ANESTHESIA PROVIDER'S USE OF THE PRECORDIAL OR ESOPHAGEAL STETHOSCOPE: IS ANYONE STILL LISTENING TO THE PATIENT?

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USE OF THE PRECORDIAL OR ESOPHAGEAL STETHOSCOPE:
IS ANYONE STILL LISTENING TO THE PATIENT?

William D. Bruening, Jr.

APPROVED:

John P. McDonough, CRNA, Ed.D. — 22 JUL 96
Chair — Date

E. Jane McCarthy, CRNA, Ph.D., FAAN — 22 Jul 96
Member — Date

Regina C. Aune, RN, Ph.D. — 29 Jul 96
Member — Date

APPROVED:

Faye G. Abdellah, RN, Sc.D., Ed.D., FAAN — Date
Dean, Graduate School of Nursing

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ABSTRACT

Anesthesia Provider's Use of the Precordial or Esophageal Stethoscope:

Is Anyone Still Listening to the Patient?

by

William D. Bruening Jr.

The purpose of this study was to ascertain the utilization rate of the precordial or esophageal stethoscope among anesthesia providers. Stethoscope utilization rates were determined through the collection and analysis of both quantitative and qualitative data.

Quantitative data were collected through random observations of anesthesia providers while they provided uninterrupted anesthesia care. Anesthesiologists, Certified Registered Nurse Anesthetists (CRNA), and Student Registered Nurse Anesthetists (SRNA) comprised the group of anesthesia providers observed. Fifty observations (N=50) were conducted that not only focused on the use of a precordial or esophageal stethoscope, but also on the use of electronic monitoring equipment. Of these 50 observations an average overall stethoscope utilization rate of 68% was observed. Specifically, 0% of the anesthesiologists (n=4), 9.1% of the CRNAs (n=11), and 94.3% of the SRNAs (n=35) who were observed used a precordial or esophageal stethoscope.

Qualitative data were analyzed from five interviews conducted with randomly selected anesthesia providers. Two anesthesiologists and three CRNAs were permitted to participate in these interviews. The interview questions were designed to elicit the anesthesia provider's thoughts and feelings as they pertained to the precordial or esophageal stethoscope and to elicit responses that could be related to clinical practice.

From those anesthesia providers interviewed, 40% stated they utilized one of these specialized stethoscopes to assess a patient's respiratory and circulatory status during the administration of an anesthetic. Eighty percent of those interviewed felt it was unacceptable to discontinue the routine use of these specialized stethoscopes and 40% of those interviewed stated that they would rely on one of these stethoscopes to monitor a patient's status in the absence of electronic monitoring equipment. In actual practice, a 6.7% utilization rate of the precordial and esophageal stethoscopes was measured when 15 observations of anesthesiologists and Certified Registered Nurse Anesthetists (CRNA) were conducted.

These findings imply use of the precordial and esophageal stethoscopes by experienced anesthesia providers occurs with less frequency than does the use of electronic monitors such as the pulse oximeter or capnograph. It appears that the use of these two stethoscopes has been substituted by, rather than supplemented with, electronic monitoring equipment.

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William D. Bruening Jr., RN, BSN

THESIS

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CHAPTER ONE

INTRODUCTION

Background of the Problem

Developed in 1909 by Bowles, the stethoscope was once the primary monitoring device employed by those administering anesthetics. Cushing (1909) described "continuous auscultation of cardiac and respiratory rhythm during the entire course of anesthesia" while using a precordial stethoscope (p. 187). Smith (1954) described the construction, placement and use of an esophageal stethoscope. Dornette (1963) wrote that "the stethoscope is a vitally important part of the anesthesiologists armamentarium - in fact, the most important single device used for monitoring purposes" (p. 719).

Although data about the frequency of use of either precordial or esophageal stethoscopes by all anesthesia providers are not available, studies conducted in the 1980s indicated their use to be 70% to 87% among anesthesia residents and 24% to 65% among anesthesia staff (Kay & Neal, 1986). But the passage of time and technological advancements have led to the development of an array of monitoring devices such as pulse oximeters, capnographs, and oxygen analyzers. Anesthesia providers of present day exhibit a preference for using these advanced monitoring devices over either the precordial or esophageal stethoscope. Consequently, use of these once respected stethoscopes has dramatically declined (Gravenstein & Weinger, 1986; Webster, 1987; Orkin, 1989; Klepper, Webb, Van Der Walt, Ludbrook, & Cockings, 1993). A recent study focusing on anesthesia related mishaps in Australia reports stethoscope use during anesthetic cases to be as low as 5% in cases where incidences occurred, and this 5% use

(or roughly 65 cases) was predominantly found during pediatric cases (Klepper et al., 1993).

Prielipp, Kelly, and Roy (1995) observed the current use of either the precordial or esophageal stethoscope among anesthesia providers in three tertiary care hospitals in the United States. Anesthesiologists (both attending anesthesiology staff and anesthesiology resident physicians), Certified Registered Nurse Anesthetists (CRNA), and Student Registered Nurse Anesthetists (SRNA) formed the group of anesthesia providers who were observed. From this group, it was determined that precordial or esophageal stethoscope use was 75% among SRNAs, 30% among CRNAs, and 19% to 23% among physicians. But do these findings reflect a national trend of stethoscope usage among anesthesia providers? With the addition of a qualitative component, a replication study was conducted to answer this very question.

Rationale and Significance of the Problem

Various textbooks and journal articles advocate the use of the precordial or esophageal stethoscope (Smith, 1954; Cullen & Larson, 1974; Saidman & Smith, 1978; Reitan & Barash, 1984; Blitt, 1985; Petty, 1987; Calverly & Scheller, 1992; Eisenkraft, Neustein, & Cohen, 1992; Cook, 1992; Foster & Reeves-Viets, 1992; Stevens & White, 1994; Stoelting & Miller, 1994). Both stethoscopes provide valuable information that is imperative to assuring the delivery of a safe anesthetic. Blitt (1985) wrote that "the precordial or esophageal stethoscope should be used in all patients" (p. 25). Moreover, Blitt (1985) probably best summarized the entire debate over the use versus disuse of the precordial or esophageal stethoscope when he wrote "It is my opinion that failure to

employ a precordial or esophageal stethoscope, except in extremely unusual circumstances, constitutes a serious breach of good medical care" (p. 27). Current support for the use of a precordial or esophageal stethoscope came from Clutton-Brock and Hutton (1994) when they wrote:

> The modern place of the stethoscope has been debated, and it is difficult to find any single good reason for it not to be used routinely. Whether oesophageal or precordial it gives beat-to-beat information on heart rate, lung sounds and tidal volumes and can give information on dysrhythmias, ventilator disconnections or malfunction, wheezing and quality of heart tones and murmurs. (p. 176)

Not all the literature, however, defends the use of an esophageal stethoscope. Schwartz and Downes (1977) reported two cases where the use of esophageal stethoscopes directly contributed to inadvertent incisions into the esophagus. In the first case "an incision was made into a structure identified by palpation and thought to be the trachea. The esophageal stethoscope, however, was immediately identified by the surgeon. The esophagus was repaired, the trachea properly identified and a tracheostomy performed" (Schwartz & Downes, 1977, p. 64). In the second case, "dissection of the internal jugular vein was misguided because the stethoscope-filled esophagus was thought to be the jugular vein containing the ventriculo-jugular shunt catheter. As a result, the esophagus was inadvertently incised" (Schwartz & Downes, 1977, p. 64). In both cases the presence of esophageal stethoscopes led to misidentification of desired anatomical structures. Consequently, erroneous and potentially disastrous incisions were made. Other mishaps, which have reportedly been caused by misplaced esophageal stethoscopes, include hypoxia, possible vocal cord paralysis, and small bowel obstruction

(Pickard & Reid, 1986; Friedman & Toriumi, 1989; Eckhardt, Patafio, & Cigarroa, 1992). Are these mishaps a consequence of the use of a dangerous monitoring device (i.e., the esophageal stethoscope) or merely attributable to a lapse of prudence on the part of the surgeon or anesthesia provider? Although difficult to quantify, the lack of literature dealing with complications associated with esophageal stethoscope use would seem to support the latter inference. Therefore, from a risk versus benefit standpoint the esophageal stethoscope remains a valuable monitoring device.

Today's anesthesia providers have at their disposal a vast array of electronic monitoring devices, but in some situations the application of the basic senses of sight, hearing, and touch often enhances the best that technology has to offer. Vandam (1995) suggested that "many a complication detectable by the senses is not presently amenable to instrumental detection, or when the monitoring device makes the discovery the warning comes too late to avert a catastrophe" (p. 8). Vandam (1995) further wrote:

> Use of a precordial or esophageal stethoscope is simply an economical extension of the senses; a means to observe the respiratory pattern and the quality of the heart sounds and rhythm; and the event of accidents, such as air embolism, pulmonary interstitial emphysema, and pneumothorax. (p. 13)

The use of a precordial or esophageal stethoscope provides a direct and continuous link between the anesthesia provider and the patient. Heart tones and breath sounds are monitored continuously. Cullen and Larson (1974) explained that "it is critical to the success of monitoring, however, to adopt and apply the concept that the monitor is the anesthetist" (p. 35). In this regard, the anesthesia provider becomes the monitor responsible for interpreting the input supplied by the specialized stethoscope.

Nevertheless, the human monitor is not infallible. Thus, technological advancements should be used by the anesthesia provider whenever available. These newer monitoring devices should be used in conjunction with either the precordial or esophageal stethoscope and not in lieu of the same.

Tyler and Halcomb's study (as cited in Paget, Lambert, & Sridhar, 1981) compared the effects of auditory input alone, visual input alone, or the combination of auditory and visual input (time-shared presentation) on performance. Although they found that performance using visual input alone was better than with auditory input alone, "detection was enhanced when both modalities were presented together under the time-shared condition rather than when either stimulus presented alone" (Paget et al., 1981, p. 361). This same principle can be applied to the use of a precordial or esophageal stethoscope and electronic monitors. Electronic monitors, when used in lieu of a precordial or esophageal stethoscope, may not necessarily improve the performance of an anesthesia provider. Electronic monitoring devices, which were created to improve clinical anesthesia, may in some instances be detrimental to clinical anesthesia. Gravenstein and Weinger (1986) stated that these devices "may trick with artifacts, distract with irrelevant data, or rob the anesthetist of the motivation to observe, record, and thus appreciate, clinical data" (p. 145). However, when the information supplied by electronic monitors is combined with the information derived from a precordial or esophageal stethoscope, the anesthesia provider's circumspection is greatly enhanced. "Most analyses of collections of cases of anesthetic mishaps, malpractice claims, or death strongly implicate failures in vigilance as a primary cause of injury" (Cooper, 1984, p. 172). What better reason for an anesthesia provider to use all available tools than for the

enhancement of patient safety?

