We conducted this qualitative study to understand the experiences of military Certified Registered Nurse Anesthetists (CRNAs) working with service personnel who have traumatic brain injury (TBI) and/or post-traumatic stress disorder (PTSD) and are emerging from general anesthesia. This study is important because there are no studies in the literature that describe the experiences of anesthetists working with patients with these specific problems. The leading questions were: “Out of all the anesthesia cases both abroad and stateside (post 9/11/2001), have you noticed service members wake from general anesthesia (not utilizing total intravenous anesthesia (TIVA), in a state of delirium? If so, can you tell me your experiences and thought processes as to why it was occurring?”

Five themes emerged: (1) Emergence delirium (ED) exists and to a much higher degree in the military than in the general population. (2) ED was much more prevalent in the younger military population. (3) TIVA was a superior anesthetic for patients thought to have TBI and/or PTSD. (4) Talking to all patients suspected of having TBI and/or PTSD before surgery and on emergence was vital for a smooth emergence. (5) There is something profound happening in regard to ketamine and PTSD and TBI.

Keywords: Emergence delirium, posttraumatic stress disorder, traumatic brain injury.

For the last decade, the United States has been involved in war in Iraq and Afghanistan. However, the US healthcare system is only recently recognizing the traumatic psychological effects of battlefield stress on soldiers. The Army, in particular, is bracing for a surge in mental health cases, notably traumatic brain injury (TBI) and posttraumatic stress disorder (PTSD).

The traumatic effects from the battlefield are being carried over rapidly into the healthcare environment, in civilian and military settings in the United States, in particular the operating room and postanesthesia care unit (PACU). From May 2005 through December 2005, the operating room of the 228th Combat Support Hospital in Mosul, Iraq, surgically treated more than 800 combat-related injuries. Personal experience of J.T.W. from the battlefield revealed that of the 800 trauma resuscitations an estimated 25% of the people treated were involved in some form of explosion (typically from roadside improvised explosive devices) that caused various forms of TBI. The 541st Forward Surgical Team from January 2007 through June 2007 in Orgun-E, Afghanistan, surgically treated more than 100 combat-related injuries. During this period, all required anesthetics were provided by 1 nurse anesthetist (J.T.W.). Of the 100 service members treated by one of us (J.T.W.), about one eighth involved explosions that caused loss of consciousness or a concussion syndrome typically seen with TBI.

Many soldiers who sustained a TBI showed signs and symptoms of PTSD and were more prone to emerging from anesthesia in a state of delirium (J.T.W., anecdotal evidence, 2005 and 2007). Some healthcare providers believe that soldiers with signs and symptoms of TBI or PTSD had more anxiety preoperatively compared with soldiers without signs and symptoms of TBI or PTSD. Behaviors seen in soldiers with signs and symptoms requiring surgical intervention in the 2 theaters of operation (Mosul, Iraq, and Orgun-E, Afghanistan), none had been previously screened for PTSD and data were not available about their presurgical mental conditions. Of the more than 900 patients requiring surgical intervention, anecdotal evidence showed that upward of 10% emerged from general anesthesia in a state of delirium while an anesthesia provider was present. Anecdotal evidence from military service personnel who had recently returned from combat and required surgery stateside showed that 1 in 10 (10%) who required general anesthesia had delirium on emergence. Historical information obtained when the patients were lucid revealed that upward of 70% had horrific past experiences involving explosions, gun battles, vehicle crashes, helicopter crashes, intense fear, seeing fellow service members dying, and a feeling of helplessness (all potential causes of PTSD). These experiences are those of the principal investigator (J.T.W.) during the period from 2005 through 2008 while caring for patients in Iraq and Afghanistan.

For the last decade, the United States has been involved in war in Iraq and Afghanistan. However, the US healthcare system is only recently recognizing the traumatic psychological effects of battlefield stress on soldiers. The Army, in particular, is bracing for a surge in mental health cases, notably traumatic brain injury (TBI) and posttraumatic stress disorder (PTSD).
of TBI or PTSD included the following: (1) extreme anxiety before surgery and the requirement for “much more” anesthetic than “average”; (2) much longer time required to become lucid following anesthesia; and (3) often awakened in a violent or thrashing manner with attempts at self-extubation, breath-holding, intravenous line displacement, and assault on the operating room staff. There was also the potential for patients to fall off the narrow operating room table during emergence. Any one or a combination of these deleterious outcomes can be catastrophic for patients. The violent behavior during emergence puts all involved in caring for the patients at risk for injury, especially the operating room and PACU staff members.

