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Advanced Airway Management In Combat Casualties By Medics At The Point Of Injury: A Sub-Group Analysis Of The Reach Study

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Abstract

Optimal airway management protocols for the prehospital battlefield setting have not been defined. Airway management strategies in this environment must take into account the injury patterns, the environment and training requirements of military prehospital providers. Methods: This is a post-hoc, sub-group analysis of the Registry of Emergency Airways Arriving at Combat Hospitals or REACH database. This study examines only those patients who had advanced airways placed for trauma by an enlisted military medic at the point of injury. Results: Twenty (100%) of the patients had a traumatic injury, 19 (95%) were male, and 13 (65%) had a gun shot wounds (GSWs) as the mechanism of injury. The majority, 12 (60%) patients had an esophageal--tracheal airway device placed. Of the remaining patients, four (20%) underwent endotracheal intubation, three (15%) had a surgical cricothyroidotomy performed, and one (5%) had a Laryngeal Mask Airway (LMA) placed. Seventeen (85%) of the twenty patients were dead on arrival or died shortly after arrival at the Combat Support Hospital (CSH). All of the patients that died had a Glasgow Coma Scale (GCS) of three upon arrival. The Glasgow Coma Scale provides a score in the range 3-15; patients with scores of 3-8 are usually said to be in a coma. Three patients in this group survived to transfer from the CSH. Two of the transfers were lost to follow up, one with a GSW to the head and GCS of three, the other with a GCS of five from injuries sustained in an explosion. The third patient had a surgical cricothyroidotomy (SC) performed in the field for an expanding neck hematoma and recovered fully following surgery. Conclusions: Casualties that tolerate invasive airway management without sedation in the context of trauma prognosticates a very high mortality. Airway management algorithms for military providers should reflect the casualties encountered on the battlefield not patients in cardiac arrest which predominate in the civilian EMS airway management practice. Further data are needed to understand the injuries encountered on the battlefield and to develop airway management solutions that optimize outcomes of patients with battlefield trauma.

Introduction

Airway obstruction is the third leading cause of potentially preventable combat death behind compressible hemorrhage and tension pneumothorax.1 Traumatic brain injury also is prevalent in the current conflict.2 Although data are lacking regarding prehospital care in battle casualties, civilian studies show brain injured patients have significantly worse outcomes if they become hypoxic in the prehospital setting.3 This is a sub--group analysis from the Registry of Emergency Airways Arriving at Combat Hospitals or REACH database by Adams et.al.4, a prospective, observational study performed under combat conditions during Operation Iraqi Freedom.In this paper we will examine only those battle casualties who had advanced airway maneuvers performed by an enlisted combat medic at the point of injury. We will discuss the role of advanced prehospital airway maneuvers and devices in the context of battlefield trauma.

Methods

In the REACH trial, consecutive data collection occurred at two Combat Support Hospitals (CSHs) within Iraq from January 2005 to March 2007. Patients with any prehospital-placed advanced airways were evaluated systematically upon arrival at the CSH by the Trauma Team Leader (TTL). Advanced airway was defined as follows: endotracheal intubation (ETI); placement of a supraglottic airway device (either a Laryngeal Mask Airway (LMA) or an esophageal-tracheal airway device (Combitube (ETC) Tyco-Kendall- Mansfield, MA); or surgical cricothyroidotomy (SC). Exclusion criteria included: (1) patients that received their initial advanced airway at the CSH; (2) patients arriving with nasopharyngeal Or oral pharyngeal airways only; and (3) any patient who had an initial attempt at advanced airway management that was then aborted for rescue breathing with bag-valve-mask (BVM).

