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En route Care Research Center

SCIENTIFIC AND TECHNICAL REPORT

Prehospital Interventions Performed in Afghanistan between November 2009 and March 2014

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NOTICE AND SIGNATURE PAGE

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14. ABSTRACT

Objective: Care provided to a casualty in the prehospital combat setting can influence subsequent medical interactions and impact patient outcomes; therefore, we aimed to describe the incidence of specific prehospital interventions (lifesaving interventions (LSIs)) performed during the resuscitation and transport of combat casualties.
Methods: We performed a prospective, observational, IRB-approved study between November 2009 and March 2014. Casualties were enrolled as they were cared for at nine (9) U.S. military medical facilities in Afghanistan. Data were collected using a standardized collection form. The receiving facility's medical provider determined if a prehospital intervention was performed correctly, performed incorrectly, or was necessary but was not performed (missed LSIs).
Results: A total of 2106 patients met inclusion criteria. The mean age was 25 years and 98% were male. The most common mechanism of injury was explosion, 57%. There were 236 airway interventions attempted, 183 chest procedures, 1673 hemorrhage control, 1698 vascular access and 1066 hypothermia preventions implemented. There were 142 incorrectly performed interventions and 360 were missed.
Conclusions: In our study, the most commonly performed prehospital LSI in a combat setting were for vascular access and hemorrhage control. The most common incorrectly performed and missed interventions were airway interventions and chest procedures respectively.

15. SUBJECT TERMS Lifesaving intervention; prehospital; resuscitation; tactical combat casualty care; emergency medical services					
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2.0 SUMMARY

Modified Abstract

Background: Care provided to a casualty in the prehospital combat setting can influence subsequent medical interactions and patient outcomes. Both historical and recently published data reveal that most combat-related deaths occur in the prehospital setting before the casualty reaches a surgical facility. A key component of combat casualty care performance improvement includes evaluating prehospital medical performance, particularly in the combat setting. This requires data regarding the interventions performed, the assessment of whether the intervention was performed correctly, and the determination if there was a missed opportunity to perform an intervention in the field. The purpose of our study was to describe the incidence of specific prehospital interventions performed to include the number of incorrectly performed or missed prehospital interventions.

Methods: Casualties were enrolled as they were treated at nine medical facilities in Afghanistan between November 2009 and March 2014. Casualties who were transported to a participating facility from the field were included. Casualties were excluded if they were transferred from another medical facility or were detainees. Subject data were collected by the Joint Combat Casualty Research Team (JC2RT) using a standardized collection form to include descriptive data and specific prehospital, lifesaving interventions (LSIs). The JC2RT is a multidisciplinary team composed of clinical researchers from the Army, Air Force, and Navy utilized to perform human research in Iraq and Afghanistan. As the casualty arrived, the receiving provider at the medical facility treating the casualty determined if an intervention was performed correctly and if an indicated intervention should have been performed in the field, but was not (missed LSI).

Results:

- 2,106 patients met inclusion criteria. The majority (98%) were male with a mean age of 25 years (SD ±8.8). The mechanism of injury was explosion in 1191 (57%), penetrating in 614 (29%), blunt in 284 (13%) and isolated burn in 27 (1%) of casualties.
- Airway management interventions: nasal/oral airway placement (4%, n=81); endotracheal intubation (5%, n=114); and cricothyroidotomy (2%, n=41).
- Chest interventions: 69 (3%) needle decompressions, 27 (1%) chest tube thoracostomies, and 87 (4%) chest seal applications.
- Hemorrhage control interventions: 515 casualties (24%) had a total of 805 tourniquets applied, 783 (37%) received pressure packing without a hemostatic agent, and 85 (4%) were administered pressure packing with a hemostatic agent applied.
- After study amendment to include capture of vascular access: 1463 (79%) of 1849 total casualties had documented vascular access attempts. There were 1698 total attempts to gain vascular access; some casualties had multiple attempts documented to include both peripheral intravenous (IV) and interosseous (IO) attempts. There were 1413 peripheral IVs and 285 IOs attempted.
- Prehospital hypothermia prevention was employed in 1066 (58%) casualties.
- Incorrectly performed interventions in the prehospital setting included: 21 (8.9%) airway interventions, 10 (5.5%) chest procedures, 35 (2.1%) hemorrhage control (of which 28

were incorrectly placed tourniquets), 70 (4.1%) vascular access, and 6 (0.6%) hypothermia prevention measures.