Besides the previously mentioned anecdotal experience, an exhaustive review of the literature showed that little is known about how these entities (TBI, PTSD, and general anesthesia) affect emergence delirium (ED) within the military patient population. A review of the TBI4-8 and PTSD9-13 research revealed that some studies provided factual statistics, while others described the clinical characteristics of emergence from anesthesia, including delirium without TBI or PTSD.14 There was, however, 1 case report that described ED with military service members. Medical personnel serving during the conflict in Somalia believed that ED was due primarily to the antimalarial medication given to the soldiers.15 There were no further studies found related to ED and the antimalaria medication.

It is important to know that ED exists in the general population but has not been well studied in the target population (military service members serving during the wars in Iraq and Afghanistan). An extensive search revealed articles on delirium in the pediatric (emergence agitation) and geriatric (postoperative delirium) populations. As many as 10% to 15% of elderly people who undergo surgery experience delirium during the postoperative period.16 Another study showed that upward of 40% of elderly people undergoing orthopedic surgery experience some form of delirium.17 Children experienced postanesthesia delirium at a rate of 12% to 13% versus 5.3% in adults.18 Another more recent study showed ED in the general adult population to be lower, at 3%.19 It is important to note that postoperative delirium is different from ED by virtue of time. Postoperative delirium usually occurs sometime after discharge from the PACU, whereas ED is seen during emergence from general anesthesia and can continue into the PACU setting. Emergence delirium is also much more profound (signs and symptoms ranging from thrashing wildly to screaming) than emergence excitement or agitation (sign and symptoms include restlessness, moaning, and incoherent speech).20 Whether these known differences seen in the signs and symptoms and timing are different conditions or variations of a single condition is not known.

A more recent study found that of 1,359 patients (age range, 15-99 years), 64 (4.7%) showed signs and symptoms of ED following general anesthesia. Patients at increased risk for ED had received benzodiazepines preoperatively, had undergone breast or abdominal surgery, and had long surgeries. Whether these are risk factors per se or confounders of an underlying risk remains to be studied.21

Numerous pediatric studies have focused on pharmacologic interventions and emergence from anesthesia,22-25 including studies that described which potent inhalation agents are responsible for emergence delirium (called emergence agitation in the pediatric literature).26,27 There were no published studies found during the extensive review of literature that focused on the combination of wartime injuries (after September 11, 2001) and ED following general anesthesia. No study was found that examined the frequency of occurrence of ED in soldiers with diagnosed or suspected TBI or PTSD as a result of battlefield conditions. This lack of data exposes and verifies a compelling need for this research.

This study offers insight into a beginning understanding of the experiences of 3 seasoned Certified Registered Nurse Anesthetists (CRNAs) who have deployed to Iraq or Afghanistan and/or taken care of military personnel in military treatment facilities since September 11, 2001. The purpose was to identify and describe the experiences of military CRNAs working with service personnel who have TBI and/or PTSD and who were emerging from anesthesia. A review of the literature revealed that ED is an adverse effect of anesthesia. The provision of safe anesthesia care in military medicine requires formal studies to substantiate (or not) the role of TBI and PTSD as risk factors for ED.

Methods

For the purpose of this research, ED (seen with military personnel with TBI and/or PTSD) was defined as any occurrence in which the patient awakens in a violent or thrashing manner with attempts at self-extubation, breath holding, intravenous line displacement, assault on the operating room staff, and/or the want to flee or the risk of falling from the narrow operating room table. This violent behavior could occur any time from the end of surgery to discharge from the PACU.

• Design. Hermeneutic (interpretive paradigm) phenomenology was used to gain a better understanding from nurse anesthetists regarding their lived experiences with this phenomenon (ED with service members). This qualitative method was selected because of its potential to generate new understandings of complex multi-dimensional human phenomena and identify the practical knowledge that is embedded in the world of meanings and of human interactions.28 Interpretive phenomenology was chosen to first see if a particular phenomenon exists.
of most of these deployments was 3 months. While deploying, he estimated that he had taken care of approximately 500 wounded service personnel and local nationals. Stateside, Alpha estimated that he had taken care of more than 1,000 service personnel after September 11, 2001. Participant Bravo graduated from nurse anesthesia school in 1999. He had 1 year-long deployment to Iraq where he provided approximately 400 anesthetics. He is currently serving as a program director for a graduate nurse anesthesia program. He estimates that he has personally provided approximately 1,000 anesthetics stateside since September 11, 2001. Participant Charlie was the last interview for this study. He graduated in 2003 and had a total of 5 deployments during the wars in Iraq and Afghanistan, with each deployment ranging from 3 to just more than 6 months. He estimates that he directly anesthetized between 400 and 500 people during those deployments. In stateside assignments since September 11, 2001, he estimates that he has administered between 2,000 and 3,000 anesthetics. This information obtained from the 3 interviewees demonstrates that they are experts in their field and adds to the trustworthiness of the study.

