
3. Change specific environmental threats
4. Promote safety design engineering
5. Encourage accelerated delivery of health care

II. Initial Stabilization, Transport and Emergency Department Care

A. Airway Management

1. Supplemental oxygen
2. Head-tilt and chin-life maneuvers
3. Oro- and nasal-pharyngeal airways
4. Bag-mask ventilation
5. Cervical spine management
6. Endotracheal intubation - indications
7. Complications

B. Preparation and Transport to Hospital

1. Basic first aid
2. Arrest hemorrhage
3. Support ventilation
4. Initiation of IV fluids and provide for adequate circulation
5. Guard against cervical spinal injury

C. Emergency Department Care

1. Communications with field personnel allows planning for emergency
2. Undress and thoroughly examine patient
3. Large bore IV catheter placement with lab studies drawn
4. Various approaches to intravenous access
5. Type and Cross match as indicated by patient presentation
6. Check for ETT placement, associated airway and pulmonary injuries
7. Approaches to securing the airway of traumatized pediatric patient
8. Implications of full stomach - Sellick maneuver
9. Pharmacological adjuncts to airway management
10. Transport within the hospital

III. Evaluation and Interventions with Associated Injuries

A. Pediatric Head Trauma

1. Evaluation
2. Interventions
3. Diagnostic workup
4. Scalp wounds
5. Severe head injury
6. Intracranial Hypertension and Management
7. Anesthetic implications

B. Thoracic Trauma in Children

1. Most commonly caused by MVA injury and armed assault
2. Pulmonary contusion and pneumothorax most common findings
3. Difference in injuries patterns between children and adults

C. Hemorrhagic Shock in the Pediatric Patient

1. Balanced salt solutions are first-line resuscitation fluids
2. In unstable, administer crystalloids at 20 ml / kg
3. Hypertonic saline and colloids as alternatives to Ringer's lactate
4. Type) or type specific blood
5. Indications for MAST suits for short periods
6. Transfusions in Children

D. Thermal Injuries

1. Causes approximately 3,000 deaths in U.S. each year
2. Using the "Rule of Nine" with modifications for children

3. More susceptible to fluid, electrolyte, and temperature abnormalities
4. Prompt fluid therapy needed
5. General Management goals
6. Airway Considerations
7. Anesthetic Considerations

IV. Pediatric Advance Life Support (PALS)

- A. ACLS not adequate for pediatric patients
- B. Different etiologies and mechanisms for cardiopulmonary arrest
- C. PALS emphasizes pre-arrest assessment, anticipatory intervention, and ventilation techniques

V. Anesthesia Considerations

- A. Child is not just a small adult
- B. Airway differences
- C. Specific Anesthetic Considerations
 1. Advantages / Disadvantages of specific agents and techniques
 2. Muscle Relaxants - What is the status of succinylcholine?

VI. Summary and Conclusions

Pain Management for the Patient with Orthopedic Trauma

Steven J. Zito, C.R.N.A.

- I. Intramuscular (IM) Injections*
- II. Intravenous Infusions*
- III. Intravenous Patient Controlled Analgesia (IV-PCA)*
 - A. Advantages vs. Disadvantages*
- IV. Epidural Analgesia (Lumbar & Thoracic)*
 - A. Narcotics alone*
 - B. Narcotics & Local Anesthetics combined*
 - C. Advantages vs. IM & IV-PCA*
 - D. Side Effects and Complications*
- V. Nerve Block Analgesia*
 - A. Brachial Plexus*
 - B. Intercostal Nerve*
 - C. Lower Extremity*
 - 1. Femoral Nerve*
 - 2. Lateral Femoral Cutaneous Nerve*
 - 3. Obturator Nerve*
 - 4. Sciatic Nerve*
- VI. Guidelines for Management of Postoperative Analgesia*

IV PCA ONLY - STANDING ORDERS

1. Monitor and record resp. rate and sedation level q 15 min x 1 hr, q 30 min/1 hr, then q 4 hr for duration of morphine infusion starting in recovery room.
2. Notify anesthesiologist Beeper 274-1005 for inadequate analgesia, excessive sedation, resp. rate less than 10/min.
3. Do not administer any narcotics, sedatives, antiemetics without new order from anesthesiologist.
4. If primary MD d/c's IV fluids and pt. on basal rate PCA, apply injection cap to blue portion "Y tubing" and continue PCA therapy. Heparin flush not necessary if primary MD d/c's IV fluids and pt. not on basal rate, give D5LR at 30cc/hr while on morphine infusion.
5. 02 _____ L/min. via nasal cannula.
6. Medications:
 - A. Initiate IV PCA-Morphine Sulfate 250 mg/250cc normal saline.
 1. Vol. Limit _____
 2. Prime Press start
 3. Conc. mg/ml 0.0 Press enter
 4. Dose _____
 5. Delay _____
 6. Basal _____
 7. 1 hr. limit _____
 8. Bolus _____
 - B. Diphenhydramine (Benadryl) 50 mg
IM q 6 hr prn for itching x 2 doses. (Contact pain service if unrelieved by 2nd dose)
 - C. Metoclophamide (Reglan) 10 mg IVPB q 8 hr prn for nausea x 2 doses. (Contact pain service if unrelieved by 2nd dose)
 - D. If Resp. Rate less than 8 or pt. obtunded or unarousable:
 1. Narcan 0.1 mg IV STAT-repeat q 2 min x 4 doses if necessary
 2. D/C Pump
 3. STAT page anesthesia and resp. therapy
 4. Admin. 100% O2 via non breather
 - E. If IV PCA d/c and pt. tolerating po and not allergic
Tylox 1-2 caps po q 3 hr prn pain

DATE: _____ SIGNATURE: _____ M.D.

PHYSICIANS MEMORIAL HOSPITAL
La Plata, Maryland 20646

NAME PLATE

PHYSICIANS ORDER SHEET

STANDING ORDER FOR THORACIC OR LUMBAR EPIDURAL ONLY

1. Label chart, kardex, and tubing with "epidural catheter"
2. Monitor and record VS and sedation level on admission to room. Starting in PACU Resp. Rate and sedation level q 15 min x 1 hr, q 30 min x 2 hr, q 1 hr x 4 hr. Then check respiratory rate q 2 hr x 8, then q 4 hrs. If resp. rate < 10/min., check level of sedation.
3. If pt. has vascular surgery, neurochecks of lower extremities q 2 hr x 24 hrs.
4. Notify anesthesiologist (Beeper # 274-1005) for inadequate analgesia, excessive sedation, resp. rate less than 10/min and prior to admin. of other analgesics, antiemetics, or sedatives.
5. Straight cath x 1 for urinary retention. Notify anesthesia if reoccurs.
6. If primary MD d/c's IV fluids, maintain IV access with hep lock.
7. O2 _____ L/min. via nasal cannula.
8. Medications:
 - A. Fentanyl _____ mcg/cc + Bupivacaine (Marcaine) _____ by PCA pump via epidural catheter. Basal Rate _____ cc/hr.
 - B. If side effects occur, and pt. not allergic:
 1. Itching Diphenhydramine (Benadryl) 25 mg IM q 4 hr PRN x 2 doses
 2. Nausea Metoclopramide (Reglan) 10 mg/IVPB q 4 hr prn x 2 doses
Contact Pain Service if unrelieved by 2nd dose of Benadryl or Reglan
 3. Inadequate anesthesia - (Ketorolac) 60 mg IM-then 30 mg IM q 6 hr prn x 48 hrs.
 - C. Insomnia - Triazolam (Halcion) 0.125 mg po q hs prn if resp. rate greater than 12/min.
 - D. After epidural analgesia d/c, pt. tolerating po fluids and not allergic,
Tylox 1-2 caps po q 3 hr prn/pain.
 - E. If resp. rate less than 8 or pt. obtunded or unarousable
 1. Narcan 0.1 mg (1/4 mL) IV STAT - repeat in 2 mins x 4 if necessary
 2. STAT page resp. therapy and Anesthesia
 3. Administer 100% O2 by face mask
 4. Stop pump (Press Stop button twice within a second.)
9. Do not ambulate lumbar epidural patients.

DATE: _____ SIGNATURE: _____ M.D.

PHYSICIANS MEMORIAL HOSPITAL
La Plata, Maryland 20646

PHYSICIANS ORDER SHEET

NAME PLATE

ANESTHETIC MANAGEMENT OF THORACIC TRAUMA

Charles R. Barton, CRNA, M.ED.

I. Introduction

A. Mechanism of Injury

B. Range of Injuries

II. Specific Types of Chest Injuries

A. Blunt vs. Penetrating Injuries

1. Tension pneumothorax
2. Massive Hemothorax
3. Pericardial Tamponade - Beck's Triad
4. Myocardial Injuries
5. Cardiac Rupture
6. Traumatic Aortic Rupture
7. Tracheobronchial Disruption
8. Esophageal rupture

B. Evaluation of Injuries

1. Physical Examination
2. Diagnostic procedures
3. CAT scan, MRI, angiography
4. Lab studies
5. Echocardiography

C. Initial Interventions

1. Securing the Airway

2. Chest tube placement

3. Fluid Management

III. Anesthesia Considerations

A. Preparation

B. Monitoring

C. Specific Agents and Techniques

D. Double Lumen Endotracheal Tube Use

E. Fluid Management

F. Complications

IV. Summary and Conclusions

Anesthetic Management of Abdominal Trauma

Charles R. Barton, CRNA, M.ED.

I. Introduction

- A. Patients sustaining abdominal trauma are at risk of two major life-threatening complications: massive hemorrhage and chemical or bacterial peritonitis**
- B. Anatomic relationships in the abdomen**

II. Clinical Evaluation and Diagnostic Studies

- A. Survey of the ABCs**
- B. Evaluation of blood loss**
 - 1. Clinical indicators**
 - 2. Laboratory indicators**
 - 3. Diagnostic studies**

III. Penetrating vs. Blunt Trauma to the Abdomen

- A. Canada: 74% of abdominal injuries Blunt vs. 26% penetrating**
- B. Brooklyn - 80% penetrating vs. 20% blunt**
- C. Implications for management**

IV. Types of Abdominal Injuries

- A. Intrathoracic "upper" abdominal injuries**
 - 1. Diaphragm**
 - 2. Stomach**
- B. Abdominal injuries to the aorta and vena cava**
- C. Retroperitoneal vascular injuries**
- C. Injuries to abdominal viscera**
 - 1. Spleen**
 - 2. Pancreas**
 - 3. Liver**
 - 4. Kidneys**
- D. Pelvic Injuries**
 - 1. Bladder**
 - 2. Iliac vessels**

V. Anesthesia Implications

THURSDAY, MAY 11, 1995

SESSION E: Scientific Free Papers
Chair: Enrico M. Camporesi, MD
Moderators: Free Papers
Colin F. Mackenzie, MD
Bruce F. Cullen, MD

THURSDAY, MAY 11, 1995 SESSION A

- 1:30 p.m. Estimation of Initial 24-HR Resuscitation Fluid Requirements in Trauma Victims Using Admission Lactate Values
- 1:43 p.m. The Effects of Changing Temperature on Isolated Vessels in Rabbits
- 1:56 p.m. Small Volume Resuscitation of Hemorrhagic Shock with Diaspirin Crosslinked Hemoglobin
- 2:09 p.m. Intraoperative Hypothermia Associated with Lower Extremity Tourniquet Deflation
- 2:22 p.m. The Effect of PGE₂ On Myocardial Contractility
- 2:35 p.m. Early Discovery of a Traumatic Carotid-Cavernous Sinus Fistula by Jugular Venous Oxygen Saturation (SJO₂) Monitoring
- 2:48 p.m. Reperfusion Kidney Syndrome in Vascular War Casualty
- 3:01 p.m. A Comparison of the Arndt Emergency Cricothyrotomy Catheter (AECC) and a 14G Angio Catheter in a Large Swine Model
-

THURSDAY, MAY 11, 1995 SESSION B

- 3:45 p.m. A Prospective Experimental Study of the Pathogenesis of Gastric Aspiration
- 3:58 p.m. Intraoperative Monitoring of Jugular Venous Oxygen Saturation in Patients with Intracranial Hematomas
- 4:11 p.m. A New Application of Near-Infrared Spectroscopy: Early Identification of Delayed Intracranial Hematoma in the Intensive Care Unit
- 4:24 p.m. Outcome of Cardiac Arrest Due to Blunt Trauma in Children: Results From a Comprehensive Pediatric Trauma System
- 4:37 p.m. Pediatric Trauma: An Analysis of Demographics, Prevalence, and Cost in the Pediatric Intensive Care Unit
- 4:50 p.m. The McCoy Laryngoscope in Patients with Potential Cervical Spine Injuries
- 5:03 p.m. Perioperative Management of Severe Trauma Patients
- 5:16 p.m. The Effects of Rocuronium on Intraocular Pressure
-

ESTIMATION OF INITIAL 24-HR RESUSCITATION FLUID REQUIREMENTS IN TRAUMA VICTIMS USING ADMISSION LACTATE VALUES. DP Milzman, TM Berry, BR Boulanger, CW Wiles, N Fakhimi, N Schmiechen, K Mitchell. Dept. Emergency Medicine, Georgetown U. Medical Center, Wash,DC; MDEMSS/Shock Trauma Center, Baltimore, MD.

PURPOSE: Blood lactate has been shown to reflect the severity of tissue hypoperfusion and thus predict survival in shock states. Lactate has recently been shown to accurately determine the injury severity and survival of trauma victims. This study will examine the relationship between the admission blood lactate and the composition and amount of fluids given during the initial 24-hour resuscitation period of trauma patients.

METHODS: The R. A. Cowley Shock Trauma Center, a state-wide Level I trauma center with over 3,200 annual admissions (90% are blunt trauma patients). All adult trauma patients admitted directly to the Shock Trauma Center who survived 24 hours were included in the study, with the exception of smoke inhalation victims over a two year period. Lactate is routinely measured on admission (pre-resuscitation). Patients were divided into groups based on admission serum lactate and compared with respect to lactate groups and fluid use. Supporting data was collected on all patients including type and exact amount of all intravenous administered fluids as recorded in the medical record.

RESULTS: An overview of the trauma victims found the mean age to be 32.8 ± 15.6 years, mean Injury Severity Score (ISS): 14.0 ± 12.9 , Admission Glasgow Coma Score (AGCS): 13.8 ± 2.8 , with a mean mortality of 5.8%. The mean admission lactate of 3.0 mmol/l was found to have required, on average, a total of 5.3 L of IV fluids consisting of 4.3 L crystalloid, 0.2 L colloid and 0.5 L of blood products. Patients were divided into groups based on serum lactate and compared with respect to amount of transfused fluids they required. An increasing serum lactate correlated with an increasing intergroup difference for crystalloid ($p < 0.001$), colloid ($p < 0.001$) and blood ($p < 0.005$). Lactate correlated with need for each fluid type used in resuscitation (Pearson $r = 0.45$, $p < 0.0001$).

LACTATE LEVEL	N	MEAN FLUIDS	MEAN BLOOD	MORTALITY
<1.0	224	2.12L	0.034L	0.4%
1.0-1.9	1348	2.90L	0.081L	1.1%
2.0-2.9	1308	4.40L	0.24L	2.2%
3.0-3.9	684	6.20L	0.56L	5.3%
4.0-4.9	327	8.24L	.093L	10.7%
5.0-5.9	194	9.85L	1.41L	19.6%
6.0-7.9	142	13.37L	2.66L	23.9%
8.0-9.9	65	15.46L	3.29L	40.0%
>10.0	75	16.26L	4.08L	49.3%

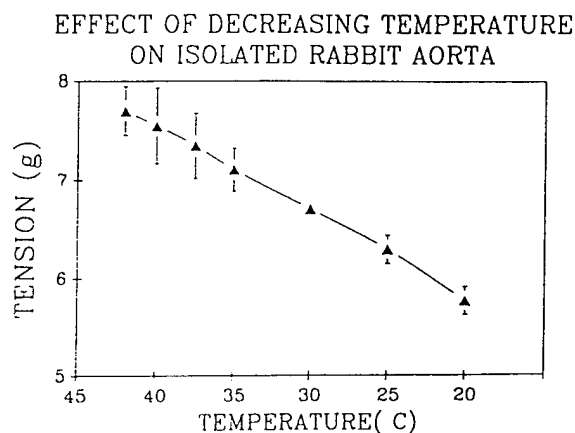
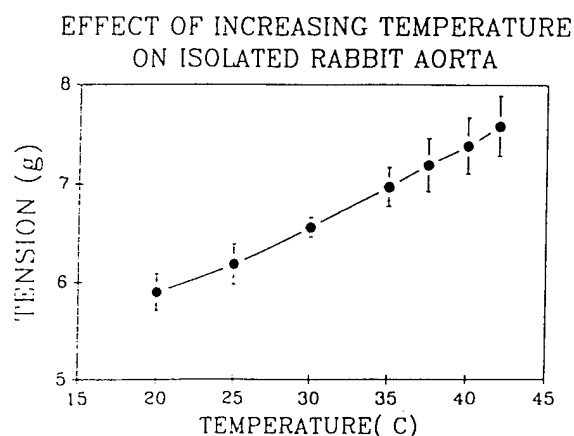
CONCLUSION: Admission lactate correlates well with the mean IV fluid needs for the initial 24-hour, resuscitation of trauma victims. Rapid lactate level determination allows for the estimation of 24-hour fluid requirements on patient arrival. Estimating 24-hour blood component and fluid usage may improve patient decision making and planning for multiple victims in Trauma Centers. Future studies will be needed to determine if trauma patient mortality can be decreased through treatment changes corresponding to the admission lactate level.

THE EFFECTS OF CHANGING TEMPERATURE ON ISOLATED VESSELS IN RABBITS
X. Hou, T. S. Lee, Department of Anesthesiology, Harbor-UCLA Medical Center,
Torrance, CA.

It is known that temperature affects vascular tones. Clinically, it is generally perceived while warming induces vasodilation, cooling causes vasoconstriction. However, it may be more complicated. For example, it has been reported that vasoconstrictor responses to norepinephrine is slightly depressed or unchanged, whereas those to clonidine and KCl are significantly suppressed by cooling. This study used a tissue bath preparation to investigate the direct responses of vascular tones of isolated rabbit aorta to changes in temperature.

Six New Zealand white rabbits, weighing 2-2.5 kg, were used for the experiment. The rabbits were anesthetized with sodium pentobarbital (40 mg/kg). A segment of aorta was removed immediately following respiratory arrest through mid-sternotomy. Precaution was exercised to avoid damage of the intimal surface. The vessels were freed from the connective tissue and cut into rings (3mm wide). The rings of aorta were immersed in a 10 ml tissue bath containing a continuously oxygenated (95% O₂, 5% CO₂) Krebs solution at 37°C and pH 7.4. The ring was suspended to an isometric transducer, the contractions were recorded on a polygraph.

Once the L_{max} was obtained, the peak tension was recorded as the control. The contraction responses of the aortic rings to temperature changes (20, 25, 30, 35, 40°C and in reversed order) of the Krebs solution were obtained. Data were expressed as mean ± SE and analyzed with Student's t-test.



Contrary to general impression, our study showed that in isolated rabbit aorta, increases in temperature caused a significant temperature-dependent vasoconstriction and vice versa. Temperature changes may affect the availability of the intracellular calcium by altering the activities of catecholamine receptors, calcium channels or sarcoplasm reticulum.

References:

1. Circulation 1988; 77:43-52
2. J Auton Pharmac 1989; 9:347-55

SMALL VOLUME RESUSCITATION OF HEMORRHAGIC SHOCK WITH DIASPIRIN CROSSLINKED HEMOGLOBIN.

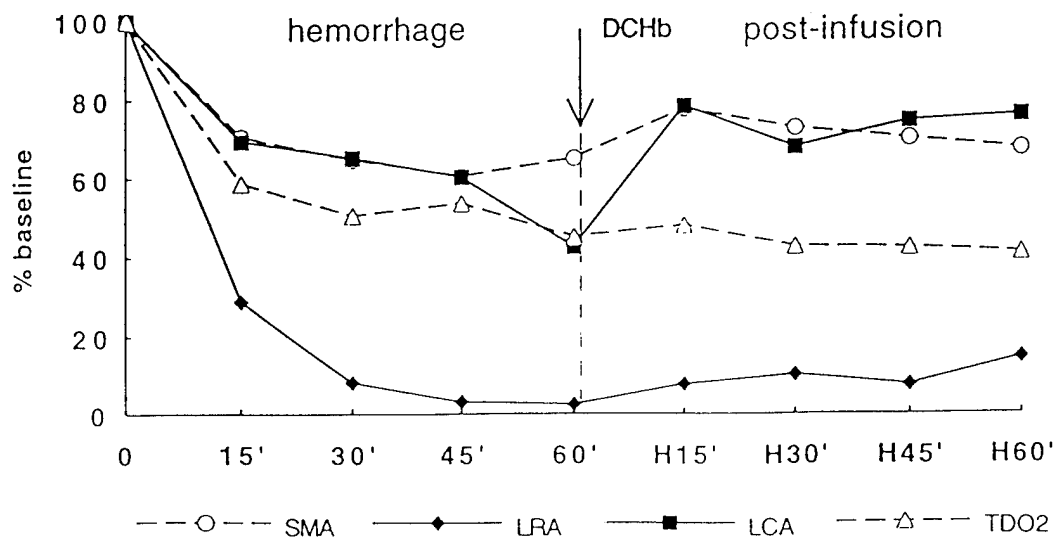
LF Poli de Figueiredo*, W Tao, WC Watson, JR Hess, VW Macdonald, GC Kramer. Dept. Anesthesiology, Univ. Texas Medical Branch at Galveston, Texas

Hemoglobin solutions offer potential as blood substitutes but their nitric oxide inhibition and vasoconstriction may limit their usefulness for the treatment of trauma. On the other hand, it has been suggested that a small volume infusion of hemoglobin may be efficacious, because it restores blood pressure and redistributes blood flow away from non-vital organs.

In the present study we evaluated the effectiveness of 4 ml/kg of 10% Diaspirin crosslinked hemoglobin (DCHb) and an equal volume of 7% albumin, iso-oncotic control, in two groups of anesthetized and hemorrhaged pigs.

Shock induced by bleeding to 45 mmHg for one hour, reduced cardiac output to 40% and reduced blood flow and oxygen delivery to brain, gut and kidney. Albumin infusion, 4 ml/kg, equal to 15 to 25% of bled volume, caused a small increase in blood pressure (10 to 20 mmHg), oxygen delivery and blood flows, while the same amount of DCHb normalized blood pressure, but was associated with no benefits in oxygen delivery and smaller increases in blood flows, except for the brain, which had higher blood flow than albumin controls. Also, a severe pulmonary artery hypertension (mean PAP = 30 to 50 mmHg) was apparent.

Figure shows representative experiment with oxygen delivery expressed as percent of baseline values for total body oxygen delivery (TDO₂, 989 ml/min) and to the superior mesenteric artery (SMA, 73.8 ml/min), left renal artery (LRA, 30.5 ml/min) and left carotid artery (LCA, 76.1 ml/min).



The benefits of increased arterial pressure and blood flow after small volume resuscitation with DCHb may be offset by the severe pulmonary hypertension and the negative effects of systemic vasoconstriction

*Supported by FAPESP

INTRAOPERATIVE HYPOTHERMIA ASSOCIATED WITH LOWER EXTREMITY TOURNIQUET DEFLATION

B. J. Sanders, J.G. D'Alessio, J.R. Jernigan

Department of Anesthesiology, University of Tennessee-Memphis, Memphis, Tennessee, USA

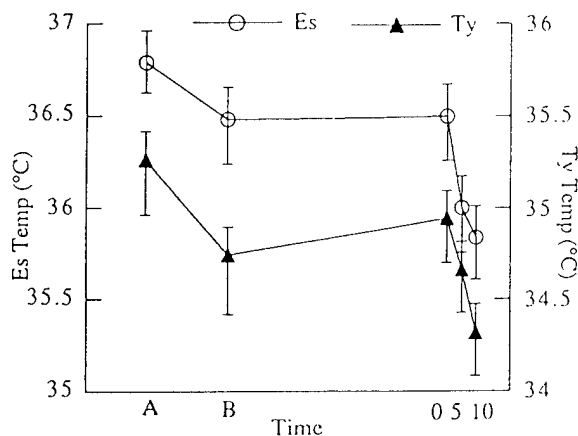
During surgical procedures of the extremity in which a pneumatic tourniquet is placed, we have noticed a precipitous fall in core temperature immediately following release of the tourniquet. Therefore, we evaluated the temperature change associated with unilateral limb tourniquet deflation in adults under general anesthesia.

After approval by the Institutional Review Board, we prospectively studied eleven ASA I or II adults undergoing operative fixation of a lower extremity fracture under general anesthesia in which an intraoperative pneumatic tourniquet was placed. Patients with open fractures, multiple trauma, or those requiring tourniquet placement on more than one extremity were excluded. Room temperature was controlled at 18°-22°C. Core temperature was measured simultaneously in the lower third of the esophagus and at the tympanic membrane, and recorded at 5 minute intervals. Anesthesia was induced with propofol or thiopental, and maintained with isoflurane ($\leq 1.2\%$) in 60% nitrous oxide and oxygen at a fresh gas flow of 3 L/m. Fentanyl was supplemented as needed. A minimal infusion of Lactated Ringer's solution at room temperature was given throughout the procedure. Standard surgical drapes covered the patient except for the operative site. After compressive limb exsanguination, the tourniquet placed on the thigh was inflated. Data were analyzed using ANOVA for repeated measures, comparing variables before with those immediately after tourniquet release. A $p < 0.05$ was considered statistically significant. Values are expressed as mean $\pm$ standard error of the mean (SEM).

Initial temperatures at induction of anesthesia(A) were $36.8 \pm 0.16^\circ\text{C}$ in the esophagus(Es), and $35.3 \pm 0.30^\circ\text{C}$ at the tympanic membrane(Ty). Temperature decreased until the tourniquet was inflated(B), and remained stable until deflation. Tourniquet times ranged from 41 to 129 minutes. At the time of tourniquet release(0), mean temperature had decreased to $36.5 \pm 0.24^\circ\text{C}$ (Es) and $34.9 \pm 0.24^\circ\text{C}$ (Ty). Immediately following tourniquet deflation, core temperature decreased in all patients, declining a maximum at 10 minutes after tourniquet release, which was the termination of measurements. Esophageal temperature decreased an average of $0.46 \pm 0.17^\circ\text{C}$ at 5 minutes, and $0.67 \pm 0.20^\circ\text{C}$ at 10 minutes; tympanic membrane temperature fell $0.28 \pm 0.20^\circ\text{C}$ and $0.62 \pm 0.15^\circ\text{C}$ at 5 and 10 minutes following tourniquet release, respectively. Temperature drops were statistically significant ($p = 0.0001$) at both measuring sites at each interval following tourniquet deflation.

Our study demonstrates a statistically significant decrease in core temperature measured at both the esophagus and tympanic membrane which occurs abruptly after release of a unilateral lower

extremity pneumatic tourniquet in adults under general anesthesia. We believe this temperature decrease is the result of 1) cooling of systemic blood as it reperfuses the hypothermic limb, and 2) mixing of cool, "washed out" blood with the systemic circulation. As the consequences of hypothermia are well-known, we recommend core temperature monitoring in all patients having intraoperative lower extremity tourniquet placed under general anesthesia, as well as vigilant monitoring for prolonged effects of anesthetic agents in the immediate post-operative period.



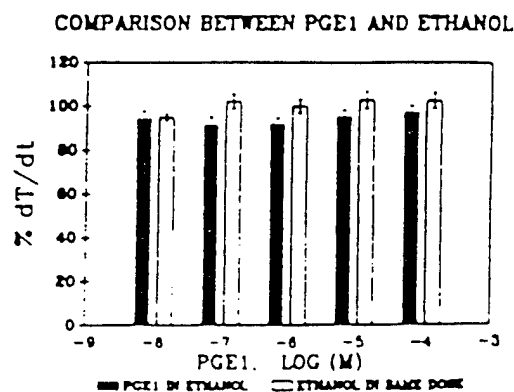
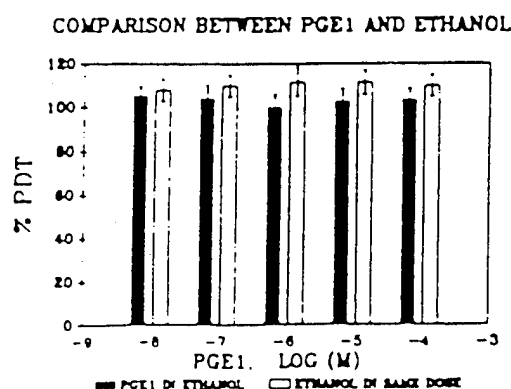
THE EFFECT OF PGE₁ ON MYOCARDIAL CONTRACTILITY

T. S. Lee, X. Hou, Department of Anesthesiology, Harbor-UCLA Medical Center, Torrance, CA.

PGE₁ has been used clinically and reported to have cardiogenic as well as pulmonary artery dilatory effects. It has been shown to be useful in improvement of oxygen delivery in ARDS. This study investigated the direct inotropic effect of PGE₁ on the isolated rabbit myocardium.

Six New Zealand white rabbits, weighing 2-3 kg, were anesthetized with 45 mg/kg i.v. pentobarbital. The heart was immediately removed. The first septal perforator of the left coronary artery was cannulated and perfused with warmed (37°C.) oxygenated modified Krebs-Ringer Bicarbonate Buffer (KRB) solution at 1 ml/gm/min. The septum was then dissected out and suspended from a Grass FTO3 tension transducer. The other two corners were fixed with tension by opposing clamps through which a 5-volt/5 msec electrical stimulation was given from a Grass stimulator at 1.6 Hz. After reaching fully stabilized contractions for at least 30 min, the artery was perfused alternately with control solution (oxygenated modified Krebs-Ringer bicarbonate buffer), PGE₁ (10⁻⁸-10⁻⁴M) and ethanol (PGE₁ vehicle, in doses yielding each concentration of PGE₁) at a rate of 1 ml/gm/min for 5 min. The peak developed tension (PDT), the maximal acceleration ($\pm dT/dt$), time to peak tension (TPT), and time to 1/2 tension relaxation (RT_{1/2}) were recorded.

The results were analyzed with paired t-test and summarized in the figures below.



PGE₁ dissolved in ethanol shows slight positive inotropic effect. However, the magnitudes of increases are similar to those with ethanol alone. We conclude that PGE₁ itself may not have significant direct cardiogenic effect in isolated rabbit myocardium.

Reference:

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EARLY DISCOVERY OF A TRAUMATIC CAROTID-CAVERNOUS SINUS FISTULA BY JUGULAR VENOUS OXYGEN SATURATION (SjO2) MONITORING

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SjO2 measurement, associated with intracranial pressure (ICP) and cerebral perfusion pressure (CPP) monitoring, is an important tool in severe head trauma (SHT) patient management. Indeed, cerebral ischemia may be detected by jugular venous oxygen desaturation, and conversely a high SjO2, associated with an elevated ICP, may indicate hyperemia. This presentation reports an unusual cause of hyperemia.

Case Report

This 29 year old man, without any medical history was admitted to our hospital with SHT (Glasgow Coma Scale 5), profuse epistaxis and right tibial fracture. The initial CT Scan showed right temporal, malar and orbital fractures, a right fronto-temporal contusion and pneumocephalus. Orbital auscultation was normal. Fiberoptic ICP, arterial, right subclavian and right jugular retrograde catheters were inserted.

The patient was sedated, ventilated and had blood and volume replacement, allowing low initial CPP to be rapidly normalized (table 1). Initial SjO2 was in the normal range, but 20 hours after injury, SjO2 values rose and remained elevated in spite of increased ventilation.

Table 1 : SjO2, ICP, CPP and pCO2 monitoring data during the 24 hours after trauma

SjO2 (%)	67,7	56,3	92,2	92,8	94,6
ICP (mmHg)	9	14	8	9	9
CPP (mmHg)	41	64	80	73	70
PCO2 (mmHg)	41	25	35	31	29
Hours post-injury	5h	13h	20h	21h	24h

Renewed temporal and orbital auscultation then revealed a right bruit, followed a few hours later by exophthalmos and chemosis. Angiography confirmed the presence of a right carotid-cavernous sinus fistula (CCSF).

CONCLUSION

- 1) This report describes the early diagnosis of a traumatic CCSF by SjO2 monitoring.
- 2) Hyperemia after SHT should only be treated if an intracerebral arterio-venous communication has been eliminated.
- 3) Orbital auscultation should be repeated in order to diagnose a traumatic CCSF of delayed onset.

REPERFUSION KIDNEY SYNDROME IN VASCULAR WAR CASUALTY

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Reperfusion syndrome definitely occurs in all vascular injured patients. Excluding primary amputations the study was performed in 140 patients accepted in our clinic with vascular war casualty from Bosnian war 1991-1994.

Clinically war casualty appeared as a severe vascular injury of main blood vessels (35%) or an early onset complication of already managed injuries (65%). Possibility of severe mixed infections not adequately treated. As well as hypovolemic/hemorrhagic shock already existed at the acceptance in our clinic. All patients underwent reconstruction of great arteries with venous or synthetic graft. There were no amputation primary done.

These parameters were followed: diuresis per hour, blood urea, creatinine, electrolytes, proteins, urine analysis, urine pH, central venous pressure, MAP, HR and RBC count, sedimentation of Er, leucocyte count.

Therapeutic management was based on maintenance of adequate diuresis per hour, adequate intravascular volume, alkalization of urine, use of free radical scavengers (Manitol sol 20%) and surgical procedure (fasciotomy in 33%) with adequate plasma protein/RBC replacement and antibiotic therapy afterwards. The follow-up period was up to 3 weeks from the injury. Only 3 patients went to dialysis. Reperfusion kidney syndrome as a main cause of renal impairment in vascular trauma along with prerenal causes, mainly hypovolemia must be treated as early as possible even at the first aid unit - particularly with maintenance of adequate intravascular volemia, use of free radical scavengers, maintenance of adequate diuresis per hour as well as the use of highly potent and efficient antibiotics.

TITLE: A COMPARISON OF THE ARNDT EMERGENCY CRICOTHYROTOMY CATHETER (AECC) AND A 14G ANGIO CATHETER IN A LARGE SWINE MODEL

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Introduction. A cricothyroid puncture for airway emergencies to provide ventilation and oxygenation has been advocated. This study examines an anesthetized adult swine model using a transtracheal jet ventilation (TTJV) protocol comparing the AECC and a 14g angio catheter.

Methods. This study examines an Ohmeda Modulus II (OM2), an Ohmeda Modulus II Plus (OM2P), an Ohmeda Excel (OEX), Ohmeda, Inc., and a North American Drager NarcoMed III (NADN3), North American Drager, Inc. to provide TTJV. The Anesthesia Oxygen Flush Button (AOFB) was manually pressed at 30 times per minute using a 1:1 I:E ratio. Either a 14 g Critikon IV cannula or a 9 Fr AECC, Cook Inc., was inserted into the swine's surgically exposed trachea and ventilated using modified high pressure tubing. The pigs were intubated with an 8.0 endotracheal tube modified with a one-way latex valve. The 9 Fr cannula was also ventilated using a Puritan Manual Resuscitator (PMR), an AMBU type bag. The protocol was approved by the University of Wisconsin Animal Research Committee. Four pigs were used, mean weight 78 kg, range 86.5 to 68.2 kg. All the animals were monitored with continuous EKG, temperature, capnography, arterial pressure and pulmonary artery pressures. All data was analyzed using Excel™ 4.0.

Results. The performance of the anesthesia machines during the adult swine TTJV study are recorded in Table 1 along with the PMR results. The ventilation performance of the 9 Fr AECC and 14 g cannulae were compared using a paired two-sided students t-test and are reported in Table 2.

Discussion. The flush systems of all the anesthesia machines are constructed and functioned differently in this study. All of the anesthesia machines were able to provide oxygenation. A 9 Fr cannula was able to provide statistically significant better ventilation with three of the machines tested. We conclude: 1) All anesthesia machines can provide oxygenation using the anesthesia oxygen flush button with a 1:1 I:E ratio at a rate of 30 times per minute in this model. 2) Standard intravenous cannula are kink prone delivering no oxygen. Cricothyrotomy cannulae should be non-obstructable. 3) A standard AMBU bag can provide oxygenation and an airway using a 9 Fr cannula. 4) The AECC uses an air contrast Seldinger technique for accurate placement. 5) The AECC is able to use either a 15mm airway connector or a luer connector to provide ventilation and oxygenation.