The debate continued into the 1980s over whether the precordial stethoscope, the esophageal stethoscope, electronic monitors, or a combination of devices provided the highest level of safety to a patient receiving anesthesia. The Harvard Minimal Monitoring Standards (adopted March 25, 1985 and later revised on July 3, 1985) outlined specific standards for the minute-to-minute management of anesthesia practice. Included in these guidelines were standards that addressed the issue of "continuous monitoring." It was the Harvard Standards that proposed continuous monitoring of the patient's ventilatory and circulatory status during every administration of general anesthesia. It was proposed that ventilatory status assessment should be accomplished by one of the following methods: palpation or observation of the reservoir breathing bag, auscultation of breath sounds, and monitoring of end-tidal carbon dioxide. Monitoring of end-tidal carbon dioxide became a new technological advancement in 1985. Accordingly, the Harvard Standards recognized this new technology by indicating it was the preferred method of monitoring ventilatory status. Circulatory assessment, it was proposed, should be conducted by using one of the following methods: palpation of a pulse, auscultation of heart sounds, waveform monitoring of intra-arterial pressure, or pulse plethysmography/oximetry.

With regard to the implementation of the Harvard Minimal Monitoring Standards, Eichhorn, Cooper, Cullen, Maier, Philip, and Seeman (1986) reported that:

> Among the immediate tangible impacts were that one hospital purchased more oxygen monitors so that there would always be a replacement instrument available. Another hospital provided free earpiece stethoscopes to all staff, who previously

> had to purchase their own (few did). The purchase of pulse oximeters (including one for each operating room at three hospitals) at an average of about $5000 each was a capital expense encouraged, at least in part, by the standards process. Also, from their own clinical experience, committee members believe there was a heightening of awareness about anesthesia accidents and the use of patient monitoring to prevent them. (pp. 1019-1020)

The Harvard Standards ushered electronic monitoring into the practice of anesthesia.

Morbidity and mortality rates relating to anesthesia incidents prior to the introduction of the Harvard Standards were varied. Small sample studies were used in 1985 to extrapolate morbidity and mortality rates and, because of this, actual rates were not easily or accurately estimated. Among thirteen studies conducted between 1947 and 1977, mortality rates varied widely. Eichhorn et al. (1986) concluded that of "the approximately 20 million patients anesthetized annually in the United States, 2000 or more may die of causes primarily attributable to anesthesia; the majority of these deaths are thought to be preventable" (p. 1017). These figures were estimated prior to the implementation of the Harvard Minimal Monitoring Standards and, as such, represent one anesthetic related death for each ten thousand cases performed. What impact, if any, did the Harvard Minimal Monitoring Standards have on anesthesia related morbidity and mortality figures? Eichhorn (1989) reported on anesthesia related accident and death rates collected over a 12½ year period from 1976 through mid-1988. During this time period 1,329,000 anesthetics were administered in nine component hospitals of the Harvard Department of Anesthesia. From this total, a subset of 1,001,000 American Society of Anesthesiologists Physical Status (ASA P.S.) I and II patients were identified.

Among this group of ASA P.S. 1 and 2 patients who had received an anesthetic, there were 11 anesthesia related accidents and 5 deaths reported. These figures yield rates of one anesthesia related accident per 91,000 anesthetics and one death per 200,200 anesthetics. This latter figure is similar to the findings reported by Lunn and Devlin (1987). Their study, covering a twelve month period, examined rates of death within 30 days of an operation. Each death was judged to have been caused by a single factor or multiple factors. Anesthesia, when reviewed as a single factor, accounted for one death in 185,056 anesthetics administered. (Lunn & Devlin, 1987).

Eichhorn (1989) further examined anesthesia related accident and death rates both pre and post implementation of the Harvard Minimal Monitoring Standards. From January 1976 to June 1985, 757,000 anesthetics were administered to ASA P.S. 1 and 2 patients. Ten intraoperative accidents (1:75,700) and five associated deaths (1:151,400) were reported. The Harvard Minimal Monitoring Standards were adopted in July of 1985 and data were collected from that time through June of 1988. It was reported that 244,000 anesthetics had been administered to ASA P.S. 1 and 2 patients with one intraoperative accident (1:244,000) and no associated deaths (0). Eichhorn (1989) wrote:

> Whether adoption of the Harvard minimal monitoring standards had an impact on the outcome of practice with respect to intraoperative accidents as defined for the purpose of this analysis is too early to tell. However, table 2 shows a reduction in the accident rate among ASA physical status 1 and 2 patients from 1/75,700 anesthetics to 1/244,000, a 3.22-fold decrease. Furthermore, there have been no deaths since the standards were adopted. These data are not yet statistically significant, illustrating the problem of small numerators over large denominators.

(p. 576)

The American Society of Anesthesiologists (ASA) Standards for Basic Anesthetic Monitoring, approved by the ASA on October 21, 1986 and last amended on October 13, 1993, identified guidelines for anesthesia care including general anesthesia, monitored anesthesia care (MAC), and regional anesthesia (Dripps, Eckenhoff, & Vandam, 1988). Standard II of these guidelines addresses the monitoring of ventilation and circulation mandating that every patient receiving general anesthesia shall have the adequacy of ventilation continuously (i.e., repeated regularly and in rapid steady succession) monitored. Although qualitative monitoring, which includes auscultation of breath sounds, chest excursion, and observation of the reservoir breathing bag, meets this requirement, quantitative monitoring of the expired carbon dioxide content and/or volume of expired gas is encouraged. This standard also states that for the patient receiving MAC or a regional anesthetic the ventilatory status shall be assessed by continual observation of qualitative clinical signs. Circulatory function also requires continual monitoring by the anesthesia provider. Monitoring of circulatory function can be performed by at least one of the following: palpation of a pulse, auscultation of heart tones, monitoring of an intra-arterial pressure tracing, ultrasound peripheral pulse monitoring, oximetry or pulse plethysmography. Therefore, an anesthesia provider need not utilize either a precordial or esophageal stethoscope to comply with the monitoring standards adopted by the ASA. This is quite a change from twenty years ago when the stethoscope was considered "vitally important" in the practice of anesthesia (Dornette, 1963, p. 719) .

In January of 1990 the American Association of Nurse Anesthetists (AANA)

established Guidelines for Nurse Anesthesia Practice. Standard V of these guidelines addressed the continuous monitoring of ventilation and circulation during the administration of an anesthetic. These original guidelines mandated continuous auscultation of breath sounds. Spirometry, ventilatory pressure monitors, and other qualitative ventilatory devices could be used in conjunction with auscultation to assess the adequacy of ventilation. Digital palpation of the pulse, auscultation of heart tones, pulse oximetry, or continuous intra-arterial pressure monitoring could be used to assess the patient's circulation. These monitoring standards, as set forth by the AANA in 1990, required the CRNA to use a precordial or esophageal stethoscope when administering an anesthetic. However, these original AANA monitoring standards were revised effective October 1, 1992. The revised standards mandate that controlled or assisted ventilation, during the administration of an anesthetic, shall be continuously monitored with an end-tidal carbon dioxide monitor. No longer does the AANA monitoring standards recommend or encourage the "continuous auscultation of breath sounds." The revised guidelines for assessment of circulatory function remained unchanged. These 1992 revisions to the AANA Patient Monitoring Standards more closely resemble the monitoring guidelines as set forth by the ASA. Following these changes, the precordial and esophageal stethoscopes have become optional monitoring devices as opposed to mandatory monitoring devices.

Both the ASA Standards for Basic Anesthetic Monitoring and the AANA Guidelines for Nurse Anesthesia Practice were created and implemented to ensure the safety of a patient receiving anesthesia. These standards and guidelines were put in place to enhance the vigilance of the anesthesia provider. Vigilance is defined as "alertness;

watchfulness in guarding against danger or providing for safety" (New Illustrated Webster's Dictionary, 1994) The use of a precordial or esophageal stethoscope during the delivery of care is an indication of vigilance. The use of precordial and esophageal stethoscopes have appeared in previous studies that examined the vigilance of anesthesia providers (Gravenstein & Weinger, 1986; Kay & Neal, 1986; Cooper & Cullen, 1990; Loeb, 1993). In these studies the primary measurement was the vigilance of the anesthesia provider and not stethoscope use, although stethoscope use was reported as secondary data. The use of stethoscopes in these studies was measured to rate the degree of vigilance of the anesthesia providers. Unlike those, this study provides an actual measure of the use of either the precordial or esophageal stethoscope. Perhaps vigilance, as previously stated, was being indirectly measured in this study as well. This area was not explored further since the issue of vigilance was not the primary focus of this study.

Textbooks expound upon their value. Institutions involved in the instruction of anesthesia to physicians and registered nurses advocate the use of the precordial or esophageal stethoscope to help cultivate a "ventilator ear" (Petty, 1987, p. 192). Yet standards and guidelines written by the ASA and the AANA do not detail the use of the precordial or esophageal stethoscope.

As with the study conducted by Prielipp et al. (1995) which looked solely at the use of the precordial or esophageal stethoscope, the quantitative aspect of this study, as a replication, also focused on precordial or esophageal stethoscope use. The qualitative aspect of this study attempted to answer the why question; why is the precordial or esophageal stethoscope either used or rejected by the anesthesia provider?

Anesthesia providers in the military have access to, for the most part, the full array

of present day electronic monitoring devices. In this regard the practice of anesthesia is no different in the military setting than it is in the civilian sector. Despite this similarity, a major difference does exist. Military anesthesia providers may be dispatched to unfamiliar and austere locations during periods of war, conflict, or humanitarian missions. The electronic monitoring equipment found in the operating room may not be dispatched with the anesthesia provider. Replacement monitoring equipment is not always readily available should the dispatched equipment incur damage or simply cease to function properly. The precordial stethoscope and the esophageal stethoscope contain no moving parts, no electronic components, and they require no electricity. These monitoring devices can be used in any setting and in any environmental condition. The precordial and esophageal stethoscope, in the absence of electronic monitoring devices, gives the anesthesia provider valuable patient information necessary to ensure the safe administration of an anesthetic. The prudent anesthesia provider in the military uses either the precordial or esophageal stethoscope in addition to whatever other electronic monitoring devices are available. Proper use of either of these two stethoscopes is a learned skill that requires a "trained ear" in order to promptly and accurately detect subtle cardiac and respiratory abnormalities. Frequent, if not continual, use of these devices allows the military anesthesia provider to maintain this learned skill and level of expertise.

Statement of the Problem

Recent literature, with the exception of the study being replicated, fails to identify current trends relating to the use of the precordial or esophageal stethoscope within

today's anesthesia arena. The purpose of this study was to examine the frequency of precordial or esophageal stethoscope use among practicing anesthesia providers - anesthesiologists, CRNAs, and SRNAs.