CSH Trauma Team Leaders (TTLs) (either active duty trauma surgeons or emergency medicine physicians) were trained on the protocol and data collection techniques. Endotracheal tube placement was determined using an explicit method.5-6 The TTL performed an airway examination, auscultated bilateral lung fields and the epigastrium. If the airway device was grossly displaced or not functioning, it was immeadiatly removed and ETI performed if indicated. The type of airway device used, device location, method of confirmation, and level of training of the person performing the intubation were contemporaneously documented on a standard data collection form. Logs were monitored on a daily basis by study investigators to ensure that all data were appropriately recorded.Weekly meetings were held between the investigators and the TTLs to ensure protocol compliance.

Our data were obtained after performing a subset analysis of the REACH database. In the original study there were 6,875 patients evaluated and 293 advanced airway devices placed prehospital by a medic, nurse anesthetist, physician assistant, or physician. This analysis examines only those patients who had advanced airway devices placed by combat medics in the prehospital setting for battlefield trauma.

Demographic as well as prehospital airway management data were compiled and analyzed. The Joint Theater Trauma Registry was used to determine mechanisms of injury, presenting Glasgow Coma Scores and to determine how many of these patients survived their battlefield injuries after having an airway placed by a combat medic. Using the Joint Theater Trauma Registry (JTTR), we were able to obtain outcome data for all of study casualties.

GSW – Gunshot wound MVC- Motor vehicle collision UNK- Unknown ETC- Esophageal-Tracheal Airway (Combitube) SC- Surgical Cricothyroidotomy LMA- Laryngeal Mask Airway ETI- Endotrachael Intubation DOA- Dead on Arrival GCS-Glasgow Coma Score

Demographic data for these patients are listed in Table 1 and reveals that 20 (100%) of the patients had a traumatic injury, 19 (95%) were male, and 13 (65%) had a gun shot wound (GSW) as the mechanism of injury. Table 2 demonstrates that the majority, 12 (60%) patients had an ETC device placed. Of the remaining patients, 4 (20%) underwent ETI, 3 (15%) had an SC performed, and 1 (5%) had an LMA placed.

Seventeen (85%) of the twenty patients were dead on arrival or died shortly after arrival at the CSH. All of the patients that died had a GCS of three upon arrival. Three patients in this group survived to transfer from the CSH. The first patient was injured by in an exposion and underwent ETI in the field. His GCS on arrival at the CSH was five. He was transferred to a local Iraqi hospital and was lost to follow-up. The second patient suffered a GSW to the head and underwent ETI in the prehospital setting. His GCS upon arrival to the CSH was three, and he survived up until transfer to a local Iraqi hospital at which point he was lost to follow-up. The third patient was as U.S. Soldier injured by a fragment to the neck from an explosion. Cricothyroidotomy was performed by a medic at the point of injury; GCS upon arrival to the CSH was not recorded. He survived his injures and was transferred to the United States.

Discussion

The military prehospital environment is different than the civilian prehospital setting. As military healthcare providers develop airway management protocols and strategies for the battlefield, differences in patients, injury patterns and providers must be taken into account.

Interventions such as advanced airway management in the civilian setting take place mostly in the context of elderly patients in cardiac arrest. When airway management is performed in civilian trauma, it is mostly in the context of blunt vehicular trauma resulting in brain or spinal injury.In the military setting, penetrating trauma typically predominates.Penetrating injures to the face and neck will often disrupt the airway anatomy leading to airway compromise. These injuries will often have significant associated hemorrhage from concomitant vascular injuries. Cricothyroidotomy, rarely performed in the civilian prehospital setting, will be the airway of choice in these patients. Blunt central nervous system (CNS) trauma does occur on the battlefield in the context of explosion-related injures, aircraft mishaps, falls, and motor vehicle collisions. As combatants increasingly come in contact with civilians on the battlefield, both local inhabitants and unprecedented numbers of civilian contractors, military prehospital personnel will occasionally encounter medical emergencies such as cardiac arrest as well.