- **Data Analysis.** The method of analysis for this research was taken from the Colaizzi approach to data analysis. This systematic approach involves 7 key steps, which are listed in the Table.

The most challenging aspect of this method for the principal investigator was the last step, in which each of the participants had to be recontacted to validate thematic content. This time-consuming aspect of the Colaizzi method of analysis was crucial and served to validate each and every aspect of the researcher’s results (themes).

The evaluation criteria for this phenomenological study were adapted from Munhall and consisted of 9 criteria that were used to enhance the rigor and merit of this qualitative research. The methods of Munhall for evaluating the rigor of the research and how these 9 criteria were used are as follows:

<table>
<thead>
<tr>
<th>Step</th>
<th>Colaizzi’s method</th>
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<tbody>
<tr>
<td>1</td>
<td>Each research informant’s verbatim transcript is read to acquire a sense of the whole.</td>
</tr>
<tr>
<td>2</td>
<td>Important or meaningful statements and phrases pertaining to the phenomenon being studied are extracted from each transcript.</td>
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<tr>
<td>3</td>
<td>Meanings are formulated from the statements in step 2.</td>
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<tr>
<td>4</td>
<td>Meanings are organized into themes, and these themes evolve into theme clusters and, eventually, into theme categories.</td>
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<tr>
<td>5</td>
<td>These results are integrated into a rich and exhaustive description of the lived experience.</td>
</tr>
<tr>
<td>6</td>
<td>The essential structure of the phenomenon is formulated.</td>
</tr>
<tr>
<td>7</td>
<td>Validation is sought from the research informants to compare the researcher’s descriptive results with their lived experiences. If necessary, the researcher’s description is modified to achieve congruence with the lived experience of the research informants.</td>
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(ED) and, if so, to attempt to gain a better understanding of the phenomenon through focused questions and later interpretation of the lived experiences into themes. An interview guide was used to obtain demographic data, and multiple general questions were asked to verify the exact experience levels of the anesthetists. The study’s primary lead questions asked: “Out of all the anesthesia cases both abroad and stateside (post 9/11/2001), have you noticed service members wake from general anesthesia (not utilizing TIVA), in a state of delirium? If so, can you elaborate on your experiences and thought processes as to why it was occurring?”

- **Participants and Data Collection.** The University and Medical Center Institutional Review Board of East Carolina University, Greenville, North Carolina, approved the research protocol, and informed consent was obtained from the 3 participants. Purposeful sampling was used for this study, which is common practice within qualitative research protocols. The 3 male CRNA participants selected for this study were chosen because they had varied backgrounds in deployment and time in service. The in-depth interviews were conducted at the participant’s desired location. The length of the interviews was individually driven, but, on average, they lasted 60 minutes. The researcher informed all participants that their individual identity would be protected by the use of letters or numbers and that the audiotapes would be kept in a secure location. For example, the first participant was assigned the letter, A or Alpha and so on.

Data collection was achieved by an audiorecording of the interviews. Supplemental data included personal observations and field notes. The researcher (J.T.W.) transcribed the interviews verbatim and sought to elucidate meanings.

Participant Alpha graduated from nurse anesthesia school in 2000. He had deployed 9 times at the time of the interview to Iraq and Afghanistan. The average length of most of these deployments was 3 months. While deployed, he estimated that he had taken care of approximately 500 wounded service personnel and local nationals. Stateside, Alpha estimated that he had taken care of more than 1,000 service personnel after September 11, 2001. Participant Charlie was the last interview for this study. He graduated in 2003 and had a total of 5 deployments during the wars in Iraq and Afghanistan, with each deployment ranging from 3 to just more than 6 months. He estimates that he directly anesthetized between 400 and 500 people during those deployments. In stateside assignments since September 11, 2001, he estimates that he has administered between 2,000 and 3,000 anesthetics. This information obtained from the 3 interviewees demonstrates that they are experts in their field and adds to the trustworthiness of the study.

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1. **Phenomenological nod** is when the researcher nods in agreement during the interview and afterward when listening to the audiotape. The researcher found that what was being stated by the interviewee made sense.