Major Research Questions

Quantitative and qualitative research was conducted for this study. The quantitative portion replicates the work of Prielipp et al. (1995). "What is the frequency of use of precordial or esophageal stethoscopes by anesthesia providers?" was the major quantitative research question. Concurrently, qualitative data were collected from anesthesia providers regarding use of the precordial or esophageal stethoscope. The following information was obtained with each interview:

Demographic Data:

1. Qualifications of anesthesia provider (e.g., anesthesiologist versus CRNA). Educational background of the CRNA interviewee (i.e., Nurse Anesthesia certificate, Bachelor's degree, Master's degree).
2. Number of years in providing anesthesia care.
3. Number of years of active duty service in a Uniformed Service or as a member of a Reserve or National Guard unit. Number of years providing anesthesia care while serving in a Uniformed Service, Reserve, or National Guard unit.
4. Amount of time deployed to another country to provide anesthesia care.

The following questions were asked during each interview:

1. How, if ever, were you trained in the use of either the precordial or esophageal

stethoscope?

2. What are your thoughts on the routine use of either of these two stethoscopes?
3. In the majority of cases, how do you now assess breath sounds and heart tones?
4. Why do you employ this/these technique(s)?
5. At what point in your career do you feel it is acceptable, if indeed you feel it is acceptable, to discontinue the routine use of either a precordial or esophageal stethoscope during the administration of an anesthetic?
6. If electronic monitors were not available, how would you monitor the patient's status during the administration of an anesthetic?
7. In your opinion, what is the best patient monitor for use during the administration of anesthesia and why did you make this selection?
8. Do you have any closing comments or statements?

Conceptual Framework

Prielipp et al. (1995) does not cite a conceptual framework or theory upon which their study was based. Results of their study indicate that SRNAs use precordial or esophageal stethoscopes, on the average, 75% of the time (Prielipp et al., 1995). The CRNAs use these devices 30% of the time (Prielipp et al., 1995). Patricia Benner's conceptual model of expert practice may be useful in helping to explain the disproportionate use of precordial and esophageal stethoscopes among novice (i.e., SRNA) and experienced (i.e., CRNA, anesthesiologists) anesthesia providers. In her model Benner characterizes five stages of skill acquisition (Benner, 1984). Individuals at the first stage are identified as "novices." Benner (1984) describes the performance

characteristics of this group as follows:

> The rule-governed behavior typical of the novice is extremely limited and inflexible. The heart of the difficulty lies in the fact that since novices have no experience of the situation they face, they must be given rules to guide their performance. (p. 21)

This description, coupled with the fact that SRNAs are required to use either a precordial or esophageal stethoscope while in training, helps to clarify the 75% SRNA utilization rate ascertained by Prielipp et al.(1995). The second, third, and fourth stages of skill acquisition, as described by Benner (1984), are intermediate levels and of minor importance to the conceptual framework of this study. The fifth stage, or "expert" level, is one in which the "expert performer no longer relies on an analytic principle [rule, guideline, maxim] to connect her or his understanding of the situation to an appropriate action" (Benner, 1984, p. 31). The individual has an intuitive awareness of the situation and couples this understanding with an appropriate action. As in the case of the CRNA, experiential background with electronic monitors may lead to the decreased use of precordial or esophageal stethoscopes. The data presented by Prielipp et al. supports the application of Benner's theory.

Definitions

This study focused on the use of either the precordial stethoscope or the esophageal stethoscope exclusively. Use of a standard medical stethoscope in anesthesia practice was not included in this study. The following criteria must have been met to establish actual use of the precordial or esophageal stethoscope:

1. Proper stethoscope placement
    a. Precordial stethoscope: Placed at the supraclavicular notch or at the apex of the left lung.
    b. Esophageal stethoscope: Inserted into the esophagus following endotracheal intubation.
2. Actual use of the earpiece
    a. Precordial or esophageal stethoscope connected with tubing to an earpiece.
    b. Earpiece (monaural) located in the anesthesia provider's external auditory meatus.

The following criteria relates to the use of supplemental electronic monitoring devices:

1. Pulse oximeter
    a. On: The pulse oximeter's power switch is in the on position and the monitoring probe is attached to the patient (i.e., finger, toe, ear).
    b. Off: The pulse oximeter's power switch is in the off position or the monitoring probe is not attached to the patient.
2. Audible alarm on the pulse oximeter
    a. On: The alarm on the pulse oximeter is active and an auditory warning tone is produced when the patient's oxygenation values fall below preset levels.
    b. Off: The alarm on the pulse oximeter has been silenced, whereas no auditory warning tone is produced when the patient's oxygenation values fall below preset levels.
3. Waveform on the capnograph is visible

a. Yes: A capnograph waveform is generated as the patient's expired carbon dioxide is captured and measured.

b. No: A capnograph waveform is not generated although the means to capture and measure the patient's expired carbon dioxide are being used.

c. NA: A capnograph waveform is not generated since the means to capture and measure the patient's expired carbon dioxide are not being used (i.e., spontaneous respiration without supplemental oxygen).

Assumptions and Limitations

Prielipp et al. (1995) collected their data from three hospitals with a combined 1,900 bed capacity and 57 operating rooms. A total of 520 observations were made at these institutions. A total of 274 anesthesiologists, resident physicians, CRNAs, and SRNAs were observed.

Limitations of this replication study includes: 1) the sample size, 2) the site of data collection, and 3) the number and composition of anesthesia providers being observed. This study was designed with a predetermined sample size of fifty. Selection of this sample size was made for both convenience sake and because of the novice status of the researcher. All observations were made in one 350 bed facility with 8 operating rooms. Resident physicians were not employed by the institution which served as the data collection site. A total of 18 anesthesiologists, CRNAs, and SRNAs were observed. Consequently, it was often an unavoidable limitation of this study that during the period of data collection certain anesthesia providers were observed more than once.

Mandatory clinical training guidelines required the SRNA to use a precordial or

esophageal stethoscope with each anesthetic he or she administered. Based on this requirement, and prior to data collection, it was postulated that the SRNA subsample would have a higher frequency of use of these stethoscopes than might otherwise be expected. This higher frequency of stethoscope use by the SRNAs had the potential to impact the average overall stethoscope use values and was, therefore, identified as a limitation of this study. Nevertheless, it was believed that the data would reflect a low rate of stethoscope use among the remaining anesthesia providers who were observed.

Summary

Historically the stethoscope has proven to be a reliable monitor of a patient's respiratory and circulatory status. Adapted for use by anesthesia providers, the precordial and esophageal stethoscopes have also served as reliable monitors of anesthetized patients' respiratory and circulatory status. Current standards of anesthesia monitoring created by the ASA and the AANA do not require the continuous use of these two stethoscopes. The purpose of this study, through the collection of quantitative and qualitative data, was to determine the frequency of use of the precordial and esophageal stethoscope by anesthesia providers.

CHAPTER TWO

REVIEW OF THE LITERATURE

Introduction to the Review of the Literature

In reviewing applicable literature, one finds editorials, journal articles, and textbook chapters that support the use of the precordial or esophageal stethoscope. However, few studies have been conducted that examine the actual use of these monitoring devices by anesthesia providers. This chapter will discuss these relevant studies and review the data which were obtained.

Review of the Literature

In a review of the literature from 1986-1996 little data pertaining to the actual use of precordial or esophageal stethoscopes among anesthesia providers could be found. Studies have been conducted using these devices as testing instruments to obtain information about vigilance of anesthesia providers. In two studies (Kay & Neal, 1986; Cooper & Cullen, 1990) the stethoscope's tubing was covertly clamped and the time period required for detection by the anesthesia provider was measured. While the results of these two studies are not relevant to this particular study, demographic data obtained by Kay and Neal are. Kay and Neal (1986) observed two groups of anesthesia residents who were administering anesthesia. These observations were made at separate institutions over a period of three consecutive days. Data collected during these observations revealed that the percentage of residents using a precordial or esophageal stethoscope averaged 87% in one group and 70% in the other.

More recently, two studies examined precordial or esophageal stethoscope use

among anesthesia providers (Klepper et al., 1993; Prielipp et al., 1995). The first study examined stethoscope use indirectly, while the second study directly observed stethoscope use. The purpose of the study conducted by Klepper et. al (1993) was to examine the relevance of stethoscope use. Klepper et al. (1993) extracted their data from incidents reported to the Australian Incident Monitoring Study (AIMS). Reports were made to AIMS on a voluntary, anonymous basis for any unintended incident which actually reduced, or had the potential to reduce, the safety margin to the patient. Initially two thousand incidents were selected and reviewed by the research team. From this total it was determined that 1256 incidents were applicable to their study. Klepper et al. (1993) identified 1099 incidents, from among the 1256 incidents, where a precordial or esophageal stethoscope could have been used. Results of their study indicated that use of these stethoscopes occurred in 65 of the 1256 incidents (5%). Analysis of the 1256 incidents found that the use of a precordial or esophageal stethoscope "could have detected 54% of the 1256 applicable incidents (almost 25% before any potential for organ damage)" (Klepper et al., 1993, p. 576). The study by Prielipp et al. (1995), which the study herein replicates, examined the actual frequency of precordial or esophageal stethoscope use by anesthesia providers at three separate institutions. The collection of data from these sites enabled the formulation of comparisons and conclusions. The results of their study, with its three sites of data collection, allow for more generalization to the practice of anesthesia than if one site had been used. Anesthesiologists, resident physicians, CRNAs, and SRNAs were observed in their study which strengthens any generalization based upon the study.

Summary

Little research has been conducted examining the actual use of the precordial or esophageal stethoscope. Current trends indicate a decline in their use (Klepper et al., 1993; Prielipp et al., 1995). Use of these stethoscopes could augment electronic monitoring devices and aid in identifying undesirable anesthesia incidents (Klepper et al., 1993).

CHAPTER THREE

METHODOLOGY

Introduction

This study includes aspects of both quantitative and qualitative research methods. Data relating to the quantitative portion were obtained by observing anesthesia providers in action. Data relating to the qualitative portion were obtained by interviewing a sample of these same anesthesia providers. A copy of this proposal was sent to the Institutional Review Boards (IRB) of both the institution where the observations were conducted and the Uniformed Services University of the Health Sciences for review and approval prior to data collection.

Sample

The study was conducted at a 350 bed community hospital in a northeastern city. As a whole the anesthesia department supports 8,000 cases a year of which 40% are general anesthesia, 40% MAC, and 20% regional anesthesia. Five anesthesiologists and nine CRNAs comprised the Department of Anesthesia at the time of the study. Anesthesiology resident physicians were not used at this facility.