Military providers work under different conditions than their civilian counterparts. Civilian EMS providers don't typically enter a scene unless it is secure. Usually there are two providers per patient.They have access to a large amount of equipment in a well-lit ambutable Lance. On-line medical control is available. In the civilian setting the patient is the primary mission while on the battlefield, the military objective is priority. Casualty management on the battlefield is in support of the tactical mission. Military operations can occur in any type of environment including sub-zero temperatures in mountainous terrain to arid desert environments with temperatures in excess of 125 degrees F. Often, operations are conducted at night. Light discipline may necessitate procedures being done in low visibility or with night vision equipment. Using white light may cause the medic to be killed or injured by enemy fire. An Israeli military physician was killed by a sniper as he used a laryngoscope to perform ETI at night.7 Military medics will often be targeted by enemy forces as they recover and treat casualties.

Military medics must be able to manage patients during and in close proximity to ongoing combat operations, an environment of extreme noise and chaos. Often one combat medic will care for multiple casualties with what supplies they carry on their backs. Body armor and other protective equipment are heavy and bulky, degrading the ability to perform fine motor skills. Auscultation with a stethoscope will probably be impossible due to the noise of combat. If it were possible, it is difficult to do properly without removing the combat helmet, an essential piece of protective gear. Battlefield airway management tools and techniques must take these environmental considerations into account.

Most populated areas of the United States have EMS systems staffed with Emergency Medical Technician--Paramedics (EMTP) in either an all-paramedic system or as part of a tiered BLS/ALS system. Paramedics are the most highly trained civilian pre-hospital providers providing the most advanced level of care. Training programs vary from between 654 to 3142 instructional hours spent in the classroom, procedure labs, clinical rotations and supervised internships.U. S. Army combat medic curriculum devotes seven weeks to obtaining EMT-Basic certification followed by an additional nine weeks of military-specific medical skills for a total of 640 hours.U. S. Marine Corpsmen undergo similar training.

Military medics do not undergo a formal internship program or hands-on clinical rotations during their initial training. Once a medic finishes school they undergo on-the-job training at their respective duty assignment locations, the quality of which varies significantly depending on the interest of the unit surgeon or physician assistant in training them. It is not unusual for an enlisted medic to have his or her first contact with a significantly traumatized patient and have their first combat experience at the same time.
Military medics are not taught to do rapid sequence (RSI) or pharmacologically-assisted intubation. The Army's Department of Combat Medic Training at Ft. Sam Houston, TX, matriculates approximately 400 new combat medics into its 16 week training program every two weeks, graduating nearly 8000 EMT-B / military healthcare specialist per year. The sheer volume of students, most of whom are recent high school graduates, makes it impossible to adequately train this skill. Resources are simply not available to teach the requisite pharmacology or provide intensive hands-on intubation practice in the lab or clinical setting to ensure competency. Even if it were desirable to teach RSI during initial training, providing adequate sustainment would be virtually impossible given the numbers of providers and vast geographic dispersion of medics across the Army. Civilian EMS agencies whose paramedics are on the streets daily with much smaller numbers of providers located in discrete jurisdictions are faced with many of the same challenges. 8-9 Even though learning how to perform RSI during initial training is not feasible for military medics, some learn how to perform direct Laryngoscopy and endotracheal intubation as they attend continuing education courses such as Advanced Cardiac Life Support (ACLS) or receive additional training from the unit physician or physician assistant.In civilian EMS services successful intubation in the field without drugs most commonly takes place in the context of cardiac arrest.10 Successful pre-hospital intubation without drugs in the context of trauma is associated with either profound hemorrhagic shock and/or significant neurological trauma. One paper from the United Kingdom cites one survivor from 486 trauma patients (0.2%) intubated without pharmacological agents in the pre-hospital setting.

This lone survivor underwent resuscitative thoracotomy in the field.Guyette et.al., published a series of 26 cases where the King LT was successfully used as an alternative airway device in the prehospital setting. Three of the patients in this series were intubated at the scene for trauma without pharmacological agents. All had GCS scores of three. All three died.13 Our study seems to confirm these findings.