- Three hundred and sixty missed LSIs were identified by providers at the receiving facility including 56 (19.2%) airway interventions, 24 (11.6%) chest procedures, 57 (3.3%) hemorrhage control (of which 6 were tourniquets), 160 (8.6%) vascular access, and 63 (5.6%) hypothermia prevention opportunities.
- The highest rate of missed LSIs included airway interventions (19.2%) and chest procedures (11.6 %), while the lowest rate of incorrectly performed interventions involved hemorrhage control (3.3%).
- The less frequently performed procedures were correlated with higher rates of incorrect performance and higher rates of missed LSIs.

Note: A comparison of the first 1,003 patients (before 2012) to the second 1,103 patients found a decrease in missed airway interventions, chest procedures, vascular access, and hemorrhage control in the second set of patients. In addition, there was a significant improvement (2.9% vs 8%) in correct performance of vascular access in the second set of patients. The authors attribute this to increased focus on Tactical Combat Casualty Care and educational initiatives provided to prehospital providers.

Conclusions: The most commonly performed interventions in our cohort were for vascular access and hemorrhage control. The most common incorrectly performed interventions as well as missed LSIs included airway interventions and chest procedures.

Evidence Based Recommendations:

Continued emphasis on Tactical Combat Casualty Care training for all military prehospital providers.

Institution of focused continuous educational programs on perishable skills that could improve the success rates of interventions that are not performed often, to include airway and chest procedures.

Gaps Addressed: 2015 ICL: AFMS(AMC) 13 - Advanced POI and ERC Resuscitation;
2017 ICL: AFMS(AMC) 137 - Research on Advanced Point of Injury through ERC

2.0 INTRODUCTION

Care provided to a casualty in the prehospital combat setting can influence subsequent medical interactions and patient outcomes. Both historical and recent published data reveal that most combat related deaths occur in the prehospital setting before the casualty reaches a surgical facility. (1-5) Early interventions during the resuscitation of the casualty can influence the overall outcome of the patient. Eastridge, et al. in a study focused on battlefield death identified that 24% of the prehospital deaths were potentially survivable injures with most these being associated with hemorrhage (90.9%) and airway compromise (8.0%). (5) The direct impact of prehospital interventions on the survival of casualties was also highlighted within this study where the rate of death from extremity hemorrhage decreased from a rate of 23.3 deaths per year prior to the introduction of tourniquets to 3.5 deaths per year after tourniquets were fully fielded. (5)

A key component of combat casualty care performance improvement includes evaluating prehospital medical performance, particularly in the combat setting. This requires data regarding the interventions performed, the assessment of whether the intervention was performed correctly, and the determination if there was a missed opportunity to perform an intervention in the field. Unfortunately, published studies regarding the prehospital care delivered in a combat zone are limited with few studies assessing if an intervention was performed correctly or if a procedure was missed and should have been attempted. (6-12) Collecting data from the prehospital setting in a combat zone has been difficult. (13)

In 2012, we published an interim analysis with the first 2 years of data which included the timeframe where a push for Tactical Combat Casualty Care (TCCC) training was growing. (12, 14) This manuscript represents the culmination of our study with an additional 1103 patients and includes the period after the publication of the 2011 Defense Health Board memo recommending that standardized, comprehensive TCCC training be provided to all deployed combatants and medical personnel across the services. (15)

The purpose of our study was to describe the incidence of specific prehospital interventions performed to include the number of incorrectly performed or missed prehospital interventions.

3.0 METHODS

3.1 Study Design and Setting

The Brooke Army Medical Center Institutional Review Board approved our prospective, observational study.

3.2 Selection of Participants

Casualties were enrolled as they were treated at nine medical facilities in Afghanistan between November 2009 and March 2014. Casualties who were transported to a participating facility from the field were included. Casualties were excluded if they were transferred from another medical facility or were detainees.

3.3 Measurements

Subject data were collected by the Joint Combat Casualty Research Team (JC2RT) using a standardized collection form to include descriptive data and specific prehospital, lifesaving interventions (LSIs). The JC2RT is a multidisciplinary team composed of clinical researchers from the Army, Air Force, and Navy utilized to perform human research in Iraq and Afghanistan. (16) As the casualty arrived, the receiving provider at the medical facility treating the casualty determined (1) if an intervention was performed correctly and (2) if an indicated intervention should have been performed in the field, but was not (missed LSI).