Prielipp et al. (1995) observed 56 cases involving SRNAs and found that the precordial or esophageal stethoscope was used 75% of the time. Since June of 1995 four SRNAs have used this study's facility as a primary training site. Prior to this class, SRNAs had not used this site for clinical education since 1980. These current SRNAs, as part of mandatory clinical training guidelines, were required to use either a precordial or esophageal stethoscope with each anesthetic he or she administered. Ideally the SRNA

should use either the precordial or esophageal stethoscope 100% of the time with each anesthetic case. However, the SRNA stethoscope use results obtained by Prielipp et al. (1995) did not reflect 100% stethoscope use. This researcher felt it necessary to observe SRNAs as part of this study to arrive at an actual stethoscope utilization rate as opposed to an "ideal" stethoscope utilization rate. A percentage of use for each provider category, along with an overall average use percentage, was calculated after observing anesthesiologists, CRNAs, and SRNAs.

Instrumentation

As with the study being replicated (Prielipp et al., 1995) the following items were observed and results recorded on self-designed charts (Appendices A, B, and C). These charts included:

1. Anesthetic type
    a. General
    b. Monitored anesthesia care (MAC)
    c. Regional
2. Stethoscope in use
    a. Precordial
    b. Esophageal
    c. Neither
3. Supplemental monitoring equipment
    a. Pulse oximeter
        1.) On

2.) Off

b. Audible alarm on the pulse oximeter

1.) On

2.) Off

c. Waveform on the capnograph visible

1.) Yes

2.) No

3.) NA (not applicable)

4. Anesthesia Provider

a. Anesthesiologist

b. Certified Registered Nurse Anesthetist (CRNA)

c. Student Registered Nurse Anesthetist (SRNA)

With each case observed, an "X" was placed in each applicable box on the data collection chart. After fifty observations had been completed, the results for each area were totaled and overall percentages calculated. To preserve uniformity of data collection, all observations were made by the primary researcher.

Quantitative Data Collection

Quantitative data were collected in the following manner. Fifty anesthetic cases were observed over a one month period. As stated previously, the anesthesia department of the institution studied provided services for general anesthesia, MAC, and regional anesthesia. The ratios for each of these anesthetic techniques were approximately 40% general, 40% MAC, and 20% regional. Accordingly, the sample of 50 observed

anesthetic cases for this study was based on these ratios with the break down as follows: 20 observed general anesthesia cases, 20 observed MAC cases, and 10 observed regional cases. These observations were conducted on a first-availability basis until all the required observations for each anesthetic technique had been completed. The anesthesia department was staffed from 7:00 a.m. to 11:00 p.m. daily Monday through Friday. The cases observed took place during these times only (e.g., no weekend or "after hours" emergency cases were included). All anesthesiologists, CRNAs, and SRNAs had an equal chance of being observed while administering anesthesia in this study. Observations were conducted in a manner so that anesthesia providers were not aware that observations were taking place. Before any data were collected, anesthesia providers were briefed as to the nature and purpose of this study. A departmental staff meeting was scheduled six weeks prior to initiation to introduce this study and answer any questions the anesthesia staff might have. In addition to the staff meeting, an informational letter pertaining to this study was disseminated to all the staff within the anesthesia department explaining the purpose of the study, although specific methodologies were not divulged.

Qualitative Data Collection

Qualitative data were obtained by interviewing five anesthesia providers. Interviews were conducted five months after the quantitative data were collected. Only anesthesiologists or CRNAs participated in these interviews, as SRNAs were required to use the precordial or esophageal stethoscopes.

Anesthesia provider's willingness to participate in the interview process was ascertained beforehand. From the eight anesthesia providers who were willing to

participate, five anesthesia providers were selected for this portion of the study. The anesthesia staff mix at the institution under study was five anesthesiologists and nine CRNAs. In keeping with this staffing ratio, a random and blinded selection of two anesthesiologists and three CRNAs was performed. Names were selected by a disinterested third party who had no affiliation to the institution or the research team. The purpose of this study was again reviewed with each of the five participants. A signed informed consent was obtained from each participant prior to conducting the interview with the individual (Appendix D). Each interview, in an effort to maintain continuity, was conducted and taped by the primary researcher. These interviews were then transcribed by an individual independent of the research group. From these taped interviews and written transcripts a theme (or themes) was formulated. The tapes, transcripts, and any identified themes were then reviewed and discussed with an accomplished qualitative researcher in an attempt to qualify these findings. Confidentiality of the participants was protected in that no names were used in taped interviews or written transcripts. Only the primary researcher had access to the signed informed consents. The following information was obtained in each interview:

Demographic Data:

1. Qualifications of anesthesia provider (e.g., anesthesiologist versus CRNA). Educational background of the CRNA interviewee (i.e., Nurse Anesthesia certificate, Bachelor's degree, Master's degree).
2. Number of years in providing anesthesia care.
3. Number of years of active duty service in a Uniformed Service or as a member of a Reserve or National Guard unit. Number of years providing

anesthesia care while serving in a Uniformed Service, Reserve, or National Guard unit.

4. Amount of time deployed to another country to provide anesthesia care.

The following questions were asked during each interview:

1. How, if ever, were you trained in the use of either the precordial or esophageal stethoscope?
2. What are your thoughts on the routine use of either of these two stethoscopes?
3. In the majority of cases, how do you now assess breath sounds and heart tones?
4. Why do you employ this/these technique(s)?
5. At what point in your career do you feel it is acceptable, if indeed you feel it is acceptable, to discontinue the routine use of either a precordial or esophageal stethoscope during the administration of an anesthetic?
6. If electronic monitors were not available, how would you monitor the patient's status during the administration of an anesthetic?
7. In your opinion, what is the best patient monitor for use during the administration of anesthesia and why did you make this selection?
8. Do you have any closing comments or statements?

Summary

This chapter has outlined data collection procedures used in this study. Quantitative data pertaining to the use of either the precordial or esophageal stethoscope was collected by observing fifty anesthetic cases. Anesthesiologists, CRNAs, or SRNAs were observed during this portion of the study. Areas which were

observed are included in Appendices A, B, and C.

Qualitative data were collected from interviews conducted with two randomly selected anesthesiologists and three randomly selected CRNAs. The information obtained from these interviews was recorded, transcribed, and reviewed with an accomplished qualitative researcher in order to provide precise content and theme interpretation. The questions asked of each participant have been included in this chapter.

CHAPTER FOUR

PRESENTATION OF DATA

Collected Data

This study includes both quantitative and qualitative data. The purpose of this chapter is to present the collected data for this study. Discussion and interpretation of the data will take place in Chapter Five.

Quantitative Data

Quantitative data were gathered by a single observation of anesthesia staff while they were in the process of administering uninterrupted anesthetic care. These observations were conducted during one month in a moderate sized northeastern hospital. During the period of data collection, it was often an unavoidable limitation of this study that certain anesthesia providers were observed more than once. These multiple observations had the potential to impact upon the final analysis. However, the end results seem to demonstrate a consistency of stethoscope use or disuse and it is felt that the actual impact is negligible. As originally planned, a total of 50 observations were made. The availability of the primary researcher to conduct observations, as well as the relevance of the anesthetic technique to the study, were factors in attaining this convenience sample. The breakdown of these 50 observations was as follows: 20 general anesthesia cases, 20 MAC cases, and 10 regional anesthesia cases. In addition to the three types of anesthetic technique observed, all types of anesthesia provider (i.e., anesthesiologists, CRNA, SRNA) were observed during this portion of the study. The observational data will be presented in the following order: 1) overall synopsis of the

data collected, 2) data based upon anesthetic technique, and 3) data based upon the type of anesthesia provider.

Overall utilization results of the precordial and esophageal stethoscopes were 68%. However, this figure is deceptive when the stethoscope utilization rate for each type of anesthesia provider is examined (Table 1). The number of cases observed for each type of anesthesia provider are not equivalent. Nevertheless, these case observation numbers accurately represent who was providing primary anesthetic care to patients during the period of time in which the data were collected (i.e., SRNAs were providing the most anesthetic care while anesthesiologists were providing the least). It is believed that even if the observed case numbers for each type of anesthesia provider had been equivalent, the results would have been similar to the data presented here. Anesthesiologists used the precordial and esophageal stethoscopes the least (0%), CRNAs ranked second (9.1%), and the SRNAs ranked first (94.3%) from among the three types of anesthesia providers observed.

The study results of precordial and esophageal stethoscope use, based upon anesthetic technique are presented in the following order: 1) the 50 cases , 2) the 20 general anesthesia cases , 3) the 20 MAC cases, and 4) the 10 regional anesthesia cases.

As shown in Table 2, observations of general anesthesia, MAC, and regional anesthesia were consolidated to elicit the required sample size. Of these 50 total cases, the precordial stethoscope was used in 22 cases (44%) while the esophageal stethoscope was used in 12 (24%). In 16 cases neither of these stethoscopes was used (32%). To gather data regarding electronic monitor use during the administration of an anesthetic, use of the pulse oximeter and capnograph was observed. The pulse oximeter was on

Table 1

Precordial and Esophageal Stethoscope Use Per Anesthesia Provider and Anesthetic Technique

	Anesthesiologist		Certified Registered Nurse Anesthestist (CRNA)		Student Registered Nurse Anesthetist (SRNA)		Row Totals	
	# Cases observed	# / % stethoscope use	# Cases observed	# / % stethoscope use	# Cases observed	# / % stethoscope use	# Cases observed	# / % stethoscope use
GENERAL ANESTHESIA	1	0 / 0%	5	1 / 20%	14	13 / 92.9%	20	14 / 70%
MONITORED ANESTHESIA CARE (MAC)	0	-	4	0 / 0%	16	15 / 93.8%	20	15 / 75%
REGIONAL ANESTHESIA	3	0 / 0%	2	0 / 0%	5	5 / 100%	10	5 / 50%
COLUMN TOTALS	**4**	**0 / 0%**	**11**	**1 / 9.1%**	**35**	**33 / 94.3%**	**50**	**34 / 68%**

in all 50 of the cases observed (100%). The audible alarm on the pulse oximeter was on in 49 observations (98%) and off in 1 (2%). To generate a waveform on the capnograph, some method of capturing and analyzing the patient's expired carbon dioxide must be used. Administration of supplemental oxygen, through either a face mask or nasal cannula provides anesthesia providers the means to capture and analyze expired carbon dioxide. Two observations were made in which the waveform on the capnograph was not visible. In both instances the patient was not receiving supplemental oxygen and, thus, no means were available to generate a waveform on the capnograph. Subsequently, these two observations met the criteria for non-applicability. The waveform on the capnograph was visible in 45 of the 48 applicable observations (94%). In 3 of the 48 applicable observations, the ability to measure expired carbon dioxide was being used, but the waveform on the capnograph was still not visible (6%).