Table 1. Performance of Anesthesia Machines During Adult Swine TTJV Study													
n = 4	Ph		PaO2		PaCO2		SaO2		SvO2		VO2		
	14 G	9 Fr	14 G	9 Fr	14 G	9 Fr	14 G	9 Fr	14 G	9 Fr	14 G	9 Fr	
OM2													
	5 min	7.49 ± .09	7.55 ± .07	505 ± 58	495 ± 12	37 ± 6	33 ± 6	100	100	88 ± 5	87 ± 4	209 ± 38	194 ± 33
	10 min	7.51 ± .13	7.57 ± .07	501 ± 47	498 ± 24	34 ± 6	32 ± 5	100	100	89 ± 4	86 ± 4	204 ± 42	199 ± 27
	15 min	7.52 ± .13	7.58 ± .06	515 ± 49	486 ± 13	34 ± 8	30 ± 5	100	100	88 ± 4	86 ± 4	217 ± 46	195 ± 23
NADN3													
	5 min	7.37 ± .07	7.53 ± .06	469 ± 36	480 ± 29	51 ± 9	33 ± 7	100	100	86 ± 3	87 ± 5	195 ± 20	186 ± 15
	10 min	7.37 ± .07	7.54 ± .06	449 ± 24	464 ± 27	54 ± 11	34 ± 5	100	100	88 ± 4	87 ± 5	202 ± 36	184 ± 16
	15 min	7.34 ± .08	7.53 ± .06	448 ± 28	456 ± 31	57 ± 12	34 ± 6	100	100	87 ± 5	86 ± 5	202 ± 37	195 ± 18
OM2P													
	5 min	7.21 ± .03	7.28 ± .05	405 ± 15	426 ± 32	86 ± 9	69 ± 10	100	100	84 ± 4	84 ± 9	186 ± 9	176 ± 14
	10 min	7.16 ± .02	7.23 ± .04	365 ± 24	406 ± 26	96 ± 5	81 ± 9	100	100	83 ± 5	85 ± 9	195 ± 18	182 ± 26
	15 min	7.13 ± .03	7.20 ± .04	329 ± 52	390 ± 23	104 ± 7	87 ± 9	100	100	85 ± 6	86 ± 9	184 ± 8	179 ± 10
OEX													
	5 min	7.28 ± .07	7.42 ± .04	464 ± 25	473 ± 24	65 ± 8	46 ± 4	100	100	87 ± 6	85 ± 6	217 ± 54	207 ± 49
	10 min	7.23 ± .08	7.41 ± .05	424 ± 22	463 ± 7	75 ± 9	47 ± 6	100	100	87 ± 6	87 ± 9	210 ± 54	170 ± 27
	15 min	7.18 ± .09	7.40 ± .05	404 ± 23	497 ± 22	85 ± 13	49 ± 6	100	100	86 ± 6	84 ± 8	210 ± 38	193 ± 9
PMR n=2*													
	5 min		7.35 ± .06		341 ± 107		71 ± 12	100		84 ± 4		175 ± 1	
	10 min		7.32 ± .05		325 ± 115		60 ± 8	100		83 ± 5		185 ± 18	
	15 min		7.31 ± .02		325 ± 146		64 ± 4	100		84 ± 5		207 ± 61	
	50 psi												

Table 2. Performance of 9 Fr and 14 g Cannulae to Provide Ventilation						
n = 4	5 min		10 min		15 min	
	14 G	9 Fr	14 G	9 Fr	14 G	9 Fr
OM2	37 ± 6	33 ± 6 p = 0.2	34 ± 6	32 ± 5 p = 0.4	34 ± 8	30 ± 5 p = 0.3
NADN3	51 ± 9	33 ± 7 p = 0.05	54 ± 11	34 ± 5 p = 0.06	57 ± 12	34 ± 6 p = 0.04
OM2P	86 ± 9	69 ± 10 p = 0.03	96 ± 5	81 ± 9 p = 0.01	104 ± 7	87 ± 9 p = 0.03
OEX	65 ± 8	46 ± 4 p = 0.02	75 ± 9	47 ± 6 p = 0.02	85 ± 13	49 ± 6 p = 0.03

A Prospective Experimental Study of the Pathogenesis of Gastric Aspiration

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Understanding the pathogenesis of aspiration pneumonitis at the cellular and molecular level is important in the development of strategies to decrease the severity of aspiration of gastric contents, once it has occurred. The role of the neutrophil as the primary effector cell involved in the aspiration-induced inflammatory lung injury is the primary direction of these experiments. The role of the macrophage, endothelium and alveolar epithelium in the regulation of the injury will also be explored. Using intrapulmonary deposition of three possible combinations of gastric contents, etiologically-linked to aspiration pneumonitis (low pH, gastric particulate, or low pH plus particulate), we will assess in Aim #1 the role of $\text{TNF}\alpha$, IL-1, MIP-2, and MCP-1 in the recruitment and activation of inflammatory cells in the rat by employing functional assays, ELISAs, and Northern assays and blocking antibodies and other inhibitors of activity. In Aim #2, we will examine the role of IL-10 in the regulation of the inflammatory injury following instillation of the three possible combinations of gastric contents by examining upregulation of IL-10 expression and the ability of anti-IL-10 antibody to alter the severity of the lung injury and other cytokine expression. We will also assess the effects of intratracheally administered IL-10 on lung injury, neutrophil infiltration, $\text{TNF}\alpha$, IL-1, MIP-2, and MCP-1 in the different models of aspiration pneumonitis. In addition, the effects of IL-10 on *in vivo* upregulation of ICAM-1 and E-selectin will be assessed. In Aim #3, we will continue to pursue our studies examining the role of neutrophil-derived proteinases and reactive oxygen, as well as, nitrogen species in the pathogenesis of the aspiration-induced lung injury by directly measuring levels of these agents, indices of their activity, and changes in lung injury brought about by selective inhibition. Examination of three models of oxidant-proteinase interaction and the relationship of each to the different aspirants will be explored in this aim.

INTRAOPERATIVE MONITORING OF JUGULAR VENOUS OXYGEN SATURATION IN PATIENTS WITH INTRACRANIAL HEMATOMAS.

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Continuous monitoring of jugular venous oxygen saturation (SjvO_2) has been useful for monitoring global cerebral oxygenation in patients in the ICU. Recently, cerebral blood flow (CBF) measurements have demonstrated significantly low values in traumatic intracranial hematomas. However, since these CBF techniques are not continuous, it has not been possible to study the effects of hematoma evacuation on the reduced CBF. The purpose of this study was to use continuous monitoring of SjvO_2 to study the consequences of surgery on CBF adequacy.

Thirteen intraoperative recordings of SjvO_2 were obtained in 12 adult (mean age 34 ± 9 years) patients during evacuation of a traumatic intracranial hematoma. The mean Glasgow Coma Scale score was 6.3 ± 1.9 (range 3-9). Values for SjvO_2 before and after evacuation of the traumatic hematoma were compared using paired t-test.

Despite the maintenance of cerebral perfusion pressure (CPP) between 60-75 mm Hg, eight of the 12 patients (on 9 of the 13 occasions) had an $\text{SjvO}_2 < 50\%$ (average 40.6 ± 8.7) prior to surgical evacuation of hematoma, suggesting a relative inadequacy of CBF. Two patients had extremely low values for SjvO_2 , 25 and 27%, respectively. Eleven of the 13 intraoperative recordings showed significant increases in SjvO_2 as the intracranial hematoma was evacuated (to an average 62.8 ± 5.3 , $p < 0.001$).

The occurrence of jugular venous desaturation was more commonly seen in the operating room than has been previously reported in the ICU. Monitoring of SjvO_2 intraoperatively may give useful information about the level of blood pressure required to maintain cerebral perfusion prior to and during the definitive surgical treatment.

A NEW APPLICATION OF NEAR-INFRARED SPECTROSCOPY: EARLY IDENTIFICATION OF DELAYED INTRACRANIAL HEMATOMA IN THE INTENSIVE CARE UNIT.

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Clinical studies have documented the importance of secondary brain insults in determining neurologic outcome after head injury. Delayed intracranial hematomas are one of the most easily remediable causes of secondary injury if identified early, but can cause significant disability or death if not promptly recognized and treated. An ideal clinical monitor for detecting intracranial hematomas would be capable of making non-invasive on-line continuous measurements in the ICU, and would identify the development of a hematoma prior to the onset of clinical neurological deterioration. A CT scan could then be performed to obtain more information about the size and location of the hematoma. The purpose of this study was to determine whether near-infrared spectroscopy (NIRS) would be useful in identifying the development of delayed intracranial hematomas in the intensive care unit.

A dual wavelength NIRS unit (RunMan, manufactured by NIM, Inc., Philadelphia, PA) was used to quantitate hemispheric differences in light absorbance to detect the development of delayed hematomas in 238 patients admitted to the ICU. The intensity of unabsorbed light at 760 nm was measured serially during the first 3 days after injury in each of the corresponding regions of the scalp. The difference in optical density (ΔOD) between the corresponding regions of the hemisphere was noted from a ready-reference table.

The ΔOD on the initial examination closely predicted the findings on the CT scan obtained on admission. Patients with an epidural hematoma had the highest ΔOD , followed by those with a subdural hematoma, an intracerebral hematoma or a contusion. Patients with diffuse brain injury had ΔOD values similar to normal individuals. Forty-two (17.6%) of the patients developed, between 2 and 72 hours after admission, a type of late intracranial hematoma: a new hematoma (n=15), an increasing hematoma (n=12), or a recurrent post-operative hematoma (n=15). 25 of the delayed hematomas caused significant mass effect and required surgical evacuation. In 38 of the 42 patients, a significant increase (> 0.3) in the ΔOD occurred prior to an increase in ICP or a change in the neurological examination.

NIRS has promise as a technology that will allow early identification and treatment of intracranial hematomas. Development of the technology in the future may improve the resolution and depth of the NIRS examination.

OUTCOME OF CARDIAC ARREST DUE TO BLUNT TRAUMA IN CHILDREN: RESULTS FROM A COMPREHENSIVE PEDIATRIC TRAUMA SYSTEM.

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Objective: To analyze a county-wide trauma system which by law mandates transport of all seriously traumatized children to a single center. We determined the characteristics and outcomes of all such children who suffered cardiac arrest due to blunt trauma.

Methods: A comprehensive computer data base was used to identify all pediatric trauma patients who received CPR in the time interval from 1984 (inception of trauma system) to July 1994. A retrospective chart review recorded patient demographics, mechanism of injury, medical interventions and outcome. Outcome measures were: restoration of spontaneous circulation by CPR, survival to hospital discharge and if so, neurologic outcome. If brain death criteria were met, frequency of organ donation was determined.

Results: 8,278 pediatric trauma patients were in the database representing all traumatized children transported to our center from 1984 to 1994. 74 were identified who had documented complete cardiopulmonary arrest following blunt trauma (0.8% of all pediatric trauma victims) Of these, 26 children (35 of study population) died in the ED despite very aggressive ACLS. (95% received ACLS medications, and volume resuscitation, 80% had CVP insertion, 70% received O- blood.) The remaining 48 children (65%) were resuscitated and admitted to the PICU. 46 of these children died. 16 (21% of study population) died of intractable cardiac failure or due to withdrawal of life support prior to brain death. 30 children (40% of study population) met brain death criteria and 5 of these (10% of all resuscitated patients) were organ donors.

Two children survived (2.7% of study population.) One had spontaneous circulation at the scene but developed asystole in transport due to airway obstruction and inability to intubate/ventilate. The second had no vital signs at the scene but had return of spontaneous circulation after basic CPR. Survivor 1 remains in a persistent vegetative state. Survivor 2 left hospital with mild cognitive defects.

County coroner statistics reveal an additional 167 children pronounced dead at the scene of accidents who did not enter our data base.

Conclusions: 1. Cardiac arrest occurs in at least 1% of traumatized children in San Diego County. 2. Survival is rare in this group despite aggressive ACLS. No child with absent vital signs at the scene who also required ACLS survived. 3. Successful organ donation occurred in 10% of children who could be resuscitated. 4. If ACLS is justifiable in children who arrest due to blunt trauma, it is so only to facilitate organ donation, not in hopes of producing intact survival.

PEDIATRIC TRAUMA: AN ANALYSIS OF DEMOGRAPHICS, PREVALENCE, AND COST IN THE PEDIATRIC INTENSIVE CARE UNIT

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PURPOSE: This study compares pediatric trauma patients versus pediatric **non-trauma** patients, with respect to demographic variables, mortality, outcome, and cost.

METHODS: This study includes **all** patients admitted to the Pediatric Intensive Care Unit (PICU) between July 1, 1993, and June 30, 1994. We recorded the following variables for each patient: age, gender, diagnosis, length of stay, PRISM score, mortality, and outcome. Additionally, we obtained financial data for each patient; this included the actual hospital *charges* as reported on the patient's itemized bill. The hospital's finance office provided us with "cost-to-charge" ratios, which we used to convert *charges* to actual *costs*.

Patients were divided into two groups: 1) trauma patients (patients admitted to the PICU secondary to injuries sustained by a traumatic mechanism), and 2) **non-trauma** patients (patients admitted to the PICU because of a disease or injury of a non traumatic etiology). Finally, we analyzed the data from the two groups to look for any differences.

RESULTS: During the twelve month period of this study, 1,377 patients were admitted to the PICU. Of these, 206 patients (15%) suffered traumatic injuries; the remaining 1,171 patients (85%) had diseases or injuries of non-traumatic etiology. The male:female gender distribution of the trauma patients was nearly 2:1; whereas males accounted for only 56% of the **non-trauma** patients. Both groups had similar age distributions: mean age of 89 months $\pm$ 60 months for the trauma patients, as compared to 79 $\pm$ 76 months. The average length of stay (LOS) in the PICU for the trauma patients was 3.2 days, which was significantly less than the mean LOS of 5.1 days for **non-trauma** patients ($p < 0.01$). Trauma patients proved to have both a higher PRISM score and a higher mortality; 11.2% of trauma patients died, as opposed to a mortality rate of only 5.3% for **non-trauma** patients. Of the 23 trauma patients who died, 18 (78%) died of brain death. The average cost incurred during the PICU hospitalization was \$10,601 $\pm$ 11,906 for the trauma patients, compared with \$15,163 $\pm$ 24,487 for **non-trauma** patients. When corrected for LOS, the difference in cost between the two groups was not statistically significant ($p = 0.17$), as each group had an average cost per day of approximately \$3,000.

CONCLUSIONS: From the above data, we conclude that pediatric trauma patients differ from pediatric **non-trauma** patient in the following ways: Trauma patients account for 15% of PICU admissions; they have a shorter length of stay, but tend to have a higher risk of mortality. Despite this higher acuity, they do not incur more costs per day in the PICU than do **non-trauma** patients. Furthermore, this study supports the fact that trauma is still a leading cause of death in the pediatric population. Specifically, traumatic brain injury resulting in brain death is, by far, the most common pathophysiologic mechanism of death in pediatric trauma patients.

THE MCCOY LARYNGOSCOPE IN PATIENTS WITH POTENTIAL CERVICAL SPINE INJURIES.

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PURPOSE OF STUDY Urgent tracheal intubation may need to be performed in patients assumed to have both a cervical spine injury and a full stomach. A recommended technique is direct laryngoscopy and orotracheal intubation following a rapid sequence induction, with cricoid pressure and manual in-line stabilization of the head and neck[1]. We wanted to find out if the McCoy laryngoscope [2] could improve the view of the larynx normally obtained by the Macintosh laryngoscope when these conditions were simulated.

METHODS We enrolled 167 patients scheduled to undergo elective surgery and who required tracheal intubation as part of their anesthetic. Patients were induced with propofol, fentanyl and atracurium and anesthesia was maintained with oxygen, nitrous oxide and isoflurane. The patients head and necks were then placed in the neutral position (without a pillow). An assistant, kneeling to the side of the anesthetist provided manual in-line cervical stabilization. An experienced operating department practitioner simultaneously applied cricoid pressure. Laryngoscopy was attempted a minimum of three minutes following the injection of atracurium. All patients underwent two laryngoscopies. Once with a Macintosh size 3 and once with a McCoy size 3 laryngoscope (with and with out the tip in the elevated position). The decision to use a McCoy or a Macintosh first was randomly determined by flipping a coin after the induction of anesthesia.

The best view obtained with each laryngoscope was graded according to standard guidelines[3]. Grade 1, most of the glottis can be exposed, grade 2, only the posterior extremity of the glottis is visible, the arytenoids can be exposed, grade 3, the epiglottis but no part of the glottis can be exposed, grade 4, neither the glottis nor even the epiglottis can be seen. Statistical analysis was calculated using the Mann-Whitney U test.

RESULTS The views obtained of the larynx with the patients' head and neck in the neutral position with manual in-line stabilization and cricoid pressure with the McCoy and Macintosh laryngoscopes are shown in the table. On no occasion was there a decrease in laryngoscopic view when the McCoy was used instead of the Macintosh laryngoscope. There was no correlation between laryngoscopic view and order of laryngoscopy. The view of the larynx remained the same in 85 (51%). The McCoy blade improved the grade by one or more in 82 (49%) and by two grades in 13 (7.8%) ($p < 0.001$). When using the McCoy blade there was a greater incidence of grade 1s 117 (70%) as compared with the Macintosh 70 (42%) ($p < 0.001$). Difficult laryngoscopy defined as the inability to see the glottis (grade 3 or 4), was found in 56 (33.5%) with the Macintosh laryngoscope and only 8 (5%) ($p < 0.001$) with the McCoy laryngoscope.

McCoy Grades	Macintosh Grades			Total (%) McCoy
	1	2	3	
1	70	34	13	117 (70)
2	0	7	35	42 (25)
3	0	0	8	8 (5)
Total (%) Macintosh	70 (42)	41 (24.5)	56 (33.5)	167 (100)

CONCLUSION We recommend that the McCoy laryngoscope be used in preference to the Macintosh when direct laryngoscopy is performed in patients with a suspected cervical spine injury and a full stomach.

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PERIOPERATIVE MANAGEMENT OF SEVERE TRAUMA PATIENTS

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428 cases of trauma victims caused by traffic accident and industrious injury, including ordinary injury 311 cases(72.7%), severe injuries 117 cases(27.3%). This article focuses on severe trauma anesthesia patients perioperative management.

117 cases of severe trauma patients divided into 3 types: 69 cases with severe closed head injuries(CHI 59%), 15 cases with severe multisystem organ injuries (MOI 13%), 33 cases with liver or/and spleen injuries(28%). Sex M 90; F 27. Age; 13-55y 79(68%)

the mortality of 117 cases with severe trauma patients

CHI	n=	69	death	19		mortality	16%
MOI	n=	15	"	7	"	"	6%
1-2 OI	"	33	"	0	"	"	0%

Total		117(428)		26			22%(6%)

It was of paramount importance that the trauma patient be rapidly assessed and supported in the E.R., and need to immediately apply the ABCDs of trauma care: A very standard primary survey (establish an open airway, assure gas exchange, maintain the circulation, and evaluate the basic neurologic states) with ongoing resuscitation and immediate surgical intervention when required.

91 cases of severe trauma patients(CHI, MOI) were performed with general anesthesia (77.8%), Epidural and local block techniques were be of particular benefit for analgesia as well as anesthesia of isolated injuries; 19 cases were performed with epidural catheterization anesthesia (15.4%), 8 cases were performed local anesthesia.

Severe major trauma patients associated with hypovolemia were be provided with short acting intravenous drugs (i.e. fentanyl, dipriven etc .) or/and low dosage of enflurane or isoflurane as tolerated, and atracurium was the first choice of the neuromuscular blocking agent.

Postoperation considerations; most of severe trauma patients after operation were sent to Intensive Care Unit for further monitoring (CVP, MAP, BP; HR, ECG, Blood Gases, CO, Spo2, PaCO2); and treatment(hypovolemia, ARDS, MOF(multisystem organ failure) and anti-infection).

THE EFFECT OF ROCURONIUM ON INTRAOCULAR PRESSURE

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It is recommended that succinylcholine be avoided in patients with open eye injuries, due to a well established increase in intraocular pressure (IOP) that can cause extrusion of the vitreous humor.^{1,3} This presents a dilemma since most penetrating ocular injury patients are considered to have full stomachs, thus requiring rapid sequence induction (RSI) to prevent gastric aspiration. To date, succinylcholine has been the drug of choice for RSI due to its rapid onset. Rocuronium bromide, a new nondepolarizing muscle relaxant, has a rapid onset (60 seconds) and is approved for RSI. The purpose of this study is to determine the effect of rocuronium on IOP. We hypothesize that rocuronium bromide will not increase IOP during a RSI.

This descriptive nonrandomized trial was approved by the Institutional Review Board. Thirty-one adults, ages 18-50 years, ASA I or II, undergoing elective non-ophthalmic surgery lasting at least one hour, requiring intubation participated in the study after obtaining informed written consent. This study was longitudinal in design and IOP measures were obtained on the same patient. IOP was measured using a Keeler Pulsair 2000 noncontact tonometer, which has a close and statistically significant correlation to the more conventional Goldmann contact applanation tonometer.⁴ Prior to sedation, the left IOP was measured in the supine position by one investigator. Each patient was induced using a similar RSI technique consisting of preoxygenation for 3 minutes, midazolam .04 mg/kg, fentanyl 5 ug/kg, thiopental 4 mg/kg followed by rocuronium bromide 1 mg/kg. The left IOP was measured 0.5, 1, 1.5, 2, and 3 minutes after induction. Intubation was performed immediately after the 1 minute IOP measurement. Multivariate ANOVA for repeated measures was used for analysis of changes in IOP during induction and intubation. A two-tailed test ($p < 0.05$) was used with a power analysis of greater than .90 to detect a difference of 1 SD using 31 subjects.

Descriptive data are shown in Table 1. Figure 1 shows mean IOP levels at each time point. A significant change ($p < .01$) in IOP from baseline was shown during the time course of the study. Compared to baseline, the 0.5 minute IOP measurement decreased by a mean of 6 mmHg (± 5), followed by a further decrease at 1 minute by a mean of 6 mmHg (± 5). At three minutes post-induction (1.5 minutes post-intubation) IOP decreased by a mean of 4 mmHg (± 6) compared to the baseline. Subjects remained hemodynamically stable throughout the testing period (Figure 2 and 3).

Our results suggest that IOP decreased during RSI using rocuronium for muscle relaxation compared to pre-induction IOP levels. Intraocular pressure decreased to its lowest level immediately prior to intubation, followed by a slight increase associated with intubation. However, at no time did the mean IOP levels exceed baseline values. Rocuronium appears to offer significant advantages over current muscle relaxants used in rapid sequence inductions for patients with open eye injuries.

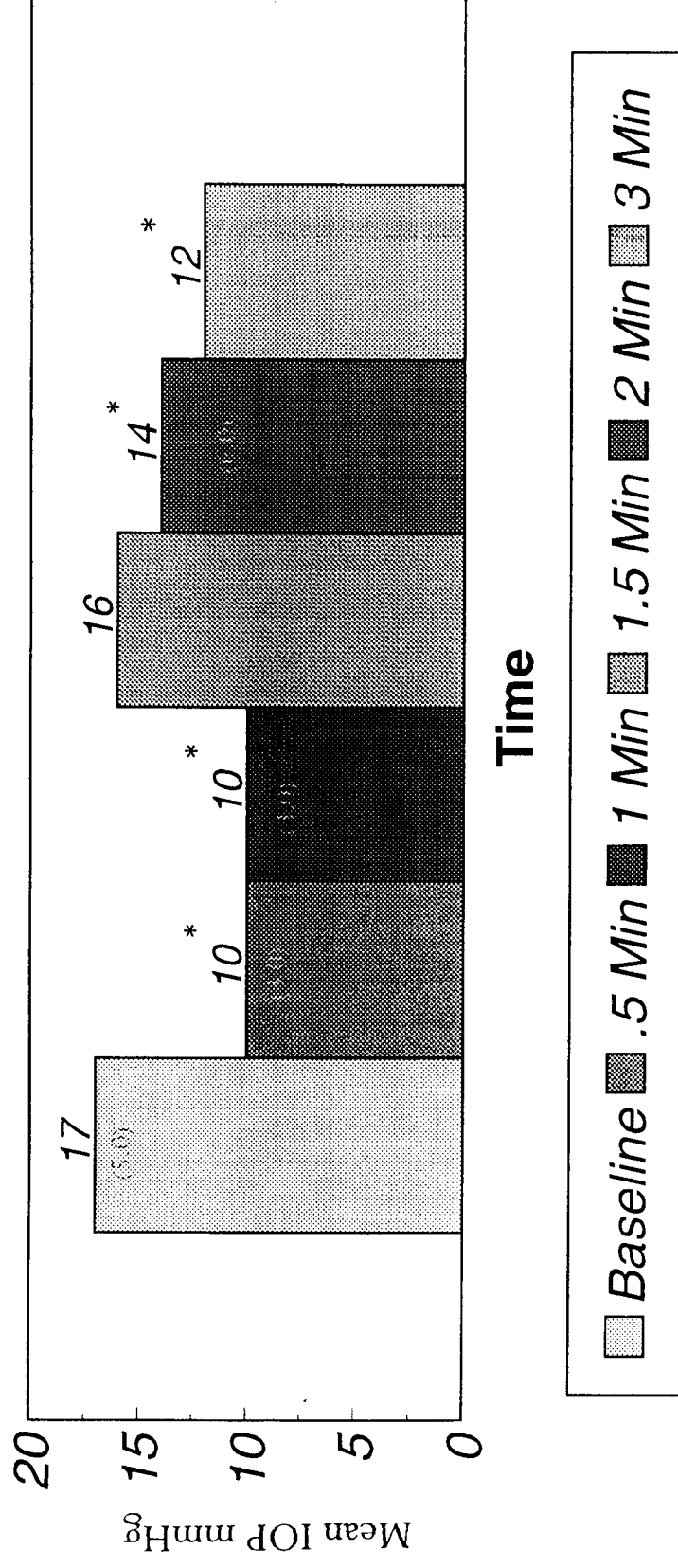
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Legend: Figure 1

Comparison of mean intraocular pressures at six assessment intervals: Pre-induction (baseline), 0.5 minute and one minute post-induction, 1.5 minutes post-induction (30 seconds post-intubation), 2 and 3 minutes post-induction (1 and 2 minutes post-intubation).

IOP Levels During RSI with Rocuronium

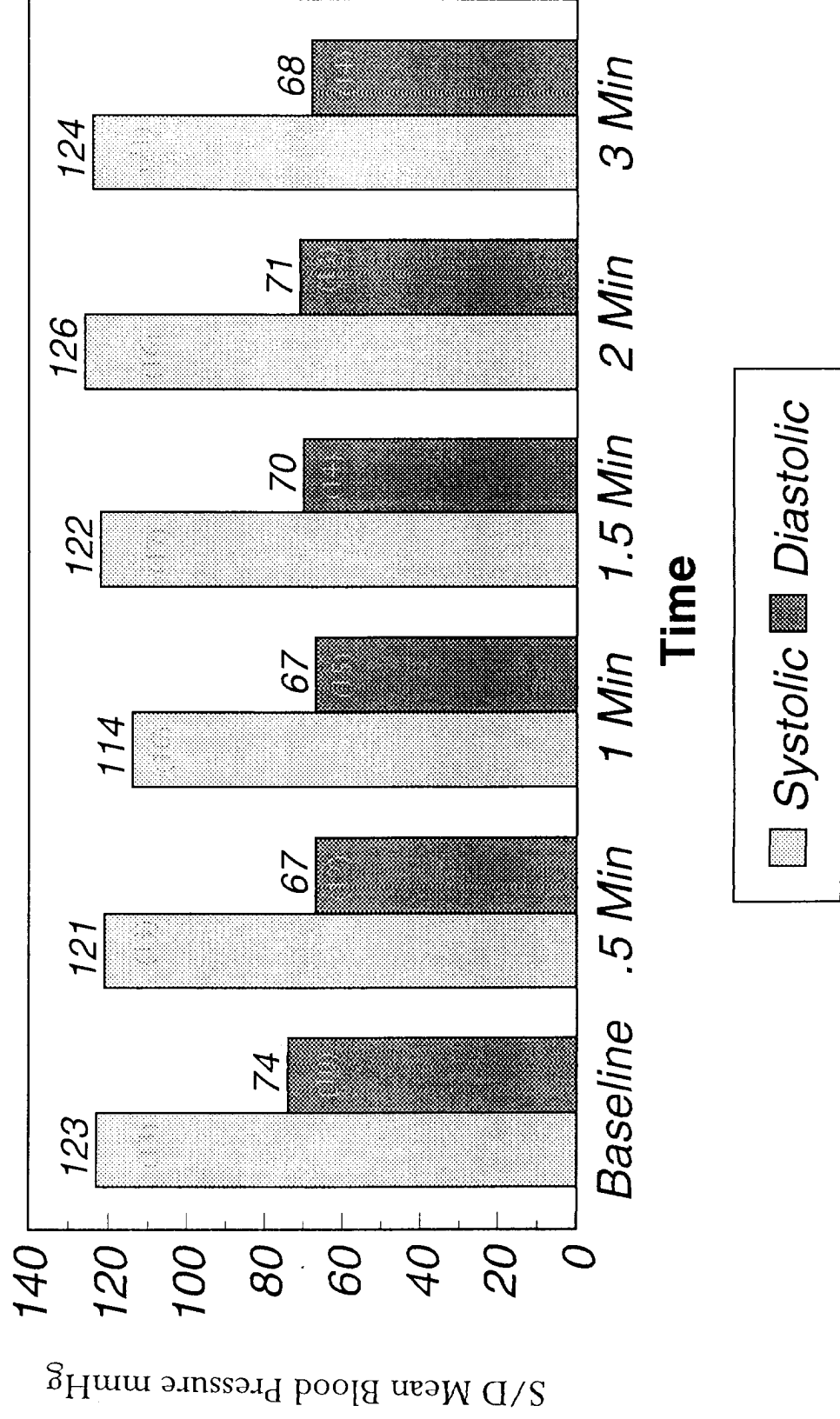


* P < .01

Legend: Figure 2

Comparison of mean systolic and diastolic blood pressures at six assessment intervals: Pre-induction (baseline), 0.5 minute and one minute post-induction, 1.5 minutes post-induction (30 seconds post-intubation), 2 and 3 minutes post-induction (1 and 2 minutes post-intubation).

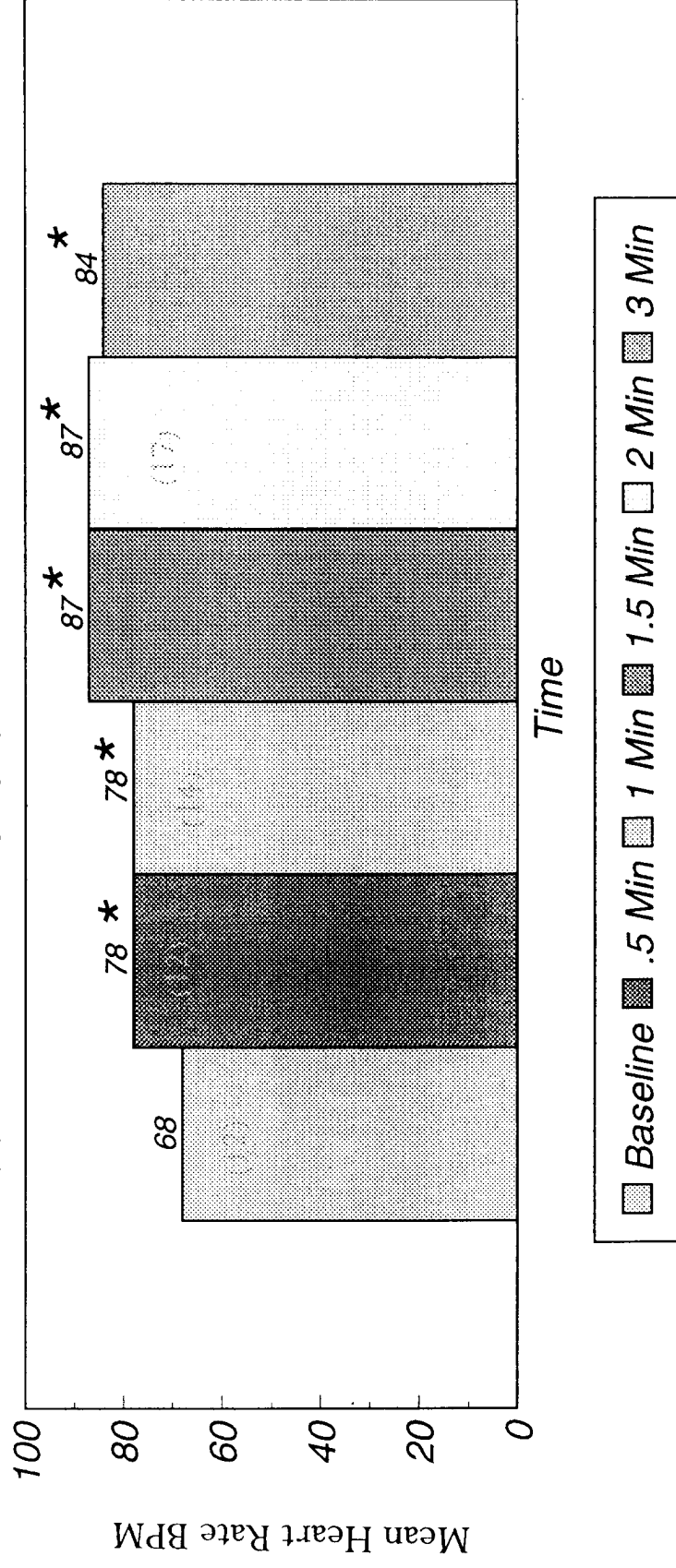
Blood Pressure Levels During RSI with Rocuronium



Legend: Figure 3

Comparison of mean heart rates at six assessment intervals:
Pre-induction (baseline), 0.5 minute and one minute post-induction,
1.5 minutes post-induction (30 seconds post-intubation), and 2 and
3 minutes post-induction (1 and 2 minutes post-intubation).

Heart Rate Levels During RSI with Rocuronium



* $P = < .05$

THURSDAY, MAY 11, 1995

SESSION E: Scientific Free Posters I
Moderators: Posters
Ronald G. Pearl, MD, PhD
John K. Stene, MD, PhD

THURSDAY, MAY 11, 1995 SESSION A

- 1:30 p.m. Influence of Hemocorrector of Complex Action "Lactoprotein" on a Course and Outcome Secondary Hemorrhagic Collapse (SHC) in Dogs
- 1:43 p.m. Complete Recovery After Severe Brain Injury With Clinical and Electrophysiological Findings of Impending Cerebral Death
- 1:56 p.m. Haemodynamic Profile of Aorto-Caval Fistula Following Penetrating Abdominal Trauma
- 2:09 p.m. The Safety and Efficacy of Anesthetic Induction and Endotracheal Intubation of Trauma Patients in the Resuscitation Suite of the Emergency Department
- 2:22 p.m. A Pharmacokinetic Approach to Comparing Epidural and Intravenous Alfentanil in Normal Volunteers: Analgesia and Side Effects
- 2:35 p.m. Efficacy of a Balloon Device in Detecting Endotracheal Tube Placement in Patients with Minimal Respiratory Effort
- 2:48 p.m. Motor Vehicle Accidents: Cost and Consequences for Pediatric Patients
- 3:01 p.m. The Effect of Rocuronium on Intraocular Pressure

THURSDAY, MAY 11, 1995 SESSION B

- 4:11 p.m. Increased Alveolar Epithelial Liquid Clearance After Hemorrhagic Shock in Anesthetized Rats is Mediated by Endogenous Release of Catecholamines
- 4:24 p.m. Resource Use After Penetrating Trauma
- 4:37 p.m. Comparative Characteristic of Effects of New Sorbitcontaining Solutions "Sorbilact" ("SL"), "Lactosorbal" ("LS") and "Rheosorbilact" ("RhSL") on the Motility of Different Parts of Gastrointestinal Tract (GIT) in Paralyticileus Dogs
- 4:50 p.m. Optimizing Endotracheal Tube Placement When Performing Retrograde Intubation: Use of the 145 CM Moveable Core "J" Wire
- 5:03 p.m. The Chinese Experience of Anesthesia on War Casualty in Soldiers (Past, Present and Future Views)
- 5:16 p.m. Comparative Effects of Nitroprusside and Hemorrhage at Equihypotension on Renal Blood Flow in Dogs Anesthetized With Sevoflurane

INFLUENCE OF HEMOCORRECTOR OF COMPLEX ACTION "LACTOPROTEIN" ON A COURSE AND OUTCOME SECONDARY HEMORRHAGIC COLLAPSE (SHC) IN DOGS
A.N.Oborin, Department of Surgery and Transfusiology, Research Institute of Hematology and Blood Transfusion, Lvov, Ukraine.