Descriptive data included: age and sex of the casualties, mechanism of injury (MOI), airway management interventions, chest procedures and hemorrhage control interventions. In April of 2010, the study was amended with addition of the following data points: vascular access, fluid administration, and hypothermia prevention. Specific prehospital interventions were categorized into airway interventions, chest procedures, hemorrhage control, vascular access and hypothermia prevention (Table 1).

Table 1

Interventions Collected	
Airway Management	Nasal/oral airway insertion Endotracheal intubation Surgical cricothyroidotomy
Chest Procedures	Chest needle decompression Chest tube thoracostomy Chest seal application
Hemorrhage Control	Tourniquet application Use of pressure packing (non-hemostatic agent) Use of pressure packing (with a hemostatic agent)
Vascular Access	Intravenous Access Intraosseous Access
Hypothermia Prevention	

3.4 Outcomes N/A

3.5 Analysis

We consolidated and maintained study data using Excel (Microsoft, Redmond, WA). We conducted descriptive analysis using JMP version 13 (SAS Institute Inc.; Cary, NC). Data were reported as frequencies or percentages. Percent missed LSIs was calculated using the provider-determined number of missed interventions divided by the sum of performed interventions plus the number of missed interventions. Comparative analyses were performed for categorical variables using chi-square (or Fisher's Exact when appropriate). Statistical significance was set at $p<0.05$.

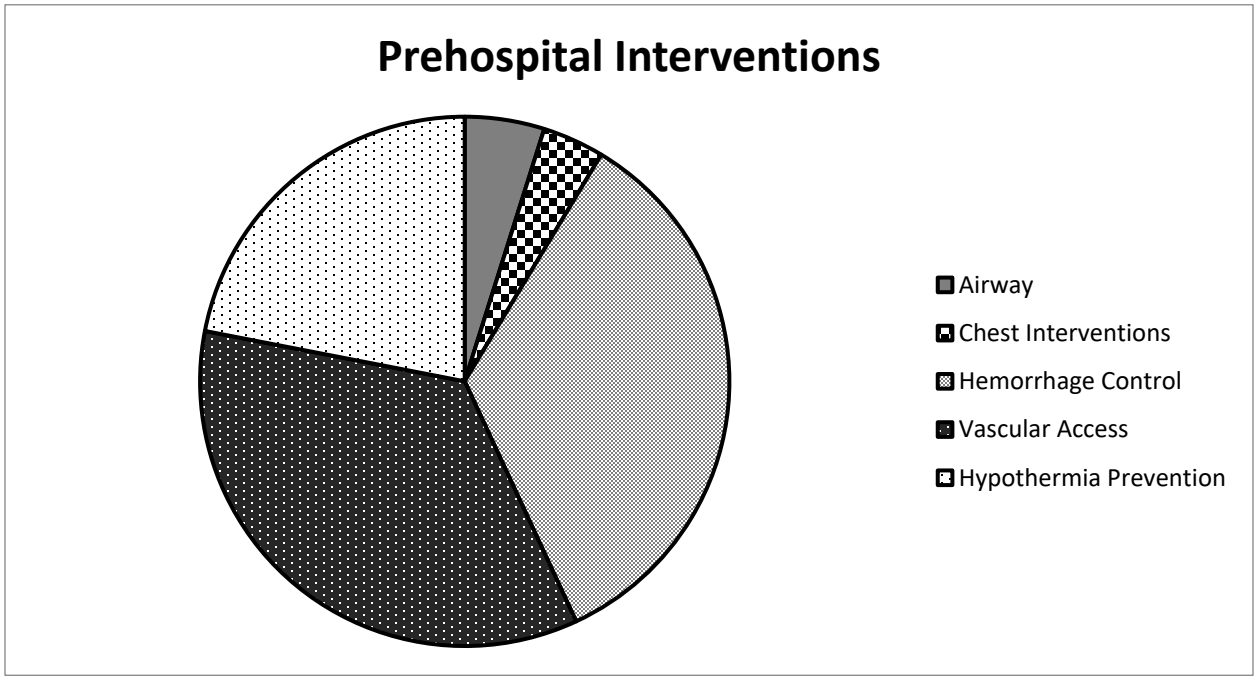
4.0 RESULTS

4.1 Characteristics of Study Subjects

Two thousand one hundred and six patients met inclusion criteria. The majority (98%) were male with a mean age of 25 years (SD ±8.8). The mechanism of injury was explosion in 1191 (57%), penetrating in 614 (29%), blunt in 284 (13%) and isolated burn in 27 (1%) of casualties.