Twenty general anesthesia cases were observed for this study (Table 3). The precordial stethoscope was used in 2 cases (10%), while the esophageal stethoscope was used in 12 (60%). The combined use of these two stethoscopes was 70%. The esophageal stethoscope has the added ability of monitoring body temperature following connection to an electrical monitor. It is possible that an esophageal stethoscope had been inserted during each of the 20 observed general anesthetic cases because of its ability to monitor body temperature. However, in 6 cases the anesthesia provider who was observed did not have the esophageal stethoscope's monaural earpiece in place as the study criteria outlines. Therefore, a 30% nonutilization rating was measured. The pulse oximeter was on during the 20 general anesthesia case observations (100%). The audible alarm on the pulse oximeter was on during these 20 observations also (100%). The

Table 2

Precordial and Esophageal Stethoscope Use Per Anesthetic Technique

OBSERVATION CRITERIA	GENERAL ANESTHESIA	MONITORED ANESTHESIA CARE (MAC)	REGIONAL ANESTHESIA	TOTAL # / %
1. Case breakdown	20	20	10	50
2. Stethoscope in use				
Precordial	2	15	5	22 / 44%
Esophageal	12	0	0	12 / 24%
Neither Stethoscope	6	5	5	16 / 32%
3. Supplemental monitoring equipment				
a. Pulse oximeter				
ON	20	20	10	50 / 100%
OFF	0	0	0	0 / 0%
b. Audible alarm on the pulse oximeter				
ON	20	19	10	49 / 98%
OFF	0	1	0	1 / 2%
c. Waveform on the capnograph				
YES	19	18	8	45 / 94% *
NO	1	2	0	3 / 6% *
NA	0	0	2 **	2 **

* Percentage based upon 48 applicable case observations.

** No supplemental oxygen being administered. Unable to obtain capnograph waveform.

waveform on the capnograph was visible in 19 of 20 cases (95%) and not visible in 1 (5%).

Twenty MAC cases were observed (Table 4). The esophageal stethoscope is not used during MAC cases since the patient does not undergo endotracheal intubation. Therefore, as would be expected, esophageal stethoscope usage was 0%. The precordial stethoscope was used in 15 cases of the 20 observed (75%) and absent in 5 (25%). The pulse oximeter was on during 20 MAC cases (100%). The audible alarm on the pulse oximeter was on in 19 (95%) observations and off in 1 (5%). The waveform on the capnograph was visible in 18 cases (90%) and not visible in 2 (10%).

Ten regional anesthesia cases were observed for this study (Table 5). As with MAC cases, esophageal stethoscope use is not suited for this type of anesthetic technique due to the absence of endotracheal intubation. Of the 10 regional anesthesia cases observed, the precordial stethoscope was used in 5 (50%). The pulse oximeter was on in 10 cases (100%). The audible alarm on the pulse oximeter was on in 10 cases (100%). The waveform on the capnograph was visible in 8 of the 10 cases. As was previously explained, no supplemental oxygen was being administered during the 2 cases in which the waveform on the capnograph was not visible. Consequently, these observations were deemed not applicable for this portion of the study. An overall rating of 100% was assigned to this category based upon the observation of 8 capnograph waveforms from 8 applicable observations.

The study results of precordial and esophageal stethoscope use based upon the type of anesthesia provider will be presented in the following manner: 1) results based upon the observations of anesthesiologists, 2) results based upon the observations of CRNAs,

Table 3

Precordial and Esophageal Stethoscope Use During General Anesthesia

OBSERVATION CRITERIA	ANESTHESIOLOGIST	CERTIFIED REGISTERED NURSE ANESTHETIST (CRNA)	STUDENT REGISTERED NURSE ANESTHETIST (SRNA)	TOTAL # / %
1. Case breakdown	1	5	14	20
2. Stethoscope in use				
Precordial	0	0	2	2 / 10%
Esophageal	0	1	11	12 / 60%
Neither Stethoscope	1	4	1	6 / 30%
3. Supplemental monitoring equipment				
a. Pulse oximeter				
ON	1	5	14	20 / 100%
OFF	0	0	0	0 / 0%
b. Audible alarm on the pulse oximeter				
ON	1	5	14	20 / 100%
OFF	0	0	0	0 / 0%
c. Waveform on the capnograph				
YES	1	5	13	19 / 95%
NO	0	0	1	1 / 5%
NA	0	0	0	0 / 0%

Table 4

Precordial and Esophageal Stethoscope Use During Monitored Anesthesia Care (MAC)

OBSERVATION CRITERIA	ANESTHESIOLOGIST	CERTIFIED REGISTERED NURSE ANESTHETIST (CRNA)	STUDENT REGISTERED NURSE ANESTHETIST (SRNA)	TOTAL # / %
1. Case breakdown	0	4	16	20
2. Stethoscope in use				
Precordial	0	0	15	15 / 75%
Esophageal	0	0	0	0 / 0 %
Neither Stethoscope	0	4	1	5 / 25%
3. Supplemental monitoring equipment				
a. Pulse oximeter				
ON	0	4	16	20 / 100%
OFF	0	0	0	0 / 0%
b. Audible alarm on the pulse oximeter				
ON	0	3	16	19 / 95%
OFF	0	1	0	1 / 5%
c. Waveform on the capnograph				
YES	0	4	14	18 / 90%
NO	0	0	2	2 / 10%
NA	0	0	0	0 / 0%

Table 5

Precordial and Esophageal Stethoscope Use During Regional Anesthesia

OBSERVATION CRITERIA	ANESTHESIOLOGIST	CERTIFIED REGISTERED NURSE ANESTHETIST (CRNA)	STUDENT REGISTERED NURSE ANESTHETIST (SRNA)	TOTAL # / %
1. Case breakdown	3	2	5	10
2. Stethoscope in use				
Precordial	0	0	5	5 / 50%
Esophageal	0	0	0	0 / 0%
Neither Stethoscope	3	2	0	5 / 50%
3. Supplemental monitoring equipment				
a. Pulse oximeter				
ON	3	2	5	10 / 100%
OFF	0	0	0	0 / 0%
b. Audible alarm on the pulse oximeter				
ON	3	2	5	10 / 100%
OFF	0	0	0	0 / 0%
c. Waveform on the capnograph				
YES	1	2	5	8 / 100% *
NO	0	0	0	0 / 0%
NA	2 **	0	0	2 **

* Percentage based upon 8 applicable case observations.

** No supplemental oxygen being administered. Unable to obtain capnograph waveform.

and 3) results based upon the observations of SRNAs.

Anesthesiologists were the primary anesthesia providers in four cases which were observed; one general anesthesia case with regional anesthesia cases constituting the remaining three (Table 6). Neither the precordial nor the esophageal stethoscope was used in any of these cases (0%). The pulse oximeter was on during the four observations (100%). The audible alarm on the pulse oximeter was on during four observations (100%). Supplemental oxygen was not administered for two of the regional anesthesia cases observed. A waveform on the capnograph, therefore, could not be obtained. These two cases were deemed not applicable to this portion of the study. Of the two remaining applicable observations, a waveform on the capnograph was visible (100%).

CRNAs were the primary anesthesia providers in 11 cases; 5 general anesthesia cases, 4 MAC cases, and 2 regional anesthesia cases (Table 7). The precordial stethoscope was not used in any of the cases observed (0%). The esophageal stethoscope was used in one case (9.1%). The overall results of stethoscope use by the CRNA was 9.1%. The pulse oximeter was on in 11 of the 11 observations made (100%). The audible alarm on the pulse oximeter was on in 10 of the 11 observations made (91.9%) and off in 1 (9.1%). The final item was the visibility of the waveform on the capnograph which was visible in 11 cases of the 11 observations (100%).

SRNAs administered anesthesia for 35 of the cases observed; 14 general anesthesia cases, 16 MAC cases, and 5 regional anesthesia cases (Table 8). Either an anesthesiologist or a CRNA had oversight of the student during each anesthetic procedure they performed. Precordial stethoscopes were used in 2 general anesthesia cases, 15 MAC cases, and 5 regional anesthesia cases for a total of 22 of the 35

Table 6

Precordial and Esophageal Stethoscope Use by Anesthesiologists

OBSERVATION CRITERIA	GENERAL ANESTHESIA	MONITORED ANESTHESIA CARE (MAC)	REGIONAL ANESTHESIA	TOTAL # / %
1. Case breakdown	1	0	3	4
2. Stethoscope in use				
Precordial	0	0	0	0 / 0%
Esophageal	0	0	0	0 / 0%
Neither Stethoscope	1	0	3	4 / 100%
3. Supplemental monitoring equipment				
a. Pulse oximeter				
ON	1	0	3	4 / 100%
OFF	0	0	0	0 / 0%
b. Audible alarm on the pulse oximeter				
ON	1	0	3	4 / 100%
OFF	0	0	0	0 / 0%
c. Waveform on the capnograph				
YES	1	0	1	2 / 100% *
NO	0	0	0	0 / 0%
NA	0	0	2 **	2 **

* Percentage based upon 4 applicable case observations.

** No supplemental oxygen being administered. Unable to obtain capnograph waveform.

Table 7

Precordial and Esophageal Stethoscope Use by Certified Registered Nurse Anesthetists (CRNA)

OBSERVATION CRITERIA	GENERAL ANESTHESIA	MONITORED ANESTHESIA CARE (MAC)	REGIONAL ANESTHESIA	TOTAL # / %
1. Case breakdown	5	4	2	11
2. Stethoscope in use				
Precordial	0	0	0	0 / 0%
Esophageal	1	0	0	1 / 9.1%
Neither Stethoscope	4	4	2	10 / 91.9%
3. Supplemental monitoring equipment				
a. Pulse oximeter				
ON	5	4	2	11 / 100%
OFF	0	0	0	0 / 0%
b. Audible alarm on the pulse oximeter				
ON	5	3	2	10 / 91.9%
OFF	0	1	0	1 / 9.1%
c. Waveform on the capnograph				
YES	5	4	2	11 / 100%
NO	0	0	0	0 / 0%
NA	0	0	0	0 / 0%

Table 8

Precordial and Esophageal Stethoscope Use by Student Registered Nurse Anesthetists (SRNA)

OBSERVATION CRITERIA	GENERAL ANESTHESIA	MONITORED ANESTHESIA CARE (MAC)	REGIONAL ANESTHESIA	TOTAL # / %
1. Case breakdown	14	16	5	35
2. Stethoscope in use				
Precordial	2	15	5	22 / 62.9%
Esophageal	11	0	0	11 / 31.4%
Neither Stethoscope	1	1	0	2 / 5.7%
3. Supplemental monitoring equipment				
a. Pulse oximeter				
ON	14	16	5	35 / 100%
OFF	0	0	0	0 / 0%
b. Audible alarm on the pulse oximeter				
ON	14	16	5	35 / 100%
OFF	0	0	0	0 / 0%
c. Waveform on the capnograph				
YES	13	14	5	32 / 91.4%
NO	1	2	0	3 / 8.6%
NA	0	0	0	0 / 0%

observations (62.9%). Use of the esophageal stethoscope was observed during 11 general anesthesia cases (31.4%). These two specialty stethoscopes were used in 33 of the 35 cases (94.3%). Two cases were observed in which neither of the stethoscopes were used by the SRNA (5.7%). The pulse oximeter was on in 35 of the 35 cases observed (100%). The audible alarm on the pulse oximeter was on during the 35 case observations (100%). The waveform on the capnograph was visible in 32 of the 35 observed cases (91.4%) and not visible in 3 cases observed (8.6%).