It is known that acute massive hemorrhage (H) leads to development of severe hemorrhagic shock (HS) in progressing of which one can easily differ early, comparative stable and late stages (Fig. 1). The final result of HS is SHC, which is resulted from a complete demolition of central mechanisms of regulation and signifies an irreversibility of a process developing.

The study was carried out in 7 dogs in which HS was induced by jet momentary H from a. femoralis (volume of bloodloss made 30.2 ± 0.5 ml/kg). For the treatment, which was started after 262.4 ± 78.8 min of H in arterial blood pressure (ABP) level of 30.0 mm Hg, "LACTOPROTEIN" was used. "LACTOPROTEIN", which is a 5% albumin solution containing 5% glucose solution, sodium lactate (180.0 mmol/l), Na⁺, K⁺, Ca²⁺, NaHCO₃ in the recipe of Ringer's solution was injected into v. femoralis at the dose of 10.0 ml/kg with a permanent rate of 20.0 ml/min.

The SHC developed unexpectedly in 2 dogs out of 7 and apnoae presented after 188.2 ± 16.8 min of H, when ABP level was 30.0 mm Hg (Fig. 1, 2).



Fig. 1. The kymogram of the experiment N 7. Bloodloss 30.5 ml/kg. From up to down: respiratory curve, ABP curve, basic zero ABP line, time mark 4 min. The letters mark: H - hemorrhage start, T - beginning of the treatment.

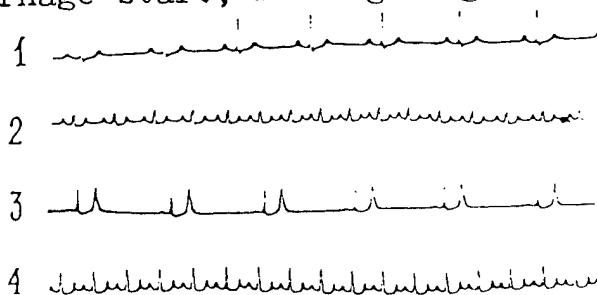


Fig. 2. Cardiogram of the dog of the experiment N 7. The figures mark: 1 - before H, 2 - late shock stage, 3 - the very moment of the SHC development, 4 - 30 min after the treatment started.

Transfusions of "LACTOPROTEIN" were accompanied by quick raising of ABP and central venous pressure (CVP) in all dogs. In 2 dogs where the treatment was carried out at the background of SHC the maximal peak of ABP and CVP raise made 82.7 ± 12.7 mm Hg (Fig. 1) and 3.5 ± 0.3 cm H₂O, correspondently. The heart rate increased to 192.0 ± 4.0 (Fig. 2) per min. The length of life in those 2 dogs after the treatment made 125.0 ± 55.0 min. The other 5 dogs survived.

Conclusion. The results of present study are the experimental for "LACTOPROTEIN" use in complex therapy of severe HS in clinic.

COMPLETE RECOVERY AFTER SEVERE BRAIN INJURY WITH CLINICAL AND ELETTROPHYSIOLOGICAL FINDINGS OF IMPENDING CEREBRAL DEATH.

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The outcome of severe head trauma is usually related to diagnostic categories of cerebral injury, age, clinical findings, ICP levels, and elettrophysiological data; however, the prognostic judgement on every single patient can result very difficult. The purpose of this paper is to show a case of severe head injury, where aggressive treatment was able to reverse clinical and instrumental signs of impending cerebral death.

CASE REPORT: N.S., a 21 years old female, on May 1994 was admitted to our ICU after head injury. CT scan showed left frontal contusion, brain swelling, shift > 5 mm, and sub-falcine herniation; pupils were small and reactive, GCS was 7, and ICP 23 mmHg; hyperventilation associated with mannitol was started, to normalize ICP. After 3 days GCS was 4, and we observed 2 ICP "plateau" waves at 45 mmHg with dilated, oval and unreactive pupils; a catheter was placed into the right jugular bulb, in order to optimize hyperventilation; further mannitol and Thiopental was given, with normalization of ICP and pupillary signs. 6 days after injury pneumonia associated with severe sepsis was revealed: dopamine and epinefrine were started in sequence, to maintain MAP and CPP; at 1 p.m. ICP was 25 mmHg, CPP 65 mmHg; all eye responses were absent; GCS was 3, and the only sign of brainstem function was the persistence of spontaneous respiration during bronchial suction; CT scan excluded surgical lesions; mannitol was given, in spite of serum osmolarity > 320 mOsm/l. At this time BAEPs revealed only the wave I (auditory nerve); EEG was severely depressed; barbiturate levels and temperature were in the normal range. At 3 p.m. right pupil reduced, but direct light reflex and motor responses were absent. After 24 hours GCS was 3, pupillary diameter reduced, and respiratory activity persisted after disconnection from ventilator; all components of BAEPs reappeared; septic state was unchanged. The 12th day septic complication was controlled, and weak motor responses were observed; pupils began reactive. The 17th day patient was aware; 30 days after trauma the patient was conscious; the 47th day the patient was admitted to a rehabilitation center. At 6 months follow-up she was conscious, motor function was normal, and she was able to return to work.

CONCLUSIONS: 1) in absence of all criteria for brain death (this subject maintained respiratory drive), the judgement on outcome and quality of life after severe head injury remains uncertain, so that a complete recovery is possible, particularly in young people, also in presence of signs of impending cerebral death; 2) sepsis could participate in worsening clinical findings of severe neurologic deterioration; 3) aggressive therapy of intracranial hypertension and herniation, guided by ICP, SjO_2 , and electrophysiological data, could play a key role in patient treatment and recovery.

HAEMODINAMIC PROFILE OF AORTO-CAVAL FISTULA FOLLOWING PENETRATING ABDOMINAL TRAUMA.

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Pavia - Varese, Ospedale Multizonale, 21100 Varese, Italy.

Penetrating abdominal trauma can result in multiple organ injury, including the intestinal tract, liver, spleen, kidney, pancreas, so that the mortality rate is proportional to the number of injured organs. Major vessels can also be involved, with consequent massive blood loss, which usually is the main clinical feature. This case report shows a case of gunshot penetrating abdominal trauma with evidence of visceral damage, where the haemodynamic data revealed a useful tool in the diagnosis of aorto-caval injury in absence of massive bleeding.

Case report: T.S., a 17 years old woman, was admitted to our ICU after abdominal trauma due to gunshot, which penetrated the left abdominal wall, and injured spleen, left kidney, duodenum and liver. During emergency exploratory laparotomy spleen was removed, duodenum and liver were repaired, and retroperitoneal haematoma was observed, without evidence of major vascular injury. During the early post operative period, a Swan Ganz catheter was inserted to optimize the cardiorespiratory support of the patient; the haemodynamic profile is showed in table 1.

Table 1: Haemodynamic findings of aorto-caval fistula.

	before embolization	after	before surgical patching	after
MAP (mmHg)	80	75	105	109
PAP (mmHg)	43	30	30	26
PVC (mmHg)	22	15	16	15
PAPO (mmHg)	28	17	24	16
CI (l/min/m ²)	4.76	4.42	6.69	6.0
SVR (dine sec/cm ⁻⁵)	562	627	614	723
SvO ₂ (%)	91.5	68.5	90	84
O ₂ ext (%)	8	31	9	16

Septic state or artero-venous fistula were considered as different diagnostic options, and angiography showed intrarenal artero-venous fistula. The haemodynamic profile remained normal for 3 days after nephrectomy, but progressive increase of SvO₂ up to 90% with hyperdynamic state were observed: new aortic angiography showed that aorto-caval fistula opened 14-15 days after trauma. Vascular repair was surgically obtained, and the Swan Ganz catheter was removed on the 3th post operative day: the clinical course of the patient was characterized by septic phenomena, coagulative disorders and renal failure which needed dialytic support; the patient was discharged from ICU 4 months after admission, and returned at home 2 months later.

Conclusions. Aortic and caval injury are generally revealed by massive bleeding and shock. This case report points out that: a) gunshot abdominal trauma can induce aorto-caval fistula, which in our clinical setting revealed several days after trauma; b) invasive haemodynamic monitoring can help in the diagnosis of artero-venous shunt, as well in the management of severe cardiovascular abnormalities, following multiple organ injury.

THE SAFETY AND EFFICACY OF ANESTHETIC INDUCTION AND ENDOTRACHEAL INTUBATION OF TRAUMA PATIENTS IN THE RESUSCITATION SUITE OF THE EMERGENCY DEPARTMENT

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Purpose of Study:

The trauma patient represents complex and unique management concerns throughout the course of their hospitalization. A number of studies have reported on the complications of airway management in the critically ill patient^{1, 2}. However, there has been little evaluation of the safety and efficacy of anesthetic induction followed by endotracheal intubation in trauma patients during resuscitation in the trauma resuscitation room. Many centers prefer to avoid this technique due to the fear of the complications that may occur as a result of patient paralysis and pharmacological induction of anesthesia³. Patients are often left awake and not paralyzed prior to intubation which does not optimize intubating conditions and may also result in adverse physiologic responses. This study was designed to evaluate the role of anesthetic induction followed by endotracheal intubation of trauma patients within the emergency department.

Methods:

All patients meeting institutional trauma team criteria receive anesthetic care and thus an anesthesia record is produced. Anesthesia records of all patients admitted to Elmhurst Hospital Center, a New York City Level 1 Trauma Center, during a two and one-half year period were reviewed. All patients requiring endotracheal intubation in the emergency department were included in the study. Data obtained included the indication for intubation, method of intubation, anesthetic agents and muscle relaxants administered, and complications associated with airway management. Demographic data, and injury severity was obtained from the institutional trauma registry. The patients complete medical record was reviewed to obtain any missing information, when necessary.

Results:

There were a total of 586 trauma teams during 1993. (Table) One hundred thirty-six (136) patients required endotracheal intubation. Of these 136 patients, 103 (76%) received induction of general anesthesia to facilitate airway management. The remaining 33 patients were intubated without the use of anesthetics or muscle relaxants; the vast majority presenting in cardiac arrest. There were 0 deaths attributable to airway management. No deaths resulted from an inability to secure the airway. There were 5 deaths in this group unrelated to airway management and anesthetic agents. There a total of 3 complications associated with all intubations. Complications included: 1 possible aspiration, 1 patient requiring multiple attempts at laryngoscopy, and the creation of one surgical airway for inability to intubate.

Table: Airway Management in the Resuscitation Room.

1993	TRAUMA TEAMS	INTUBATIONS (%)	ANESTHETIC INDUCTIONS (%)	COMPLICATIONS (%)
January - June	245	67 (27%)	53 (79%)	2 (2.9%)
July -December	341	69 (20%)	50 (73%)	1 (1.4%)
Totals	586	136 (23%)	103 (76%)	3 (2.2%)

Conclusion:

The authors feel that the proposed technique can be used safely and effectively as the method of choice for maintenance and protection of the airway, assurance of oxygenation and ventilation, and safe diagnosis and treatment of critically injured trauma patients.

References:

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- ² Rotundo MF, et al. Urgent Paralysis and Intubation of Trauma Patients: Is It Safe?. The Journal of Trauma, February 1993; 34(2): 242-6
- ³ Schwartz DE, et al. Death and Other Complications of Emergency Airway Management in Critically Ill Adults. Anesthesiology February 1995; 85(2): 367-76

A PHARMACOKINETIC APPROACH TO COMPARING EPIDURAL AND INTRAVENOUS ALFENTANIL IN NORMAL VOLUNTEERS: ANALGESIA AND SIDE EFFECTS

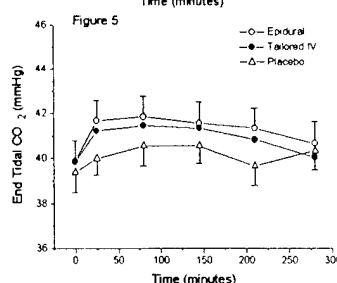
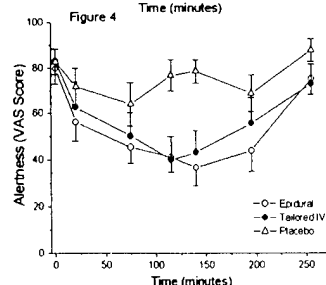
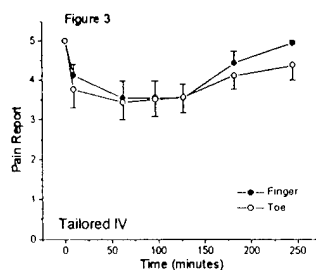
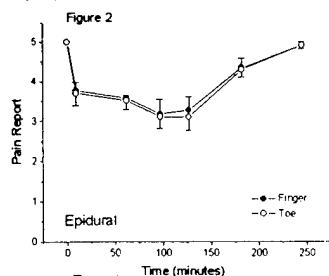
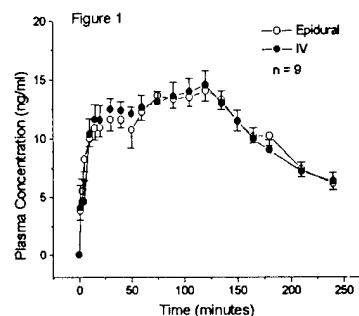
BA. Coda M.D., M. Cleveland Brown R.N., R.L. Schaffer M.S., D.D. Shen Ph.D.

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INTRODUCTION: Epidural opioids and local anesthetics have been advocated to improve analgesia in trauma patients, particularly those in the ICU. In recent years, several investigators have compared intravenous (IV) and epidural (EP) infusions of fentanyl and its derivatives (1,2). Some have suggested that EP infusions act primarily by systemic absorption to produce analgesia and provide little advantage over IV infusions. We investigated this hypothesis using a single-blind, placebo-controlled study design normal volunteers who received EP or IV alfentanil infusions. Rather than titrate to equivalent analgesia, we used a novel approach involving pharmacokinetically tailored IV infusions to provide identical plasma alfentanil concentrations with EP and IV administration. We then compared the magnitude of analgesia and side effects achieved with each method of administration.

METHODS: Nine normal volunteers gave written, informed consent as approved by the IRB, and participated in 1 pretest and 3 test sessions. In a pretest session, subjects received an IV bolus of alfentanil (15 $\mu\text{g/kg}$) and individual pharmacokinetics were determined. Our pain model was cutaneous electrical stimulation of the finger and toe, adjusted to produce a pain report (PR) of 5 (strong pain on a 0-5 scale). End tidal CO_2 and pupil size were measured, and subjective side effects were quantified using visual analog scales. On each study day, after a baseline battery of measurements, a lumbar epidural catheter was placed and tested with 2 mL air and precordial doppler. On one test day, subjects received EP alfentanil (400 μg bolus + 400 $\mu\text{g/hour}$ infusion for 2 hours) and an IV saline infusion. We repeated the test battery at regular intervals and measured plasma alfentanil concentration over 4 hours. On another test day, subjects received EP saline and a tailored IV infusion designed to reproduce the plasma concentration profile measured on the EP day. The test battery was repeated as on the first test day; we measured plasma alfentanil to verify tailored infusion accuracy. On a third test day, subjects received both EP and IV saline infusions. The order of this placebo day was randomized.

RESULTS: Pharmacokinetically tailored infusions produced identical plasma alfentanil concentrations profiles to those from epidural infusion (Fig.1). Peak plasma alfentanil concentrations were near reported minimum effective analgesic concentration (MEAC)(3). Pain relief of rapid onset, and 2 hours duration was seen with both IV and EP alfentanil (Figs. 2&3), but no difference between upper and lower extremity analgesia was seen. Analgesia is nearly equivalent with EP and IV alfentanil. Sedation and mild respiratory depression were observed with both EP and IV infusion (Figs. 4&5). There were no differences in sedation, ETCO_2 , pupil size, or subjective side effects between EP vs. IV administration.



CONCLUSIONS: Epidural alfentanil infusion produces plasma concentrations near the systemic analgesic range. Systemic redistribution of alfentanil from the epidural space accounts for most of the analgesia as well as side effects produced by epidural infusion. There is no clinical benefit to EP administration of alfentanil when plasma alfentanil concentrations are near MEAC.

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2. Anesth Analg 1993; 76:1251-1258
3. Acta Anaesthesiol Scand 1991; 35:221-22

(This work supported by NCI grant CA 38552)

Efficacy of a Balloon Device in Detecting Endotracheal Tube Placement in Patients With Minimal Respiratory Effort

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This study tests the efficacy of a balloon device in determining Endotracheal Tube placement in patients having minimal respiratory effort. Using a Balloon Device that collapses and distends synchronous to patients inspiratory/expiratory effort, the study evaluated its results against capnography.

The prototype device consisted of an ordinary 7cm balloon connected to a 15/22 mm respiratory connector which could easily be snapped on or off the external end of an Endotracheal Tube.

As approved by the hospital Institutional Review Board, 50 subjects were tested during emergence from General Anesthesia. While still intubated, their Endotracheal Tube position was verified by capnography. These patients were currently in their early stage of having spontaneous respiratory effort. The study procedure itself consisted of the anesthesia machine with a semi-closed breathing circuit being interrupted and replaced by the Balloon Device for a maximum period of 7 seconds. The Balloon collapse/distension motion synchronous with patients respiratory effort was observed as an indication that the tip of the tube was in the respiratory tree or trachea.

In all 50 patients studied there was 100% consistency in the Balloon collapse/distension motion synchronous with patients' respiratory effort, indicating tube position in the respiratory tree. The youngest patient studied was a 6 month old infant with a Tidal Volume of 60 cc. The prototype used on this patient had a gauge 5 catheter oxygen line going to a number 3 Endotracheal Tube through the balloon as a port for supplementary oxygen administration. The balloon works even with the addition of supplementary oxygen insufflation because the cross-sectional diameter of the catheter is smaller than the Endotracheal Tube. The balloon resistance is so small that the minimal pressure changes are readily reflected in the balloon movement as was found in this study.

In a separate clinical application, the balloon device was used as an aid to blind nasotracheal intubation, in a respiratory distress patient. Instead of listening and feeling for continuous airflow with the danger of secretion exposure to the operator, the balloon collapse and distention motion was used as a guide for tube placement. When it was felt that there was good placement in the respiratory tree, the device was replaced with the appropriate ventilating aid. In the same clinical application, it was observed that when the Endotracheal Tube entered the esophagus instead of the trachea, balloon movement ceased. The balloon remained motionless inspite of the patient retching and gagging, indicating that the Endotracheal Tube was not in the trachea. Therefore it had to be removed and reinserted properly while observing for continued balloon movement. In 2 patient having F18 nasogastric tubes in place, there was balloon movement with a properly positioned E.T. tube. There was no movement when the balloon was attached to the external end of the N.G. tube in the same 2 patients.

The Balloon Device is a useful and practical visual indicator of Endotracheal Tube placement in patients with minimal respiratory effort which could be added to the armamentarium of the E.D. physician, and other health care providers.

MOTOR VEHICLE ACCIDENTS: COST AND CONSEQUENCES FOR
PEDIATRIC PATIENTS

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Introduction: Trauma continues to be the leading cause of death and disability for children. The purpose of this project was to analyze the cost, utilization of resources, and patient outcome of motor vehicle accidents involving children.

Methods: A retrospective chart review was conducted for all pediatric victims (age ≤ 12 years) of vehicular trauma who received care at this Level I trauma center from January-December 1992. Demographics, treatment, patient outcome, and hospital billing information were recorded for all patients admitted as a result of their injuries. Injuries were classified by system.

Results: One hundred thirty-five charts were identified. Of these, seven patients died during initial resuscitative efforts and three records were unavailable for review. Fifty of the injured children that were admitted were pedestrians, fifty-seven were passengers in motor vehicles, and eighteen were riding bicycles. Nineteen of forty-four children (43%) wore seatbelts, eight of thirteen (62%) were in carseats, and two of eighteen (11%) wore helmets. Breakdown of injuries is as follows: CNS - 85 (68%), orthopedic - 51 (41%), chest - 8 (6%), and abdomen - 18 (14%). Thirty-one patients had multiple system injuries. The severity of injuries resulted in: 68 total mechanical ventilator days, 46 surgical procedure in the operating room some involving multiple surgical subspecialties), and placement of 8 intracranial pressure monitors. The patients spent 714 days in the hospital (intensive care unit - 100 days, intermediate care unit - 116 days, pediatric ward - 498 days). One hundred two of the one hundred twenty-five patients (82%) had a full recovery, 17/125 (14%) had residual disability, and 6/125 (5%) died. In addition, as previously mentioned, seven patients who reached our facility died prior to hospital admission. Total hospital billing cost for the 125 patients was 1.3 million dollars. This figure does not include physician costs.

Conclusions: Motor vehicle accidents and their associated patient mortality, morbidity, and residual disability continue to tax our society both economically and socially. Despite public information campaigns and school education programs, compliance with legal mandates regarding the use of safety equipment continues to be poor.

THE EFFECT OF ROCURONIUM ON INTRAOCULAR PRESSURE

V. McGeachie, RNAS, P. Norko RNAS, R. Alisoglu, CRNA, MS, M. Jones, CRNA, MS, S. Thota, MD, Department of Anesthesia, Hurley Medical Center and University of Michigan, Flint, MI, USA.

It is recommended that succinylcholine be avoided in patients with open eye injuries, due to a well established increase in intraocular pressure (IOP) that can cause extrusion of the vitreous humor.^{1,3} This presents a dilemma since most penetrating ocular injury patients are considered to have full stomachs, thus requiring rapid sequence induction (RSI) to prevent gastric aspiration. To date, succinylcholine has been the drug of choice for RSI due to its rapid onset. Rocuronium bromide, a new nondepolarizing muscle relaxant, has a rapid onset (60 seconds) and is approved for RSI. The purpose of this study is to determine the effect of rocuronium on IOP. We hypothesize that rocuronium bromide will not increase IOP during a RSI.

This descriptive nonrandomized trial was approved by the Institutional Review Board. Thirty-one adults, ages 18-50 years, ASA I or II, undergoing elective non-ophthalmic surgery lasting at least one hour, requiring intubation participated in the study after obtaining informed written consent. This study was longitudinal in design and IOP measures were obtained on the same patient. IOP was measured using a Keeler Pulsair 2000 noncontact tonometer, which has a close and statistically significant correlation to the more conventional Goldmann contact applanation tonometer.⁴ Prior to sedation, the left IOP was measured in the supine position by one investigator. Each patient was induced using a similar RSI technique consisting of preoxygenation for 3 minutes, midazolam .04 mg/kg, fentanyl 5 ug/kg, thiopental 4 mg/kg followed by rocuronium bromide 1 mg/kg. The left IOP was measured 0.5, 1, 1.5, 2, and 3 minutes after induction. Intubation was performed immediately after the 1 minute IOP measurement. Multivariate ANOVA for repeated measures was used for analysis of changes in IOP during induction and intubation. A two-tailed test ($p < 0.05$) was used with a power analysis of greater than .90 to detect a difference of 1 SD using 31 subjects.

Descriptive data are shown in Table 1. Figure 1 shows mean IOP levels at each time point. A significant change ($p < .01$) in IOP from baseline was shown during the time course of the study. Compared to baseline, the 0.5 minute IOP measurement decreased by a mean of 6 mmHg (± 5), followed by a further decrease at 1 minute by a mean of 6 mmHg (± 5). At three minutes post-induction (1.5 minutes post-intubation) IOP decreased by a mean of 4 mmHg (± 6) compared to the baseline. Subjects remained hemodynamically stable throughout the testing period (Figure 2 and 3).

Our results suggest that IOP decreased during RSI using rocuronium for muscle relaxation compared to pre-induction IOP levels. Intraocular pressure decreased to its lowest level immediately prior to intubation, followed by a slight increase associated with intubation. However, at no time did the mean IOP levels exceed baseline values. Rocuronium appears to offer significant advantages over current muscle relaxants used in rapid sequence inductions for patients with open eye injuries.

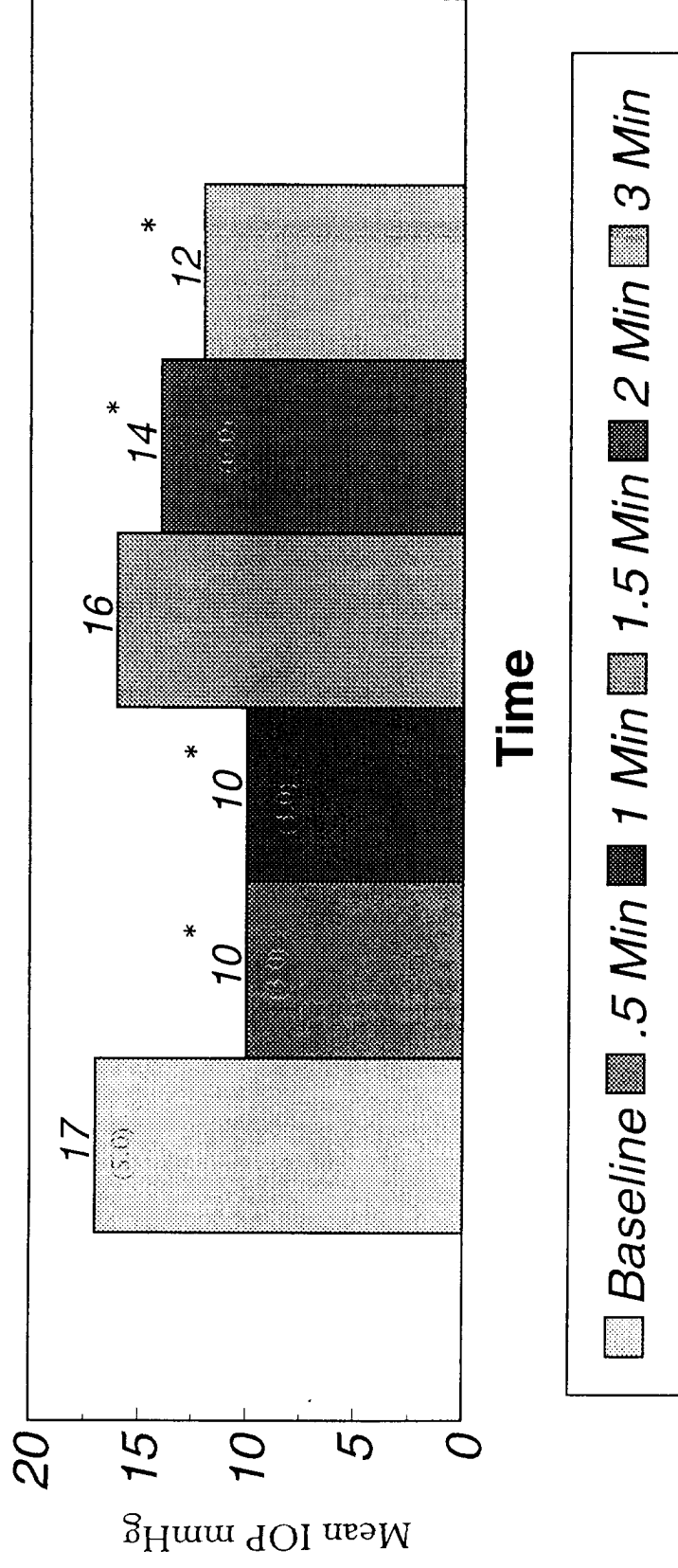
References

1. Libonati MM, Leahy JJ, Ellison NE. The use of succinylcholine in open eye surgery. *Anesthesiology*. 1985; 62:637-640.
2. Kelly RE, Dinner M, Turner LS. Succinylcholine increases intraocular pressure in the human eye with the intraocular muscles detached. *Anesthesiology*. 1993; 79:948-952.
3. Frawley P. A review of anesthesia for the open globe. *CRNA: The Clinical Forum for Nurse Anesthetists*. 1992; Feb:3:1:30-34.
4. Bonomi L, Baravelli S, Cobbe C. Evaluation of Keeler Pulsair non-contact tonometry: Reliability and reproducibility. *Graefe's Archive for Clinical and Experimental Ophthalmology*. 1991; 229:210-212.

Legend: Figure 1

Comparison of mean intraocular pressures at six assessment intervals: Pre-induction (baseline), 0.5 minute and one minute post-induction, 1.5 minutes post-induction (30 seconds post-intubation), 2 and 3 minutes post-induction (1 and 2 minutes post-intubation).

IOP Levels During RSI with Rocuronium

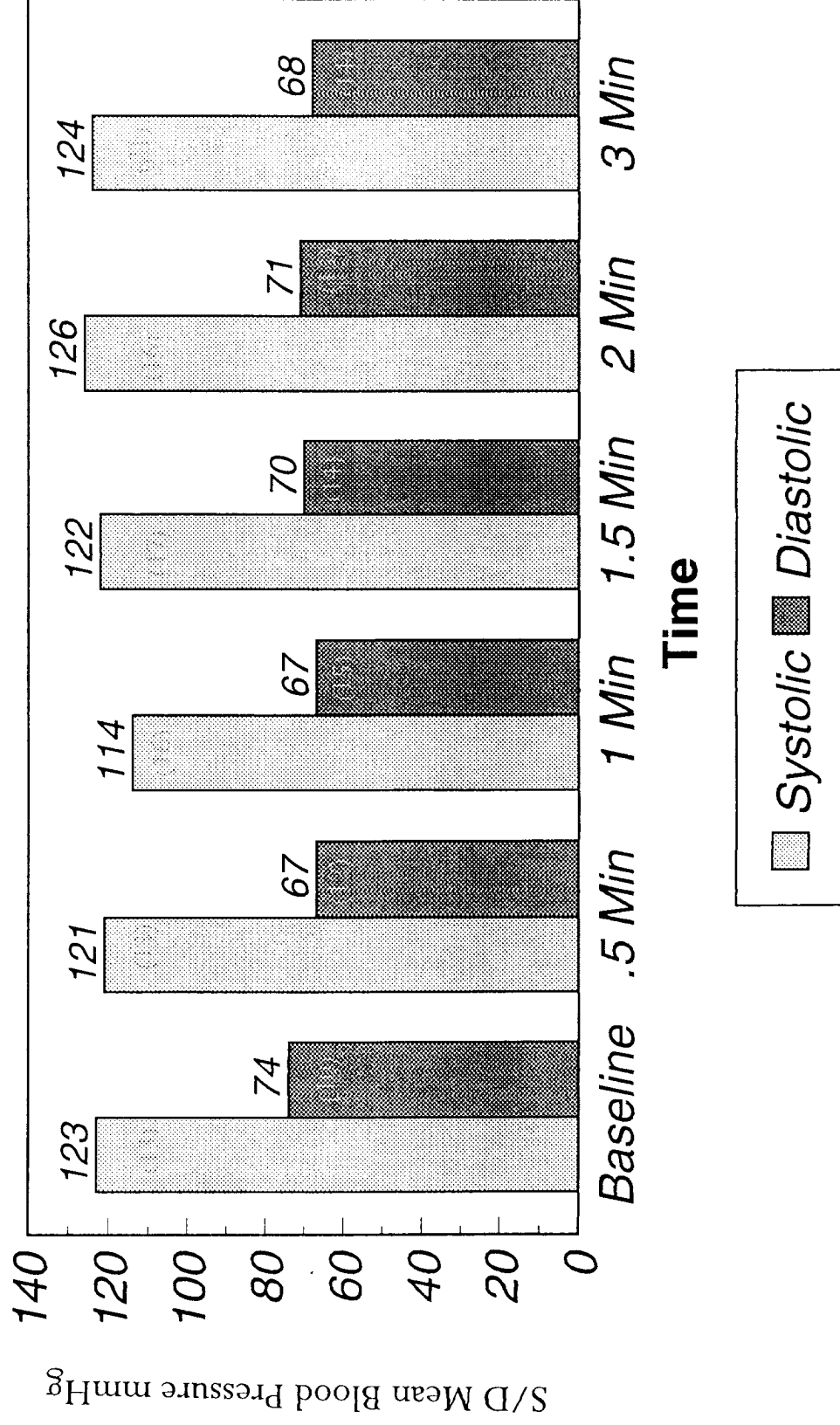


* P < .01

Legend: Figure 2

Comparison of mean systolic and diastolic blood pressures at six assessment intervals: Pre-induction (baseline), 0.5 minute and one minute post-induction, 1.5 minutes post-induction (30 seconds post-intubation), 2 and 3 minutes post-induction (1 and 2 minutes post-intubation).

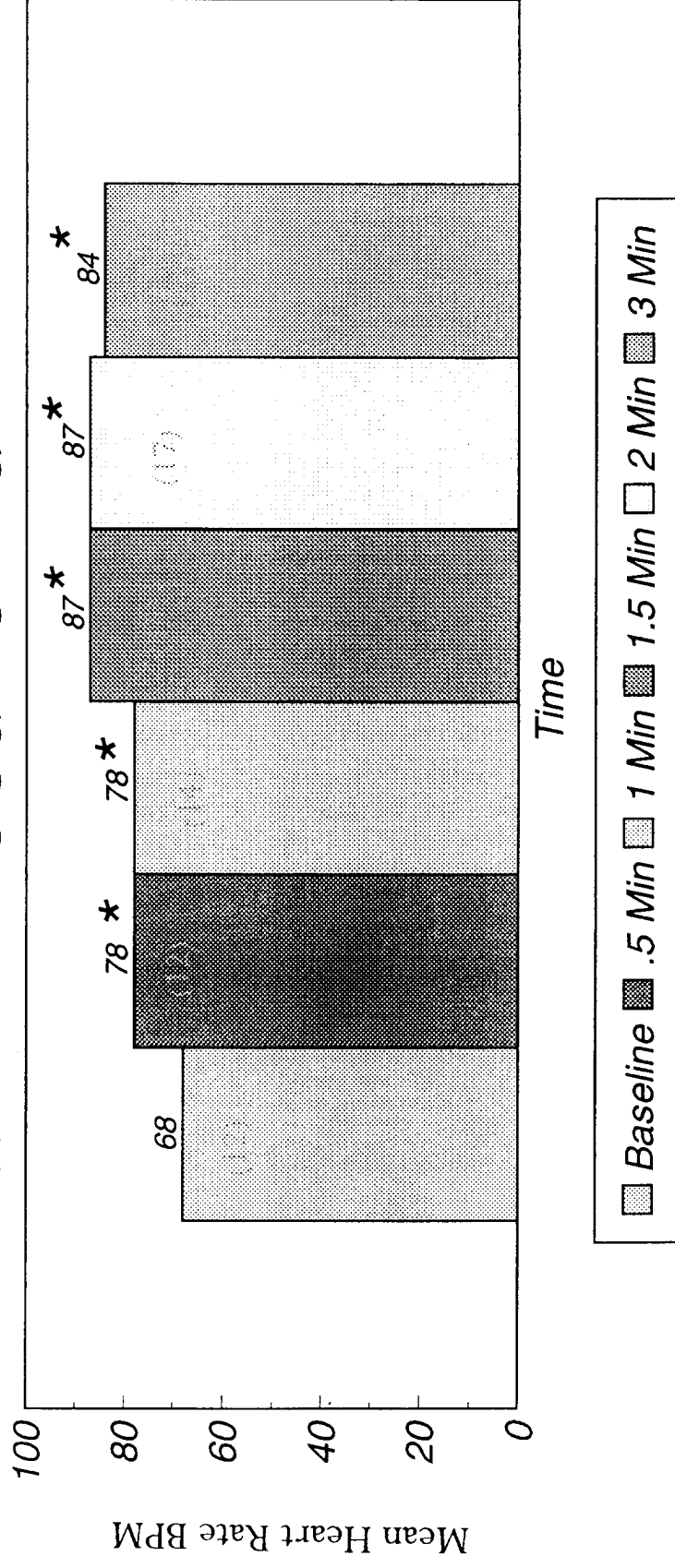
Blood Pressure Levels During RSI with Rocuronium



Legend: Figure 3

Comparison of mean heart rates at six assessment intervals:
Pre-induction (baseline), 0.5 minute and one minute post-induction,
1.5 minutes post-induction (30 seconds post-intubation), and 2 and
3 minutes post-induction (1 and 2 minutes post-intubation).