4.2 Main Results

Casualties underwent the following airway management interventions included: nasal/oral airway placement (4%, n=81); endotracheal intubation (5%, n=114); and cricothyroidotomy attempted (2%, n=41). The breakdown of chest interventions included: 69 (3%) needle decompressions, 27 (1%) chest tube thoracostomies, and 87 (4%) chest seal applications. When evaluating hemorrhage control interventions: 515 casualties (24%) had a total of 805 tourniquets applied, 783 (37%) received pressure packing without a hemostatic agent, and 85 (4%) were administered pressure packing with a hemostatic agent applied. After the study amendment was approved to include capture of vascular access, the study cohort comprised of 1849 total casualties of which 1463 (79%) casualties had documented vascular access attempts. There were 1698 total attempts to gain vascular access where some casualties had multiple attempts documented to include the combination of both peripheral intravenous (IV) and interosseous (IO) attempts. The total documented vascular attempts were inclusive of 1413 peripheral IVs and 285 IOs. Prehospital hypothermia prevention was employed in 1066 (58%) casualties. Vascular access and hemorrhage control were the most common interventions performed (Figure 1).



Incorrectly performed interventions in the prehospital setting included: 21 airway interventions, 10 chest procedures, 35 hemorrhage control (of which 28 were incorrectly placed tourniquets), 70 vascular access, and 6 hypothermia prevention measures. The highest rate of incorrectly performed interventions included airway interventions (8.9%) and chest procedures (5.5%), while the lowest rate of incorrectly performed interventions involved hypothermia prevention (0.6%) and hemorrhage control (2.1%) (Table 2). When compared to the first 1,003 patients from the interim manuscript in 2012, the second set of 1,103 patients were less likely to have incorrectly placed vascular access (p<0.0001) (Table 3).

Table 2: Incorrectly performed Interventions

	No. Incorrectly Performed	Total No. Interventions	Percentage of Incorrectly Performed Interventions
Airway Interventions	21	236	8.9%
Chest Procedures	10	183	5.5%
Vascular Access	70	1698	4.1%
Hemorrhage Control	35	1673	2.1%
Hypothermia Prevention	6	1066	0.6%

Table 3: Incorrectly Performed Interventions Comparison of first 1003 patients to second 1103 patients

	Overall Data	Interim* (n=1003)	Post-Interim (1103)	P-Value**
Airway Interventions	8.9%	8.6%	9.0%	0.9165
Chest Procedures	5.5%	6.7%	5.2%	0.6726
Vascular Access	4.1%	8.0%	2.9%	*<.0001*
Hypothermia Prevention	0.6%	0.7%	0.5%	0.6860
Hemorrhage Control	2.1%	2.2%	2%	0.8643

**Interim; data reported in interim analysis of LSI study (12)*

***Comparison of Interim versus Post-Interim*

Three hundred and sixty missed LSIs were identified by providers at the receiving facility including 56 airway interventions, 24 chest procedures, 57 hemorrhage control (of which 6 were tourniquets), 160 vascular access, and 63 hypothermia prevention opportunities. The highest rate of missed LSIs included airway interventions (19.2%) and chest procedures (11.6 %), while the lowest rate of incorrectly performed interventions involved hemorrhage control (3.3%) (Table 4). When compared to the first 1,003 patients from the interim manuscript in 2012, the second set of patients were less likely to have missed airway interventions (p<0.0001), chest procedures (p=0.0013), vascular access (p<0.0001), and hemorrhage control (p<0.0001) (Table 5).