2. **Resonancy** describes the process of interpretation, and the meaning is correct or sounds familiar. In this study the descriptions of these CRNAs experience is sufficiently vivid or powerful and can draw readers in and enable them to reflect on their own experience/understandings.

3. **Reasonableness** is nothing more than what was reported and what is later interpreted is reasonable.

4. **Representativeness** asks whether what is reported is accurate and consists of all the dimensions of the lived experience. Criteria 3 and 4 were accomplished when the researcher validated the interpretations and themes with the participants as well as with the coauthor and a peer colleague who reviewed the findings.

5. **Recognizability** is the fifth criterion. With recognizability, the researcher becomes more aware of what is being experienced by the participants. After listening to the participants, the researcher could begin to identify with what was being stated.

6. **Raised consciousness** occurs when the researcher or reader of the study becomes more aware or has new insight into the phenomenon being studied. An example of this new insight would be the use of ketamine in this specific patient population (see the “Results” section).

7. **Readability**, as it pertains to this study, is the ability for the researcher to understand with ease and certainty that the information provided is understandable and flows in a logical way.

8. **Relevance** applies to the notion that what is being read should offer meaning. Professionally, the meanings derived offer guidance for practice and the potential for further studies.

9. **Revelations** occur when the researcher finds deeper meaning in the data.30

The trustworthiness of this study was judged by using 4 elements or characteristics from Lincoln and Guba.31 They are **credibility**, which refers to value and truth and replaces internal validity; **transferability**, which replaces external validity and applicability of the research; **dependability**, which encompasses the consistency of the research; and **conformability**, which replaces objectivity and seeks neutrality within the qualitative research design. Conformability for this research study was carried out by the principal investigator’s instructor (M.E.P.) and a peer who analyzed the data, performed a research audit, and provided valuable feedback to enhance the rigor and trustworthiness of this qualitative study.

**Results**

There were 5 themes identified by the data analysis: (1) In the recalled experience of the 3 participants, ED exists and to a much higher degree in the military than with the general population. (2) ED was much more prevalent in the younger military population. (3) TIVA was a superior anesthetic for patients thought to have TBI and/or PTSD. (4) Talking to all patients suspected of having a TBI and/or PTSD before surgery and during emergence was vital for smooth emergence. (5) There is something profound happening in regard to ketamine and PTSD and/or TBI.

- **Theme 1. ED exists and to a much higher degree than with the general population.** The perception or feeling gained from all 3 CRNAs interviewed is that ED exists within the target population and was supported by the following quotes: Alpha: “Absolutely, I have seen evidence of PTSD or ED on numerous occasions….” “I would estimate that incidence of ED [is] more than 75% of those [who] have been treated.” Bravo: “Last year, we saw a lot of patients waking up very agitated or dysphoric and [who] were extremely combative. I believe a lot of what we saw was related to posttraumatic issues.” Charlie: “Yes, I have seen a number of soldiers waking up in a state of delirium. I call them combative. For whatever reason, I have seen it. So, have I noticed it? Yes, I have.” This is an important theme that was identified because it is the first time that others besides the principal investigator have documented ED within the target population. The second theme identified is more specific as it relates to ED.

- **Theme 2. ED was much more prevalent in the younger military population.** For some reason (no specific rationale was provided), all 3 participants believed that ED was much more prevalent in the younger military population. There are, however, some potential reasons why ED is seen more in younger military personnel. One reason might be because younger soldiers are often on the front lines of combat in greater numbers and, thus, are more susceptible to TBI and/or PTSD. Another reason is that older, more seasoned military personnel may have better coping strategies and maturity and, therefore, are able to avoid waking up in such a violent manner. These 2 examples are possible factors why ED is higher in younger troops.

The second theme of ED being seen more within younger military personnel was supported by the following quotes: Alpha: “…especially with the younger population of soldiers.” Bravo: “Some of the more older, maybe 30-year-old, soldiers will go into it and control their outward experiences but will say things like I am going to smack you or you better get out of my face and you can tell that they are very angry and mentally they are not in control of what they are saying and they will sometimes verbalize that they will be having or reliving events from other places.” Charlie: “Maybe too much testosterone.” This theme suggests there is an age component to ED within the target population. This is interesting to note because the majority of the literature on ED...
focuses on the very young (pediatric population) and the elderly (geriatric population).