Heart Rate Levels During RSI with Rocuronium



* $P = < .05$

INCREASED ALVEOLAR EPITHELIAL LIQUID CLEARANCE AFTER HEMORRHAGIC SHOCK IN ANESTHETIZED RATS IS MEDIATED BY ENDOGENOUS RELEASE OF CATECHOLAMINES. T.J. Brenner, M.A.

Matthay, J.F. Pittet, Departments of Anesthesia and Medicine, Cardiovascular Research Institute, University of California - San Francisco, San Francisco, CA.

Our recent study demonstrated that alveolar epithelial liquid clearance is markedly stimulated during the early phases of septic shock by a mechanism dependent on the release of endogenous catecholamines (JCI 94:663, 1994). We hypothesized that a similar process may protect the airspaces against alveolar flooding in acute hemorrhagic shock. We instilled 3cc/kg of 5% bovine albumin into the right lung of 17 anesthetized rats in order to quantify alveolar epithelial liquid clearance. Thirteen animals were hemorrhaged to a mean arterial pressure of 40mmHg for 90 minutes; in eight of these animals, amiloride (10^{-4} M) (n=4) or propranolol (10^{-4} M) (n=4) was added to the alveolar protein instillate. Four animals served as controls. At the end of the experiment, the rats were sacrificed and the lungs removed. Residual alveolar fluid was aspirated and its protein concentration measured. Alveolar epithelial liquid clearance was estimated by the increase in alveolar protein concentration over 120 minutes. Total lung liquid clearance was determined by gravimetric measurement of excess lung water. The data are summarized in the table.

Experimental condition	N	Alveolar protein concentration (g/100mL)		Final/Initial alveolar protein ratio	Alveolar liquid clearance (% of instilled)
		Initial	Final		
Controls	4	5.4 ± 0.8	7.9 ± 0.9	1.48 ± 0.06	39 ± 3
Hemorrhagic shock	5	4.9 ± 0.7	9.0 ± 2.5*	1.81 ± 0.44*	49 ± 13*
Shock + Amiloride	4	5.4 ± 0.5	7.8 ± 1.2	1.44 ± 0.23	37 ± 10
Shock + Propranolol	4	4.6 ± 0.3	7.3 ± 1.0	1.58 ± 0.14	42 ± 5

mean ± SD, *p<0.05 from controls

Total lung liquid clearance was also significantly increased in hemorrhaged rats compared to control rats ($59 \pm 20\%$ vs. $40 \pm 10\%$, p<0.05). This effect was abolished when amiloride or propranolol was added to the alveolar instillate ($45 \pm 10\%$ and $40 \pm 2\%$ respectively). We conclude that alveolar epithelial and lung liquid clearances are markedly increased during hemorrhagic shock, due to an increase in the active transport of sodium across the alveolar epithelium that is mediated by the endogenous release of catecholamines. This may represent a new, previously unrecognized mechanism that protects the distal airspaces of the lung against alveolar flooding in hemorrhagic shock. (Supported by HL 51854).

RESOURCE USE AFTER PENETRATING TRAUMA

D. J. Newman, E. Vittinghoff, D. Morabito, A. Campbell, W. Schechter,
Departments of Anesthesia and Surgery, San Francisco General Hospital,
University of California, San Francisco.

Cost accounting remains rudimentary at our Level-I trauma center. This continues despite the accelerating trend toward prospective payment for all medical services, often involving negotiation of rates with HMOs and other insurers. Therefore, we are developing accounting models based on resource utilization. To this end, we hypothesized that trauma patients could be categorized to predict their aggregate utilization of various resources. In combination with unit costs for the larger items, predicted utilization may in turn be used to construct a prospective payment scheme more realistic than DRG for trauma care.

Methods: All patients who sustained penetrating torso injury from April through October 1994 were retrospectively examined and grouped by first surgical diagnosis. For each patient we recorded time in the ED, OR, PACU as well as days in the ICU, ventilator days and total length of stay (LOS); procedures by type and day of hospitalization; and cumulative utilization of resources including imaging, laboratory, blood products, respiratory; and professional as well as PT, OT, and social services. Emphasizing larger categories of charges, which should reflect cost centers, we used chi-square trend analysis to compare resource utilization across groups defined by first surgical diagnosis.

Results: Of the 103 patients admitted with penetrating torso trauma in this study, 72 (70%) had stab wounds and 31 (30%) GSW with 67 (65%) requiring a surgical procedure. The largest estimated components of total charges were OR (25%), ED (20%), ICU/ward (20%), and lab (12%). The patients could be grouped into three categories that were strongly predictive of utilization within each of the charge centers: liver reconstruction/any thoracotomy; other surgery; and non-operative/negative laparotomy. This grouping was significantly associated with ISS ($p=0.008$), ED time ($p<0.001$), number of procedures ($p<0.001$), OR time ($p=0.068$), number of labs ($p<0.001$), and imaging procedures ($p=0.012$), ICU days ($p=0.057$) and LOS ($p<0.001$).

Conclusions: While the heterogeneity of trauma appears to suggest that simple categorizations are inadequate for prediction of costs, we found that a 3-way grouping strongly predicted most large charge centers. In future work, analysis of the resource costs will be used to estimate the aggregate costs of treating these and other, comparably simple groupings of trauma patients.

COMPARATIVE CHARACTERISTIC OF EFFECTS OF NEW SORBITCONTAINING SOLUTIONS "SORBILACT" ("SL"), "LACTOSORBAL" ("LS") AND "RHEOSORBI-LACT" ("RhSL") ON THE MOTILITY OF DIFFERENT PARTS OF GASTROINTESTINAL TRACT (GIT) IN PARALITIC ILEUS DOGS.

T.M.Ivankiv, A.N.Oborin*, M.P.Pavlovsky, M.V.Myndiuk*,
Medical Institute, Research Institute of Hematology and Blood
Transfusion*, Lviv, UKRAINE.

It is known that sorbit solution are used together with
another medicines for stimulation of motility of GIT in clinic.

In 15 dogs, being experimented on paralytic ileus has
developed in a result of severe operation. The antrum (An),
jejunum (Je) and distal colon (DC) motility was estimated by
frequency of contractions, mean amplitude of contractions and
motor index measured by method of tensography. In all cases the
solutions being investigated of were administrated into
v.cephalica antebrachii at the dose of 10.0 ml/kg 24 hrs later
operation.

It was established that 24 hrs later the operation trauma the
complete absence of motility has taken place in the all animals.
Tensogrammes of these parts of GIT just after administration of
"SL", "LS" and "RhSL" are represented on the fig.1.

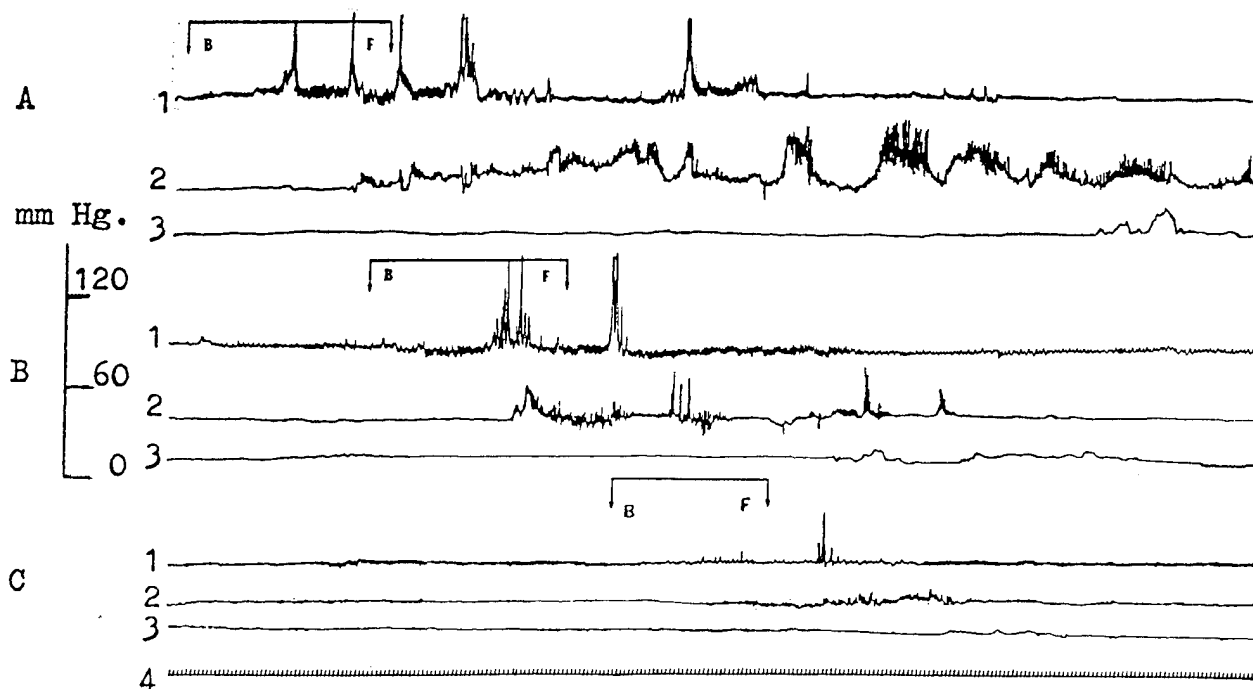


Fig.1. The influence of administration of "SL" (A), "LS" (B)
and "RhSL" (C) on motility of An (1), Je (2) and DC (3).
The figure marks: B↓ - the beginning and F↓ - the
finish of administration. 4. - time mark 10 sec.

Conclusion. The results of present study are the experimented
ground for the use of the sorbitcontaining solutions in the
complex therapy of paralytic ileus in clinic. The preparations
should be chosen are "Lactosorbal" and "Sorbilact".

OPTIMIZING ENDOTRACHEAL TUBE PLACEMENT WHEN PERFORMING RETROGRADE INTUBATION: USE OF THE 145 CM MOVEABLE CORE J-WIRE

C.C. Fox, Department of Anesthesiology, Louisiana State University Medical Center, New Orleans, La.

Various reasons for failure to secure the airway with retrograde intubation have been reported¹. One of the most vexing of these is the inability to advance the endotracheal tube (ETT) to an adequate depth in the trachea past the level of the cricothyroid membrane (CTM) because of the retrograde wire! At this point the ETT is reliably only ~1.5 cm past the vocal cords. The cuff is still in the pharynx; the airway is not protected. With the guidewire technique¹, the wire is retracted when the ETT is advanced to the level of the CTM and resistance met, thus losing the option of using the wire as a guide for a different size tube or for having the wire in place should the ETT inadvertently be dislodged. The CTM is an attractive insertion point for the wire due to its relative avascularity, distance from the thyroid, and the avoidance of the lower tracheal rings should definitive surgical tracheostomy be required.

A study was undertaken to optimize ETT placement by use of a 145 cm, 3mm moveable core J-wire as manufactured by BARDTM Inc. for angiography. Using an unembalmed human cadaver specimen transected at the subclavicular level, retrograde endotracheal intubation was performed. A 16-gauge IV catheter was inserted at the CTM with positive aspiration for air. The catheter was angled slightly cephalad. The J-wire was inserted through catheter, advanced to the oropharynx and retrieved through the mouth. The moveable core was removed and replaced from the oral end of the guide wire until it was seen emerging through CTM. A hemostat was placed on the soft portion of the wire at the CTM. A 7.0 ETT was passed over oral end of wire and advanced blindly. When the ETT appeared to be at level of the CTM, the hemostat was removed and the non-styleted (soft) portion of wire was allowed to track inferiorly and distally as the ETT was advanced. Placement of the ETT was confirmed by direct visualization at the open thoracic end of the trachea.

Recent literature describes use of the fiberoptic bronchoscope for optimizing ETT placement² but there is frequently a problem with access to this equipment in a crisis. The moveable core J-wire, in contrast, is available as standard equipment for angiography; it is accessible, portable, and disposable. The technique described above for use of the moveable core J-wire to optimally place the ETT is a feasible alternative when retrograde intubation is indicated. This approach could provide an additional advantage in that the patient can be ventilated or given a trial of extubation with the original wire left in place and core removed.

References:

1. Sanchez AS: "Preventing the Difficult from Becoming the Impossible Airway: The Retrograde Cookbook" ASA Workshop on Management of the Difficult Airway, Orlando, Fla. Nov. 1994.
2. Lehrman MJ, Donahoo JS, Marvough H: Endotracheal intubation using percutaneous retrograde guidewire insertion followed by anterograde fiberoptic bronchoscopy. Crit Care Med 14:589-590, 1986

THE CHINESE EXPERIENCE OF ANESTHESIA ON WAR CASUALTY IN SOLDIERS: (PAST PRESENT AND FUTURE VIEWS)

Chen Zhi-jin, Mi Wei-dong, Jin Bing, Department of Anesthesiology, Chinese PLA General Hospital, Beijing 100853 P. R. China.

Before the years of mid-seventy, most of Chinese surgeons and anesthesiologists used procaine local infiltration, field block or intravenous continuous drip following pentothal induction for war surgery of soldiers. It was not until 1979, ketamine and Scopolamine-fentanyl-ketamine anesthesia were used extensively during the wartime with satisfactory result. Debridement were well done these around 1/3 of all wounded within 12h in field hospitals including complicated vascular injury accomplished by surgical repair.

Since then we discovered subdissociative ketamine could give an appropriate state of amnesia as well as analgesia for military mass casualty, a series of clinical research were performed within recent 15 years. IM ketamine 2mg/kg with low dose of pethidine could give a fairly good anesthesia for operations lesser than 1h without any need of muscular relaxation. IV 0.5mg/kg ketamine bolus had a potency determined to be equivalent to somewhat about 1MAC of currently used potent inhalation anesthesia. The cardiovascular stimulant effect was significantly lesser in comparison with 1mg/kg dose.

Subdissociative dose of ketamine less than 1mg/kg/h iv dripping at rate of 1-3mg/min, in association with initial iv loading or supplemented fentanyl 5.4 μ g/kg/h; Sufentanil 0.66 μ g/kg/h or dihydroetorphine 0.47 μ g/kg/h at the potency ratio of 1:8.2:11.1 made the dosage of ketamine reduced further with recovery time shortened significantly, yet might cause some risk of minimal postoperative respiratory depression.

Combination of slow iv dripping of small dose midazolam or propofol could increase amnesia and sedation but not analgesia. The cardiovascular adverse depression would not occur when no bolus administration was allowed. Antidote to promote early recovery of consciousness might be necessary in case of moderate dose of midazolam used for prolonged operation.

The major drawback of this method is lack of muscular relaxation and no suppression of autonomic reflex stresses. If necessary, muscle relaxant as well as local block should be given as the supplementary.

As for the essential monitoring in the field or emergency department, pulse oximeter and doppler blood pressure measurement should be used with caution, because they may often give false figures when the wounded is not paralyzed by muscle relaxants.

At present we are still short of supplies and anesthesiologists, therefore we recommend that mechanical ventilation and inhalation anesthetics could only be used in selective cases, at a well equipped operation room, under the supervision of a qualified anesthetist.

COMPARATIVE EFFECTS OF NITROPRUSSIDE AND HEMORRHAGE EQUIHYPOTENSION
ON RENAL BLOOD FLOW IN DOGS ANESTHETIZED WITH SEVOFLURANE

Wang Gang, Jing Bing. Department of Anesthesiology, Chinese PLA General Hospital, Beijing, China.

Twelve mongrel dogs weighing 11-18.5kg were randomly divided into 2 groups: one nitroprusside deliberate hypotension group, and the other hemorrhagic shock group. After surgical preparation under intravenous anesthesia, sevoflurane was administered with an end-tidal concentration of 1%. The MAP of the dogs was decreased to 60mmHg for 30min either by infusing nitroprusside or by withdrawing arterial blood. Following nitroprusside discontinuation and withdrawn blood reinfused, the dogs were allowed to recover for staying 30min. RBF, MAP, HR, CO and CVP were monitored continuously. The results showed that all indices in two groups didn't give any significant change during 1% sevoflurane inhaled for 20min, but after 30min of hypotension, hemorrhage caused more decrease on RBF than nitroprusside (59% vs 37.5%). Meanwhile, hemorrhage caused a significant increase of 79% in renal vascular resistance, this was not seen with nitroprusside. Hypotension induced by hemorrhage was also associated with significant decrease in CO, SV and CVP in comparing with nitroprusside. There was no significant change in HR. In recovery period of 30min, RBF in both groups showed an increase, but remained lesser than baseline significantly in hemorrhagic group; in nitroprusside group it approached close to the baseline. The results suggest that hemorrhage results more drop in RBF with a subsequent slower recovery than with nitroprusside at the same level of hypotension.

FRIDAY, MAY 12, 1995

SESSION A: Special Equipment and Techniques for Trauma
Chair: Louis M. Guzzi, MD, MAJ, MC

08:00 - 08:05 Introduction to Special Techniques and
Equipment for Trauma
Louis M. Guzzi, MD, MAJ, MC

08:05 - 08:35 Research and Development of Ultra-Long Acting Local
Anesthetics: Potential Utilization in Field Anesthesia
Benjamin H. Boedecker, MD, MAJ, MC

08:35 - 09:05 Implementation of Target-Controlled Anesthesia
and Analgesia in the Austere Situation and Forward
Casualty Care
W. Bosseau Murray, M.D.

09:05 - 09:45 Portable Ventilators and Monitors for Trauma Anesthesia
Rusty T. Reid, RCP, RRT

10:15 - 11:00 LSTAT™: Life Support for Trauma and Transport:
Innovative Role in Forward Casualty Care
William P. Weismunn, MD, COL, MC

11:00 - 12:15 SPECIAL HANDS-ON WORKSHOP:
Equipment Review and Demonstrations –
Portable Ventilators, Portable Monitors,
Cricothyroidotomy Sets, Needle Thoracostomy Sets,
LSTAT™, Emergency Medical Manager™, TCCM™,
Portable Capnography

IMPLEMENTATION
of
TARGET CONTROLLED
ANESTHESIA and ANALGESIA
in the
AUSTERE SITUATION
and
FAR FORWARD FRONT

W. Bosseau Murray, M.D., Ph.D.
Penn State University
College of Medicine

MILITARY USES
for
TARGET CONTROLLED ANESTHESIA and ANALGESIA

W. Bosseau Murray, M.D., Ph.D.
Penn State University
College of Medicine

REQUIREMENTS for ANESTHESIA SYSTEM

simple, robust

controllable

predictable

safe

TIVA (Total Intravenous Anesthesia) PROBLEMS of CLASSICAL TIVA

equipment

variability of patients

mathematical model problems

depth of anesthesia

awareness

predictability

TIVA
(Total Intravenous Anesthesia)
METHODS OF ADMINISTRATION

bolus

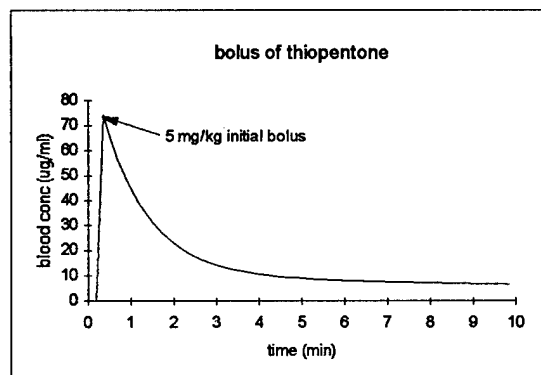
intermittent bolus

constant infusion

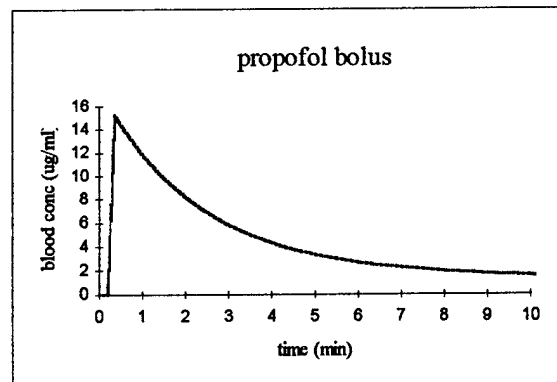
BET - bolus, excretion, transfer

target control

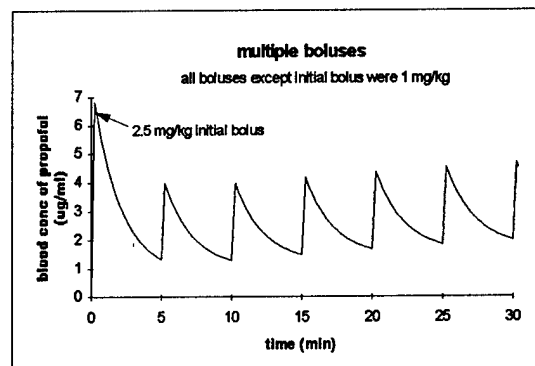
BOLUS ADMINISTRATION



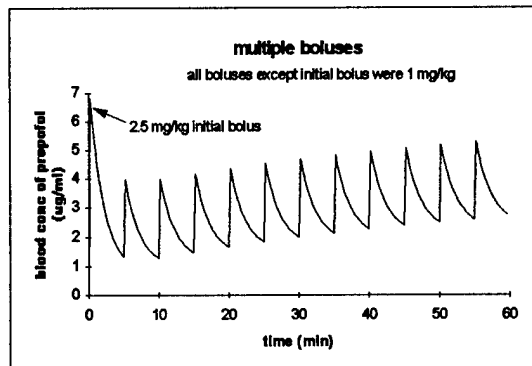
BOLUS ADMINISTRATION



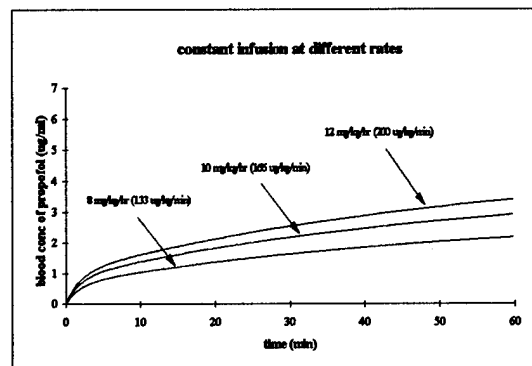
INTERMITTENT BOLUS



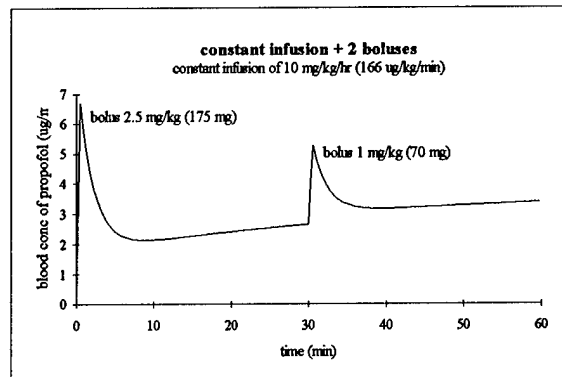
INTERMITTENT BOLUS



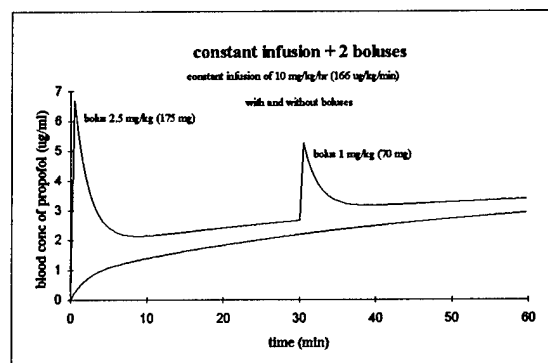
CONSTANT INFUSION



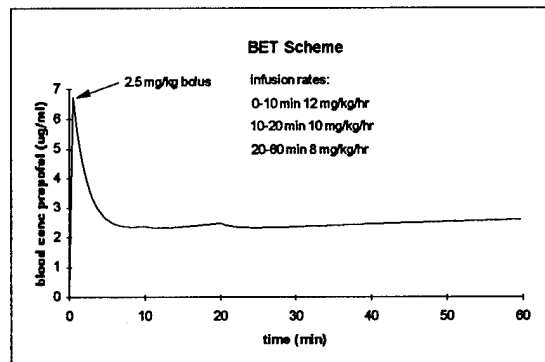
BOLUS PLUS INFUSION



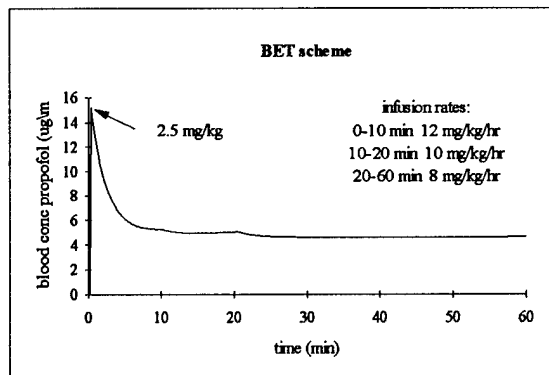
BOLUS PLUS INFUSION



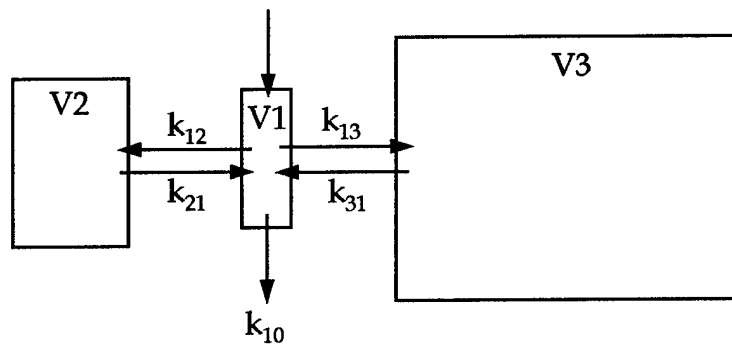
BET SCHEME - BOLUS, EXCRETION, TRANSFER IVA-Sim Parameters



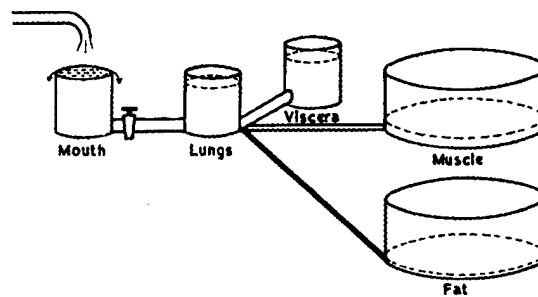
BET SCHEME - BOLUS, EXCRETION, TRANSFER Gepts Parameters



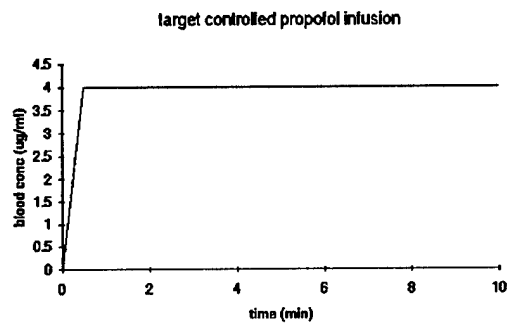
3 COMPARTMENT MODEL



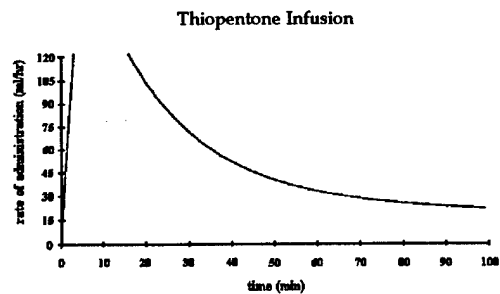
HYDRAULIC EQUIVALENT Mapleson Diagrams



TARGET CONTROL BLOOD CONCENTRATION



TARGET CONTROL RATE OF ADMINISTRATION



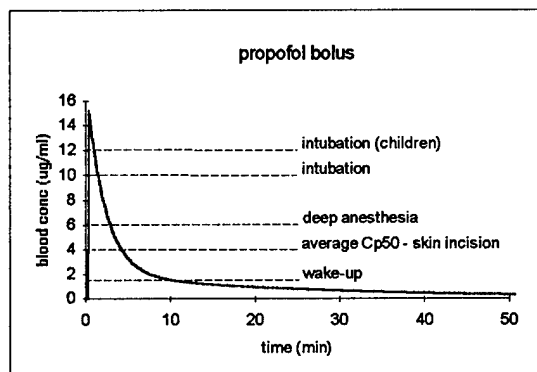
TARGET CONTROL ADVANTAGES

control of blood concentration
control of effect site concentration
rapid adjustment upwards
control of downwards adjustment
“lock onto” new setting

VARIABILITY Volatile Agents

MAC 50
MAC 95 (1.3 x MAC)
MAC-BAR (1.5 x MAC)
MAC-M&M (2.0 x MAC)

VARIABILITY TIVA - propofol



VARIABILITY - TIVA

pharmacokinetic 30%
blood concentration vs
mathematical model prediction

pharmacodynamic 600%
surgical stimulus

VARIABILITY DECREASE

balanced anesthesia

triad: sleep

analgesia

muscle relaxants

TIVA

midazolam and thiopentone

alfentanil and thiopentone

midazolam and propofol

CO-INDUCTION and SYNERGISM

minimal analgesic dose alfentanil (one tenth)

sleep dose midazolam (one half)

Vinik 1989

Supplemented, Target Controlled
Induction of Propofol Anesthesia

Dr. WB Murray

Dr. BH Boedeker

Dr. AO Clapin

Dr. DM Martin

PROPOFOL REQUIREMENT REDUCTION
Hershey Study, 1994

Method: 40 outpatients

Adjuvant: control
lidocaine 1.5 mg/kg
alfentanil 50 mcg/kg
midazolam 0.05 mg/kg

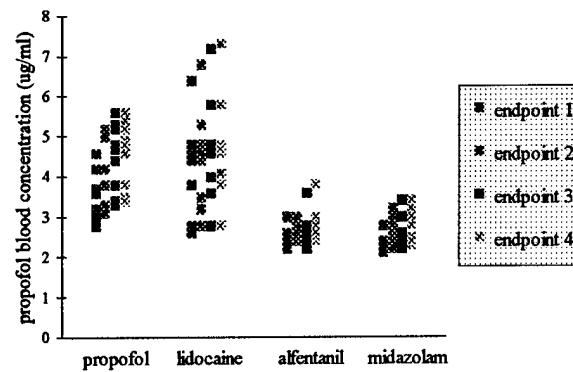
Target Control Propofol:
increase target every 30 seconds

STUDY ENDPOINTS

1. hand holding mask starts to fall
2. hand drops
3. fails to open eyes
4. eyelash reflex lost

RESULTS

Dose and Variability



RESULTS

	1	2	3	4
propofol	3.6	4.0	4.4	4.5
lidocaine	4.2	4.6	5.0	5.0
alfentanil	2.5	2.6	2.7	2.9
midazolam	2.4	2.6	2.8	2.9
p-value	<0.001	<0.001	<0.001	<0.001

RESULTS

	1	2	3	4
propofol	3.6 ± 0.59	4.0 ± 0.86	4.4 ± 0.88	4.5 ± 0.86
lidocaine	4.2 ± 1.26	4.6 ± 1.19	5.0 ± 1.2	5.0 ± 1.18
alfentanil	2.5 ± 0.27	2.6 ± 0.26	2.7 ± 0.49	2.9 ± 0.51
midazolam	2.4 ± 0.22	2.6 ± 0.27	2.8 ± 0.57	2.9 ± 0.19
H-value	27.9	27.7	25.7	25.3
p-value	<0.001	<0.001	<0.001	<0.001

CONCLUSION

Dose reduction

- CVS stability
- trauma patient
- awareness
- wake up time

Variability

- better control
- fewer alterations
- awareness
- apnea incidence

FURTHER STUDIES

target controlled adjuvants

multiple adjuvants

optimal synergism - drugs, doses

side effects

trauma patients

airway / spontaneous respiration

anesthesia and analgesia - phase of excitement

FURTHER STUDIES (cont)

Awareness - Depth of Anesthesia
- requires multiple inputs

Low BP - too deep
- volume depleted

High BP - too light
- high CO₂

Peripheral pulse plethysmograph

USES of PULSE OXIMETER

amplitude

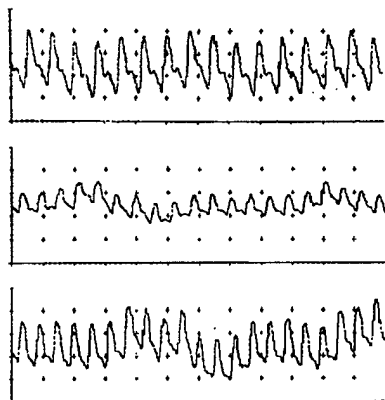
position of dichrotic notch

respiratory fluctuation

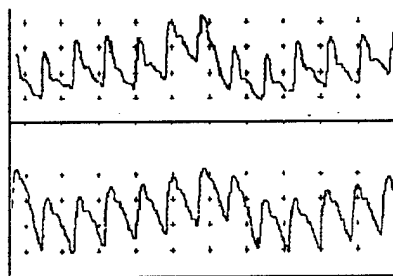
area under the curve

baseline width

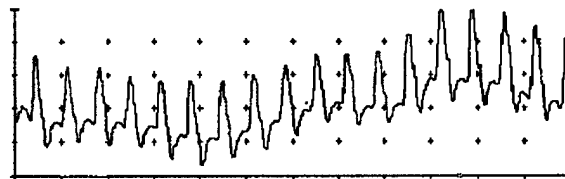
Pulse Oximetry
AMPLITUDE



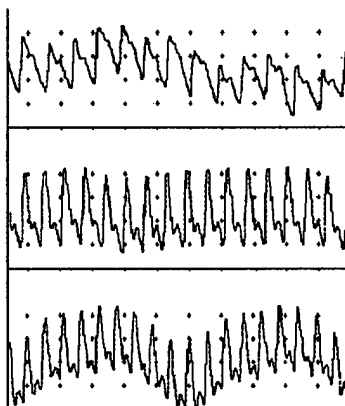
Pulse Oximetry
AREA UNDER THE CURVE



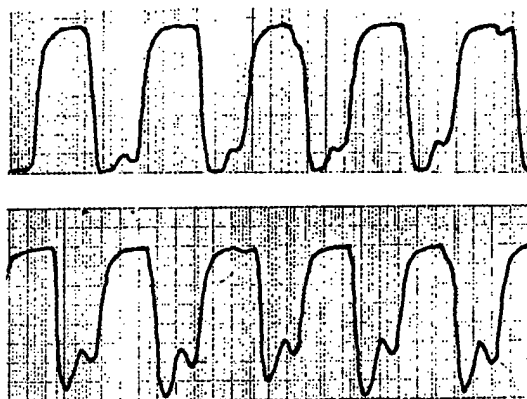
Pulse Oximetry
POSITION of DICHROTIC NOTCH
in ASCENDING LIMB of NEXT WAVE



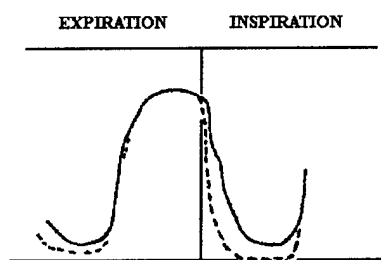
Pulse Oximetry
POSITION of DICHROTIC NOTCH



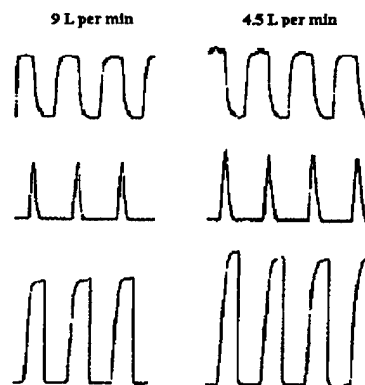
REBREATHING IN A BAIN SYSTEM



REBREATHING IN A MAPLESON A SYSTEM



REBREATHING IN A MAPLESON A SYSTEM



USES FOR TARGET CONTROL

far forward front

anesthesia for fracture setting / extraction
analgesia for transport

transport land, sea, air

minimal equipment
spontaneous respiration

prolonged transport

hours to days

connects to computer at the base hospital

anesthesia machine
ICU

THE FUTURE

computer controlled infusion

telemedicine

- telecontrol

- closed feedback loop

- download infusion history on arrival
after transport

encapsulated agents

- volatile agents IV

- high concentration propofol

WAKE-UP ISSUES

context sensitive half-time

long duration volatile agent

- longer to wake up

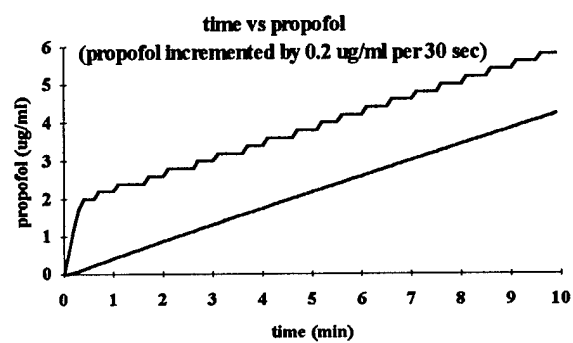
alfentanil infusion

- long wake-up times

prolonged propofol infusion

- still only 27 min wake-up
if dose is not excessive

EFFECT SITE CONCENTRATION



Portable Transport Ventilators and Monitors For Trauma Anesthesia Outline

I. Reasons For Using A Transport Ventilator

A. Studies Demonstrating Adverse Effects of Bagging

1. Waddel Study
2. Braman Study
3. Gervis Study
4. Hurst Study

B. Additional Problems Associated with Manual Ventilation

1. Difficulty in consistent delivery and measurement of exhaled volumes and inspiratory pressure
2. Difficulty in physically ventilating the patient while moving through the hospital
3. inability to rapidly detect inadvertent disconnection of the oxygen supply to some current resuscitator designs on the market

II. Problems Associated with Use of Transport Ventilators

- A. Inaccurate Volume Delivery
- B. Pseudo Calibration of Controls
- C. Loss of Power Supply
- D. Mechanical Failure
- E. Inappropriate Alarm Settings
- F. Lack of Alarms

III. Selection of a Portable Transport Ventilator

- A. Performance Characteristics
- B. Patient Population Served
- C. Size (dimensions and weight)

IV. Portable Monitors

- A. Pulse Oximeter (SpO₂)
 1. Factors effecting the accuracy of SpO₂ measurements
- B. End Tidal CO₂ Monitor
 1. Factors effecting the accuracy of EtCO₂ measurements
- C. Transcutaneous CO₂ Monitor (PtcCO₂)
 1. Factors effecting the accuracy of PtcCO₂ measurements
- D. Combination Monitors (ECG, NIBP, Temperature)

V. Operation of Equipment In Special Environments

- A. MRI
- B. Hyperbaric Chamber
- C. Aeromedical Application

Portable Ventilators and Monitors For Trauma Anesthesia

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Patients may be transported for a variety of reasons in the modern health care facility. Patient transports may be initiated for diagnostic procedures, therapeutic procedures or relocation to an intensive care unit offering specialized care. The intrahospital transport of the critically ill requires planning and coordination among transport team members to ensure success. Appropriate equipment selection is a vital component in the safe transport of the critically ill patient. Patient needs may dictate that the patient be moved rapidly, therefore, all required equipment should be readily available.