Table 4: Missed LSIs (Missed Opportunities)

Missed LSIs			
	No. Missed LSIs	**Total No. Interventions + Missed Opportunities**	**Percentage of Missed LSIs**
Airway Interventions	56	292	19.2%
Chest Procedures	24	207	11.6%
Vascular Access	160	1858	8.6%
Hypothermia Prevention	63	1129	5.6%
Hemorrhage Control	57	1730	3.3%

Table 5: Missed Interventions

	Overall Data	**Interim* (n=1003)**	**Post-Interim (n=1103)**	**P-Value****
Airway Interventions	19.2%	39%	5.7%	*<0.0001*
Chest Procedures	11.6%	27%	6.7%	*0.0013*
Vascular Access	8.6%	20%	4.4%	*<0.0001*
Hypothermia Prevention	5.6%	5.7%	6.1%	0.8698
Hemorrhage Control	3.3%	6.3%	1.6	*<0.0001*

**Interim; data reported in interim analysis of LSI study (12)*

***Comparison of Interim versus Post-Interim*

5.0 DISCUSSION

Our study found that the most commonly performed prehospital interventions involved those for vascular access and hemorrhage control, while the interventions performed least frequently included chest and airway procedures (Figure 1). A direct correlation can be seen where the less frequently performed procedures had the higher rate of incorrectly performed interventions, while those performed more often had a lower rate of error (Table 2).

Our results also highlight another important area for advancement of prehospital battlefield care – missed opportunities (missed LSIs). Our data identified that the highest rates of missed LSIs also correlated with the less frequently performed interventions (Table 4). This finding may be a result of skill degradation due to lower exposure of the cases that necessitate such an intervention as well as comfort level with the intervention. This hypothesis is supported by the finding that the missed opportunity rate was lowest for those needing an intervention for hemorrhage control which was also one of the largest number of interventions performed within our cohort (Table 4).

As we compare the results from our interim analysis published in 2012 with the post interim analysis study group, we identified a trend toward improvement in success rates involving chest procedures and hemorrhage control. A statistically significant improvement was seen in vascular access ($p<0.0001$), with the number of incorrectly placed interventions decreasing in the second set of patients. (12) A similar comparison of the rate of missed LSIs also identifies a lower rate of missed opportunities in the second set of patients with airway interventions, chest procedures, vascular access, and hemorrhage control all showing a statistically significant decline in missed interventions. (12) These findings may be a result of increased focus on Tactical Combat Casualty Care and educational initiatives provided to prehospital providers. (14)

Skill competence and skill degradation is a challenge that has been identified in civilian Emergency Medical Systems. (17-18) An evaluation of paramedics and endotracheal intubation success rates identified that performing an intervention more often resulted in higher success rates. (17) This increased exposure to an intervention can help mitigate skill degradation. A focused and directed continuing education program can also improve skill performance. (19) Instituting focused continuous educational programs on perishable skills serves as a mitigating strategy that helps improve the success rates of interventions that are not performed often.

When executing a continuing education program, field data on skill performance is necessary to ensure that the improvements implemented to medical training programs are clinically effective. The difficulty obtaining prehospital data collected as part of the casualties' medical record has been documented. Therien et al. identified that only 24% of their studied population had prehospital data documented within their medical records. (13) A model that has been successful in collecting data from the prehospital setting for performance improvement is the 75th Ranger Regiment's prehospital trauma registry. (20) A limitation of this registry was that it focused on the 75th Ranger Regiment, did not capture interventions that were potentially missed in the field and may not be applicable to the disparate levels of training in conventional forces. In an effort to capture prehospital data the Department of Defense (DoD) Joint Trauma System (JTS) Prehospital Trauma Registry (PHTR) was launched. (21) Though a recent study by Schauer, et al. identified limitations regarding the data that has been captured. (21) As we

move forward, we need to continue to work to improve the quality of data collected from the prehospital setting to adequately assess the care that is being provided. The results of our study may be used by educators across the services to help tailor continuing education programs for medics to ensure that global skill maintenance is sustained.

Limitations

The primary limitation is that the study was a convenience sample. It was not a consecutive enrollment study because of the challenges of performing it within a combat zone; however, the study was prospective, allowing for better collection of the LSIs and procedural errors. Also, given the limitations of prehospital medical record data, we cannot confirm the true denominator of our population. However, we have trained research staff at each large medical facility and we collected a large sample size. Another limitation includes the descriptive nature of the study as well as the lack of outcome data on all patients, however, we reported outcome data on approximately 26 patients in a previous publication. (22) Additionally, the subjective nature of determining the need for an intervention by the receiving provider and the inability to estimate the inter-provider validity when determining that an intervention was performed incorrectly or a missed LSI add to the limitations of the study. Other limitations were that the data was collected during resuscitations and our study does not consider the tactical situation that may have been encountered by the prehospital provider or the level of training of the prehospital provider. Also, this is combat data and may not translate directly to civilian teams or international humanitarian settings.