Qualitative Data

Qualitative data were analyzed from five interviews which were conducted. The responses made by each interviewee were the personal thoughts of that individual. The responses did not necessarily represent the position of the ASA or the AANA. Two anesthesiologists and three CRNAs took part in these interview sessions. These individuals were randomly chosen and gave written consent prior to the initiation of the interview.

Demographic data were obtained from each of the five anesthesia providers who were interviewed. Of the three CRNAs interviewed, two had Master's degrees and the one had a Nurse Anesthesia certificate. The five anesthesia providers who were interviewed have been providing anesthesia care between 5 and 33 years. Four of the anesthesia providers had never been members of a Uniformed Service. One anesthesia provider had been a member of a Uniformed Service but did not provide anesthesia care. None of the interview participants had ever been deployed to a foreign country to provide anesthesia care.

Each of the interview participants were asked the same questions and their responses were recorded and later transcribed. Analysis of these transcripts provided information that pertained to the use of the precordial or esophageal stethoscope.

The first question examined how, if ever, each anesthesia provider was trained in the use of either the precordial or esophageal stethoscope. All respondents indicated they had received some type of formalized instruction, while in their respective anesthesia education program, on the use of these specialized stethoscopes. The anesthesia provider who had practiced for over 33 years stated that anesthesia training had been received in the 1960s. However, the esophageal stethoscope was not introduced until the 1970s. For this individual, proper use of this particular stethoscope was self taught.

The second question explored the anesthesia provider's thoughts on the routine use of either the precordial or esophageal stethoscope. All respondents indicated that there is still a need for these two stethoscopes within the practice of anesthesia in the 1990s. However, one interviewee went on to say that the use of the precordial and esophageal stethoscope is not as important as it was 10-15 years ago because of the advent of the pulse oximeter and the continuous updating of anesthesia machines. An anesthesiologist replied, "I think, however, there are certain times when it really is not necessary [to use a precordial or esophageal stethoscope]. We're talking mostly about monitored anesthetic care cases where you're in voice contact with the patient and not giving a deep sedation." But this same individual stated that these stethoscopes are definitely useful during general anesthesia cases, thereby eliminating sole reliance upon electronic monitors. This inclination for precordial or esophageal stethoscope use during general anesthesia was also expressed by two other anesthesia providers when they stated

that the "esophageal stethoscope is a must for every general anesthetic case" and "the esophageal stethoscope should be used on all patients who are intubated."

The participants were then asked how they now assess breath sounds and heart tones during the administration of anesthesia. The responses were mixed. Two anesthesia providers stated they use precordial or esophageal stethoscopes to assess breath sounds and heart tones during induction and on into the maintenance phase of the case. Two other anesthesia providers stated they use standard medical stethoscopes to assess breath sounds, while using the two specialized stethoscopes only periodically. One participant stated that breath sounds could best be assessed through the use of electronic monitors. This provider stated that confounding variables, such as continuous suctioning and certain surgical instrumentation, negates the effectiveness of the precordial or esophageal stethoscope. This particular anesthesia provider listens to the pulse oximeter tone and scans the corresponding oxygen saturation value to evaluate the patient's respiratory function. This author must point out that breath sounds can only be assessed through auscultation of the lung fields and not through the use of electronic monitors. Information obtained from pulse oximeter relates to the patient's hemoglobin oxygenation and not to the quality of breath sounds.

The fourth question was written as a "tie-in" to the preceding question. The five anesthesia providers were asked why they employed the aforementioned technique of breath sounds and heart tones assessment. One provider reiterated the value of precordial and esophageal stethoscopes by stating "I think they are very valuable tools. You can't rely on your monitors." Another stated that breath sound abnormalities can be detected when using an esophageal stethoscope. Presumably the esophageal stethoscope will

detect these abnormalities before the electronic monitors, although this explanation was not made clear during the interview. One CRNA stated that precordial or esophageal stethoscopes should be used "... routinely in certain cases today - prone cases and especially in children - it's an absolute must."

Question five asked at what point did the anesthesia providers feel it is acceptable, if indeed they felt it was acceptable, to discontinue the routine use of the precordial or esophageal stethoscope during the administration of an anesthetic. All five interviewees stated that it was not acceptable to completely discontinue the use of these two stethoscopes. A CRNA's comment pertaining to the discontinued use of these stethoscopes best summarizes the group's thoughts when she said, "... We rely a lot on the pulse oximeter but I don't believe that the precordial or the esophageal [stethoscopes] will ever go out of use." On the other hand, all the providers cited instances where the diminished use of these stethoscopes was acceptable to them. One anesthesia provider remarked that there comes a time when you become comfortable with the information obtained from monitors as opposed to the precordial or esophageal stethoscopes. When this point is reached, it was stated, use of these two stethoscopes can be decreased but should not be completely discontinued. A CRNA stated that use of the precordial or esophageal stethoscope could be curtailed with ASA P.S. 1 patients who are receiving "light" intravenous sedation [MAC]. Similar comments were made by an anesthesiologist who contends that maintaining voice contact with a patient during the administration of MAC anesthesia makes the use of a precordial stethoscope inessential. Unlike the CRNA, however, the anesthesiologist added that when the depth of anesthesia is increased and voice contact is lost then it is acceptable and prudent to use either the

precordial or esophageal stethoscope as the situation merits. A final situation where the diminished use of these stethoscopes was acceptable to those anesthesia providers interviewed was during the maintenance phase of an anesthetic. It was stated that the precordial stethoscope should be used during the induction and emergence phases of anesthesia, but not necessarily during the maintenance phase.

In question six, the participants were given a scenario in which electronic monitors were not available. Each participant was then asked how they would monitor the patient's status during the administration of an anesthetic. Three anesthesia providers stated they would use the precordial or esophageal stethoscope. One of the anesthesia providers recounted a recent situation that closely resembled the scenario presented. Approximately five years ago this provider was employed at an institution that did not have state-of-the-art monitoring equipment available to the anesthesia staff. Therefore, it became essential for this provider to use the precordial stethoscope. The two remaining anesthesia providers replied that they would utilize clinical evaluation skills in the absence of electronic monitoring equipment. Specifically, one interviewee replied, "I think the most important way of monitoring the patient, even when electronic monitors are there, is clinical evaluation." This evaluation would include, but not be limited to, observation of the patient's chest rising and falling with each breath and auscultation of heart tones with a medical stethoscope.

In question seven, participants were asked what they thought was the best patient monitor for use during the administration of anesthesia. The overwhelming response was the pulse oximeter with capnography selected as the second overall choice. The anesthesia providers stated that the pulse oximeter could measure two parameters: 1) the

heart rate of the patient and 2) the oxygen saturation within the patient's blood.

In closing, each participant who took part in the interview process was asked if they had any closing comments to make. Three responses which were made bear repeating. One anesthesia provider stated that the precordial or esophageal stethoscope should be used at all times, even though the data from this study reveals the anesthesia provider's practice habits to be contrary to this statement. Another anesthesia provider stated that "... when there is a student nurse anesthetist, these monitoring tools [precordial and esophageal stethoscopes] should be used at all times." With experience, this anesthesia provider feels, will come the ability to decide which cases require use of these specialized stethoscopes and which do not. The last comment was made by an anesthesiologist who speculated on other reasons which might be responsible for the nonutilization of the precordial and esophageal stethoscopes. Some of those hypothesized reasons were poor fit of the monaural earpiece (e.g., uncomfortable), poor quality of the sound transmitted through the monaural earpiece as opposed to the sound transmitted through a binaural medical stethoscope, and finally the comment "it gets in the way."

Summary

This study contains both quantitative and qualitative data. The quantitative data were obtained by observing anesthesiologists, CRNAs, and SRNAs administer uninterrupted anesthetic care during 50 cases. Individual observations of 20 general anesthesia, 20 MAC, and 10 regional anesthesia cases were combined for a total sample. With each observation conducted, the following measures were either met or not met by the anesthesia provider being studied: use of either a precordial or esophageal

stethoscope, pulse oximeter on, audible alarm on the pulse oximeter on, and waveform on the capnograph visible. The qualitative data were analyzed from interviews conducted with five anesthesia providers. Two anesthesiologists and three CRNAs were participants in these interviews. After obtaining preliminary demographic data from each participant, the five anesthesia providers were asked a series of questions created for this portion of the study. These questions were specifically designed to uncover personal thoughts, feelings, or beliefs regarding the use of the precordial or esophageal stethoscope and electronic monitors in general.

The quantitative data revealed precordial and esophageal stethoscope use to be 68% among the observed anesthesia providers. The pulse oximeter was on during 100% of the observations. The audible alarm on the pulse oximeter was on during 98% of the observations and off during 2%. The waveform on the capnograph was visible during 94% of the observations made.

Further analysis of the quantitative data established precordial and esophageal stethoscope use rates for each type of anesthesia provider. Anesthesiologists were observed 4 times with no positive findings (0%); CRNAs were observed 11 times with 1 positive finding (9.1%); SRNAs were observed 35 times with 33 positive findings (94.3%). The calculated overall average use of the precordial and esophageal stethoscope by anesthesiologists, CRNAs, and SRNAs was 68%.

The qualitative data demonstrated that all of the interviewed anesthesia providers had received some formalized instruction during their anesthesia education on the use of the precordial stethoscope. Four of the interviewees had also received formalized instruction on the use of the esophageal stethoscope while in anesthesia training, while

the fifth interviewee learned esophageal stethoscope use on-the-job. Each respondent stated there is still a need for these specialized stethoscopes in the practice of anesthesia, although two remarked that these stethoscopes are not needed for every case nor are they as important today as 10-15 years ago. This decreasing importance was reflected in responses given to the question of how they currently assess breath sounds and heart tones. Two anesthesia providers did state that they use either a precordial or esophageal stethoscope, while two other providers reported they use a standard medical stethoscope. The fifth anesthesia provider interviewed stated that breath sounds can best be assessed through the use of a pulse oximeter. It must be noted that breath sounds can only be assessed through auscultation of the lung fields. (What this particular anesthesia provider is assessing is actually the patient's level of oxygenation and not breath sounds.) None of the anesthesia providers interviewed stated that it was acceptable to completely discontinue the use of the precordial or esophageal stethoscope. However, all respondents cited particular situations where the diminished or suspended use of these two stethoscopes would be acceptable to them. When asked how a patient's status would be monitored if electronic monitors were not available, three anesthesia providers said they would employ the precordial or esophageal stethoscope while the remaining two providers chose other methods to clinically evaluate the patient. All the anesthesia providers interviewed stated that the pulse oximeter was the best patient monitor for use during the administration of an anesthetic with capnography rated as second best.