The equipment required during transport of the critically ill patient can be divided into several broad functional categories as follows: 1) maintenance of a patent airway; 2) support of ventilation and oxygenation; 3) patient monitors and 4) specialty equipment. Each of these functional categories will be discussed in more detail.

Maintenance of A Patent Airway

The requirement for maintenance of a patent airway during transport, in the intubated critically ill patient, is of self evident importance. A vital component of the contents of any "transport box" are the supplies required for airway management. These supplies are listed in Table 1. The box containing these supplies should accompany the patient at all times during transport since inadvertent extubation could be a disaster if the transport personnel are unequipped to deal with such an adverse event.

Support of Oxygenation and Ventilation In The Intubated Patient

Paracelsus who attempted ventilation with a tube placed in a patients mouth attached to a fireplace bellows was probably the first to conceive of a manual resuscitator.¹ Patients, currently, may be intubated and require ventilatory support during transport which may be provided by either manual resuscitator bag or portable transport ventilator.

Evidence gathered during several clinical studies demonstrated complications that may arise during transport. The evidence would suggest these complications are attributable to inappropriate ventilation. Braman et al prospectively evaluated the transport of thirty six (36) critically ill patients inside the hospital with the first twenty

being ventilated by manual resuscitator bag.² These twenty (20) patients demonstrated alterations in $\text{PaCO}_2 > 10$ mm Hg or pH > 0.05 units on 14 occasions. There was significant correlation with disturbances in hemodynamics, variables of hypotension and cardiac arrhythmias, in these patients.

Gervais and co-workers conducted a randomized prospective analysis of thirty (30) ventilator patients with randomization of the patients to one of three groups of ten. Group 1 was ventilated by manual resuscitator bag. Group 2 was ventilated by manual resuscitator with volume measurements. While Group 3 was ventilated by a portable transport ventilator.³

Group 1 and the Group 3 demonstrated significant decreases in PaCO_2 and central venous PO_2 with a concomitant increase in arterial pH; changes were smaller in Group 3. The portable transport ventilator exceeded its preset minute ventilation by 2.35 L/min; it is unclear whether the excess minute ventilation was due to patient demand (i.e. additional patient triggered breaths) or simply inaccuracy of the ventilators delivered tidal volume and/or respiratory rate. Group 2 experienced no significant changes in PaCO_2 , central venous PO_2 , or arterial pH. These investigators concluded that minute ventilation should be monitored during transport.

Finally a study by Hurst et al, confirming acute respiratory alkalosis during the transport of critically patients being manually ventilated demonstrated a significant change in the p.H. and PaCO_2 .⁴ The mean pre-transport values were a pH of 7.39 and PaCO_2 39 mm Hg, compared to a mean pH of 7.51 and PaCO_2 30 mm Hg during transport with manual ventilation.

These studies demonstrated respiratory alkalosis to be the major complication of inappropriate ventilation. Respiratory alkalosis has been associated with reduced myocardial and cerebral blood flows. A simultaneous shift of the oxyhemoglobin dissociation curve to the left results in decreased delivery of oxygen to the tissues. Hyperventilation can lead to coronary artery vasospasm which can result in myocardial

ischemia. ⁵⁻⁶ Additional complications may arise in neurosurgical patients that experience inadvertant hyperventilation. These patients, already being hyperventilated to prevent cerebral edema, may have cerebral blood flow reduced to a precipitous level by any additional drop in PaCO₂.⁷

It is clear from these studies that patients transported while being ventilated with a manual resuscitator suffer from inconsistent ventilation and large upward swings in pH when volume delivery isn't being monitored. Critically ill patients poorly tolerate inconsistencies in ventilatory parameters ultimately resulting in respiratory alkalosis induced by inappropriate manual ventilation.

While potential problems may exist with the use of either manual ventilation or a portable transport ventilator the properly used modern transport ventilators should achieve consistent ventilation. Additionally, medical personnel are freed from the task of manual ventilation allowing more appropriate use of this valuable resource..

Selection of A Portable Transport Ventilator

The selection of a transport ventilator depends upon a multitude of factors which include performance characteristics, patient population served, size, weight, cost, durability, complexity and the operational environment.

Performance characteristics that should be considered include: 1) available modes of ventilation 2) tidal volume ranges, 3) respiratory rate ranges, 4) PEEP range 5) minimum and maximum flow capabilities, 6) duration and type of power source, 7) I:E ratio options, 8) FiO₂ range, 9) pneumatic valve design, 10) alarm features and ranges 11) monitoring capabilities, and 12) availability of accessory equipment. Table 2 lists the performance characteristics of 11 transport ventilators.

There are a variety of ventilator modes that are available for use on the current generation of portable transport ventilators which include: 1) Controlled Mechanical Ventilation (CMV), 2) Assisted Mechanical Ventilation (AMV), 3) Intermittent Mandatory Ventilation (IMV), 4) Synchronized Intermittent Mandatory Ventilation

(SIMV), 5) Continuous Positive Airway Pressure (CPAP) and 6) a modified form of Pressure Controlled Ventilation.

A complete discussion of the use of various modes of ventilation⁸⁻¹³ is beyond the scope of this paper, however, two of these modes deserve mention. The risk of hyperventilation with subsequent acute respiratory alkalosis and/or inadvertent gas trapping, exists, in patients with an intact respiratory drive. Patients that become agitated during transport while being ventilated in the Assist/Control mode are at considerable risk for these complications. Care must also be taken to ensure that a patient in a spontaneous mode of ventilation such as CPAP doesn't have their respiratory drive depressed through narcotic administration or sedation during a diagnostic procedure after reaching their transport destination.

It has been recommended that tidal volume delivery in transport ventilators should vary no more than 10% from the set tidal volume.¹⁴ McGough and co-workers examined the variations in the tidal volume delivered by eight transport ventilators. These investigators utilized a mechanical lung model whereby airway resistance and lung compliance could be altered and the respective effects on delivered volume studied.¹⁵

This investigators demonstrated significant fluctuations in delivered tidal volumes as mechanical lung compliance was decreased or airway resistance increased either independent of one another or in tandem. Under the most rigorous conditions (Lung Compliance 0.02 L/cm H₂O and Airway Resistance 20 cm H₂O/L/s) the portable ventilators tested delivered tidal volumes that varied from 20 mL to 590 mL below the set volume. The manufacturers use of preset internal popoff valves limited the delivered volumes in several of these ventilators while the use of a venturi mechanism used to generate flow was responsible for decreased tidal volume delivery in at least one ventilator.

The power source used for transport ventilators is another critical issue that should be taken into consideration. There are two primary types of power sources commonly

available: 1) electrical and 2) pneumatic. The type of battery (lead-acid, gel cell, rechargeable alkaline, etc.) utilized in the electrically powered device influences total ventilator weight, duration of power availability and recharge time. In general electrically powered devices consume less gas than pneumatically powered transport ventilators. Exceptions do exist with some electrically powered portable transport ventilators utilizing blenders that have significant "bleed" flows which allow gas to leak at a controlled rate from the blender. This "bleed" flow must be taken into consideration when calculating estimated gas usage.¹⁶ This may be an important issue depending upon the size of the compressed gas reservoir available during transport.

Pneumatically powered fluidic logic transport ventilators have the advantage of lighter weight and more compact dimensions. However, in addition to usually having a greater gas consumption these ventilators have the additional disadvantage of significant variances in the operator set parameters. These parameters include respiratory rate, inspiratory time, peak inspiratory pressure and tidal volume. Significant changes in barometric pressure may cause deviations in the set parameters in a pneumatically controlled ventilator. These barometric pressure changes may occur in settings such as a hyperbaric chamber.¹⁷

Alarm features are of paramount importance when selecting a transport ventilator and should give the clinician both audible and visual feedback. The ventilator should be minimally equipped with a high and low pressure alarm. The high pressure alarm is adequate to warn of high pressure conditions that may occur secondary to patient coughing, obstruction of the endotracheal tube, displacement of the endotracheal tube, pneumothorax, airway obstruction, bronchospasm and other events leading to an increase in peak airway pressures.

The high pressure alarm should be an integral part of the transport ventilator and capable of terminating a breath upon detection of a high pressure situation. A mechanical pressure limiting device independent of any electronically based high pressure alarm

should also be incorporated into the ventilator circuit. The mechanical pressure popoff serves as a secondary pressure relief mechanism when the electronic pressure popoff is functioning properly and becomes the primary popoff valve in the event of electrical failure. If an electronic high pressure alarm isn't integral to the transport ventilator a mechanical pressure popoff may be used as the primary means to limit peak airway pressure.

The low pressure alarm is used to detect any events leading to inadequate ventilation of the patient. These events may include ventilator circuit disconnects, ventilator circuit leaks, loss of power source, or various mechanical failures. The low pressure alarm by itself, however, is inadequate if the ventilator is being used as a pressure limited time cycled ventilator. Any event leading to airway obstruction, while the ventilator is being used in the pressure limited mode, will allow the ventilator to pressurize the ventilator circuit effectively defeating the low pressure alarm. This situation may lead to clinically significant hypoventilation of the patient. Exhaled volume based alarms, monitoring either tidal volume or minute ventilation, should be used if the ventilator is used as a pressure limited time cycled ventilator.

Electrically powered transport ventilators should also incorporate a low battery voltage alarm that alerts the clinician prior to actual loss of battery function. Additionally, the transport ventilator should incorporate an independent analog meter or digital display indicating the state of battery charge or absolute battery voltage.

Finally an apnea alarm is recommended for any transport ventilator utilizing a completely spontaneous mode of ventilation such as CPAP. The alarm trigger mechanism typically is referenced to airway pressure drops.

It may be difficult to find a transport ventilator that incorporates all of the alarm features that have been discussed. There are, however, many ventilator manufacturers and third party vendors that offer accessory alarm packages that may be easily retrofitted

to existing transport ventilators. However, there is no level of alarm protection that can replace clinical observation of the patient by a skilled clinician.

There are a number of visual indicators that should be present on transport ventilators that enable the operator to use their eyes while in monitoring the patient. These visual indicators include an airway pressure manometer, indicators for breath type (i.e. assisted mechanical, mechanical, or spontaneous) and battery in use indicator (if applicable). The transport ventilator controls should be calibrated, plainly labeled and easily read from several feet away. In addition all circuit connections should be plainly labeled and have fittings of different sizes to minimize the risk of inappropriate assembly.

The patient undergoing transport while on a portable transport ventilator should have inspired gases adequately humidified. During transport and diagnostic or therapeutic procedure the gas supplied to the ventilator may be from compressed sources of oxygen and air; therefore virtually all of the moisture will have been removed from these gas sources. Chalon et al demonstrated destruction of ciliated cells in non-smoking adult patients breathing dry anesthetic gases occurs after only 2 hours.¹⁸ The average intrahospital transport requires approximately 80 minutes.¹⁹⁻²⁰

The use of a heated humidifier significantly decreases the time an electrically powered transport ventilator may operate on battery. The use of a heated humidifier with a pneumatically powered ventilator requires a dedicated battery for the humidifier. The most practical substitute for a heated humidifier is a Heat Moisture Exchanger (HME) or Hygroscopic Condenser Humidifier (HCH). Much controversy remains concerning the minimal level of humidification required for normal mucociliary function.²¹⁻²⁴ However the use of HCHs, which were reported to have humidity outputs ranging from 21-28 mg H₂O/L in one study²⁵, would seem prudent until definitive data is forthcoming.

Patient Monitors

The Latin origin of the word "monitoring" is *monere* which translates "to warn". The new generation of patient monitors are capable of quickly warning the clinician of changes in the patients underlying status. The development of portable monitors capable of monitoring ECGs, arterial oxygen saturation (SpO₂), end-tidal CO₂ (ETCO₂) and multiple function monitors (i.e. intracranial pressure (ICP), pulmonary artery pressure (PAP), non-invasive blood pressure (NIBP), ECG, temperature, SpO₂, respiratory rate) allows the continuous monitoring of critical physiologic parameters during transport. Table 3 lists several multiple function monitors currently available.

Pulse oximetry was first applied during World War II while studying the effects of altitude on aviators.²⁶ Current evidence suggests that appropriate therapeutic intervention may be initiated as a result of feedback from the pulse oximeter. A recent retrospective study suggested that the use of pulse oximetry, during transport, led to therapeutic interventions that increased the patients post-transport SpO₂ and systolic blood pressure.²⁷

There are certain patients in which satisfactory pulse oximetry readings are difficult to obtain such as burns, shock or patients presenting with peripheral vascular disease. Additionally, dysfunctional hemoglobin may cause the pulse oximeter to either variably underestimate or overestimate the patients actual arterial saturation. For example the presence of significant levels of carboxyhemoglobin uniformly causes the pulse oximeter to overestimate the actual SaO₂.²⁸ The presence of methemoglobin may cause the pulse oximeter to underestimate the patients SaO₂ when the actual SaO₂ is < 85% or it may cause it to overestimate the SaO₂ when the patients actual SaO₂ is > 85%.²⁹ On the whole, however, pulse oximetry is quick, easily applied and provides valuable data regarding the patients oxygenation with certain limitations.

The use of ETCO₂ monitors has been described for a multitude of purposes in the clinical setting. For instance the use of ETCO₂ has been described for the verification of

endotracheal intubation³⁰, as prognostic indicators for survival during cardiopulmonary resuscitation³¹, to assist in the weaning of patients undergoing mechanical ventilation and titration of settings for mechanical ventilation.³² These monitors range from relatively simple disposable colorimetric devices to sophisticated microprocessor controlled devices that display capnograms, respiratory rate and have high - low ETCO_2 alarms. The greatest probable utility of this device during transport is the titration of ventilation, verification of ET tube placement and warning of any untoward event effecting ventilation. Table 4 lists a variety of pulse oximeters and ETCO_2 monitors currently available.

An additional device that has demonstrated utility in non invasively monitoring PaCO_2 is the transcutaneous monitor (PtcCO_2). This device has been used in both neonatal and adult patients and has demonstrated acceptable results in monitoring PtcCO_2 on critically ill adult patients when cardiac index is greater then 1.5 L/min/M^2 .³³

Unusual Environments or Modalities Requiring The Use of Specialty Equipment

Certain operating environments or patient requirements may dictate the use of specialized types of portable transport ventilators and associated monitors. For example the use of a transport ventilator in a hyperbaric chamber may significantly effect the performance of the ventilator. Magnetic Resonance Imaging (MRI) may also require specialized ventilator construction with non-ferromagnetic components or shielding of the ventilator as a necessity.³⁴ In addition the transport of patients receiving advanced ventilatory modalities such as high frequency jet ventilation may require even further specialized equipment and personnel.³⁵

Gas consumption in certain operating environments where the supply may be limited, such as MRI, may also be a factor that eliminates some portable transport ventilators from further consideration. A transport ventilator equipped with 4 aluminum E-cylinders has a total gas capacity of 2,488 liters. Each E-cylinder contains 622 liters of gas when full.³⁶

Using standard formulae for estimating the duration of cylinders³⁷, including a 500 pound safety factor, illustrates the differences in depletion of compressed gas reservoirs. Transportation of a patient with a 15 L/min minute ventilation requirement, using a Bio-Med IC-2A ventilator, consumes an E-cylinder every 15.5 minutes or a total of 4 E-cylinders for approximately 1.0 hour. The stated gas consumption, to power the IC-2A fluid logic is 12 L/min (total gas consumption including the patient's minute volume equals 27 L/min)

In conclusion the personnel responsible for patient transport should be thoroughly trained in the operation of all transport equipment. This point is particularly critical with regard to the operation of equipment in unusual environments. As the information presented within this paper clearly indicates equipment considerations play a vital role in the successful and safe transport of the critically ill intubated patient. Each institution should assess the required level of training and composition of the critical care transport team.

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Quantity	Item
1 ea	E-Cylinder Wrench
1 ea	Non-Rebreathing Mask
1 ea	Manual Resuscitator Bag
1 ea	Small, Medium and Large Non Conductive Resucitator Bag Masks
2 ea	PEEP Valves
2 ea	5, 6, 8 (Infant) ,10, 12, 14, 16 (Adult) French Suction Catheters
2 ea	Yaunkers Oral Suction or Bulb Syringe (as appropriate)
2 ea	2.5, 3.0, 3.5, 4.0, 5.0 mm I.D. ET Tube (Infant) - 6.0, 7.0 , 8.0 , 8.5 , 9.0 , 10 mm I.D ET Tubes (Adult)
2 ea	Endotracheal Tube Stylettes
1 ea	McGill Forceps
1 ea	Laryngoscope Handle, Curved and Straight Blades of Appropriate Size
5 ea	Sterile Water Soluble Lubricant
1 ea	20 cc Syringe for ET Tube Cuff Inflation
1 ea	Roll of Cloth Tape or Precut
1 ea	Twill Tape
1 ea	Bite Block

Table 1- A list of essential equipment and supplies for the maintenance of a patent airway.

Ventilator	Hamilton MAX	PnuetPAC	Autovent 3000	Bird Mini TXP	Bio-Med IC-2A	Newport E100i	Logic 07a	Bird Avian	P-B 2801	Uni-Vent 750	Omni-Vent
Modes	IMV	CMV	IMV, CMV	CMV	CMV, SIMV, CPAP	CMV, AMV, SIMV, CPAP	CMV	CMV, AMV, SIMV, CPAP, Sigh	CMV, AMV, SIMV, Sigh	CMV, AMV, SIMV, Sigh	CMV, IMV
Rate (breaths/min)	2-30	11-14, 16, 19, 21	Peds 9-27, Adult 8-20	4-15	1-66	1-120	10-40	0-150	1-69	1-150	
Tidal Volume (mL)	50-1,500	340-1,450	Peds 200 - 600, Adults 400 - 1200	50-2500	0-3000	10-2500	100-2000	50-2000	50-2800	10-3000	30-3000
Max. Pressure (cmH2O)	60	55	45	Variable	≤100	≤100	70	100	100	100	NS
Peak Flow (L/min)	90	40	48	120	75	100	65	100	120	100	45
FiO2	1.0	.45 or 1.0	1.0	.45-.60	1.0	.21-1.0	.5 or 1.0	1.0	.21-1.0	1.0	1.0
PEEP (cmH2O)	No	No	No	No	No	0-25	No	0-25 (external valve)	No	No	No
Alarms	Low Battery, Audible high pressure	Audible high pressure	Audible high pressure	None	None	Audible/ Visual, high & low pressure, Inverse I:E, Low Battery, Apnea, Visual External Power Failure	Audible high pressure	Audible/ Visual Inverse I:E, External Power Failure, Apnea, Disconnect, PEEP Not Set, Battery Low	Audible/ Visual high & low pressure, Inverse I:E, Apnea, Low Battery, Ventilator Malfunction, Power Failure	Audible N/visual, high & low pressure, Disconnect, Inverse I:E, Low battery, Apnea, PEEP Not Set, Power Failure	None
Monitoring	Airway Pressures	None	None	None	Airway Pressures	Airway Pressures, Battery Charge, Power Source	Airway Pressures	Airway Pressures, Respiratory Rate, I. Time, Flow	Airway Pressures, Sensitivity, Flow, Volume Voltage	Airway Pressures	Airway Pressures
Gas Consumption (L/min)	0	5	5	0	12	9	2	0	0	0	0
Weight (kg/lbs)	5.0 / 11.0	1.3 / 2.9	0.68 / 1.5	1.2 / 2.6	3.85 / 8.5	5.4 / 11.9	5.0 / 11.0	5.0 / 11.0	17.6 / 35.5	2.9 / 6.4	2.0 / 4.5
Dimensions (cm)	30x8x16.5	18x9x6	NS	7x6x8.5	8.6x15.6x26	24x18x15	18x13x15	25.4x30.5x13	32.4x27x33.7	22x29x11	10x13x15

Table 2- Lists performance characteristics for eleven commercially available transport ventilators. *NS=Not specified

Manufacturer	Model	Monitored Parameters	Battery Duration	Weight
Protocol	PROPAQ 106	ECG, Invasive and Non-Invasive Blood Pressure, SpO2, Temperature	6.5 hours	8.3 lbs
Medical Data Electronics	Escort 100	ECG, Non-Invasive Blood Pressure, Respiratory Rate SpO2, Temperature	2.5 hours	16.5 lbs
Medical Data Electronics	Escort 300	ECG, Invasive and Non-Invasive Blood Pressure, Respiratory Rate SpO2, Temperature	3 hours	16.5 lbs
SpaceLabs	90308 PC Express Monitor	ECG, Invasive and Non-Invasive Blood Pressure, Respiratory Rate SpO2, Cardiac Output	2.5 hours	16.3 lbs
Invivo Research	Omega 1445	SpO2, Non-invasive Blood Pressure	.75 hours	10.8 lbs

Table 3- Lists 5 different multifunction transport monitors.

Type of Moniotr	Manufacturer	Model	Monitored Parameters	Battery Duration	Weight
Pulse Oximeter	MSA Catalyst Research	Mini-Ox	SpO ₂ , Signal Strength, Pulse	200 hours	.87 lbs
Pulse Oximeter	Novamatrix	Oxypleth	SpO ₂ , Signal Strength, Pulse, Waveform Display	20-100 hours (depends on type of display)	7.3 lbs
Pulse Oximeter	Criticare Systems Inc.	503	SpO ₂ , Signal Strength, Pulse	10 hour minimum	1.8 lbs
Pulse Oximeter	Nonin	8604D	SpO ₂ , Pulse		2.1 lbs
Pulse Oximeter	Nellcor	N-10	SpO ₂ , Pulse, Signal Strength	100 cycles	2.6 lbs
ET CO ₂	Nellcor/Fenem	FEF	Qualitative ET CO ₂	Dispoasable	<.06 lbs
ET CO ₂	MSA Catalyst Research	MiniCAP III	ET CO ₂	8 hours	.89 lbs
ET CO ₂	Ohmeda	4700 Oxi Cap	ET CO ₂	.75 hours	15 lbs
ET CO ₂	Armstrong Medical	AD-600	ET CO ₂	5 hours	2. 5 lbs

Table 4- Lists a variety of available pulse oximeters and ET CO₂ monitors.

FRIDAY, MAY 12, 1995

SESSION B: Trauma, Anesthesia, Critical Care:
Interfaces

Chairs: David T. Porembka, DO, FCCM

Thomas M. Fuhrman, MD, FCCM, FCCP

08:00 - 08:35 New Insights in CPR: Have we Reached the Limits?
Nicholas G. Bircher, MD

08:35 - 09:10 Traumatic Brain Injury: Innovative Monitoring and Therapy
Donald S. Prough, MD

09:10 - 09:45 Analgesia and Sedation: Modification of the
Injury Response?
Thomas M. Fuhrman, MD, FCCM, FCCP

10:15 - 10:50 Transesophageal Echocardiography in the
Critically Ill and Injured
David T. Porembka, DO, FCCM, FCCP

10:50 - 11:25 The Critical Role of Nutrition and Immune Function in
the Critically Ill and Injured
Gary P. Zaloga, MD, FCCM

11:25 - 12:00 Nitric Oxide and Innovative Therapy in ARDS
Ronald G. Pearl, MD, PhD

12:00 - 12:15 Discussion/Questions and Answers

Modification of the Injury Response: Analgesia and Sedation.

Thomas M. Fuhrman, MD, FCCM, FCCP

I. Introduction

- A. What is the injury response?
- B. Is it modifiable?
- C. Why modify the response.

II. Responses to Injury/Surgery.

- A. Endocrine
- B. Metabolic
- C. Respiratory
- D. Cardiovascular
- E. Fluid and Electrolyte
- F. Psychologic

III. Perioperative data - Modification of the response to surgery.

- A. Estimated blood loss
- B. Thromboembolism
- C. Cardiovascular
- D. Ileus
- E. Cerebral function
- F. Length of stay
- G. Mortality

IV. Conclusions

- A. Is pain relief important?
- B. No studies available
- C. Ideas to contemplate

8th Annual Trauma Anesthesia and Critical Care Symposium
Baltimore, Maryland
May 11-13, 1995

TRANSESOPHAGEAL ECHOCARDIOGRAPHY IN THE CRITICALLY ILL AND INJURED

David T. Porembka

Introduction

TEE as an Emergency Technology

Indications

Left Ventricular Performance

Myocardial Ischemia

Systolic/Diastolic Function

Preload Assessment

Trauma

Intracardiac Shunts

Aortic Pathology

Trauma

Debris, Thrombus

Other Applications

Endocarditis, Masses, Pulmonary Embolism

Future Applications

Conclusion

The Critical Role of Nutrition and Immune Function in the Critically Ill

Gary P. Zaloga, MD, FCCM
Professor of Anesthesia/Critical Care and Medicine
Bowman Gray School of Medicine
Wake Forest University
Winston-Salem, NC

OBJECTIVES

1. Review the effects of nutrients on organ and immune function
2. Discuss clinical studies of early enteral feeding in critically ill patients

PRESENTATION OUTLINE

I. Effect of nutrients on organ function

A. Gut blood flow: Luminal nutrients increase gut blood flow. Blood flow usually increases in excess of metabolic demand. Luminal nutrients counteract the effect of vasoconstrictors (ie. catecholamines, vasopressin, angiotensin) upon gut blood vessels. Luminal nutrients also increase blood flow to the liver via the portal circulation.

B. Gut structure/function: Glutamine, SCFA (short chain fatty acids), and peptides are trophic to the gut mucosa and help maintain the gut barrier. Glutamine has its major action upon the small intestine, SCFA upon the colon, and peptides upon both small and large intestine. SCFAs are normally produced in the colon via bacterial fermentation of fiber. Formulas deficient in glutamine or composed of amino acids are associated with gut atrophy and loss of gut barrier function.

C. Bacterial translocation/bacterial adherence: Current evidence using electron microscopy and bacterial staining indicate that bacterial translocation is common in humans after trauma. Bacterial adherence is required for gut organisms to interact with the gut mucosa and induce cytokine production, increase permeability, or translocate. Current experimental evidence suggests that enteral nutrients can prevent both bacterial adherence and translocation.

D. Wound healing: Luminal nutrients stimulate healing of the gut following surgery. Peptides and Arginine have been shown to increase wound healing.

E. Renal function: Protein is a potent stimulus increasing renal blood flow and glomerular filtration rate. Experimental studies indicate that enteral feeding protects animals from renal failure.

F. Liver function: Luminal nutrients increase portal blood flow and have been shown to protect the liver from injury following experimental hemorrhagic shock and endotoxin shock. On the other hand, parenteral nutrients diminish liver function.

G. Immune function: Peptides, Arg, O-6/O-3 LCFA ratios, and RNA alter function of the immune system. In general, peptides, arginine, omega-6 LCFAs, and RNA stimulate immune function (proinflammatory) while Omega-3 fatty acids are anti-inflammatory.

H. Hypermetabolism: early enteral feeding has been shown to blunt the hypermetabolic response to experimental burn injury.

II. Clinical studies of enteral vs parenteral nutrition: Most evidence indicates that parenteral nutrition is associated with immune compromise and increased infection rates when compared to enteral nutrition.

A. Trauma

B. Surgery

C. Cancer chemotherapy

III. Clinical studies of early vs delayed enteral nutrition: Most evidence indicates that early enteral feeding decreases infection rates and may improve outcome.

A. Trauma/Burn

B. Neuroinjury

C. Surgery

D. Hip fracture

NITRIC OXIDE AND INNOVATIVE THERAPY IN ARDS

Ronald G. Pearl, Ph.D., M.D.

- I. Introduction: Need for new therapies in ARDS
- II. Inhaled nitric oxide
 - A. Nitric oxide as an endogenous vasodilator
 - B. Inhaled nitric oxide as a selective pulmonary vasodilator
 - C. Clinical development of inhaled nitric oxide
 - 1. Primary pulmonary hypertension
 - 2. Persistent pulmonary hypertension of the newborn
 - 3. Perioperative pulmonary hypertension
 - D. Results in ARDS
 - 1. Pulmonary hemodynamics
 - 2. Gas exchange
 - a. Results
 - b. Rationale for improved gas exchange
 - 3. Predictors of response
 - 4. Dose-response data
 - 5. Safety and toxicity issues
 - 6. Outcome data
- III. Anti-mediator therapy

- A. Complement-neutrophil hypothesis
- B. Current concept of mediators in ARDS
- C. Results of anti-mediator therapies in ARDS
 - 1. Septic shock therapies (anti-endotoxin, anti-TNF, IL-1ra)
 - 2. Anti-thromboxane therapy
 - 3. Antioxidant therapy

IV. Surfactant therapy

- A. Surfactant deficiency in ARDS
- B. Results of surfactant therapy in ARDS

V. Mechanical ventilation in ARDS

- A. Conventional mechanical ventilation in ARDS
- B. Heterogeneity of lung injury in ARDS
- C. Ventilator-induced lung injury in ARDS
- D. Permissive hypercapnia
- E. Extracorporeal carbon dioxide removal (ECCO₂R)
- F. Pressure-controlled inverse-ratio ventilation
 - 1. Results
 - 2. Caveats

VI. Improving prognosis in ARDS

VII. Summary

FRIDAY, MAY 12, 1995

SESSION C: LOTAS: Level One Trauma Anesthesia Simulations/Human Factors in Emergencies
Chair: Colin F. Mackenzie, MD

08:00 - 08:10 Introduction
Colin F. Mackenzie, MD

08:10 - 08:40 Communication During Management of Trauma Patients
Richard L. Horst, PhD

08:40 - 09:15 Videoanalysis of Tracheal Intubation for Trauma Patients
Colin F. Mackenzie, MD

09:15 - 09:45 Decision-Making Models in Trauma Anesthesia
Yan Xiao, PhD

10:15 - 10:45 Human Factors in Crisis Management
Matthew B. Weinger, MD

10:45 - 11:15 Panel Discussion
Yoel Donchin, MD
Stefano Badiali, MD
Marzio G. Mezzetti, MD, PhD
LOTAS Faculty

11:15 - 12:15 Special Demonstration:
Opportunities on Simulators –
Be the “Attending Trauma Anesthesiologist”
for a Real Case from the Shock Trauma
Center. Featuring: LORAL and
CAE-Link Simulators and Technology
Colin F. Mackenzie, MD
Kenneth J. Abrams, MD
Christopher M. Greene, MD

LOTAS Level One Trauma Anesthesia Simulations
HUMAN FACTORS IN EMERGENCIES
Colin F. Mackenzie, M.D.

8:00 - 8:10am

- I. Human Factors in Emergencies**
 - A. Includes: Ergonomics, Equipment design, Workplace Layout, Training, Team Communication and Coordination, Social pressures and other stressors**
 - B. Overview of different presentations**
 - C. Brief Description of Simulation Demonstration**

LOTAS Level One Trauma Anesthesia Simulations
HUMAN FACTORS IN EMERGENCIES
Colin F. Mackenzie, M.D.

8:40 - 9:15am VIDEOANALYSIS OF TRACHEAL INTUBATION FOR TRAUMA PATIENTS

- I. Data Collection**
 - A. Advantages of Videotaping Intubation**
 - 1. Succinctness**
 - 2. Emergency vs. Elective**
 - B. Task Analysis of Tracheal Intubation**
 - 1. Preparatory**
 - 2. During**
 - 3. After**
 - C. Standard Operating Procedures Algorithm**
- II. Analysis Techniques**
 - A. Subject Matter Expert**
 - B. Intubation Analysis Form**
 - C. Critical Incident Technique**
 - D. Communication Transcription**
 - E. Vital Signs/ Monitoring Data**
- III. Data From Analysis**
 - A. Task Shed vs. Task Omission**
 - B. Monitored Status Emergency vs. Semi-emergency vs. Elective Intubation**
 - C. Stressors Before, During, and After Intubation**
 - D. Holter and BP Data of Anesthesia Care Providers**
- IV. Ergonomics Data**
 - A. Positioning of Monitors**
 - B. Design of Ventilator Controls**
 - C. Workplace Layout**
 - D. Training**
- V. Summary of Findings**

Decision Making Models in Trauma Anesthesia

Yan Xiao, PhD

Abstract

Decisions in trauma anesthesia are often made under extreme time pressure while the patient conditions change dramatically. Previous formulations of decision trees for trauma anesthesia are highly informative and succinct, but they do not reflect how decisions are usually made. Drawn upon the episodes from video taped trauma anesthesia, several models of decision making will be described in the lecture that capture the general characteristics of the decision making process during trauma anesthesia.