Conclusions

In our prospective study of prehospital performed lifesaving interventions performed in a combat setting, the most commonly performed interventions in our cohort were for vascular access and hemorrhage control. The most common incorrectly performed interventions as well as missed LSIs included: airway interventions and chest procedures.

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APPENDIX: Publications and Presentations

A.1 Publications

Schauer SG, Mora AG, Maddry JK, Bebarta VS. Multicenter, prospective study of prehospital administration of analgesia in the US combat theater of Afghanistan. Prehosp Emerg Care 2017;21(6):744-749.

Petz LN, Tyner S, Barnard E, Ervin A, Mora A, Clifford J, Fowler M, Bebarta VS. Prehospital and en route analgesic use in the combat setting: a prospectively designed, multicenter, observational study. Mil Med. 2015; 180(3 Suppl):14-8.

Barnard EB, Ervin AT, Mabry RL, Bebarta VS. Prehospital and en route cricothyrotomy performed in the combat setting: a prospective, multicenter, observational study. J Spec Oper Med. 2014; 14(4):35-9.

Lairet JR, Bebarta VS, Burns CJ, Lairet KF, Rasmussen TE, Renz EM, King BT, Fernandez W, Gerhardt R, Butler F, DuBose J, Cestero R, Salinas J, Torres P, Minnick J, Blackbourne LH. Prehospital interventions performed in a combat zone: a prospective multicenter study of 1,003 combat wounded. J Trauma Acute Care Surg. 2012;73(2 Suppl 1):S38-42.

A.2 Presentations

Bebarta VS, Ervin AT, Mora AG, Ganem V. Pediatric pre-hospital lifesaving interventions in a combat setting – a prospective, multicenter study. Poster. MHSRS 2013.

Bebarta VS. Pre-Hospital lifesaving interventions and cardiac arrest in combat – a multicenter prospective study. Podium. SAEM, 2013.

Bebarta VS. Pre-hospital lifesaving interventions in combat, pediatric vs. adult. Podium. SAEM, 2013.

Bebarta VS, Ervin AT, Mora AG, Ganem V. Lifesaving interventions perform by provider type – a multicenter prospective study. Poster. MHSRS, 2013.

Bebarta VS, Mora AG, Ervin AT. Comparison of provider types who performed prehospital lifesaving interventions (LSIs): a multicenter prospective study. Poster. SCCM, 2015.

Schauer, S. Multicenter, prospective study of prehospital administration of analgesia in the Afghanistan combat theater. Podium. MHSRS, 2015.

Lear JD, Reeves LK, Mora AG, Maddry JK. Prehospital lifesaving interventions in patients with cardiac arrest in a combat setting- a prospective, multicenter study. Poster. SURF, May 2016.

Paciocco JA, Schauer SG, Mora AG, Maddry JK. Prehospital analgesics used in Afghanistan: A prospective, multi-center observational study. Poster. SURF, 2016.

Russell SS, Mora AG, Savell SA, Maddry JK. Pediatric pre-hospital lifesaving interventions on a combat setting – a prospective, multicenter study. Poster. SURF, 2016.

Lairet J, Bebarta V, Maddry J, Reeves L, Mora A, Blackbourne L, Rasmussen T. Prehospital Interventions Performed in a Combat Zone. Poster. MHSRS, 2017, GSACEP 2018.

Lairet J, Bebarta V, Maddry J, Reeves L, Mora A, Blackbourne L, Rasmussen T. Long term outcomes associated with lifesaving interventions preformed in a prehospital combat setting – A multicenter, prospective observational study. Poster. MHSRS, 2018

Bebarta V, Bebarta E, Mora A, Reeves L, Maddry J, Schauer S, Lairet J. Prehospital use of Ketamine in the combat setting; A sub-analysis of patients with head injuries evaluated in the prospective lifesaving intervention (LSI) study. Poster. MHSRS, 2013.

Appendix B Brief Report on Sub-analysis

Prehospital Life Saving Interventions Performed on Pediatric Patients in a Combat Zone – a multicenter prospective study

Modified Abstract

Background: US military medical personnel are tasked with providing care to wounded and sick allied forces in combat theaters. In addition, circumstances frequently mandate the care of local civilians, including children. During conflicts, children are often caught in the cross fire or become victims of explosive devices. Reports from the wars in Iraq and Afghanistan found pediatric patients accounted for 5 to 10% of admissions to combat hospitals and of these, as many as half were noncombat humanitarian admissions. Most of the children suffered penetrating injury secondary to explosives.