CHAPTER FIVE

DISCUSSION, CONCLUSIONS, RECOMMENDATIONS

Overview of the Study

Historically the stethoscope has proven itself to be a reliable monitor of a patient's respiratory and circulatory status. Adapted for use by the anesthesia provider, precordial and esophageal stethoscopes have also served as reliable monitors of anesthetized patients' respiratory and circulatory status. Little research has been performed examining the actual usage rates of the precordial and esophageal stethoscopes among anesthesia providers. Previous studies indicate a decline in their use (Kay & Neal, 1986; Klepper et al., 1993; Prielipp et al., 1995). Despite the proven capability of the precordial and esophageal stethoscope and current standards of monitoring created by the ASA and the AANA, these stethoscopes have been substituted by, rather than supplemented with, advanced electronic monitoring devices. This substitution has taken place even though studies have shown that the use of the precordial or esophageal stethoscope could augment electronic monitoring devices and aid in identifying undesirable anesthesia incidents (Klepper et al., 1993).

This study examined the rate of use of precordial or esophageal stethoscopes among anesthesia providers. This was partially accomplished through observations made of anesthesiologists, CRNAs, and SRNAs while administering anesthesia care during 50 cases. General anesthesia (n=20), MAC (n=20), and regional anesthesia (n=10) case observations were the sample for this study. With each observation conducted, the following measures were either met or not met: use of a precordial or esophageal

stethoscope by the anesthesia provider, pulse oximeter on, audible alarm on the pulse oximeter on, and the waveform on the capnograph visible. This study also analyzed the responses of five interviews conducted with two anesthesiologists and three CRNAs. The interview questions were specifically designed to elicit responses that would uncover the individual anesthesia provider's thoughts, feelings, and beliefs as they pertained to both the precordial and esophageal stethoscopes and electronic monitors in general.

The number of observations per anesthesia provider were not equal for this study. But, the observations which were conducted accurately reflected who was providing the majority of anesthesia care at that point in time. Observations of SRNAs were the most prevalent (n=35) while observations of anesthesiologists were the least prevalent (n=4). Observations of CRNAs fell between the two previously mentioned types of anesthesia provider (n=11). From the observations which were conducted, overall utilization rates of the precordial and esophageal stethoscopes was 68%. Individual utilization rates of these two stethoscopes by the anesthesia providers was 0% for anesthesiologists, 9.1% for CRNAs, and 94.3% for SRNAs. The pulse oximeter was used in all cases observed (100%). The pulse oximeter audible alarm was on in 49 of the cases (98%). The capnograph waveform was visible in 94% of the cases observed.

Interviews with the five anesthesia providers revealed that all but one had received formalized instruction on the use of the precordial or esophageal stethoscope. When asked their thoughts on the routine use of either of these two stethoscopes, the anesthesia providers related situations where the use of these stethoscopes becomes conditional rather than routine. Two anesthesia providers stated that they felt the importance of the precordial and esophageal stethoscope had declined in recent years. These interviews

provided factual proof of this decline when only two of the five anesthesia providers reported that they currently use the precordial or esophageal stethoscope to assess breath sounds and heart tones during the administration of an anesthetic. Despite this low rate of use, none of the respondents felt it was acceptable to discontinue the use of these stethoscopes. However, each anesthesia provider went on to identify particular situations where the discontinued use of these two stethoscopes was acceptable. When those interviewed were asked to identify the best patient monitor for use during the administration of anesthesia, the overwhelming choice was the pulse oximeter. The capnograph was selected as the second best monitor by these same individuals.

Overview of the Results

Experienced anesthesia providers use the precordial and esophageal stethoscopes less frequently than electronic monitors (e.g., pulse oximeter, capnograph). The average rate of use of these two stethoscopes among anesthesia providers was 68%, while the utilization rates for the electronic monitors was 100%. Kay and Neal (1986) reported that of the two groups they observed "the percentage of residents using a precordial or esophageal earpiece averaged 87% in program A and 70% in Program B (difference not statistically significant)" (p. 149). The findings of this study correlate well with those of Kay and Neal. The study by Klepper et al. (1993) was conducted in Australia and consisted of a retrospective anesthesia record review when "any unintended incident which reduced, or could have reduced, the safety margin for a patient" occurred (pp. 575-576). Of the 1256 anesthetic cases reviewed by Klepper et al., stethoscope use was computed to be approximately 5%. The stethoscope utilization rates of 68% and 5%

do not correlate. However, this large variance should not imply the findings obtained by Klepper et al. are erroneous in nature. Perhaps there are valid explanations for the vast difference in stethoscope utilization rates between the two studies. First, the study's sample size employed by Klepper et al. was much larger (N=1256) than the sample size employed by this study (N=50). No logarithmic conclusions can be drawn, but had this study's sample size been larger than the 50 case observations, then perhaps the overall average stethoscope utilization rate would have been reduced. Secondly, although the anesthesia monitoring standards are written similarly for both the United States and Australia, actual practice habits relating to the administration of anesthesia may be very different between he two countries. It is unknown how many, if any, SRNA administered anesthetics were included in the study by Klepper et al. If all the anesthetic incidences reviewed by Klepper et al. were attributable to anesthesiologists, then their reported stethoscope utilization rate of 5% closely mirrors the 0% found in this study. Finally, the study conducted by Klepper et al. entailed a review of anesthesia records - or simply stated, a review of documentation. The absence of adequate or detailed documentation might lead one to determine that a precordial or esophageal stethoscope had not been used when in reality it had. The end results, therefore, are only as valid as the information at hand. The results of this study were obtained by actual observations whereas retrospective record reviews were used in the Klepper et al. study. Each technique, when used to study the same event, may yield conflicting results.

This study is smaller, modified replication of a study conducted by Prielipp et al. (1995). Prielipp et al. reported the average use of a precordial or esophageal stethoscope as 28%. Anesthesiologists, CRNA, student-CRNA, and anesthesia residents were

observed in the Prielipp et al. study. This replication study was conducted at an institution where all types of anesthesia providers were present except for the anesthesia residents. The observation of anesthesia residents was not included in this replication study. Of the total 520 cases observed by Prielipp et al., 296 observations were of anesthesia residents. Excluding these observations reduces the total cases observed to 224. The number of case observations and stethoscope utilization rates per anesthesia provider, as reported by Prielipp, et al, were as follows: anesthesiologists (n=13) 23%, CRNAs (n=155) 30%, student-CRNA (n=56) 75%. If the anesthesia resident observations are excluded, the average use of the precordial or esophageal stethoscope among the three remaining types of anesthesia provider increases to 41%. This replication study determined the average use of these same stethoscopes by the same type of anesthesia providers to be 68%. Both the similarities and dissimilarities of the results from the two studies become clearer when the observations for each subsample are examined. The following discussion is based upon the results of the subsample observations.

To appreciate the similarities of the findings of this study and the study conducted by Prielipp et al., one must look at the correlation of each finding as it pertains to the type of anesthesia provider. Prielipp et al. reported precordial or esophageal stethoscope use among anesthesiologists to be 23% of the 13 observations conducted. This 23% represents 3 positive observations of precordial or esophageal stethoscope use out of the 13 conducted. Four observations were made for this study that focused on the anesthesiologist's use of these specialized stethoscopes. As previously reported, the rate of use for this group was 0% since no positive observations were made. Prielipp et al.

conducted a total of 13 observations of anesthesiologists in three different institutions. It is unknown how many consecutive negative observations were conducted by Prielipp, et al. before the three positive observations were made. What is known is that only one positive observation, for a total of three, was made at each of the three different institutions. Had one positive observation been made of an anesthesiologist using a precordial or esophageal stethoscope in this study, the findings of this study and those reported by Prielipp et al. would have been identical. These results are not similar by valuation, since 0% is not the equivalent of 23%, but more a similarity in trend. The sample size of anesthesiologist observations in the study conducted by Prielipp et al. was larger than this study. Welkowitz, Ewen, and Cohen (1991) wrote "whatever else the accuracy of a sample statistic may depend upon, it always depends on the size of the sample on which it has been determined' (p. 226). Had the subsample size (n=4) of anesthesiologist observations been larger for this study, then perhaps these results and those from the Prielipp et al. study would have been equal. "Other things being equal, error decreases and power increases as N increases" (Welkowitz, Ewen, & Cohen, 1991, p. 226).

This study demonstrated a 9.1% utilization rate of the precordial and esophageal stethoscopes among CRNAs (n=11). The CRNA subsample comprised 22% of the total sample size. Prielipp et al. reported a 30% stethoscope utilization rate out of 155 observations in their study. In the Prielipp et al. study the CRNA subsample comprised 69% of the total sample size if the anesthesia resident observations are excluded from the sampling. A difference between the two studies involving the observations of CRNAs is that of the three types of anesthesia providers observed for this study, the group with the

second highest number of observations were CRNAs. In the Prielipp et al. study the group with the highest number of observations were CRNAs. Logically it would seem that by increasing the number of observations of a particular type of anesthesia provider, the chances of recording positive findings would also increase.

The subsample of SRNAs for this study consisted of 35 observations with a 94.3% utilization rating. As previously reported, SRNAs were the most frequently observed type of anesthesia provider for this study. The SRNA subsample comprised 70% of the total sample (N=50). The study conducted by Prielipp et al. consisted of 56 student-CRNA (same as SRNA) observations with a 75% utilization rating. With the exception of the anesthesia resident observations, student-CRNAs were the second highest observed type of anesthesia provider in the Prielipp et al. study. Both studies, nevertheless, report a high precordial and esophageal stethoscope utilization rate among SRNAs.