- **Theme 3.** TIVA was a superior anesthetic for patients thought to have TBI and/or PTSD. All 3 participants thought that TIVA was a far superior anesthetic for patients thought to have TBI and/or PTSD. The third theme, that the type of anesthetic used matters, was evidenced by the following comments: Alpha: “It is hard to beat a TIVA wake up. If done correctly, one can really wake them up smoothly. I can tell you that the patients I do TIVA on wake up very smoothly. I do not have a way to attribute that scientifically other than the way drugs are metabolized.” Bravo: “If I know a patient has had ED and a TBI, I will [use] a TIVA on them. Based on my experiences, they wake up better.” Charlie: “Yes, I have rarely, rarely seen ED with TIVA. As far as percents, I would say that less than 1% of my TIVA [patients] wake up in a state of delirium.” The type of anesthetic used, TIVA or potent inhalational anesthesia, has been documented extensively in the pediatric anesthesia literature, but this is not the case for the targeted population. No published research was found in regard to service personnel and the type of anesthesia received.

- **Theme 4.** Talking to all patients suspected of having a TBI and/or PTSD before surgery and during emergence was vital for smooth emergence (vocal local). The phrase, “vocal local,” is commonly used in the anesthesia community and expresses the open dialogue between provider and patient. Talking to and encouraging 2-way communication with all patients suspected of having a TBI and/or PTSD before surgery and during emergence was thought to be vital for smooth emergence. The fourth theme was supported by the following quotes: Alpha: “I have kind of taken the approach; I attended a hypnosis course 2 years ago and I do a lot of preemptive talking with patients, some guided imagery, and reassurance of patients whom I know are susceptible to this, and it has paid big dividends for me ever since 2008 when I took this course; I’ve noticed a change when I talk to patients and reassure them….” Bravo: “Give them simple commands…. Usually just talking to them, reorienting them orally usually works 50% of the time or better.” Charlie: “I try and keep the operating room quiet. I talk softly to patients, some guided imagery, and reassure them….” All 3 interviews described using verbal communication to help alleviate preoperative anxiety. Many who practice in anesthesia talk with their patients and often inform them of everything they will experience, but we do not know to what extent this approach has been used to alleviate or ameliorate ED following anesthesia.

- **Theme 5.** In the beliefs of the 3 participants, there is something profound happening in regard to ketamine and PTSD/TBI. The fifth and final theme identified during this qualitative research was the relationship of ketamine with the emergence in patients diagnosed with or suspected of having PTSD and/or TBI. It is not known to what extent ketamine has a role in ED, but it is evident through these focused interviews that this induction agent has a role in alleviating what is seen with ED. Alpha: “Using ketamine to facilitate the healing process on the inside, absolutely.” Bravo: “I will use propofol, ketamine, and sufentanil. I use 1 mg of ketamine per 10 mg of propofol, and I don’t like to mix my opiod with my propofol and ketamine.” Charlie: “Contrary to what other anesthesia providers gave him anesthetic-wise in the past, I induced him with 100 mg of ketamine and 100 mg of propofol and did a TIVA for him. He woke up so nicely.” More research needs to be conducted on the role of ketamine as it relates to ED.

- **Reflections.** The current lack of data in this area of research supported this qualitative research study. TBI and/or PTSD and ED have been shown to be an important topic for military personnel who require general anesthesia. Battlefield anecdotal evidence has shown the possibility of a relationship between ED and TBI and/or PTSD. The current research study seeking to better understand the lived experiences of CRNAs was captured as it relates to ED. The 5 themes that evolved from this study were: (1) ED exists and to a much higher degree than with the general population. (2) ED was much more prevalent in the younger military population. (3) TIVA was a superior anesthetic for patients thought to have TBI and/or PTSD. (4) Talking to all patients suspected of having TBI and/or PTSD before surgery and during emergence was vital for smooth emergence. (5) There is something profound happening in regard to ketamine and PTSD/TBI. The findings from this qualitative study provide a beginning understanding into the experiences of CRNAs who have witnessed ED within the military population. Their narratives suggest that ED is a complex phenomenon that warrants further study.

**Conclusion**

Conducting research with 3 nurse anesthetists produced a first step in identifying a phenomenon that had been documented only by the principal investigator. This phenomenon has now been shown through this qualitative research to be experienced by other nurse anesthetists. Based on the results of this study, additional research could proceed with Army, Air Force, and Navy anesthesia providers to explore the existence of ED. Further study is recommended on the interplay of TBI and/or PTSD with ED. When ED is more clearly understood, CRNAs may be in a better position to develop strategies that support safe anesthetics and quality nursing care in this vulnerable patient population.

**REFERENCES**