We aimed to conduct the first prospective study evaluating the performance of life saving interventions (LSIs) in pediatric patients in a combat setting. The purpose of this prospective observational study was to describe and evaluate prehospital pediatric LSIs performed in the prehospital setting in Afghanistan between January 2009 and March 2014.

Methods: Casualties were enrolled as they were treated at nine medical facilities in Afghanistan between November 2009 and March 2014. Casualties who were transported to a participating facility from the field were included. Casualties were excluded if they were transferred from another medical facility or were detainees. Subject data were collected by the Joint Combat Casualty Research Team (JC2RT) using a standardized collection form to include descriptive data and specific prehospital, lifesaving interventions (LSIs). The JC2RT is a multidisciplinary team composed of clinical researchers from the Army, Air Force, and Navy utilized to perform human research in Iraq and Afghanistan. As the casualty arrived, the receiving provider at the medical facility treating the casualty determined if an intervention was performed correctly and if an indicated intervention should have been performed in the field, but was not (missed LSI).

Results:

- We enrolled 2,106 patients, of which 5.6% (n=118) were pediatric. Eighty-two percent of the pediatric patients were male, with a median age of 9 [Interquartile Range: 6-12] years. The mechanism of injury was blast in 43% (n=51), penetrating in 26% (n=31), blunt in 24% (n=28), and isolated burn in 9% (n=11).
- Pediatric patients were more likely to suffer blunt injuries, isolated burns, and traumatic brain injury (TBI), while adult patients were more likely to suffer blast injuries.
- A total of 295 prehospital LSIs were performed on the 118 pediatric patients, for an average of 2.5 LSIs per patient, similar to the LSI rates among adults (2.6).
- Airway and chest interventions made up the lowest percentage of LSIs performed in the prehospital setting.
- None of the pediatric casualties received wound packing with a hemostatic agent.
- Vascular access was similar between the Adult and Pediatric groups. Seventeen pediatric casualties had both IV and IO access.

- Normal saline was the most common IV fluids administered. None of the pediatric casualties received blood in the prehospital setting.
- The majority of the airway management procedures and all of the chest procedures performed on pediatric patients were deemed lifesaving by the receiving physician at the surgical facility.
- Incorrectly performed LSIs in pediatric patients were rare, with 98% (n=288 out of 295) deemed by the onsite treating physician to have been performed correctly.
- The most common incorrectly performed LSI was vascular access.
- Missed LSIs in pediatric patients were rare, with a total of 24 identified over the six year period. The most commonly missed were vascular access, and non-hemostatic wound packing. Two intubations and two nasal/oral airways were missed in the prehospital setting.
- At the surgical facility, a total of 200 lifesaving interventions were performed in the Pediatric group, for an average of 1.7 LSIs per patient, similar to the rates among adults (2.0).
- Airway interventions, chest procedures, volume replacement, and vascular access were performed at similar rates among the Pediatric and Adult population.
- Vascular access and volume replacement were the most common interventions performed on pediatric patients.

Conclusions: In our prospective study of prehospital lifesaving interventions performed on pediatric patients in a combat setting, the most common intervention was vascular access followed by hypothermia prevention and hemorrhage control. The occurrence of missed or incorrectly performed lifesaving interventions were rare.

Evidence Based Recommendations:

- Conduct further research in the use of prehospital blood products in pediatric combat casualties.
- Develop training and/or equipment development to assist medics in establishing intravenous access in pediatric casualties.
- Future research should aim to help military medical leaders determine the resources and training necessary to ensure high-quality pediatric trauma care.

Gaps Addressed: 2015 ICL: AFMS (AMC) 13 - Advanced POI and ERC Resuscitation;
2017 ICL: AFMS (AMC) 137 - Research on Advanced Point of Injury through ERC

LIST OF SYMBOLS, ABBREVIATIONS, AND ACRONYMS

DOD	Department of Defense
IRB	Institutional Review Board
JC2RT	Joint Combat Casualty Research Team
JTS	Joint Trauma System
MOI	Mechanism of Injury
LSI	Life Saving Intervention
PHTR	Prehospital Trauma Registry
TCCC	Tactical Combat Casualty Care