Given the difficulties involved with training and sustaining military medics in ETI, other airway devices that don't require direct laryngoscopy have gained popularity with civilian EMS systems and the military. These are generally placed blindly in the oropharynx and are seated supraglotticly with an inflatable balloon. Some occlude or are purposefully placed into the esophagus. The Esophageal- Tracheal Combitube (ETC), the King Laryngeal-Tracheal (LT) airway and Laryngeal Mast Airway (LMA) are three of the most common ones in use. Military medics are currently trained to use the ETC and the King LT.

While these supraglottic airway (SGA) devices have gained popularity in the military setting, there are a number of concerns that question their utility. These devices were designed for use in patients in cardiac arrest or in the case of the LMA: sedated, fasting, elective surgical patients. All of these devices can also be used in the "can't intubate, can't ventilate" scenario where the patient has undergone sedation and paralysis (RSI) and intubation has failed. None of these circumstances are applicable to the battlefield. Most patients who require immediate airway management on the battlefield will have had trauma to the neck and/or face which will often be accompanied with significant airway hemorrhage.14 Airway anatomy will be disrupted and these patients will likely be ineffective. Adequate portable suction in the tactical environment is notoriously unreliable and DoD Should support research efforts to improve this vital technology.Rapid cricothyroidotomy will often be the airway maneuver of choice in these patients. Inserting a large supraglottic airway in semiconscious trauma patients without sedation will produce a significant noxious stimuli and will likely induce vomiting. If upper airway anatomy is disrupted, supraglottic devices may not seat properly and will likely be ineffective. For those patients with head injures, having an SGA placed without sedation will increase intercerebral pressure (ICP) and decrease cerebral perfusion pressure (CPP). Vomiting and aspiration will cause additional hypoxia and make further airway management more difficult. All of which will worsen any brain injury.

If patients on the battlefield are obtunded enough to tolerate a SGA, they likely have profound hemorrhage shock and/or significant traumatic brain injury. The likelihood these patients will survive with a favorable outcome is extremely small. This raises some ethical and operational concerns unique to the battlefield. Should patients who tolerate invasive airway management without sedation (other than cricothyroidotomy for airway trauma) be considered expectant?Should we risk an aircrew or vehicle convoy to rapidly evacuate these casualties when prospects of survival are extremely low? These are gut-wrenching decisions made in the most difficult and chaotic of circumstances: the battlefield.

Our training models do not reflect the reality of the battlefield.When performing airway procedures in training, medics use manikins. Studies comparing the utility or ease insertion among several airway devices used by medics use these same manikins.15-16 These manikins simulate nicely a completely relaxed patient in cardiac and respiratory arrest. On the battlefield these patients are considered dead. These models do not reproduce the challenges of airway management medics will encounter such as airway trauma, hemorrhage, vomiting, trismus, head injuries, or patients that are semi-conscious.Using models such as this to assess the utility of an airway device for pre-hospital battlefield use is a flawed strategy. First we must understand who will need airway management on the battlefield and why, then we can design airway strategies and training to address this group of patients.

Unfortunately, pre-hospital data from the battlefield is difficult to obtain and data sets are often incomplete. This study is the only case series of advanced airway maneuvers performed at the point of injury by a medic in the field that we are aware of. Complete sets of pre-hospital data are needed to drive training, techniques and equipment.Efforts are underway to collect pre-hospital data, but are hindered because of competing systems and multiple overlapping authorities. Improving data collection at the First Responder level will be a significant leap forward in improving survival of battle casualties.

Conclusion

Airway management on the battlefield may be life-saving in a small but not insignificant group of patients. Often casualties requiring airway management will have facial or airway trauma. Casualties that tolerate invasive airway management without sedation in the context of trauma have a very high mortality. Airway training for military providers should reflect the casualties encountered on the battlefield, not patients in cardiac arrest, which predominates in civilian EMS airway management practices. Data are needed to understand the injuries encountered on the battlefield and to develop airway management solutions that make sense and are trainable and sustainable by the combat medic.

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