Human Factors in Crisis Management

Matthew B. Weinger, M. D.
Department of Anesthesiology
University of California, San Diego

O U T L I N E

What is human factors/ergonomics

Medical mishaps and human error

- Types of error

- Error recovery

What is different about a crisis (compared to routine work)

Performance Shaping Factors

- The human component

 - Sleep deprivation and disturbance

 - Circadian effects and shiftwork

 - Stress (physical and psychological) and workload

 - State of health

 - Substance use/abuse

- Team work (or lack thereof)

- Impact of training and experience

Environmental Factors

- Noise and music

- Alarms

Equipmental Factors

- Human-centered design

Task Factors

- Task distribution

- Workload

- Impact of secondary tasks

Performance Shaping Factors and Crisis Management

FRIDAY, MAY 12, 1995

SESSION D: Scientific Free Papers II
Chair: Enrico M. Camporesi, MD
Moderators: Free Papers
Enrico M. Camporesi, MD
Bruce F. Cullen, MD

FRIDAY, MAY 12, 1995 SESSION A

- 8:00 a.m.** Use of Mechanical Ventilation with the Ohmeda Universal Protable Anesthesia Complete (UPAC) Draw-over Anesthesia System
- 8:13 a.m.** Simulated Clinical Evaluation of Conventional and Newer Fluid Warming Devices
- 8:39 a.m.** Clinical Factors Predicting Death in Pediatric Trauma Patients
- 8:52 a.m.** Clinical Factors Predicting Death in Comatose Children With Head Trauma
- 9:05 a.m.** Norepinephrine but not Epinephrine Stimulates the Release of CRF From In Vitro Superfused Rat Hypothalamus
- 9:18 a.m.** A Prospective In-Field Evaluation of Endotracheal Intubation by Emergency Medical Services Physicians
- 9:31 a.m.** Upregulation of the Acetylcholine Receptors (AChRs) In Burns

FRIDAY, MAY 12, 1995 SESSION B

- 10:15 a.m.** Risk of Aspiration Pneumonia Following Gastric Versus Jejunal Feedings in Multiple Injured Trauma Patients
- 10:28 a.m.** A Versatile Stylet for Difficult Orotracheal Intubations
- 10:41 a.m.** Thoracic Spinal Trauma and Associated Injuries: Can Early Spinal Decompression be Considered?
- 10:54 a.m.** Computerassisted Documentation in EMS – A Contribution to Quality Control in Prehospital Trauma Care
- 11:07 a.m.** Arterial To End-Tidal Carbon Dioxide Gradient and Horovitz-Quotient – of Value in Diagnosing Blunt Chest Trauma?
- 11:20 a.m.** Diagnostic Approach to Myocardial Contusion in Multi-System Trauma
- 11:33 a.m.** Awake Endotracheal Intubation in Patients with Cervical Spine Disease: A Comparison of Techniques

USE OF MECHANICAL VENTILATION WITH THE OHMEDA UNIVERSAL PORTABLE ANESTHESIA COMPLETE (UPAC) DRAW-OVER ANESTHESIA SYSTEM

J. K. Hawkins, S. A. Ciresi, W. J. Phillips, Anesthesia and Operative Services, Department of Surgery, Womack Army Medical Center, Fort Bragg, NC.

The purpose of this study is to provide a suggested method of mechanical ventilation for the Ohmeda Universal Portable Anesthesia Complete (UPAC) draw-over anesthesia system utilizing the Portable LIFECARE (PLV-100) ventilator. The UPAC vaporizer and system was designed specifically for use in austere or military battlefield conditions where conventional anesthesia machines and/or compressed gas sources are not available. To date, there is no ventilator specifically designed for use with the UPAC system. The PLV-100 ventilator is an electrically powered volume ventilator designed for out of hospital or field use. The characteristics of this ventilator make it suitable for use with the UPAC vaporizer in field conditions.

A review of the literature suggests that a descending bellows type ventilator that is placed downstream or distal to the vaporizer should be used with the UPAC. By placing this type of ventilator downstream of the vaporizer, the mechanism of drawing-over or "pulling" air through the vaporizer is maintained. There is no data available on the use of a ventilator upstream or proximal to the vaporizer that would "push" air through the vaporizer. The descending bellows type of ventilator requires the use of compressed gas for power and is therefore not practical for use in small field medical units where compressed gas supplies are limited. Furthermore, laboratory studies in which this type of ventilator was used, the ventilatory rate and volume delivered was such as to simulate the spontaneously breathing patient. Therefore, the vaporizer performance curves for the delivery of anesthetic agent that have been documented are based on these previous studies with no performance data reported when acceptable mechanical ventilatory parameters are used.

In our laboratory studies the UPAC vaporizer was utilized with the PLV-100 ventilator positioned proximal or upstream to the vaporizer. In this position, the ventilator "pushes" oxygen enriched ambient air through the vaporizer towards the patient as opposed to the air being "pulled" through the system. Vaporizer performance curves were established with minute volumes of 4, 6, 8, and 10 liters/minute at ventilatory rates of 8 and 10. The inhalation anesthetic concentrations delivered were within acceptable limits with measured output comparable to findings in previous vaporizer studies. Most importantly, the vaporizer output was constant with no erratic or unacceptable peak levels delivered.

The information obtained in this study would suggest that mechanical ventilation using the PLV-100 ventilator can be accomplished with the UPAC draw-over system. Furthermore, it suggests that the method of ventilation through the vaporizer, whether the air is drawn through or pushed through, has no effect on the performance of the vaporizer.

Title: SIMULATED CLINICAL EVALUATION OF CONVENTIONAL AND NEWER FLUID WARMING DEVICES

Authors: N. Patel, MD, D.Knapke, C.E. Smith, MD, FRCPC, T. Napora, J. Hagen, BA

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Case Western Reserve University, Cleveland, OH

INTRODUCTION: Administration of inadequately warmed IV fluids contributes to perioperative hypothermia (1), such that 3-4 liters of IV fluids at room temperature is equivalent to one hours heat production or 1°C temperature loss in anesthetized patients.(2,3) The purpose of this study was to evaluate the fluid warming capabilities of five (FDA approved) fluid warmers (4 newer devices and 1 conventional) at clinically encountered flow rates.

METHODS: The fluid warmers studied were (Alton Dean Medical Inc., Woods Cross, UT) FW-537 (dry heat-metal), (Level 1 Technologies, Rockland, MA) H1000 (D60 tubing) and Hotline (countercurrent water), (Augustine Medical Inc., Edene Prairie, MN) Bair Hugger 500 (convective air-plastic) and (DataChem, Indianapolis, IN) Flotem Ile (dryheat-plastic). A 33" extension with stopcork (Argyle EZ Flo, Sherwood Medical, Inc., St. Louis, MO), was attached to all warmers except to the FW-537, as is routine in our clinical practice. We additionally evaluated the two countercurrent warmers (H1000 and Hotline) at higher waterbath set point of 42°C and with a shorter (8") extension tubing. Fluids tested were lactated ringers solution and diluted PRBC's. Rapid response in-line thermistors were connected along the tubing to measure the actual fluid temperatures at inlet (before warmer), outlet (immediately after the warmer) and distal (where the fluid would normally enter the patient) points. Forty temperature (°C) and flow rate (ml/min) readings were obtained from each warmer at each flow rate, 6.5, 13, 19, 25 cc/min, at gravity (wide open), and under (300 mmHg pressure) rapid infusion. Data were compared between warmers using GLM procedure with Tukey's test (SAS software) for multiple comparison. A p<0.05 was considered significant.

RESULTS: Summarized in Table 1. Data are mean distal temperatures with actual mean flow rates in brackets.

DISCUSSION: The FW537 and H1000A (42), H1000 (39) are the only warmers capable of delivering normothermic temperatures at higher flow rates such as would be encountered in patients requiring volume resuscitation. Data suggest that Hotline (42°C) with a short extension tubing would be ideal for most other (lower) flow rates. Although the heating capabilities were adequate, the heat loss along the tubing distal to the warmer is significant for Flotem Ile, the FW537 and the BairHugger fluid warmers and accounts for the low distal temperatures from these warmers.

REFERENCES

1. Can J Anaesth 1994; 41:A36A
2. Br J Anaesth 1990; 64:346-354.
3. Anesth Analg 1982; 61:383-384.

Table 1 SEVEN WARMERS MEAN DISTAL TEMPERATURES (°C) WITH MEAN FLOW RATES (cc/min) PARENTHESES

Warmer (Setpoint) °C	Extension (Inch)	6.5 cc/min	13 cc/min	20 cc/min	25 cc/min	Gravity	Pressure
Hotline (40)	33	31.7 (6.3)	33.1 (13.2)	35.3 (19.9)	35.6 (24.9)	34.2 (59)	26.5 (219)
Hotline (42)	8	35.3* (6.3)	37.8* (13.6)	38.2* (20.2)	37.9* (25.3)	34.7 (79)	28.9 (331)
FW 537 (39.5)	None	23.4 (6.4)	27.0 (13.6)	28.5 (19.7)	29.4 (24.1)	36.0 (194)	36.5 (596)+
H1000 (40)	33	29.6 (6.9)	32.8 (13.4)	33.5 (19.6)	34.0 (25.1)	36.6 (89)	37.2 (332)
H1000 (42)	8	33.8 (6.3)	36.1 (13.3)	37.4 (20.2)	37.7 (24.9)	39.0* (151)	39.0* (467)
BairHugger (43)	33	29.4 (6.5)	33.3 (13.6)	34.1 (19.9)	34.2 (25.0)	29.2 (77)	24.1 (356)
Flotem Ile (38)	33	26.1 (6.6)	29.6 (13.4)	30.8 (19.9)	31.5 (25.1)	29.7 (68)	24.2 (263)
Inlet Temp. (°C) Mean ± SD		22 ± 0.4	21.1 ± 0.3	21.8 ± 0.6	21.8 ± 0.5	21.9 ± 0.6	22.7 ± 0.7
Flow (cc/min) Mean ± SD		6.5 ± 0.3	13.4 ± 0.3	19.9 ± 0.4	24.9 ± 0.6	106 ± 53	397 ± 139

* p<0.05 compared with other warmers (temperature)

+ p<0.05 compared with other warmers (flow rate)

CLINICAL FACTORS PREDICTING DEATH IN PEDIATRIC TRAUMA

PATIENTS. G. Orliaguet, P. G. Meyer, S. Blanot, H. Cuttaree, A. C. Perrie, M.M. Jarreau, B. Charron, P. Carli. Department of pediatric anesthesia and SAMU de Paris, Hôpital des Enfants Malades, Paris France.

Determination of criteria for adequately predicting outcome of pediatric trauma patients is a mandatory part of quality assessment. Most of the reports, in the area of severe pediatric trauma, have been done in poorly homogenous populations with wide variations in initial critical management principles (1,2). Inadequate initial evaluation and treatment could contribute to almost 30% of the early deaths in children with severe trauma. The aim of this prospective study was to analyze the factors predicting outcome in a large series of injured children seen in a single regional institution with a standardized protocol of initial critical care management (3).

Over a 3 years period, 411 pediatric trauma patients, with injuries meriting trauma team activation at the study site, were included in the study. GCS and Pediatric Trauma Score (PTS) were determined upon arrival to the hospital, Injury Severity Score (ISS) was calculated within 48 hours or based upon results of body CT-scan examination when death occurred before 48 hours. Age, injury mechanism, main traumatic injury and initial therapeutic, especially the need and abundance of early transfusion, were recorded. Independent predictors of death were determined with a multiple linear regression analysis. Results are expressed as means $\pm$ SD, and were considered significant if $p < 0.05$.

The average age of the study patients was 6.9 ± 4.2 (median 6.0, 25 percentile 3.0, 75 percentile 11.0). Pedestrian-automobile collisions were 31% of the accidents, falls 40%, motor vehicle crashes 13%, cycle crashes 8% and other 8%. Critical care was initiated at the scene by the teams of the Mobile Intensive Care Unit of the SAMU in all the cases, with venous access insertion in 100% of the cases and tracheal intubation in 47% of the cases. In-hospital management was as previously described (3). Global mortality was 11.7% (5.7 at 12 H, 2% at 24 H, 4% later on). None of these deaths could be considered as avoidable. The main traumatic injuries were : head trauma in 77%, thoracic trauma in 3%, spine trauma in 3%, abdominal trauma in 2.5%, musculoskeletal injuries in 10.7% and other in 3.8%. The mean GCS, PTS and ISS were 10.1 ± 3.9 , 6.3 ± 3.9 and 19.9 ± 15.1 respectively. Of the different possible predictors tested, only ISS ($p < 0.001$), the need for early transfusion ($p < 0.001$) and GCS ($p = 0.016$) independently predicted death. PTS, injury mechanism and age did not reach significance.

It can be conclude that mortality of pediatric trauma patient is about 12%. The majority of these deaths occur within 24 hours after trauma, whatever the initial critical care management is. Clinical factors, especially ISS, GCS and the need for early transfusion, can predict the risk of early death and can be used for quality assessment.

1/ Am J Dis Child **144**: 1088-1091, 1990

2/JAMA **263**: 69-72, 1990

3/ International Anesth. Clinics **32** 142-170 1994

CLINICAL FACTORS PREDICTING DEATH IN COMATOSE CHILDREN WITH HEAD TRAUMA. P. G. Meyer, G. Orliaguet, M.M. Jarreau, B. Charron, P. Carli. Department of pediatric anesthesia and SAMU de Paris, Hôpital des Enfants Malades, Paris France.

Determination of clinical factors predicting adequately the risk of death is a mandatory part of quality assessment. Most of the reports, in the area of severe pediatric head trauma, have been done in poorly homogenous populations with wide variations in initial critical management principles (1,2). Inadequate initial evaluation and treatment could contribute to almost 30% of the early deaths in children with severe trauma. The aim of this prospective study was to analyze the factors predicting death in a large series of children seen in a single regional institution with a standardized protocol of initial critical care management (3).

Over a 3 years period, 159 children with a Glasgow Coma Scale score (GCS) of 8 or less determined before initiation of critical care at the scene of the accident were enrolled in the study. GCS and Pediatric Trauma Score (PTS) were determined upon arrival to the hospital, Injury Severity Score (ISS) was calculated within 48 hours or based upon results of body CT-scan examination when death occurred before 48 hours. Age, mechanism of the accident, associated lesions and initial therapeutic were recorded. Deaths were divided in 3 groups: occurring within 12 hours, within 24 hours, or later. Statistical analysis used contingency table, ANOVA, and Spearman rank test as appropriate.

Pedestrian/MVA were 33% of the accidents, falls 35%, MVA 14%, and cycle 10%. Critical care was initiated at the scene by the teams of the Mobile Intensive Care Unit of the SAMU in all the cases, with venous access insertion in 100% of the cases and tracheal intubation in 94% of the cases. Shock upon arrival was noted in 18% of the cases. In-hospital management was as previously described (3). Global mortality was 31.5% (15% at 12 H, 5% at 24 H, 11.5% later). None of these deaths could be considered as avoidable. Head trauma was isolated in 51% and multiple trauma represented 45.4% of the cases. Acute sub or epi-dural hematomas were noted in 3.6% (12% in less than 2 year-old children). Main associated lesions were chest (36%), abdominal (21%), and orthopedic (25%) trauma. The most determining factors predicting early death were: GCS ($p < .0001$), ISS ($p < .0001$), need for early transfusion ($p < .0001$), shock upon arrival ($p < .0001$), type of injury ($p < .0002$), PTS ($p < .04$). Mechanism of the accident and age did not reach significance. Analysis is summarized in the table. Results are expressed as means $\pm$ standard deviation.

	AGE (years)	GCS	PTS	ISS
total	7.2 $\pm$ 4.3	5.9 $\pm$ 1.8	2.9 $\pm$ 3.2	31.5 $\pm$ 16
survival	7 $\pm$ 4	6.6 $\pm$ 1.2 *	4 $\pm$ 2.4*	25.4 $\pm$ 10.4*
death 12H	8 $\pm$ 4.5	3.3 $\pm$ 1.4*	1.6 $\pm$ 2.5*	56.4 $\pm$ 18.1*
death 24H	7.5 $\pm$ 4.5	3.3 $\pm$.5	1.25 $\pm$ 1.9*	39.1 $\pm$ 15.4*
death late	7.3 $\pm$ 5.5	6 $\pm$ 1.8	2.5 $\pm$ 2.9	38.5 $\pm$ 6.3

It can be conclude that mortality of comatose head injured children is about 30%. The majority of these deaths will occur within 24 hours after trauma whatever the initial critical care management is. Clinical factors can predict adequately the risk of early death and can be used for quality assessment.

1/ J. Neurosurg. **76** 450-454 1992

2/ Neurosurgery **31** 435-443 1992

3/ International Anesth. Clinics **32** 142-170 1994

NOREPINEPHRINE BUT NOT EPINEPHRINE STIMULATES THE RELEASE OF CRF FROM IN VITRO SUPERFUSED RAT HYPOTHALAMUS. G. Orliaguet¹, S. Melik Parsadaniantz, V. Lenoir, P. Duval,

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Increased hormonal and metabolic responses to major surgery may be directly related to postoperative complications (1). The neuroendocrine axis plays a major role in this response, especially the hypothalamus, by the release of the Corticotropin Releasing Factor (CRF). A better understanding of the mechanisms activating this response to stress could enable to modulate it, therefore reducing postoperative complications. But there are still controversies concerning the role of catecholaminergic systems in regulating hypothalamic CRF secretion (2). To clarify these controversies, we assessed the direct effects of norepinephrine (NE) and epinephrine (E), alone and in association with mixed α and β antagonists on hypothalamic CRF secretion, using an in vitro rat mediobasal hypothalamus (MBH) superfusion system.

MBH, from Wistar male rats sacrificed by decapitation, were transferred after dissection, to superfusion chambers, continuously supplied with an oxygenated basic salt medium. After an initial stabilizing period of 80 min., the effluent of the superfusion system was collected at 10 min. intervals, from 90 min. to 240 min. of perfusion. The first three fractions of effluent were used to assess basal CRF release in each group. Then, the MBH were stimulated (except for Control group) with either a pulse of NE (10^{-10} , 10^{-8} , 10^{-6} M) or E (10^{-9} , 10^{-7} , 10^{-6} M), during a 20 min. perfusion period (from the time 120 min. to the time 130 min. of perfusion). At 200 min. of perfusion a 10 min. pulse of veratridine $3 \cdot 10^{-5}$ M was administered to test the viability and secretory capacity of the MBH, and MBH which did not respond were excluded from the study. The effluent was then collected for 30 min. more. To explore the adrenergic receptor subtypes involved in the stimulatory action of NE upon CRF secretion, we examined the effects of two adrenergic antagonists : 10^{-6} M phentolamine (Ph) and 10^{-7} M propranolol (Pr) on NE induced CRF secretion. CRF was measured using a radioimmunoassay method. The limit of detection of the assay was 5 pg./tube, with intra- and inter-assay variation coefficients of 5 and 6 %, respectively. Comparison of basal CRF release among groups was performed with the use of a one-way ANOVA. A repeated-measure ANOVA was used to compare all parameters. A $p < 0.05$ was considered significant.

CRF release from Control group MBH, was stable during the whole duration of the study. No statistical differences were observed in basal CRF release among the different groups. Veratridine induced a dramatic increase in CRF release in all groups, without any statistical difference among groups. NE significantly stimulated CRF secretion ($p < 0.05$), with peak effects at 10^{-8} M; whereas E did not. The effects of NE on CRF release were antagonized by Ph and Pr.

We conclude that NE, but not E stimulate hypothalamic CRF secretion via α and β receptors. The data support the idea that the central noradrenergic systems are excitatory upon CRF secretion when acting directly at the hypothalamic level.

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A PROSPECTIVE IN-FIELD EVALUATION OF ENDOTRACHEAL INTUBATION BY EMERGENCY MEDICAL SERVICES PHYSICIANS.

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Securing the airway, to provide adequate ventilation, and consequently oxygenation, and to prevent aspiration, is of uttermost importance for the prehospital care of critically ill patients (1). No previous field study have prospectively assess endotracheal intubation when performed by a transport team including at least one emergency physician or anesthesiologist. So, the aim of this study was to assess the incidence of difficult airway in the prehospital setting, as well as the reasons explaining the difficulty at intubating the patients.

Over a 3 months period, from July to September 1994, we have prospectively assessed all tracheal intubations performed on patients 16 years or older, in the field, by the teams of the Mobile Intensive Care Units of an urban Emergency Medical service (EMS) system. For each patient included in the study, we recorded : the clinical characteristics; the indication for tracheal intubation; if the attempt was performed either nasally or orally; the number of attempts at tracheal intubation; if the attempt was easy, difficult or failed; the reason likely to be responsible for a difficult airway; and finally the hazards and complications related to the emergency endotracheal intubation.

Over the 3 months period, 169 patients were included in the study. There were 107 male and 62 female (mean age: 50 ± 20 years). Among these 169 patients, 67 were in cardiopulmonary arrest, 16 presented with respiratory distress (including 5 cardiogenic pulmonary edema, 5 acute asthma and 6 miscellaneous), 4 with severe head injured and 13 with multiple injuries, 13 patients suffered from drugs abuse, and finally there were 56 comatose patients from miscellaneous causes. There were 152 attempts at oral intubation, 16 at nasal intubation and for one patient, in which endotracheal intubation failed, a tracheotomy was performed in the field. There were 27 (16%) difficult airways, and 5 failed intubations (3%), including the one for which a tracheotomy airway was performed. The mean number of attempts, before successfully intubating the trachea was 1.5 ± 1.3 (range: 1-10). Over the 169 patients, 126 were intubated successfully at the first attempt, while 25 need 2 attempts, 8 need 3, 3 need 5 and 2 need 10 or more attempts. Among the 169 patients, 27 experienced vomiting just before or during the attempt at intubation, and 44 were found to have some degree of aspiration. The main reasons explaining the difficulties in managing the airway were related to functional airway anatomy (13), maxillofacial trauma (1), laryngeal cancer (3), laryngeal spasm (3), trismus (3), or massive aspiration (2), and in 7 cases no clear explanation was found.

The results of this prospective study suggest that difficult airway is an important problem in the prehospital setting, with a higher incidence than in the operating room. The consequences of these problems with difficult airway could be disastrous in these patients already severely hypoxic, worsening the outcome. Difficult airway seems to be relatively frequent in the field, and there is a need for teaching techniques for management of the difficult airway, to emergency physicians working out of the hospital.

1) Jacobs L. JAMA, 250: 2175-2177, 1983.

UPREGULATION OF THE ACETYLCHOLINE RECEPTORS (AChRs) IN BURNS

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Introduction: Burn injury is associated with aberrant responses to neuromuscular relaxants which include resistance to d-tubocurarine (dTC)-like drugs, and increased sensitivity or a hyperkalemic response to succinylcholine (SCh). An association exists between these aberrant responses and upregulation (increase) of AChRs. The role of burn injury alone, immobilization and chronic infusions of dTC in this upregulation of AChRs was studied.

Methods: A sham or 50% burn injury was inflicted on a group of rats. Three days after injury, an infusion of dTC or saline was initiated via Alzet® osmotic pumps, which were implanted subcutaneously. The free end of the tubing from the pump was inserted close to the left gastrocnemius muscle, close to the popliteal fossa. The sham-burned animals received saline only. The burn group, divided into two, received saline or dTC. In another group of animals with no burn injury, the effects of immobilization and dTC infusion, alone and/or in combination, on AChRs in gastrocnemius were studied. Immobilization was performed with plaster casts to both legs. Four weeks later the K⁺ response to SCh was also studied *in vivo*.

Results: The left gastrocnemius AChRs (which received the catheter infusion of saline or dTC) were consistently higher than contralateral AChRs within the same group (Table 1). The AChRs on the right gastrocnemius in the burn groups were higher than the sham-injured group. The burn group receiving dTC to the left gastrocnemius had significantly higher AChRs than the ipsilateral muscle of the other two groups (Table 1). Immobilization or dTC infusion alone increased AChRs, while the combination caused the highest increase of AChRs (Table 2). The hyperkalemia to SCh was directly correlated to AChR number (Table 2).

Table 1. AChR Number in the Gastrocnemius Muscles (fmol/mg protein)

	Sham-Burns with Saline Infusion (n=10)	Burns with Saline Infusion (n=9)	Burns with dTC Infusion (n=15)
Left gastrocnemius	7.13±0.47 [@]	9.84±1.21 [@]	13.93±1.07 ^{@#}
Right gastrocnemius	5.72±0.47	7.18±0.88 [*]	7.33±0.43 [*]

[@] p<0.05 left compared to right gastrocnemius within each group

^{*} p<0.05 compared to ipsilateral muscle in sham-burned animals

[#] p<0.05 compared to sham or burned-group receiving saline

Table 2. K⁺ Response to SCh and AChRs Following Immobilization and/or dTC Infusion

	Mobilized + Saline Infusion	Mobilized + dTC Infusion	Immobilized + Saline Infusion	Immobilized + dTC Infusion
K ⁺ - Baseline (MEq/L)	3.4±0.2	3.3±0.2	3.3±0.3	3.4±0.2
K ⁺ foll. SCh (MEq/L)	4.2±0.2 [*]	5.7±0.3 [*]	6.5±0.4 [*]	6.8±0.4 [*]
AChR (fm/mg Prot.)	17±3	96±26 ^{**}	233±29 ^{**}	262±37 ^{**}

^{*} p< 0.05 compared to baseline values within same groups; ^{**} p< 0.05 compared to mobile saline group

Conclusions: Burns, immobilization, dTC infusion, independent of each other can increase AChRs; the combination of any two exaggerates this increase. Higher the AChRs, the more profound is hyperkalemia to SCh. Higher doses and/or long infusions of dTC or nondepolarizing muscle relaxants may cause greater increases in AChRs. Administration of dTC-like drugs to facilitate mechanical ventilation (as in the ICU setting) may result in further exaggeration of the aberrant responses to neuromuscular relaxants.

RISK OF ASPIRATION PNEUMONIA FOLLOWING GASTRIC VERSUS JEJUNAL FEEDINGS IN MULTIPLE INJURED TRAUMA PATIENTS

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Acute injury is associated with a generalized catabolic response mediated largely by a complex hormonal milieu including cortisol, epinephrine and norepinephrine. This metabolic response in part is characterized by reduced total body protein synthesis, increased protein catabolism, increased hepatic protein synthesis, and increased use of amino acids as oxidative fuels. The unsupported nitrogen balance proportionate to the degree of metabolic stress.

Poor nutritional status has been associated with more postoperative complications, increased rates of infection, poor wound healing and higher mortality rates. In several patient populations, specifically burn patients and closed head injury patients, the benefit of early nutritional support is clearly evident regarding the improvement of nitrogen balance and overall survival. Thus the need for maintaining nutritional integrity is widely accepted. Enteral nutrition has become the standard of care for nutritional support in the 1990s. Even with the overwhelming pool of data supporting enteral nutrition, the fear of feeding aspiration pneumonia(FAP) remains in the minds of most intensivists. FAP is a nebulous diagnosis which needs better delineation. Although many studies discuss aspiration or feeding related pneumonia, very few actually address the presence of feeds in the lungs of patients who develop pneumonia. Unfortunately, the currently used methods of checking for feeds in the lungs(food coloring, glucose testing, etc.) have been very inconsistent markers for detecting feeds in the lungs. Even the use of radiolabelled isotope is fraught with problems. Dilute barium may hold the answer to unraveling the mystery of FAP detection. If dilute barium is provided in feeds, even if low levels of feeds are aspirated, they may be detected by CT scan of the chest.

Gastric versus jejunal feedings is a controversy which has been continuing because of FAP detection problems. The proponents of gastric feeds over jejunal feeds stress the ease of initiating feeds and placement of feeding tube. However the proponents of jejunal feeds continue to admonish us with the seemingly high aspiration rate as compared to jejunal feeds. The major problem with this controversy has been a lack of consistency in the diagnosis of FAP.

We propose to resolve this controversy by using dilute barium in feedings and obtaining a CT scan of the chest in patients with pneumonia to diagnose FAP. Using this method, the controversy of gastric versus jejunal feedings should be resolved.

A VERSATILE STYLET FOR DIFFICULT OROTRACHEAL INTUBATIONS
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The aim is to present the use of a versatile, unitized stylet which is used in several modes for difficult orotracheal intubation. Animal work and clinical application are illustrated with photos, text and an AV tape.

The stylet is a flexible, but springy, atraumatic, hollow, plastic tube with an O.D. of 19F and approximately 62 cm. in length, with an I.D. adequate for suctioning. The leading segment which first enters the larynx has an inner solid stylet bent to form a desired angle. Just behind this segment there is a small opening which can be occluded with the fingertip when suction is desired (the inner solid stylet having been removed).

An ETT is pre-loaded on the outer segment and as soon as the leading segment enters the larynx, the well-lubricated ETT is slid over the stylet into the trachea as the lubricated stylet is withdrawn. Photos, text and an AV tape illustrate the multiple uses of the stylet which are:

1. Orotracheal intubation with simultaneous suction as needed.
2. Orotracheal intubation in anatomically difficult patients using bendable, removable inner stylet.
3. Digital orotracheal intubation by bending the flexible anterior segment of the stylet.
4. Use as an ETT exchanger.

THORACIC SPINAL TRAUMA AND ASSOCIATED INJURIES: CAN EARLY SPINAL DECOMPRESSION BE CONSIDERED?

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The relative benefits of conservative or surgical treatment in thoracic spinal trauma are still controversial. Related to its anatomical relations, thoracic spinal trauma presents specificities as to the high incidence of associated injuries, the neurological prognosis and the surgical management. The literature is rare concerning this particular problem, dealing only with spinal cord trauma in isolation. The purpose of this study is to identify the incidence of associated injuries in thoracic spinal trauma with spinal cord damage, and to discuss management strategy.

Over a thirty months period, 164 spinal cord injured patients were admitted to the Emergency Department. Forty nine patients sustained a thoracic spinal trauma with neurological impairment. No spinal cord injury due to gunshot was included in this study. Population characteristics, associated injuries and surgical management are reviewed.

The mean age and mean Injury Severity Score (ISS) were respectively 37,3 years $\pm$ 17,3 and 33 $\pm$ 9,4. Mean time elapsed between injury and admission was 4,48 hours (30 min to 14 hours). Road accidents were the leading cause (53%) followed by domestic (16%) and work-related accidents (16%). Ten patients had incomplete paraplegia, and all the other 39 patients had complete paraplegia. Thirty-two patients suffered from head injury, mild in 26 patients and severe in 6. Thoraco-pulmonary lesions were present in 42 patients (86%). Details of injuries are given in table I. Chest drainage was performed in 19 patients and was bilateral in 11 cases. Ventilatory support was required in 25 patients, 9 at admission and 16 during their stay in intensive care, owing to hypoxemia despite daily active respiratory physiotherapy. Nine patients presented a mediastinal widening: aortography did not reveal aortic rupture. Abdominal ultrasonography revealed intraperitoneal fluid in 7 patients (14%). Further investigation with computed tomography showed liver trauma in 6, kidney trauma in 3, and spleen trauma in two. Abdominal emergency surgery was performed in two patients, and conservative treatment was possible in the other five. Extra-vertebral orthopedic lesion concerned 19% of the patients. Early surgery (open reduction and internal stabilisation) was performed in ten patients (5 incomplete paraplegic patients and 5 complete paraplegic patients) in a mean delay of 12 hours after injury. Four out of five incomplete paraplegic patients made a good neurologic recovery, none of the 5 complete paraplegic made some neurologic improvement. As for the other 39 patients, 22 underwent late surgery (open reduction and internal stabilisation). The mean delay for late surgery was 9 days post injury. In this group, none of the five remaining incomplete paraplegic patients who had late surgery or conservative treatment made a partial recovery. Concerning the 34 complete patients no neurologic improvement was noted, except in two patients: one had some sensitive recovery and one had motor improvement which allowed locomotion without assistance. In this series, 3 patients, mean age 67,3 $\pm$ 3, died on days 3, 4, 12, the cause of death being refractory hypoxemia in 2 and multiple organ failure in 1.

To our opinion early spinal decompression has no indication in complete paraplegia. Concerning partial paraplegia, early surgery may enhance neurological recovery. Nevertheless to perform whether or not early surgery, the authors recommend to consider three main points: the existence of a remaining spinal compression, the degree of neurological impairment, and the presence of potential haemorrhagic lesion or blunt chest trauma, especially pulmonary contusion. However, surgery is of value for nursing care and prevention of kiphotic deformities. The timing of such surgery will essentially depend on associated injuries.

Ribs fracture	Scapula/clavicle fracture	Sternum fracture	Pulmonary contusion	Hemo/pneumothorax
71 %	14 %	12 %	33 %	59 %

Table I

COMPUTERASSISTED DOCUMENTATION IN EMS - A CONTRIBUTION TO QUALITY CONTROL IN PREHOSPITAL TRAUMA CARE

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Basis for quality control in prehospital trauma care is the precise documentation of the complete trauma anesthesiologists findings and therapy upon a record [1]. Though, in Germany, as well as in other countries, kind and extent of collected data vary between the different prehospital trauma care programs [4]. Furthermore, computer-assisted documentation and the evaluation of trauma records, is to date only performed after mission completion and only to a very limited extent. It requires time consuming manual transfer of (hand written) data into a computer.

The different documentation concepts and only occasionally realized electronic data management concepts make the comparison of analysis to quality control in prehospital trauma care on national, as well as on international level, more difficult or impossible.

A possible solution to this problem consists of a combination of a nationwide standardized documentation concept (including a "Minimal Dataset" [3] for international use) and an electronic data management concept, which starts right from the beginning (that means: already during the pre-hospital phase). Following possibilities for realization are conceivable:

a) Basis for an uniform dataset is the: "Bundeseinheitliche Notarzteinsatzprotokoll" (National German Emergency Record) [2], which is in use in Germany, as well as in a growing number of european countries. This record includes the Minimal Dataset.

b) Prehospital usage of a Notepad (pen computer).

c) Automatic "on-line" documentation of vital parameters (e.i.: Blood pressure, heart frequency, oxygen saturation) for real time documentation.

Our approach to cope with a) - c) will be discussed.

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1. Ahnefeld FW. Dokumentation. Notfallmedizin 11/ 1993.pp 430-432.
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3. Helm M, Hauke J, Berlis A, Lampl L, Bock KH. Quality assurance in prehospital trauma care - the Minimal Dataset. JEUR 7/1994.pp 39.
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ARTERIAL TO END-TIDAL CARBON DIOXIDE GRADIENT AND HOROVITZ-QUOTIENT - OF VALUE IN DIAGNOSING BLUNT CHEST TRAUMA ?

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Purpose of study: The mortality of multi-system-trauma patients with associated chest trauma (especially those with lung contusion [LuCo]) is in comparison to those patients with the same degree of severity, but without accompanying chest trauma definitely higher [1,2]. Mortality can be reduced by timely initiation of differentiated therapy. Prerequisites however are aside from adequate prehospital treatment, the rapid determination of inhospital diagnosis. Purpose of this study was to determine the value of parameters ($\Delta(\text{pa-et})\text{CO}_2$ as well as $\text{paO}_2/\text{FiO}_2$), which are rapidly determined in the Emergency Department [ED] as a part of the diagnostic of blunt chest trauma.

Methods: Prospective study (01.09.93-31.08.94) covering 75 trauma cases, which after prehospital treatment (including endotracheal intubation) were admitted to our hospital. Determination of $\Delta(\text{pa-et})\text{CO}_2$ and $\text{paO}_2/\text{FiO}_2$ was continuously performed upon admission over a 24h period.

Results: Of the 75 patients (57 male, 18 female, age 42 ± 22 years), 22 (29%) were afflicted with an associated blunt chest trauma (LuCo). The development of $\Delta(\text{pa-et})\text{CO}_2$ and $\text{paO}_2/\text{FiO}_2$ is depicted in the chart below:

Time	$\Delta(\text{pa-et})\text{CO}_2$			$\text{paO}_2/\text{FiO}_2$		
	ED	12h	24h	ED	12h	24h
Trauma total	4.0	1.5	2.0	357	359	329
Trauma w/o LuCo	3.0*	1.0	2.0	362	362	337*
Trauma with LuCo	6.5*	3.0	2.0	351	288	311*

* $p < 0.01$ (Mann-Whitney) Trauma collective with and without (w/o) lung contusion are regarding both, biometric data, as well as degree of severity of injuries, comparable.

Conclusion: Within the study group, patients with lung contusions showed a significantly higher arterial to end-tidal CO_2 gradient, than those without lung contusions right upon admission to hospital (ED). The determination of arterial to end-tidal CO_2 gradients facilitates a quick identification of patients with severe lung trauma, thereby permitting the rapid initiation of a differentiated (i.e. respiratory) therapy. The Horovitz Quotient ($\text{paO}_2/\text{FiO}_2$) does not have any inference upon the differential diagnosis, as to determine the degree of severity of lung trauma during the early inhospital phase.