What correlation can be derived from the quantitative data and qualitative data analysis from this study? When asked their thoughts on the routine use of either the precordial or esophageal stethoscopes, the anesthesiologists and CRNAs interviewed made comments that would indicate that these stethoscopes are not routinely used. These comments are reflected in the actual practice during the observation phase of this study. The stethoscope utilization rates of 0% by anesthesiologists and 9.1% by CRNAs best reflects the comments made during the interview process. Four of the anesthesia providers interviewed stated that they now assess breath sounds and heart tones with a precordial or esophageal stethoscope. Of the 15 combined observations of anesthesiologists and CRNAs, there were no positive observations made where the precordial stethoscope was used and only one positive observation was made where an

esophageal stethoscope was used which occurred during the observation of a CRNA. None of the anesthesia providers who were interviewed felt it was acceptable to discontinue the routine use of the precordial or esophageal stethoscope. In contrast, only 1 observation of the 15 made revealed that either of these stethoscopes was actually being used (6.7%) during the administration of an anesthetic. Four of the five anesthesia providers interviewed identified the pulse oximeter as the best patient monitor for use during the administration of anesthesia. The combined 15 observations of both anesthesiologists and CRNAs found that the pulse oximeter was used during 100% of the cases observed. The capnograph was selected as the second best patient monitor for use during the administration of an anesthetic. The 15 observations found a 100% utilization rate of the capnograph.

These results indicate that qualitative data on the use of the precordial or esophageal stethoscope does not correlate with the quantitative findings. Qualitative data pertaining to the use of electronic monitors does correlate to quantitative findings based upon the utilization ratings of these same electronic monitors.

Implications of the Results in Terms of Theory

This study incorporated the theory of Patricia Benner. Benner characterizes five stages of skill acquisition (Benner, 1984). How these stages of skill acquisition pertain to the findings of this study will now be presented.

The first stage, or novice level, is characterized by beginners who "have had no experience of the situations in which they are expected to perform" (Benner, 1984, p. 20). Consequently, "since novices have no experience of the situations they face, they must be

given rules to guide their performance" (Benner, 1984, p.21). The SRNAs, as part of a mandatory clinical education requirement, were expected to use either the precordial or esophageal stethoscope with each anesthetic administration. This encouragement was reflected in the 94.3% utilization rate that SRNA observations revealed. This high utilization rate was not attained because the SRNAs had an experience base on which to predicate precordial or esophageal stethoscope use. On the contrary, as novice anesthesia providers the SRNAs displayed "rule-governed behavior typical of the novice" (Benner, 1984, p. 21). This behavior is described as limited and inflexible.

The fifth stage, or expert level, "no longer relies on an analytic principle (rule, guideline, maxim) to connect her or his understanding of the situation to an appropriate action" (Benner, 1984, p. 31). Therefore, Benner's model helps to explain the respective 0% and 9.1% stethoscope utilization rates among anesthesiologists and CRNAs. The expert anesthesiologist or CRNA, "with an enormous background of experience, now has an intuitive grasp of each situation and zeroes in on the accurate region of the problem without wasteful consideration of a large range of unfruitful, alternative diagnoses and solutions" (Benner, 1984, p. 32). In practice, the electronic monitors provide the information necessary to assess a patient's respiratory and circulatory status. This information, coupled with the experience of the anesthesiologist or CRNA, often deters the use of the precordial or esophageal stethoscope. The qualitative data supports a preference for electronic monitoring by the expert anesthesia provider.

Implications of the Results in Terms of Research

The sample size of 50 in this study was selected based on convenience and the

inexperience of the primary researcher. Future research should focus on all anesthesia providers equally. Both this study and the study conducted by Prielipp et al. collected data based upon arbitrary and random observations. From the data collected during these observations, generalizations regarding the use of the precordial or esophageal stethoscope were drawn. As an example, four observations of anesthesiologists were conducted for this study. Neither of the specialized stethoscopes were utilized during any of these four observations for a 0% utilization rating. If one of these stethoscopes had been utilized in just one observation the rating would have changed to 25%. One observation, whether a positive or negative finding, should not be allowed to exert this much influence on the overall results. For this reason this study should be replicated in the future and each type of anesthesia provider should be viewed for an equal number of observations. Another area of future study would involve a military setting. Is the use of the precordial or esophageal stethoscope by military anesthesia providers higher, lower, or the same as their civilian counterparts?

Implications of the Results in Terms of Practice

The results of this study indicate that novices in the field of anesthesia, SRNAs, use the precordial or esophageal stethoscope quite frequently. They are taught that these specialized stethoscopes provide a continuous and valuable assessment of the anesthetized patient's respiratory and circulatory status. It remains unclear if this high utilization rate occurs because of mandated training requirements or because of inexperience on the part of the SRNA Expert anesthesia providers (e.g., anesthesiologists, CRNAs), as this study indicates, rely on electronic monitoring devices

and use the stethoscopes with less frequency. Thus, an inexpensive and minimally invasive patient monitor has been neglected.

Summary

The purpose of this study was to ascertain the current utilization rates of the precordial and esophageal stethoscope among anesthesia providers. Stethoscope utilization rates were determined following the collection of quantitative data. The qualitative data related actual stethoscope use to the anesthesia providers' opinions regarding these stethoscopes.

Quantitative data were collected through observations of anesthesia providers while they administered uninterrupted anesthesia care. Anesthesiologists, CRNAs, and SRNAs formed the group of anesthesia providers who were observed. General anesthesia, MAC, and regional anesthesia cases were included in the observations (N=50). These observations focused on the use of a precordial or esophageal stethoscope and electronic monitoring devices. The results revealed an average overall stethoscope utilization rate of 68%. Anesthesiologists used these instruments 0% of the observations conducted (n=4). CRNAs used these instruments 9.1% of the observations conducted (n=11). SRNAs used these instruments 94.3% of the observations conducted (n=35).

Qualitative data were analyzed from interviews conducted with five randomly selected anesthesia providers. Only anesthesiologists and CRNAs were permitted to take part in these interviews. The first two questions were designed to specifically elicit the anesthesia provider's thoughts and feelings as they pertained to the precordial or esophageal stethoscope. The responses to these first two questions revealed that, as part

of their anesthesia training, each anesthesia provider had received formalized instruction in the proper use of one or both of these stethoscopes. The participants felt these stethoscopes were valuable monitors and still served a purpose during the administration of an anesthetic. Of the anesthesia providers interviewed, 40% acknowledged use of one of the specialized stethoscopes to assess a patient's respiratory and circulatory status, 80% stated they did not feel it was acceptable to discontinue the routine use of these stethoscopes, and 40% stated that in the absence of electronic monitors they would monitor a patient's status with one of these specialized stethoscopes. In actual practice the precordial or esophageal stethoscope was used 6.7% of the 15 observations of anesthesiologists and CRNAs. The anesthesia providers who were interviewed selected the pulse oximeter and capnograph as the best electronic monitors for use during the administration of an anesthetic. In practice, the observations revealed a 100% utilization rate for these two monitors among anesthesiologists and CRNAs.

Among experienced anesthesia providers the precordial and esophageal stethoscopes are used with less frequency than electronic monitoring devices such as the pulse oximeter and capnograph. These data support the suspicion that electronic monitors have substituted, rather than supplemented, the precordial or esophageal stethoscope.

APPENDIX A

GENERAL ANESTHESIA DATA COLLECTION SHEET

Case #	Anesthetic type	Stethoscope in use			Supplemental monitoring equipment						Provider background			Observation date & time
					Pulse oximeter		Pulse oximeter audible alarm		Waveform on the capnograph					
		Precordial	Esophageal	Neither	ON	OFF	ON	OFF	YES	NO NA	Anesthesiologist	CRNA	SRNA	
1	GENERAL													
2	GENERAL													
3	GENERAL													
4	GENERAL													
5	GENERAL													
6	GENERAL													
7	GENERAL													
8	GENERAL													
9	GENERAL													
10	GENERAL													
11	GENERAL													
12	GENERAL													
13	GENERAL													
14	GENERAL													
15	GENERAL													
16	GENERAL													
17	GENERAL													
18	GENERAL													
19	GENERAL													
20	GENERAL													

APPENDIX B

MONITORED ANESTHESIA CARE (MAC) DATA COLLECTION SHEET

Case #	Anesthetic type	Stethoscope in use			Supplemental monitoring equipment						Provider background			Observation date & time
					Pulse oximeter		Pulse oximeter audible alarm		Waveform on the capnograph					
		Precordial	Esophageal	Neither	ON	OFF	ON	OFF	YES	NO NA	Anesthesiologist	CRNA	SRNA	
1	MAC													
2	MAC													
3	MAC													
4	MAC													
5	MAC													
6	MAC													
7	MAC													
8	MAC													
9	MAC													
10	MAC													
11	MAC													
12	MAC													
13	MAC													
14	MAC													
15	MAC													
16	MAC													
17	MAC													
18	MAC													
19	MAC													
20	MAC													

APPENDIX C

REGIONAL ANESTHESIA DATA COLLECTION SHEET

Case #	Anesthetic type	Stethoscope in use			Supplemental monitoring equipment						Provider background			Observation date & time
					Pulse oximeter		Pulse oximeter audible alarm		Waveform on the capnograph					
		Precordial	Esophageal	Neither	ON	OFF	ON	OFF	YES	NO NA	Anesthesiologist	CRNA	SRNA	
1	REGIONAL													
2	REGIONAL													
3	REGIONAL													
4	REGIONAL													
5	REGIONAL													
6	REGIONAL													
7	REGIONAL													
8	REGIONAL													
9	REGIONAL													
10	REGIONAL													

APPENDIX D

INTERVIEW CONSENT FORM

UNIFORMED SERVICES UNIVERSITY OF THE HEALTH SCIENCES
4301 Jones Bridge Road
Bethesda, Maryland 20814-4799

Subject Title: Anesthesia Provider's Use of the Precordial or Esophageal Stethoscope: Is Anyone Still Listening to the Patient?
Investigator: William D. Bruening Jr., R.N.

Mr. Bruening is a registered nurse with over eight years civilian and military nursing experience. He is currently enrolled in the graduate nursing program (nurse anesthetist track) at the Uniformed Services University of the Health Sciences in Bethesda, Maryland.

This study will examine the use of the precordial or esophageal stethoscope among anesthesia providers. The information obtained may help to explain the roles of these stethoscopes and electronic monitoring equipment during the delivery of anesthesia. This study will not have a direct impact upon your practice of anesthesia.

The study procedures involve no foreseeable risks or harm to you. The procedures include: (1) participation in a private interview that will be recorded and (2) completion of a brief demographic data sheet. Participation in this study will take approximately 45 minutes, with the interview to be scheduled at your convenience. You are free to ask questions about the study or about being a subject. You may contact Mr. Bruening at one of the following numbers if you have any further questions:

USUHS Graduate School of Nursing: (301) 295-6565
Work: (202) 574-6846 (please leave a message)
Home: (301) 438-3425

Your participation in this study is voluntary and you are under no obligation to participate. You have the right to withdraw at any time. Your identity will not be revealed at any time while the study is being conducted or when the study is reported or published. All study data will be collected by Mr. Bruening, stored in a secure place, and not shared with any other person without your permission.

I have read this consent form and voluntarily consent to participate in this study.

_____
Subject's Signature Date

I have explained this study to the above subject and have sought his/her understanding for informed consent.

_____
Investigator's Signature Date

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