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DIAGNOSTIC APPROACH TO MYOCARDIAL CONTUSION IN MULTI-SYSTEM TRAUMA

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Purpose of study: The myocardial contusion is considered to be the most overlooked blunt injury to the heart [1,2]. The primary reason for this is, the often none existant or ambiguous clinical signs, especially in multi-system-trauma cases. The purpose of our study is, to optimize the early diagnosis of myocardial contusion, that is in the shock-room at the beginning of clinical treatment.

Methods: We designed a prospective evaluation, involving thirty (30) multi-system-trauma patients, utilizing three diagnostic modalities: ECG, 2-D-Echocardiography and CPK/CPK-MB, to detect myocardial contusion during the initial in-hospital resuscitation.

Results: The average age of the thirty (30) patients (23 male, 7 female) was $32 \pm 21.5^*$ years. Traffic accidents (90%) were the most frequent cause of injury, followed by sports (6.7%) and on the job accidents (3.3%). The Injury Severity Score (ISS) was $34 \pm 14.6^*$. Predominant were threefold (36.7%), twofold (33.3%) and quadruple traumas (30%). The proportion of multi-system-trauma cases was 60%. In 40% of the cases deviations in ECG patterns indicated possible myocardial damage. An increased CPK-MB value ($>5\%$ of total CPK) was found in 66.7% of the patients. Positive 2-D-Echo (hypokinesis) findings were noted in 30% of the cases. All nine (9) patients with pathological 2-D-Echo findings showed elevated CPK-MB values; however in only six (6) patients, ECG deviations had been noted. During treatment, four (4) patients developed cardiac complications (i.e. heart failure); in all of these, ECG, 2-D-Echocardiography, as well as CPK-MB showed pathologic changes.

Conclusion: Based on the results of this study, the evaluation of cardiac injury should take a multifaced approach. The described (combined) diagnostic procedure has already proven itself and its value, especially in multi-system-trauma cases during the initial in-hospital resuscitation and even more so when blunt chest trauma is involved.

References: 1. Helling ThS, Duke P, Beggs ChW, Crouse J. A prospective Evaluation of 68 Patients Suffering Blunt Chest Trauma for Evidence of Cardiac Injury. J Trauma 1989, Vol. 29, No 7, pp 961-966. 2. McLean RF, Devitt JH, McLellan BA. Significance of myocardial contusion following blunt chest trauma. J Trauma 1992, Vol. 33, No 8, pp 240-243.

* Mean $\pm$ SD

AWAKE ENDOTRACHEAL INTUBATION IN PATIENTS WITH CERVICAL SPINE DISEASE: A COMPARISON OF TECHNIQUES

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Many techniques are acceptable for endotracheal intubation in the patient with an unstable cervical spine (1). Recently, we encountered a patient in whom the Bullard laryngoscope (BL) succeeded easily after failure by multiple experienced operators using the fiberoptic bronchoscope (FOB) (2). We therefore designed this study to: 1) compare the two fiberoptic techniques (BL and FOB) with respect to rapidity and success of endotracheal intubation, and 2) detect characteristics correlated with difficult intubation in these patients.

After IRB approval and written informed consent, 13 patients were randomized for awake intubation using the BL (7 pts) or the FOB (6 pts). All patients were judged to be at risk for neurologic injury during intubation based on: 1) radicular symptoms on neck extension, or 2) a request for awake fiberoptic intubation by a neurosurgeon. Height, weight, Mallampati class, and thyromental distance were recorded for each patient. The patients were sedated and topical anesthesia was applied to the airway. All intubations were performed with the neck in neutral position using any neck immobilization devices already applied (e.g., cervical collar, traction). The time to visualize the vocal cords with the BL and the FOB was recorded as was time to successful placement of the endotracheal tube. Laryngoscopies and intubations were done by either experienced senior residents or faculty members. Data are means $\pm$ SD $p < .05$ by t-test is considered significant.

Tracheal intubation was successful without new neurologic deficits on the first attempt in each case. One FOB intubation nearly failed due to difficulty passing the endotracheal tube, although the FOB had easily passed the glottis. Glottic visualization was significantly faster ($p = .004$) with the BL (9.8 ± 5.6 sec) than with the FOB (31.5 ± 23.4 sec). Intubation was also significantly faster ($p = .027$) with the BL (46.1 ± 20.5 sec) than the FOB (105.2 ± 57.7 sec). Body mass index and Mallampati class were not correlated with time required for glottic visualization with either technique.

Both glottic visualization and endotracheal intubation are significantly faster with the BL than with the FOB. The BL may also be preferred for difficult intubations because it is less expensive, more durable and more portable than the FOB. Further study is required to determine whether micrognathia is significantly correlated with prolonged fiberoptic intubation in this patient population.

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1. Hastings RH, Marks JD: Airway management for trauma patients with potential cervical spine injuries. *Anesth Analg* 1991;73: 471-82.
2. Cohn AI, McGraw SR, King WH: Awake intubation of the adult trachea using the Bullard laryngoscope. *Can J Anaesth* 1995; 42:246-248.

FRIDAY, MAY 12, 1995

SESSION D: Scientific Free Posters II
Chair: Enrico M. Camporesi, MD
Moderators: Posters
Adolph H. Giesecke, MD
John K. Stene, MD, PhD

FRIDAY, MAY 12, 1995 SESSION A

- 8:00 a.m.** Trauma
- 8:13 a.m.** Safe and Normothermic Massive Transfusions with Optional Leukocyte Depletion By Modification of an Infusion Warming and Pressure Device
- 8:26 a.m.** Minimum Training Requirements for Doctors in Pre-Hospital Medicine
- 8:39 a.m.** Effectiveness of a Teaching Module for Blind Orotracheal Intubation with the Augustine Guide
- 8:52 a.m.** Learning to Intubate With the Augustine Guide
- 9:05 a.m.** Toxicology Screening and the Incidence of Perioperative Critical Incidents in Trauma Patients
- 9:18 a.m.** Direct Laryngoscopy Training With the Macintosh Laryngoscope Blade and the Fiberoptic Bronchoscope
- 9:31 a.m.** Occupational Exposure to Bloodborne Pathogens in the Burn Center - A Serologic Study of Burn Patients
- 10:15 a.m.** Study of Anesthesiological Procedures Performed in a Norwegian EMS Helicopter Program in 1994
- 10:28 a.m.** Does Dobutamine Improve Resuscitation in Patients With Multiple Trauma?
- 10:40 a.m.** Hyperoxic Effects on Reactive Oxygen Radicals in Acid Aspiration Lung Injury
- 10:53 a.m.** Differential Effect of Hypovolemic Shock on the Alveolar Epithelial and Endothelial Barriers of the Lung in Anesthetized Rats

Trauma

A

Scientific Free Paper

For

The 8th Annual Trauma Anesthesia

And

Critical Care Symposium

Baltimore, Maryland

Submitted

By

Lady Ellen Germond

March 01, 1995

Trauma

Rapid transportation and immediate emergency treatment, improved resuscitation in the field and efficient organized medical care lower the mortality rate in trauma cases. Trauma ranks first as the cause of death for persons under the age of forty and fourth for all age groups. The development of health care providers as traumacologists requires examining new and successful techniques for managing trauma patients. It is necessary to provide and maintain an on-going educational framework in order to insure, train, and nurture the care of critically injured patients.

The field of trauma and critical care addresses a wide range of topics, specialists, and treatment therapy. The trauma care provider functions in the clinical sphere as an important member of the trauma team, as acute emergency treatment and surgical care expand and encompass more complex and challenging procedures. Members of the trauma team must both grow and cope with inherent new demands for improving in the life saving management of trauma.

It has been estimated that more than 150,000 Americans are killed and ten million disabling accidents occur each year, at a cost of more than 180 billion dollars in insurance coverage and hospital cost. Motor vehicle accidents are the cause of the majority of trauma related deaths; falls, homicides, gun shot and stab wounds, suicides, and burns follow.

Patient outcome following trauma depends on three variables:

1. The severity of the injury or injuries
2. The time interval between the occurrence of the injury and emergency medical treatment
3. The quality of emergency care received.

Trauma victims are first seen in the field at the scene of an accident or injury. The severity of the injury is usually estimated by medical personnel who are not physicians. There is a triage index which is based on the functional variables of the central nervous system, the cardiovascular system, and the respiratory system. The degree of dysfunction is estimated using the Glasgow Coma Score.*

The complete physical examination is performed as soon as possible following admission to the Critical Care Emergency Facility. This includes examination for head or cranial defects, maxillo facial fractures, auditory intraoral, and ophthalmic injuries.

The neck and cervical spine are closely examined. All patients are considered to have a cervical spine injury until proven otherwise. The presence of carotid bruits and crepitation palpation must be ruled out.

Bilateral expansion of the chest and equal breath sounds must be observed and heard. Tracheal shift must be noted.

The triage index includes the following readings: vital signs, values, blood pressure, capillary return, respiratory rate, and respiratory effort. The Glasgow Coma Score identifies eye opening, verbal response, and motor response.

The field severity categories of trauma patients include:

Category I:	Combined systems injury Open, bleeding fractures Uncontrolled hemorrhage Severe maxillofacial injuries Severe head, neck, upper respiratory tract injuries Unstable chest injuries Pelvic fractures
Category II:	Blunt abdominal trauma with hypotension and/or penetrating abdominal injuries Severe neurological injuries
Category III:	Open or closed fractures Soft tissue injuries and bleeding Multiple rib fractures Blunt abdominal trauma Loss of consciousness
Category IV:	Uncomplicated fractures No hypotension or hypovolemia No neurological injury No abdominal injury Moderate soft tissue injuries Chest injuries without respiratory distress

The trauma team provides efficient and organized care in the emergency room. Members of the trauma team include: surgeons, anesthesiologists, nurse anesthetists, nurses, and paramedics. A team leader directs, manages, and is responsible for the treatment of the patient and for the team's activity. Each member of the team should have sufficient experience to provide the best possible patient care. The three conditions which will cause death very quickly if not recognized and corrected immediately are airway obstruction and inadequate ventilation, uncontrolled hemorrhage, circulatory insufficiency, and cardiac arrest.

The initial treatment and objective for the trauma patient is to obtain and maintain control of the airway, ventilation, and to replenish and to replace intravascular volume loss. Following this initial evaluation and establishing this life-sustaining condition, other assessments and diagnoses may be conducted. Treatment and therapy is started using the customary technical

procedures, which are required for the condition and control of the traumatic injuries sustained by the patient. The establishment of the airway is always given the highest priority and most immediate attention. Upper airway obstruction and altered chest wall mechanics will usually require endotracheal intubation and artificial ventilation. This is clearly indicated in the unconscious patient. Care should be taken to prevent extension of the neck, which could cause paralysis in the event of a cervical spine injury.

The immediate causes of death following trauma are mechanical, obstructive, or volume related. The most common causes of shock and arrest are hemorrhage, cardiac arrhythmias, infarction, pericardial tamponade, and tension pneumothorax. Hemorrhage/Cardiovascular Compromise will often result from major trauma and may create serious cardiovascular compromise. Direct pressure can control external bleeding. Internal hemorrhage and interthoracic hemorrhage can be diagnosed with abdominal lavage and chest X-ray. Fractured extremities with hematomas can be diagnosed by examination and X-ray. Retroperitoneal bleeding is often very difficult to assess and massive blood loss may occur, especially with pelvic fractures. Intracerebral injuries are rarely the site of exanguinating hemorrhage. Treatment and therapy of hemorrhage include the establishment of an adequate, 14 gauge, intravenous access in order to replace volume deficit and prevent continuous blood loss. Lactated Ringers Solution, is usually started. After two liters of Lactated Ringers, blood replacement is required. Clotting factors must be considered, replaced, and replenished by the administration of fresh frozen plasma, and platelets, cryoprecipitate.

Examination of the abdomen includes checking for penetrating wounds, distention, bowel sounds, and tenderness. The pelvis must be examined for the incidence of pelvic rami and iliac wings. A rectal examination should be performed and the patency of the urethra checked. Extremities should be examined for fractures and neurovascular injury. The back should be examined for posterior injuries and hematomas. Thoracic and lumbar spine injuries must be excluded.

Assessment, diagnosis, and therapy usually proceed simultaneously. The technical procedures include establishing an adequate airway, by endotracheal intubation, if necessary. Establishing an intravenous access through a 14 gauge, intravenous catheter, or through central venous line. Urinary output must be monitored. A Foley catheter is usually placed in the bladder.

In the incidence of chest or thoracic injury, chest tubes must be inserted in order to prevent blood loss or pneumothorax. A nasogastric tube is often inserted and connected to suction to prevent aspiration and to evacuate the content of the stomach. Baseline hemoglobin and hematocrit levels are drawn. Fluid balance profiles are determined. Blood is drawn for type and cross match.

History may be obtained during examination either from the patient or through a family member. This cultural information includes past medical and surgical history, allergies, current medication, previous diseases or conditions, age, weight, the last time patient ate or drank; the use or misuse of alcohol, drugs, or tobacco; and the events leading to the trauma. Patients and family members deserve the clinical expertise of the trauma teams, both in the field and in the emergency medical, surgical hospital setting.

Life threatening traumatic accidents and injuries change lives, attitudes, and create an awareness of just how precious the gift of life, living, and health can be. For the newly injured and their family, many changes are brought about through neglect, hostility, and resulting disabilities or death. There are support systems which can provide additional help and comfort. These departments include the chaplaincy, social work, financial aid, laboratories, and dietary.

There are movements and recommendations being made in order to reduce the statistics of civilian mortality and morbidity, but culture changes slowly. These include federal and local councils on accident prevention, emergency first aid and medical care through educational programs for basic and advance life support, the development of trauma registries, hospital trauma committees, convalescent, disability, and rehabilitation, medical problem solving; care of casualties under conditions of natural disaster, and trauma research.

In summary, it is the responsibility of every individual to try to prevent accidents, injuries, and trauma. When faced with trauma occurrences, it is important to be knowledgeable about every aspect of trauma care from the onset; in order to provide and receive the best possible care and recovery.

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Special Appreciation to Members of the Anesthesia Department, Methodist Medical Center of
Dallas, Texas, USA.

SAFE AND NORMOTHERMIC MASSIVE TRANSFUSIONS WITH OPTIONAL LEUKOCYTE DEPLETION BY MODIFICATION OF AN INFUSION WARMING AND PRESSURE DEVICE

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Purpose of study. The fatal consequences of hypothermia in trauma patients are undisputed^{1,2}. Pump driven warming devices for rapid volume replacement are either expensive (e.g. R.I.S., Haemonetics) or not originally designed for massive transfusions (H-500/H-25i, Level 1). The Level 1 device is not capable of retaining micro-aggregates and provides gas separation only up to a flow rate of 400 ml/min. Incorrect filling techniques of the infusion system increase the risk of accidental air embolism during massive transfusions. Since recent work suggests that immune suppression and the rate of infection can significantly be reduced by using leukocyte depleted products, leukocyte depletion may be advisable especially in emergency patients in hemorrhagic shock^{3,4}. In order to obtain a device for massive transfusions which is safe to use, has effective flow rates, warms fluids effectively, and is reasonably priced we modified the infusion system of the Level 1 device by incorporating an additional filter which is also available as a leukocyte depletion filter. The preliminary results are presented of the practicability of the system and the feasibility of leukocyte depletion during massive transfusions in hemorrhagic shock patients.

Materials and methods. Institutional approval and written informed consent was obtained. A Pall-filter (AV-SP resp. LG-6) originally used for extracorporeal circulation was modified to fit the D-300 infusion set of the Level 1 H-500/H-25i by Luer lock distal to the D-300-filter. These Pall-filters provide gas separation with automatic venting at flow rates up to 6 L/min. The LG-6-filter version is a leukocyte depletion filter. The Level 1 with AV-SP-filter was used in ten patients, LG-6-filters were used in 6 patients. All patients had major hemorrhage due to trauma or complications during surgery. The volume of transfused blood and the time period of massive volume substitution were recorded. Blood samples for leukocyte counts (WBC) were taken distal to the leukocyte depletion filter following transfusion of the first and the last unit of blood. The WBC were determined in the Nageotte-chamber with a sensitivity of 0,1 leukocyte/ μ L. The WBC was then calculated for a therapeutic unit of 250 ml packed red cells.

Results. Following staff training the time for preparation of the Level 1/Pall-filter combination was less than 8 minutes. The system was operated by a single nurse. Mean values ($\pm$ S.D.) of transfusion related parameters in ten patients with the AV-SP/Level 1 combination are listed in table 1. Mean values ($\pm$ S.D.) of transfused red cells and WBC following the passage of the LG-6-filter in six patients are listed in table 2.

PRC Transfused (ml)	WBC-first (n x 10 ⁶ /250 ml)	WBC-last (n x 10 ⁶ /250 ml)
2708	0,97	2,72***
± 797	$\pm 0,5$	$\pm 0,9$

Tab.2: WCC-first/last = leukocyte counts following passage of the LG-6-filter of the first and the last unit of red packed cells (***)p<0,001; Wilcoxon-Test for Paired Samples).

PRC Transfused (ml)	PRC Storage Time (days)	Colloids (ml)	Transfusion and Infusion Time (min)	Flow Rate Required (ml/min)	ΔT ($^{\circ}$ C)
3375	5,8	3375	55	140	- 0,3
± 1926	$\pm 1,2$	± 1049	± 30	± 41	$\pm 0,5$

Tab.1: PRC = packed red cells; ΔT = change of body temperature

Mean flow rates were sufficient to restore and maintain adequate intravascular filling pressures in all but two patients. Two patients died following uncontrollable surgical bleeding. At the end of massive transfusions the number of leukocytes in the packed red cells that had been filtered by the LG-6-filter had increased significantly by a factor of 3. No evidence is available of the risk of air embolism during massive transfusions.

Conclusions. Modification of the Level 1 (H-500/H-25i) by implementation of the filters AV-SP and LG-6, respectively, results in a device which is suitable for safe, effective and normothermic massive transfusions in the prevailing majority of patients with blunt trauma. The extent of leukocyte depletion is reduced with increasing filtration volume but leukocyte counts always remained within the 10⁶ range which has been reported to be of beneficial value⁵. The significance of leukocyte depleted blood products for trauma patients still has to be elucidated. The presented device may be useful in the performance of future studies related to this subject.

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MINIMUM TRAINING REQUIREMENTS FOR DOCTORS IN PRE-HOSPITAL MEDICINE.

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Guidelines are currently being drawn up by the Pre-Hospital Committee of ITACCS to standardise pre-hospital emergency reporting. These will include the definitions of pre-hospital emergency medicine providers involved in pre-hospital care. A specialist in emergency medicine cannot be expected to be skilled at pre-hospital emergency care without additional training. Placing a physician in an unfamiliar and fraught pre-hospital environment, away from the hospital staff and equipment to which he normally has access will not produce satisfactory performance of advanced life support without specific training. This has been demonstrated admirably at many recent major incidents in this country. A minimum standard of training must therefore be defined for doctors practicing pre-hospital medicine.

Minimum standards have been drawn up for doctors who fly with the Helicopter Emergency Medical Service (HEMS) in London. Doctors from accident & emergency, anaesthetics, and surgery are accepted and all have previous experience in the management of acute trauma in a hospital setting. In addition to their basic medical qualifications, all doctors must have passed higher specialist exams in their own field. In practice, this results in doctors flying with HEMS who have been fully qualified for at least five years. All doctors are expected to be reasonably fit.

In addition to these requirements, doctors must be current in their Advanced Trauma Life Support (ATLS) qualification. Many have additional qualifications of, and are instructors in, Advanced Cardiac Life Support, Pre-Hospital Advanced Life Support and Advanced Paediatric Life Support.

Before flying with HEMS all doctors undergo a structured program of exposure to the pre-hospital environment. This includes attachments to the ambulance service, both with basic ambulance crews and the more specialised rapid response units manned by paramedics. Familiarisation with the role of the police and fire brigade at pre-hospital incidents is gained by visits to both services. Several doctors flying with HEMS also have prior experience of pre-hospital medicine through a voluntary callout arrangement with the ambulance service.

On completion of the basic training, doctors initially fly as observers and attend a short course on aspects of aviation. Over a four week period, the new doctors are introduced to the pre-hospital environment before being allowed to fly 'solo'. Additional training is undertaken in methods of extrication from road traffic accident entrapments, confined space and cave rescue and railway/underground incidents. Further training includes the medical management of major incidents for which all HEMS doctors are expected to act as Medical Incident Officer if required.

Based on our experience, we believe that the minimum requirements for doctors involved in pre-hospital medicine should include:

- Full qualification for at least 5 years with previous hospital experience in the management of acute trauma.
- A background in accident & emergency / anaesthetics / surgery.
- Completion of ATLS and ACLS courses.
- A reasonable level of fitness.
- An ability to act as Medical Incident Officer at a major incident.
- Participation in ongoing training and teaching.
- Maintaining a log book of pre-hospital experience.

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EFFECTIVENESS OF A TEACHING MODULE FOR BLIND OROTRACHEAL INTUBATION WITH THE AUGUSTINE GUIDE

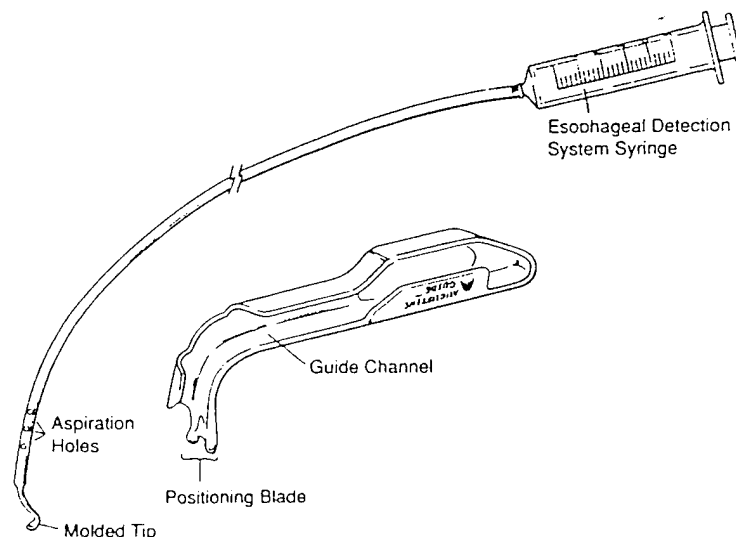
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The Augustine Guide (AG, Augustine Medical Inc., Eden Prairie, MN), a new device for blind orotracheal intubation in patients with difficult airways or in whom head and neck manipulation is contraindicated, is composed of an intubation guide, an esophageal detector device (EDD) syringe, and a stylet. A teaching module for the AG was presented to 6 anesthesia care provider subjects with no prior AG experience to evaluate the effectiveness regarding: (1) the degree of ease or difficulty of learning, (2) the number of patients needed to achieve a successful operating room intubation with the AG.

Following IRB approval, the education module consisted of video, instruction booklet, and mannequin practice, followed by a written test. After completing the module, the provider-subjects attempted blind orotracheal intubation with the AG on twenty-one patients age 18-80 years (ASA physical class I-II, and Mallampati airway class I-II), scheduled for elective, general anesthesia with thiopental and vecuronium. Mean time to successful intubation for each provider and overall group, and success rates were determined. Results were evaluated by ANOVA and Chi-square test. A $p < 0.05$ level was considered significant.

All providers scored 100% on the written test. Four out of six providers (67.67%) had a successful intubation with the first patient, one (16.67%) with the second, and one (16.67%) required 3 patients. All were successful by the third patient. Time to intubation (mean $\pm$ SD) for the group was 71 ± 24 sec (range 40-115 sec.)

Success rates in the educational and clinical phases of the study suggest that the educational module is effective in teaching the key concepts and skills necessary for success with the AG. These include (1) correct placement of the AG positioning blade tip in the vallecula; (2) aspiration and interpretation of the EDD syringe and stylet for determining correct tracheal placement. Simplicity of the education module, the short time required to present it (approximately 1 to 2 hours), and the 100% success rates after three patients suggest that the AG is an effective and practical alternative method for blind orotracheal intubation that can be easily learned.



The Augustine Stylet (top) and Intubation Guide (bottom).

LEARNING TO INTUBATE WITH THE AUGUSTINE GUIDE

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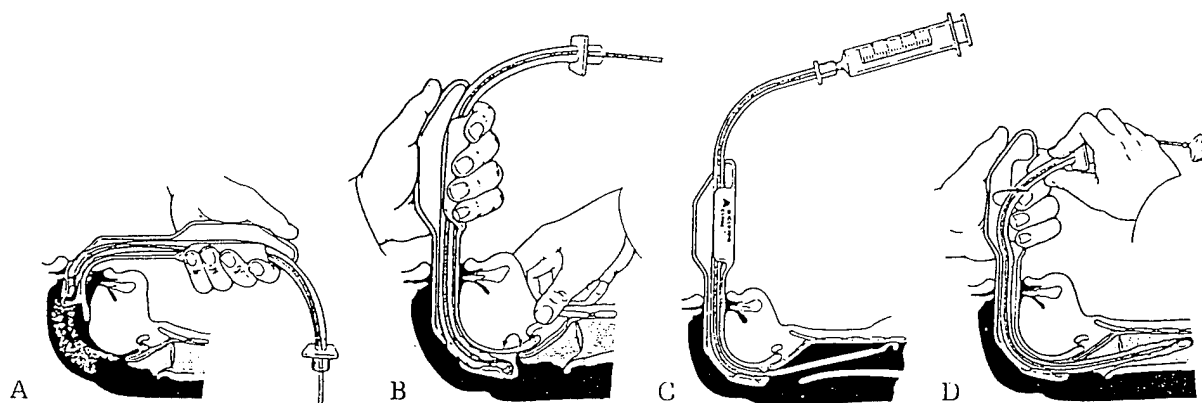
The Augustine Guide (AG, Augustine Medical Inc., Eden Prairie, MN) (Figure), is a new device designed for rapid, for blind endotracheal intubation on anesthetized, awake or cervically immobilized adult patients with possible C-spine injury. An esophageal detector device (EDD) stylet and 30 ml syringe is used as an adjunct to indicate whether the stylet tip is located in the trachea or esophagus. The endotracheal tube is threaded over the stylet into the trachea. Purpose of study: to evaluate the effectiveness of instructional materials (manual, videotape) and intubation mannequin practice in teaching the correct method to intubate to students unfamiliar with endotracheal intubation, and to determine the problems which occur when initially learning to use the AG.

Following IRB approval, 22 students with no prior airway or intubation experience participated in a 2-day study, with first day instruction and second day testing. Participants read an instruction manual, viewed a videotape, and practiced on a mannequin. Testing was by multiple choice quiz and mannequin.

Quiz grade distribution: 21/22 (95%) of participants scored $\geq 70\%$, 1/22 (5%) had a score of 40%. Most common questions missed involved the correct size of endotracheal tube to be used with the AG, and the correct test procedure to be used with the EDD in determining esophageal or tracheal placement of the stylet tip. The most common mannequin maneuver errors were failure to check for the correct placement of the AG positioning blade by feeling the neck (hyoid bone check), and failure to aspirate 30 ml of air into the EDD syringe to check for EDD stylet tip placement.

The AG is a new non-visualized method of oral intubation, requiring more steps than a Macintosh laryngoscope. Concepts to be learned specifically involve the EDD stylet and syringe, testing stylet tip placement in esophagus or trachea. Intubation steps to be mastered which differ from the technique of the Macintosh laryngoscope include: (1) Hyoid bone check for AG positioning blade in vallecula; (2) AG at 90° angle to plane of table; (3) advancement of stylet with "probe" attempts; (4) aspiration and interpretation of EDD stylet and syringe; (5) threading endotracheal tube over stylet into trachea (Figs. A-D).

Initially the AG appears simple. Until the basic points of correct placement in the vallecula and testing with the EDD stylet and syringe are understood and completed, success with the AG in the clinical situation will not be attained. These extra steps are new and may take some individuals longer to learn.



TOXICOLOGY SCREENING AND THE INCIDENCE OF PERIOPERATIVE CRITICAL INCIDENTS IN TRAUMA PATIENTS

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INTRODUCTION

Toxicology screening is routine practice in the initial assessment of the trauma patient. Whilst there have been studies investigating injury severity and outcome in relation to toxicology screening, few have addressed the issue of complications occurring under general anaesthesia as a result of a positive toxicology screen. There are good theoretical reasons for suspecting an increased incidence of untoward, physiologic critical incidents under anaesthesia since the effects of alcohol, cocaine, opiates and amphetamines on the cardiovascular, respiratory and central nervous systems are well known. With this in mind and the data available on a trauma registry (1), the records of 1199 adult trauma patients who underwent general anaesthesia within two hours of arrival at a trauma centre between January 1991 and December 1992 were reviewed.

RESULTS

1108 (92.3%) had toxicology screens done and of these 596 (53.8%) were positive. Alcohol was the commonest drug detected (86.2%) followed by cocaine (25.8%), opiates (16.4%) and cannabis (14.9%). Benzodiazepines, barbiturates, amphetamines and phenylcyclidine were only infrequently encountered (5.8%). Physiologic critical incidents (seizure, arrhythmia, bradycardia, hypertension, hypotension, cardiac arrest, bronchospasm, hypoxia) were documented in 98 patients (8.9%) whilst under general anaesthetic. 51 of these critical incidents occurred in toxicology negative patients and 47 in toxicology positive patients. Of those who had critical incidents and were toxicology positive, alcohol was detected in 38 patients (80.8%), cocaine in 10 (21.3%), opiates in 8 (17.0%), cannabis in 4 (8.5%) and benzodiazepines in 2 (4.3%). Two or more compounds were detected in 12 patients. The total number of deaths or cardiac arrests under anaesthesia was 19 (40.4%) in the toxicology negative group and 29 (56.8%) in the toxicology positive group.

DISCUSSION

Accepting the limitations of using retrospective data analysis from a registry, it would appear from the above data that a positive toxicology screen does not influence the incidence of physiologic critical incidents occurring during general anaesthesia. This is surprising in view of the known potential side-effects of many of the drugs screened for. Whilst patients were not matched for injury severity, previous studies have shown higher injury severity scores for toxicology positive patients and this may influence the nature of the general anaesthetic given. However one might expect a greater number of adverse physiologic events to occur in the more severely injured patient. This was not the case reviewing the above data and this limited analysis appears to show that toxicology screening, whilst of benefit in patient management, does not accurately predict which patients will behave adversely under the influence of general anaesthesia.

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DIRECT LARYNGOSCOPY TRAINING WITH THE MACINTOSH LARYNGOSCOPE BLADE
AND THE FIBEROPTIC BRONCHOSCOPE.

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Formal training in direct laryngoscopy for medical students, ER and paramedical staff is generally undertaken during brief attachments in the OR. The aim of this project was to develop a method of monitoring direct laryngoscopy with a fiberoptic bronchoscope so that the quality of teaching in the OR could be improved and instructional videotapes could be made.

The light bulb of a Macintosh 3 laryngoscope blade (SunMed) was removed and an Olympus LF - 1 bronchoscope fixed proximally to the blade with the flexible tip left free. The bronchoscope acted as the light source. The eyepiece of the bronchoscope was attached to a video camera system. Trainees were then able to perform laryngoscopy on ASA grade 1 patients undergoing elective surgery following informed consent. The supervising anesthesiologist was able to observe their progress directly with the bronchoscope, correct faulty technique and demonstrate the value of cricoid pressure, intubation stylets and adjusting head position. The anesthesiologist was able to use the flexible tip of the bronchoscope to adjust his / her view if the epiglottis obscured the laryngeal inlet. It was also possible to make instructional video tapes of these techniques.

A similar system has recently been described using the Miller blade [1] which is much easier to combine with the bronchoscope. However, we feel that learning to use the Macintosh blade is more relevant to personnel dealing with trauma patients. In conclusion, we feel that this system improves the quality of trainees experience in the OR.

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OCCUPATIONAL EXPOSURE TO BLOODBORNE PATHOGENS IN THE BURN CENTER - A SEROLOGIC STUDY OF BURN PATIENTS

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PURPOSE OF STUDY: Bloodborne pathogens such as human immunodeficiency virus (HIV), viral hepatitis and syphilis pose an occupational risk to healthcare providers. This risk is proportional to both number of exposures and the prevalence of bloodborne disease in the population treated. Burn care providers are repetitively exposed to open wounds, blood products and body fluids. Despite this, few large-scale serologic studies of burn patients have been performed. We examined serologic markers for bloodborne pathogens in patients admitted to one burn center in a 26 month period.

METHODS USED: Records of 551 burn patients admitted between June 1992 and August 1994 were examined. The average burn size was 17.6% TBSA (5.8% full thickness). Serologic testing performed on admission included ELISA with confirmatory Western Blot for HIV-1, rapid plasma reagin (RPR) with confirmatory fluorescent treponemal antibody-absorption assay for syphilis, hepatitis B surface antigen (HBsAg), and antibody to hepatitis B core antigen (Anti-HBc).

RESULTS: During the study period, 1017 operative procedures were performed in addition to frequent bedside procedures including central venous and arterial cannulation and fiberoptic endoscopy. There were 10 documented needlestick or sharp object exposures, none of which resulted in disease transmission. Serologic evidence of bloodborne disease was detected in 64 patients. The most common serologic marker was Anti-HBc, representing previous hepatitis B infection.

	RPR	HIV	HBsAg	Anti-HBc
NUMBER TESTED	321	387	480	433
NUMBER POSITIVE	4 (1.2%)	1 (0.2%)	7 (1.4%)	52 (12%)

CONCLUSIONS: The prevalence of bloodborne disease as measured by serologic markers was low in the tested population. While window-phase false negative results cannot be excluded, most patients studied did not have evidence of active communicable disease and did not present an occupational risk to the burn team.

STUDY OF ANESTHESIOLOGICAL PROCEDURES PERFORMED IN A NORWEGIAN EMS HELICOPTER PROGRAM IN 1994.

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The national Air Ambulance Service in Norway is organized by the government and includes 15 military and civilian helicopters and 6 fixed-wing aircrafts, at 15 locations. (1) Our study includes the missions performed by 3 of the EMS-helicopter-bases. The area of operation is a rural / suburban area with approx. 2 mill. inhabitants in the central south-east part of Norway. Each base is permanently staffed with an anesthesiologist and operates a dedicated EMS helicopter (BO 105 / BK117) and a ground-vehicle for rendez-vous assistance of local ambulance services and for use when helicopter operations is prohibited due to weather conditions. All missions are registered in a PC-database.

In 1994 these 3 bases received 1663 emergency calls, which resulted in 1224 missions (928 helicopter and 296 ground-vehicle). 976 (79%) were on-scene responses, 213 (19%) interhospital transfers, 35 (2%) Search And Rescue (SAR).

MEAN time interval from alarm to patient-contact for on-scene responses with helicopter was 27,5 minutes and 14 minutes with ground-vehicle. (SD respectively 20,1 and 13,1 minutes)

428 (35 %) of the total number of missions (n=1224) were related to trauma, nearly all caused by blunt injury. 74 trauma patients were categorized as multitraumatized, of which 45 also included a severe head injury. 213 (50%) of the traumatized patients were scored 4 or higher according to the NACA (National Advisory Committee on Aeronautics) Scale.

Anesthesiological related procedures are considered important for the traumatized patients. Our protocols are equivalent to the «German model» (2), emphasizing airway control with adequate sedation and/or anesthesia with muscle-paralysis. The procedures are performed on scene by anesthesiologist.

Anesthesiological procedures (n=183) in our database were divided into four groups according to a National coding system:

1: sedation (conscious patient)	28	(15%)
2: heavy sedation with ketamine only	22	(12%)
3: total i.v. anesthesia (muscle-paralysis and intubation)	116	(64%)
4: other techniques	17	(9%)

Drugs used in performing anesthesia were fentanyl, morphine, thiopentone, ketamine, succinylcholine, pancuronium, diazepam and midazolam.

Endotracheal intubation were performed on 133 patients on-scene, of which 82 were traumatized. 68 (83%) of the intubations on the traumatized patients were performed after induction of i.v. anesthesia with muscle-paralysis. There was no failed intubation attempts, and no need for establishing a surgical airway, even in cases of maxillo-facial injuries.

From this study we conclude that there is evidence for the benefit of anesthesiological experience present in our EMS helicopter program.

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Title: DOES DOBUTAMINE IMPROVE
RESUSCITATION IN PATIENTS WITH
MULTIPLE TRAUMA?

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Introduction: In seriously ill surgical patients, increased oxygen delivery is beneficial and improves outcome (1,2). Although it would be logical to extrapolate this finding to trauma victims, this issue has not been well studied. Indeed, no data guide the trauma team in selecting patients in whom pharmacologic intervention to increase oxygen delivery will be of benefit. Many patients who appear to have been adequately resuscitated as judged by clinical signs and on the basis of invasive monitors may remain in a form of subclinical shock. In support of this hypothesis, we present the following collection of cases.

Methods: Data were collected on five trauma patients admitted to our institution. All had invasive monitors placed per the attending trauma team. There was a mean delay of 4 hrs between the time of injury and initiation of definitive care. Two patients suffered multisystem trauma, 2 patients suffered orthopedic injuries only, and 1 patient had a vascular injury. After initial stabilization, adequacy of resuscitation was based on clinical findings and invasive monitoring data, including pulmonary artery pressure (PAP), cardiac output (CO), and SVO₂. Clinically, all patients appeared to be adequately resuscitated, with normal heart rate, blood pressure, and urine output > 1 cc/kg/hr. PAP and CO were normal. Inotropic support (dobutamine 5-10 mcg/kg/min) or transfusion of packed cells was added, as indicated by SVO₂ ≤ 60 or Hct ≤ 25%.

Results: All patients had absolute improvement in measured SVO₂ and CO (Table 1). Discontinuation of dobutamine caused a decline in CO and SVO₂. Restarting inotropic support restored CO and SVO₂ (Table 2).

Table 1.

Pt #	Before intervention		After intervention		injuries
	SVO ₂	CO	SVO ₂	CO	
1	58	7.0	68	13	multiple fx: femur, pelvis, arm
2	60	6.1	71	14	multiple fx
3	55	8.5	69	12.8	multi system
4	53	6.0	75	12.2	multi system
5	51	7.0	68	10.5	isolated femoral vein, art. injury, gunshot wound

Table 2. Cardiac output and SVO₂
Before and After Dobutamine

	Before (± SEM)	After (± SEM)
CO	6.9 ± 0.45	12.5 ± 0.58*
SVO ₂	55 ± 1.5	70 ± 1.3*

*p < 0.0001 paired t-test

Discussion: Restoration of blood flow and reversal of shock is of paramount importance to the prevention of organ failure, which carries a high morbidity. Our data suggest that the shock state often persists despite normalization of hemodynamic variables. This issue can be addressed only in a larger, prospective study.

References: 1. Shoemaker WC. Chest 94:1176-1186, 1988.
2. Fleming A. Arch Surg 127:1175-1179, 1992.

TITLE: HYPEROXIC EFFECTS ON REACTIVE OXYGEN RADICALS IN ACID ASPIRATION LUNG INJURY.

AUTHORS: N. Nader-Djalal, M.D.*, B.A. Davidson, B.S.*, K. Thusu, M.S.†, J.D. Helinski, M.S.*, A. Aljada, B.S.†, P. Dandona, MBBS, D.Phil.†, P.R Knight, M.D., Ph.D*.

AFFILIATION:

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Background: A biphasic mode of injury has been shown following acid aspiration in rats¹. The second phase, which peaks at five hours post-aspiration, is neutrophil dependent. In hyperoxic conditions, this injury was partly blocked by deferoxamine treatment which suggested the requirement for oxygen and/or nitrogen reactive species in the lung injury.² Since hyperoxia has been shown to increase the generation of oxidants,³ we investigated the effects of 100% O₂ on activation of neutrophil NADPH oxidase and lipid peroxide production in the lung tissue following acid aspiration.

Methods: Use of animals in this study was approved by the Animal IRB of SUNY at Buffalo. Halothane anesthetized, male, Long-Evans rats (250-300g) were injured by instillation of 1.2ml/kg normal saline (NS), pH=5.3 or NS/HCl, pH=1.25 (acid) into their lungs, via a catheter tracheotomy (with the animal in a 60° upright position). Rats were exposed to an atmosphere of either 21 or 100% O₂ for five hours. Then bronchoalveolar lavage (BAL) was performed using balanced Hank's buffer with 1% BSA. Superoxide ($^{\circ}\text{O}_2^-$) production was measured for a period of 10 min with chemiluminescence in the presence of luminol and zymosan in an aliquot of 10⁵ WBC's recovered from BAL. The lungs were then homogenized and sonicated. Thiobarbiturate reactants (TBARs) were measured with flurometric analysis and values were expressed in pmol/mg of protein. The antioxidant capacity was measured by 2(azo-bis) amidinopropane HCl (AAPH) neutralizing assay in minutes. Data are expressed as mean±sem (n=6) and significance was determined at 95% confidence by one way ANOVA.

Results: The capacity of WBCs isolated from the BAL to generate $^{\circ}\text{O}_2^-$ is less in animals exposed to 100% O₂ (43.5±14.3) compared to air (63±25) following acid aspiration. In contrast there was an opposite effect in WBCs collected from the peripheral blood of these animals (25±7 vs. 10±3.7, p<0.02). TBARs in the lungs of oxygen exposed (880±40 vs. 810±30 pmol/mg) in air-exposed acid injured rats. The difference in total antioxidant reserve normally seen following exposure of animals to 100% O₂ is abolished following acid aspiration (1.2±0.40, p<0.01 vs.<0.15, p>0.5)

Conclusion: While the administration of oxygen at higher concentrations following acid aspiration increases the extent of lung injury in rats², the magnitude of $^{\circ}\text{O}_2^-$ generation shows a paradoxical effect at the endothelial (cells recovered from blood) compared to the epithelial (cells recovered from BAL) sites. Lipid peroxidation is probably not affected during this short time period. Finally, the enhancement of antioxidant reserve, seen with oxygen exposure, disappears following acid aspiration. This finding implies that increased activity of either oxygen and/or nitrogen reactive species, is required for hyperoxic exacerbation of microvascular damage following acid aspiration.

References:

1. Anesth Analg 69:87-92, 1989
2. Anesthesiology 81:A 1174, 1994

Differential Effect of Hypovolemic Shock on the Alveolar Epithelial and Endothelial Barriers of the Lung in Anesthetized Rats

(July 1, 1995 - June 30, 1996)

Jean-Francois Pittet, M.D.
Department of Anesthesia,
University of California San Francisco

Project Summary

The overall objective of this grant is to determine the effect of acute hemorrhagic shock and reperfusion on the function of the different barriers of the lung in anesthetized rats. The experiments included in the present grant will propose a rationale approach to study the effect of hypovolemic shock on the lung, one of the important cause of acute lung injury, a disease that affects the different barriers of the lung in a nonuniform manner. First, we propose to study the effect of hemorrhagic shock and reperfusion on the function of alveolar epithelium, lung endothelium, and pleural mesothelium. The results of recent clinical studies have indicated that the presence of injury to the alveolar epithelial barrier in patients with acute lung injury (whatever was the causal factor) is associated with a slow removal of alveolar edema fluid from the airspaces and this correlated with a low survival rate of these patients. Therefore, alveolar epithelial damage appears to be associated with an increase in mortality.

The second question addressed by this grant proposal is of primary importance for trauma patients with acute lung injury. These studies will help to determine how different resuscitation solutions affect the function of the different lung barriers. Although numerous reports have described advantages and disadvantages of crystalloid versus colloid solutions for fluid resuscitation in regard of their potential effect on the lung function, there have been no definitive studies. The proposed studies will clarify the effects of the resuscitation solutions in the lung.

Finally, the third question addressed by this grant proposal will determine how effective therapies aimed to protect the lung endothelium that appears to be severely injured by hemorrhagic shock and reperfusion, will affect the function of other barriers of the lung and whether these specific therapies may restore a normal gas exchange function of the lung.

FRIDAY, MAY 12, 1995

SESSION A: Multi-Trauma: Problem-Based Learning Discussion and Case Presentations

Chair: Adolph H. Giesecke, MD

This session will take a multi-format approach including problem-based case presentations and round-table discussion of various important aspects of triage, resuscitation, choice of anesthesia, fluid therapy and post-operative care.

ATACCS delegates will receive the case material in advance and thus have an opportunity to actively participate in an interactive format.

Panelists: Elizabeth A.M. Frost, MD
Thomas E. Knuth, MD, MPH
Mark Murphy, MD
Joseph M. Rustick, MD
Vance E. Shearer, MD

MOTOCYCLE MADNESS

An 87 year old male resident of a rural town in Northern Texas was riding his motorcycle and was broad-sided by a car. He arrived at the hospital by helicopter approximately 7 hours following the accident. He was awake and oriented times 3 on oxygen and cardiac monitoring. Apparent injuries included immediate onset quadriplegia at the time of the accident (cervical collar is in place). Open left femur fracture and open left tibial/fibular fracture with near amputation of the left foot. Peripheral IV is running with plasmalyte wide open, foley is draining blood-changed urine.

1. What is the role of the injury severity score and the evaluation of such a patient?
2. How do we clear his cervical spine and how do we manage his airway?
3. How do we evaluate the severity of his blood loss and what fluids should be used for resuscitation?
4. The injury severity scale does not take into account his pre-existing state of health. Would his pre-existing health influence his outcome and what particular things should we look for?
5. He was wearing a state of the art motorcycle helmet. Does this explain the absence of a head injury and the presence of a cervical spine injury?

On arrival in the Emergency Room he had a right subclavian line inserted and the CVP was found to be 15. At the recommendation of the neurosurgeons the methylprednisolone protocol was instituted for acute spinal cord injury and a neosynephrine drip was begun. At this point the patient's wife arrived with the history that the patient had episode of syncope in 1993, which was treated by pacemaker insertion and at that time he had completed a "Directive to Physicians" which is part of the Texas Natural Death Act.

1. Has methylprednisolone really improved the outcome of acute spinal cord injury?
2. Was neosynephrine indicated in this case and what are the potential side effects?
3. How do you manage a voluntary DNR order in the Emergency Room and Operating Room for traumatized patient?
4. According to the papers presented by the wife the pacemaker was a AAIR-VVIR? What should we watch out for in his management?

Cervical spine films showed severe degenerative changes at C₅ to C₇, but no fractures. The superior mediastinum was wide suggesting an aortic injury. The pacemaker was visualized and the Swan Ganz catheter was noted to be in the right pulmonary artery. The patient arrived in the Operating Room at 1010pm for a left below the knee amputation which required three hours.

1. Discuss the anesthetic plan including induction and airway management.
 2. What monitoring is advised and what specific things do we search for?
 3. Discuss fluid therapy especially with regard to balanced salt solution, colloid solutions, packed red cells.
 4. Can we and should we monitor his neurological status?
-

PREGNANT MEDICAL STUDENT

A 25 year old female senior medical student was scheduled for a laparotomy and external fixation of a fractured left femur following a motor vehicle collision. She had a period of unconsciousness following the accident and is now awake but moderately confused. She is 30 weeks pregnant has positive peritoneal levage and complains of pain in the abdomen.

1. What should be done to evaluate and manage her pregnancy?
 2. Does the history of a brief period of unconsciousness modify our plan for anesthesia?
-

PENETRATING OCULAR TRAUMA

A 54 year old male machine shop worker was struck in the eye with a steel splinter from a metal lathe. He had just returned from his lunch hour. He is 6'3" tall and weighs 245lbs. He denies any significant medical history.

1. How should his full stomach be evaluated and managed?
2. What muscle relaxant should be selected for induction of anesthesia?

FRIDAY, MAY 12, 1995

SESSION B: Difficult Airway Management for the Trauma Patient, Part II: Round-Table Discussions and Hands-On Workshop
Chairs: Kenneth J. Abrams, MD
Elizabeth C. Behringer, MD

SPECIAL HANDS-ON WORKSHOP:

This session will begin with representative case presentations of controversial clinical issues and the use of special management techniques. Audience participation is emphasized in the form of questions and answers and commentary dialogue.

The second portion of the session will feature "hands-on" skill stations such as fiberoptic intubation procedures, protection of cervical spine injury and performing cricothyroidotomy and other techniques covered during Part I of the Workshop.

AUGUSTINE GUIDE IN TRAUMA

CASE STUDIES / ROUND TABLE DISCUSSIONS

Anthony L. Kovac, MD

- A. HX: 27 year-old male S/P MVA
 No seatbelt
 Patient was thrown forward into dashboard and windshield.
 C-spine not cleared
- P.E.: Lacerations on L arm and neck
 Moderate respiratory difficulty
 vital signs stable
- Scheduled for emergency surgery for neck exploration
 and closure of lacerations.
 Intubation unsuccessful with Macintosh laryngoscope
 Successful intubation with Augustine Guide
- B. HX: 57-year old male S/P MVA
 Wearing seatbelt
 Car ran off road and overturned
 Multiple facial contusions
 Fracture of L-3
 C-spine not cleared
 Emergency lumbar spine fusion/stabilization
 Fiberoptic intubation with Augustine Guide handle
 will be discussed

FRIDAY, MAY 12, 1995

SESSION C: Pediatric Trauma Anesthesia, Part I: Didactic Discussion
Chair: Jeffrey M. Berman, MD

13:30 - 14:05 Airway Management of the Pediatric Trauma Patient
Timothy W. Martin, MD

14:05 - 14:40 Vascular Access in the Pediatric Trauma Patient
John K. Hall, MD, FRCPC

14:40 - 15:15 Transfusion Guidelines for Pediatric Trauma:
When? Why? How Much?
Gail E. Rasmussen, MD

15:45 - 16:20 Anesthetic Management of Pediatric Head Injury
Phillipe G. Meyer, MD

16:20 - 16:55 Pain Management in the Pediatric Trauma Patients
Joseph D. Tobias, MD

16:55 - 17:30 Discussion/Questions and Answers

"AIRWAY MANAGEMENT FOR PEDIATRIC TRAUMA PATIENTS"

Timothy W. Martin, M.D.

I. INTRODUCTION

- a. Incidence of pediatric trauma
- b. Critical comparisons with adult trauma
- c. Importance of prompt, appropriate airway management in pediatric patients

II. PERTINENT ANATOMIC FEATURES OF THE PEDIATRIC AIRWAY

- a. Larger head-to-body ratio
- b. Relative sizes of oral cavity and tongue
- c. Potential for adenoidal hypertrophy
- d. Differences in the epiglottis
- e. Location of larynx
- f. Differences in tracheal size and narrowest section

III. ASSESSMENT OF THE PEDIATRIC AIRWAY AND VENTILATION

- a. Respiratory rate
- b. Work of breathing
- c. Anatomical distortion or injury
- d. Evidence of airway obstruction
 - 1. anatomic
 - 2. foreign body
- e. Level of consciousness
- f. Visual inspection of skin, mucosa, nailbeds
- g. Pulse oximetry, capnography
- h. Laboratory studies and radiographs

IV. ASSESSMENT AND PROTECTION OF THE CERVICAL SPINE

- a. Conditions suspicious for C-spine injury
- b. Common patterns of injury
- c. Pertinent anatomic features of the pediatric cervical spine
- d. Methods of protection of the cervical spine: in-line immobilization vs. traction.

V. NON-INTUBATION MANAGEMENT OF THE AIRWAY

- a. Oxygen administration
- b. Relief of upper-airway (supraglottic) obstruction
 - 1. maneuvers
 - 2. airway adjuncts
- c. Bag and mask ventilation

VI. INDICATIONS FOR ENDOTRACHEAL INTUBATION

- a. Persistent apnea
- b. Impending respiratory failure
- c. Upper airway obstruction

- d. Airway protection
 - 1. depressed level of consciousness
 - 2. loss of protective reflexes
 - 3. potential airway obstruction
- e. Need for hyperventilation
- f. Cardiac arrest
- g. Administration of some resuscitative medications

VII. PREPARATION FOR ENDOTRACHEAL INTUBATION OF THE CHILD

- a. Airway supplies
- b. Medications
- c. Suction apparatus
- d. Monitoring
- e. Additional personnel

VIII. INTUBATION ALTERNATIVES FOR PEDIATRIC TRAUMA VICTIMS

- a. "Awake" (non-sedated, non-paralyzed)
 - 1. nasal
 - 2. oral
- b. Rapid-sequence induction and intubation
- c. Mask inhalation induction and intubation
- d. Special techniques

IX. RAPID-SEQUENCE INTUBATION IN THE CHILD

- a. Definition
- b. Advantages
- c. Contraindications
- d. Protocol
- e. Application of cricoid pressure
 - 1. benefits
 - 2. efficacy
 - 3. technique
- f. Selection of sedative agents and muscle relaxants

X. ALTERNATIVES TO "ROUTINE" TRANS-LARYNGEAL INTUBATION

- a. Intubation (with direct laryngoscopy) contraindicated
- b. Failed intubation
 - 1. Laryngeal mask airway
 - 2. Needle cricothyrotomy
 - 3. Surgical cricothyrotomy or tracheostomy

XI. COMPLICATIONS OF ENDOTRACHEAL INTUBATION IN CHILDREN

Vascular Access Techniques in Pediatric Anesthesia

John K. Hall, M.D., FRCPC

I) Problem

- A) hypovolemia, hypotension, low CO
- B) resuscitation- critical to outcome
- C) smaller patients/smaller vessels
- D) familiarity

II) Normal anatomy

- A) upper extremity
- B) lower extremity
- C) inguinal
- D) axillary
- E) neck
- F) bones

III) Equipment

- A) steel needles/butterfly
- B) catheter over needle
- C) catheter through needle
- D) intraosseous needle

IV) Techniques

- A) peripheral venous cannulation
 - 1) hand/arm
 - 2) foot/leg
 - 3) other
- B) central venous cannulation
 - 1) neck
 - 2) subclavian/axillary
 - 3) femoral
- C) intraosseous

V) Complications

TRANSFUSION PRACTICES
IN
PEDIATRIC TRAUMA PATIENTS

Gail E. Rasmussen, M.D.
Division of Pediatric Critical Care and Anesthesia
Vanderbilt University Medical Center
Nashville, Tennessee

I. Introduction:

Blood transfusion and component therapy has undergone extensive revision in the last decade due to the threat of infectious disease transmission. The biggest single factor affecting these changes has been the potential spread of HIV and AIDS from contaminated blood products. This has also generated a new era of transfusion medicine and blood banking practices that have evolved stricter guidelines for fractionation of the blood pool, refinement of better intraoperative blood salvage techniques, development of new adjunctive agents to decrease blood loss, techniques to control blood loss (i.e., controlled hypotension), and exhaustive research into potential blood substitutes.

II. Complications of blood transfusion

- A. HIV Transmission
- B. Hepatitis
- C. Hemolytic transfusion reaction (86% human clinical error)
- D. Anaphylaxis
- E. Transfusion related lung injury

III. Special Concerns of Pediatric Trauma Patient

- A. Reason to Transfuse
- B. Recognition of Hemorrhagic Shock
- C. Initial Fluid Resuscitation/Access
- D. When to transfuse (acceptable hematocrits)

IV. Treatment of Hemorrhagic Shock

- A. Problems of Massive Transfusion
- B. Management of Dilutional Thrombocytopenia
- C. PRBC's/Whole Blood
- D. Component Therapy (FFP, Cryoprecipitate, Platelets)

V. Blood Conservation and Intraoperative Salvage

- A. Isovolemic Hemodilution
- B. Controlled Hypotension
- C. Blood Salvage - Cell Saver/Pleurivac
- D. Adjunct Agents to Decrease Bleeding
 - (1) Aprotinin
 - (2) Human Recombinant Erythropoietin
 - (3) DDAVP
 - (4) Antifibrinolytics
 - (i) EACA
 - (ii) Tranxemic Acid

- E. Preoperative Donation
 - (1) Autologous
 - (2) Donor Directed

VI. Blood Substitutes

- A. Perfluorocarbons
- B. Stroma free Hgb

VII. Conclusion

- A. Future Trends in Transfusion Therapy.

References:

1. Centers for Disease Control. HIV/AIDS Surveillance Report, April 1992:1-18.
2. Faust RJ, Warner MA. Transfusion Risks. Int Anesth Clin 1990;28:184-188.
3. Tremper KK. Techniques and Solutions to Avoid Homogogous Blood Trnasufsion Refresher Course Lectures in Anesthesiology 1992; 136:1-7.
4. Cote CJ. Strategies for Blood Product Managemennt and Blood Salvage in: Cote CJ, Ryan JF, Todres ID, Goudosouzian NG, (eds) A Practice of Anesthesia for Infants and Children. Philadephia: WB Saunders Company 1993:183-200.
5. Williamson KR, Taswell HF, Intraoperative Blood Salvage: A Review. Transfusion 1991;31:662-675.
6. Royston D. Aprotinin in Open Heart Surgery. Perfusion 1990;5 (suppl):63-72.
7. D'Ambra MN, Risk SC. Aprotinin, Erythropoietin, and Blood Substitutes. Int Anesth Clin 1990;28:237-240.
8. Looker D, Abbott-Brown D, Cozart P, *et al.* A Human Recombinant Haemoglobin Designed for Use as a Blood Substitute. Nature 1992;356:258-260.

PAIN MANAGEMENT IN THE PEDIATRIC TRAUMA PATIENT

Joseph D. Tobias, M.D.
Associate Director, Division of Pediatric Anesthesiology/
Critical Care Medicine
Director, Pediatric Pain Management Service
Associate Professor of Anesthesiology and Pediatrics
Vanderbilt University
Medical Center North T-0118
Nashville, Tennessee

I. Introduction:

- a. Causes of pain and anxiety in pediatric trauma
- b. Why treat pain: The post-surgical stress response
- c. Safety issues in the use of analgesic/sedative agents

II. Sedation during mechanical ventilation:

- a. inhalational anesthetic agents
- b. benzodiazepines
- c. ketamine
- d. barbiturates
- e. propofol
- f. opioids

III. Opioids for analgesia:

- a. choice of agent:
 - morphine
 - meperidine
 - hydromorphone
 - synthetic agents (fentanyl, sufentanil)
- b. alternatives to intravenous administration:
 - subcutaneous
 - transdermal
 - transmucosal
- c. routes of delivery:
 - PCA versus intermittent dosing
 - basal infusion in PCA: yes or no?
- d. adverse effects of opioids:
 - chest wall rigidity
 - increased intracranial pressure
 - decrease gastrointestinal motility

IV. Regional anesthesia in pediatric trauma:

- a. interpleural analgesia
- b. epidural analgesia
- c. continuous femoral nerve blockade

FRIDAY, MAY 12, 1995

SESSION D: Trauma Anesthesia Simulators The LOTAS Faculty

SPECIAL HANDS-ON WORKSHOP:

Opportunities on Simulators – Be the “Attending Trauma Anesthesiologist” for a Real Case from the Shock Trauma Center. Featuring: LORAL and CAE-Link Simulators and Technology.

A limited number of delegates will have the opportunity for an extended experience with current simulator technology and scenarios adapted especially for trauma anesthesia.

The group will be divided into sections and rotate between the different simulators.

SATURDAY, MAY 13, 1995

SESSION A:

International Trauma Systems

Panelists: Kenneth J. Abrams, MD

Christopher M. Grande, MD, MPH

Louis M. Guzzi, MD, MAJ, MC

Nyugen D. Kien, PhD

Charles P. Kingsley, MD

Thomas E. Knuth, MD, MPH

Debra J. Newman, MD, MS

In roundtable format, officers and committee chairpersons of ITACCS will address the various components of a multifaceted program currently in development, designed to fuse civilian and military trauma management systems, and be flexible enough to address the needs of the developed, developing and underdeveloped worlds, with respect to the burgeoning global trauma epidemic.

In addition, representatives from notable national and international government and private agencies such as ASA, WFSA, SCCM, WHO, WAEDM, CDC, USAID, UN, US Army, ATS, AAST, AAAM, International Red Cross, PAHO, and DHHS will be invited to participate and join the development of the project.

SATURDAY, MAY 13, 1995

SESSION B:

Neurotrauma: Problem-Based Learning

Discussion: Case Presentations

Chair: Elizabeth A.M. Frost, MD

This session will take a multi-format approach including problem-based case presentations and round-table discussion of various important aspects of triage, resuscitation, choice of anesthesia, fluid therapy and post-operative care.

ATACCS Delegates will receive the case material in advance, and thus have an opportunity to actively participate in an interactive format.

08:00 - 08:10 Introduction

08:10 - 08:45 Resuscitation: The Golden Hour
Kenneth J. Abrams, MD

08:45 - 09:15 Anesthetic Management of Neurodiagnosis
Irene Osborne, MD

09:15 - 09:45 Anesthesia for Head Injury
Elizabeth A.M. Frost, MD

10:15 - 10:45 Post-Operative and Intensive Care of Neuro Trauma
Elizabeth C. Behringer, MD

10:45 - 11:15 The Patient with Spinal Cord Injury
Mariano Pimental, Jr., MD

11:15 - 11:45 Pediatric Neurotrauma
Arno H. Fried, MD

11:45 - 12:15 Conclusions

ANESTHETIC MANAGEMENT OF NEURODIAGNOSIS

Irene P. Osborn, M.D.

- I. Introduction: Why are we needed?
 - A. Role of neurodiagnostic evaluation
 - B. Considerations for Computed Tomography
 - 1. Monitoring & Manpower
 - 2. The Traumatized Patient
 - 3. The Pediatric Patient
 - C. Magnetic Resonance Imaging
 - 1. Monitoring & Safety - what works
 - 2. Anesthetic Techniques
 - 3. Critically Ill Patients
 - D. Angiography
 - 1. Considerations
 - 2. Complications
 - E. Conclusions

Table 1. Agents for Sedation of Intubated Patients

	Advantages	Disadvantages
Opioids:		
Morphine sulfate	analgesia	respiratory depression
0.05-0.1mg/kg	sedation	hypotension
	reversibility	
Fentanyl	same	same, short duration
1-2ug/kg		
Benzodiazepines:		
Midazolam	anxiolysis	respiratory depression
0.01-0.04mg/kg	amnesia	hypotension
	reversible	opioid interaction
Diazepam	similar effect	not as profound
0.1mg/kg-.3mg/kg	long duration	
	anticonvulsive	
Lorazepam	as above	as above
2-4 mg	as above	long duration
Other agents:		
Propofol	rapid sedation	hypotension
1-2 mg/kg +	rapid recovery	resp. depression
inf-20-50ug/kg/min		sepsis ?

Table 2. Pediatric Sedation Agents for CT/MRI

Agent	Dose	Comments
Chloral hydrate	75-100mg/kg	Allow 15-20 min. onset Best for infants up to 6 mos.
Pentobarbital	5mg/kg p.o.	Mix w. conc. Kool-Aid
Pentobarbital	2-3mg/kg i.v. up to 9mg/kg	Give slowly, sedation in 5-10 min
Pentobarbital	4-5mg/kg i.m.	Painful injection, long duration
Ketamine	4-6mg/kg i.m.	Fast onset, lasts 20-25 min.
Ketamine	1mg/kg, slowly divided doses	Analgesia, secretions, good for asthmatics
Methohexital	25-30mg/kg p.r.	Onset 8-10 min, duration 25 min-1 hr
Methohexital	1-2 mg/kg i.v.	Give slowly, watch for apnea, repeat bolus or give infusion
Midazolam	0.25-0.75 mg/kg	Give slowly, avoid other agents
Propofol	2-3 mg/kg i.v., dilute w. lidocaine inf-50/100ug/kg/min	Painful injection, may cause apnea repeat bolus or give infusion

Table 3. Computed Tomography vs. Magnetic Resonance Imaging

rapid study capability	long studies
ionizing radiation	no radiation/ magnetic field
routine monitors	MR compatible monitors/ distance
bony structures	soft tissue structures
iodine contrast medium	less noxious contrast
patient visibility	lack of patient visibility

Table 5. Criteria for exclusion from MRI scanning

Unstable vital signs including severely labile ICP

Permanent cardiac pacemaker

Temporary cardiac pacemaker

Automated internal cardiac defibrillator

Intravascular wire or transthoracic pacing wires

Neuroaneurysmal or vascular surgical clips

Intraocular metallic foreign body

Ferrous endoprostheses

Dependence on technology incompatible with MRI:

Extracorporeal membrane oxygenator, intra-aortic balloon
pump, ventricular assist device

Anesthesia for Neurodiagnosis

Case History:

A 4 year old child was admitted for observation after falling off a playground swing. He had briefly lost consciousness and was now sleepy, but responsive. In the CT scanner he was uncooperative and would not lie still. The pediatrician administered Valium 2.5 mg which quieted the child briefly. After 5 minutes the child began moving and the scan could not be completed, he sat up and vomited approximately 30 cc of clear fluid with "Cheerios" noted. Anesthesia was called at that point for assistance.

Physical exam revealed a distressed, whining child weighing about 20kg, the child would not lie flat but swayed from side to side. A 22 gauge IV was being pulled precariously and the fluid was not running. The child appeared to have a normal airway although he would not open his mouth upon request. Chest sounds were clear without rhonchi. A moderate sized bump was noted over the left occipital region. A pulse oximeter placed (briefly) on his toe read 98% with a heart rate of 120/min.

Guidelines for Discussion:

1. Physical assessment
2. Neurologic assessment
3. Options for sedation
4. Airway management (?)
5. Post-sedation plan

Postoperative and Intensive Care of Neurotrauma

Elizabeth C. Behringer, M.D.

Case Stem: A 23 yo, 70 kg, black male is admitted to the ICU approximately 3 hours following a small caliber gunshot wound to the right supraorbital region. He was intubated orally at the scene. He received an ICP bolt, arterial line and central venous line during initial workup in the ER.

Upon arrival in the ICU: VS: T99° BP 100/60 P 120 CVP 2 ICP 20

Vent settings: FiO₂ 100%/IMV 12/TV 900/PEEP 0

ABG: 7.55/26/120

The ER nurses report that his urine output has been 820 cc in the last 2 hours.

Guidelines for discussion:

1. What are the medical complications of severe head injury?
 - A. Cardiovascular effects of head injury
 - B. Respiratory complications of head injury
 - C. Hematologic complications of head injury
 - D. Gastrointestinal complications of head injury
 - E. Endocrine and metabolic complications of head injury
 - F. Infectious complications of head injury

References

1. Kaufman HH, Timberlake G, Voelker J, Pait TG: Medical complications of head injury. *Med Clin No Am* 1993; 77:43.
2. Borel C, Hanley D, Diringier MN, Rogers MC: Intensive management of severe head injury. *Chest* 1990; 98:180.
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4. Prough DS, Coker LH, Lee S, Yates F, McWhorter JM: Hyperglycemia and neurologic outcome in patients with closed head injury. *Anesthesiology* 1988; 69:A584.
5. Simon RP: Neurogenic pulmonary edema. *Neurol Clin* 1993; 11:309.

THE PATIENT WITH SPINAL CORD INJURY

Mariano C. Pimentel, Jr., M.D.

A. Case History

A 17 year old male unrestrained front seat passenger was involved in a MVA. The car crushed into a store and he hit his forehead against the windshield.

The patient was brought to the ER fully immobilized on a long spine board with hard cervical collar and bilateral sandbags in place and the head taped on the board. Initial vital signs were BP 90/50, PR 55, RR 38, Temp. 97.4 F, GCS 15, CVP 4 cm H₂O. He was alert and responsive with moderate respiratory distress. ABG pH 7.31, pCO₂ 52, pO₂ 69 on supplemental oxygen. Minor lacerations were noted on the forehead. He was unable to move all extremities with no sensation below the nipple line. No spinal reflexes were elicited. He was intubated awake while manual stabilization of the neck was applied. During intubation, he developed severe bradycardia which responded to IV atropine. CT scan revealed a C5 body fracture with 20% retrolisthesis. Gardner Wells Tongs were inserted with good alignment obtained after application of 25 lbs weight. High dose Methylprednisolone was given for 24 hours plus Cimetidine.

Three days after admission to the ICU, a leak around the ETT necessitated reintubation. This was accomplished with the aid of a fiberoptic bronchoscope. The patient remained hemodynamically stable with partial recovery from spinal shock as evidenced by return of peristalsis. On the 7th day he was scheduled for cervical arthrodesis and fusion of C4,C5,C6 with iliac crest bone graft.

B. Guidelines for Discussion

1. Airway management of the patient with suspected unstable cervical spine.
 - A. Oral intubation
 - B. Fiberoptic intubation
 - C. Bullard Laryngoscope
 - D. LMA
 - E. Combitube
 - F. Surgical airway
2. Physiologic sequelae of acute spinal cord injury.
3. Spinal cord resuscitation
 - A. Corticosteroids
 - B. Opiate antagonists
 - C. GM1 Gangliosides
 - D. Glucose
 - E. Hypothermia
4. Intraoperative monitoring of spinal cord function.
5. Intraoperative and postoperative adverse events peculiar to upper cervical spine surgery

C. References

1. Hastings RH, Marks JD: Airway management for trauma patients with potential cervical spine injuries. *Anesth Analg* 1991; 73: 471-48
2. Cooper SD, Benumof JL, Ozaki GT: Evaluation of the Bullard Laryngoscope Using the New Intubating Stylet: Comparison with Conventional Laryngoscopy. *Anesth Analg* 1994;79:965-70.
3. Albin MS. Critical Care Clinics. Acute spinal cord injury. Philadelphia. W.B. Saunders, July 1987.
4. Bracken MB, Shepard MJ, Collins WF, et al. Methylprednisolone or naloxone treatment after acute spinal cord injury: one year follow up data. *J Neurosurg* 1992;76:23-31.
5. Geisler FH, Dorsey FC, Coleman WP: Recovery of motor function after spinal cord injury-a randomized placebo-controlled trial with GM-1 ganglioside. *N Engl J Med* 1991;324:1829-38.
6. Kalkman CJ, Been HD, Ongerboer de Visser BW: Intraoperative monitoring of spinal cord function. A review. *Acta Orthop Scand* 1993;64:114-123.

SATURDAY, MAY 13, 1995

SESSION C: Pediatric Trauma Anesthesia, Part II: Round-Table Discussion
and Hands-On Workshops

Chair: Jeffrey M. Berman, MD

Faculty: A. Mazurek	G. Rasmussen
P. Meyer	J. Hall
J. Berman	T. Martin

SPECIAL HANDS-ON WORKSHOP:

08:00 - 09:45 Case Presentations/Panel

A roundtable panel discussion will address several case presentations of pediatric trauma. Case materials will be made available to session participants in advance to facilitate faculty-audience interaction. Following the panel the program will shift to a hands-on format in which session participants will have the opportunity to participate in three (3) special skills stations.

10:15 - 12:15 Hands-On Skills Stations

Pediatric Airway Management and C-Spine Immobilization

Aleksandra J. Mazurek, MD and

Phillipe Meyer, MD

Interosseous Infusion and Vascular Access

Jeffrey M. Berman, MD and

Gail E. Rasmussen, MD

X-Ray Interpretation: C-Spine;

CT; Abdomen, Chest, Head

John K. Hall, MD and Timothy N. Martin, MD

SATURDAY, MAY 13, 1995

SESSION D: Trauma Anesthesia and Critical Care for Disasters:
Multi-Media Interactive Simulation
Chair: Vladimir Kvetan, MD
Special Speaker: Peter J.F. Baskett, MB, BCh, FRCA, MRCP

Panelists: Yoel Donchin, MD
Derek Angus, MB, ChB, MPH, MRCP
Joseph Barbera, MD
Michael A. Olds, PA-C, NREMT-P
Lee Brent, MD
Marzio G. Mezzetti, MD, PhD
T. Michael Moles, MBBS, FFARCS, DTMH

This session will begin with a short didactic presentation on comparison of natural and manmade disasters by the special speaker titled "A Visit to Sarajevo in July 1994." Then, beginning with the explanation of the rules of engagement, moderators and members of the audience will be assigned various roles that they will assume during the simulation. The simulation will consist of a scenario of a major earthquake in an urban area complicated by HAZMAT incident involving mass toxic inhalation designed as a tabletop management mock-up model. The learning process will include problem solving of specific sequential parts of the disaster management by participants under the guidance of a panel of experts. Round-table format will also be used for regular review of the progress and final summary by the expert panel.

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the companies who contributed to this program after the printing of the syllabus.*