Airway management for victims of penetrating trauma: analysis of 50,000 cases

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Abstract

BACKGROUND: Current recommendations for victims of penetrating trauma include prompt transportation to a trauma center. It remains unclear whether field intubation allows for improvements in mortality rate.

METHODS: A retrospective review of the National Trauma Data Bank of adult victims of penetrating trauma was performed. Standard demographic data, method, and location of airway management were examined. Mortality rate was used as the primary outcome measure.

RESULTS: There were 56,094 victims of penetrating trauma identified. A total of 1,925 patients required a prehospital airway. The mortality rate for patients who underwent airway management at the scene was 69.2%, compared with a rate of 35.9% for patients in whom airway management was deferred. The mortality rate for patients undergoing surgical airway management at the scene was only 23.9%.

CONCLUSIONS: Victims of penetrating trauma who require any airway management have a high mortality rate. The cause of this difference awaits further prospective investigation.

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KEYWORDS: Cricothyroidotomy; Cricothyrotomy; Prehospital; Airway; Wounds and injuries

Prehospital care for victims of trauma has continued to evolve since the creation of Advanced Trauma Life Support algorithms. The roles of prehospital airway stabilization, tube thoracostomy placement, intravenous access, and fluid administration all have been re-examined in the past decade. Although few prospective randomized clinical trials are available, there has been a general transition away from providing definitive prehospital stabilization, particularly for victims of penetrating trauma. Instead, rapid transfer to a trauma care center has become more prevalent. Several investigators have stated that in the absence of a blunt traumatic brain injury, prehospital airway placement is of limited value.

Prehospital airway clearance generally begins with a set of essential skills, including manual evacuation of foreign bodies, jaw thrust or chin lift, oropharyngeal suctioning, and insertion of basic oral or nasal airways. All emergency medical services (EMS) providers receive education in these basic maneuvers, often during Prehospital Trauma Life Support training. Indications for advanced airway management include diminished level of consciousness, a threatened airway, or need for assisted ventilation. Many EMS providers now are trained in endotracheal intubation, with success rates of 90%. Several intubating adjuncts, including dual-lumen airways and laryngeal mask airways, are becoming more prevalent. Factors associated with a difficult intubation include a history of ear, nose, or throat
cancer or surgery; obesity; facial trauma; the operator’s previous training; and accessibility to the airway. In a situation in which EMS providers are unable to ventilate or intubate a patient, prehospital cricothyroidotomy may be a valuable alternative.

It remains unclear if victims of penetrating trauma benefit from prehospital airway management. In addition, the value of training emergency medical personnel in advanced airway techniques, including cricothyroidotomy, has not been addressed definitively on a large scale. Previous investigators have examined the role of teaching prehospital personnel advanced airway maneuvers with good results. Most of these studies, however, have consisted of relatively small numbers of patients. Given the rarity of prehospital airway management for victims of penetrating trauma, a nationwide data system allows collection of information beyond what a single trauma center is capable of performing.

Methods

The National Trauma Data Bank (NTDB) was queried retrospectively to list all adult (age, >17 y) patients who were victims of penetrating trauma between 2001 and 2005. The NTDB only includes patients who either died in the emergency room or who were admitted to the hospital. Victims of penetrating trauma who were discharged home after observation in the emergency department were not included.

Patients were divided into those who received prehospital airway intubation or cricothyroidotomy, those who received in-hospital intubation or cricothyroidotomy, and those who did not receive placement of an airway. The NTDB does not differentiate between routine endotracheal intubation and intubation using an alternative airway (ie, laryngeal mask airway). In addition, no distinction was made between those patients who were intubated for physiologic distress versus those intubated semi-electively for a subsequent surgical procedure. Standard demographic data were collected. Initial vital signs indicated measurements taken on arrival to the hospital. Mortality, length of stay, and intensive care unit length of stay were the primary outcome measures.

Continuous data are presented as means ± standard deviation, and independent Student t tests were used to determine statistical significance. A probability value of less than .05 was considered significant. Post hoc analysis was performed using the SPSS statistical software package (SPSS, Inc., Chicago, IL).

Results

There were 56,094 adult victims of penetrating trauma identified. Their demographic data are presented in Table 1. As expected, most victims were young males. Their average injury severity score (ISS) was 11.3 ± 12.7, and the overall mortality rate was 14.1%.

Of the 56,094 victims, there were 13,898 (24.8%) who received either intubation or cricothyroidotomy at some point. A total of 1,925 patients (13.9%) with an ISS of 24.3 ± 19.7 had prehospital airway placement and a mortality rate of 69.2%. A total of 11,973 patients with an ISS of 20.3 ± 15.5 had airways placed after arrival at the hospital and a mortality rate of 35.9% (P < .05 for both ISS and mortality rate). Patients receiving prehospital intubation presented with a lower initial systolic blood pressure than patients whose airway was placed after arrival. There were no differences in sex or age between the two groups (Table 2).

Of those victims who received prehospital airway placement, 1,858 patients with an ISS of 24.7 ± 19.9 underwent endotracheal intubation and had a mortality rate of 70.9%. Sixty-seven patients with an ISS of 14.1 ± 12.4 underwent prehospital cricothyroidotomy and had a mortality rate of 23.9% (P < .05 for mortality).

Comments

Penetrating trauma continues to be a potentially lethal form of injury. Most victims of penetrating trauma do not require any prehospital airway management, and nation-
wide databases are helpful to perform meaningful statistical analysis. The NTDB has seen increasing use as a research tool since its inception, and, although it does not capture every single injured patient, it allows for much broader sampling as described earlier. In addition, the use of aggregate data eliminates the influence of a single trauma system that may use prehospital advanced airway maneuvers more frequently than others.

Our data suggest that the need for prehospital intubation for victims of penetrating trauma is associated with a 2-fold increase in mortality rates when compared with those patients whose airway placement can be deferred until arrival at a hospital. Such patients also have a 5-fold increase in mortality when compared with victims who never require intubation. Although a large retrospective series such as the NTDB allows for meaningful statistical analysis, care must be taken not to infer causality from the data. One would expect patients who require prehospital airway placement to have a higher mortality rate than those patients who do not require airway management. The NTDB does not, however, describe the indication for intubation. Certainly, a gunshot wound to the neck mandates a different algorithm for airway control than a stab wound to the abdomen with loss of vital signs. Of the 69% of patients who died after prehospital intubation, it is unclear how many actually had initial signs of life. Current recommendations allow an EMS provider to withhold treatment for victims of penetrating trauma if signs of life are not present on their arrival (pupillary reflexes, spontaneous movement, or organized cardiac activity). Many providers, however, are hesitant to terminate care before transfer to the trauma center. In addition, we were unable to precisely define injury patterns among the cohorts. For example, it would be useful to identify what percentage of patients suffered traumatic brain injuries.

Previous studies examining the (lack of) utility of prehospital intervention for victims of penetrating trauma often have relied on short transit times from injury site to hospital. Conclusions from such series may not be applicable on a widespread basis, where access to advanced trauma care may be limited. Unfortunately, the NTDB does not have data on transit times for the described patient population, but deferring airway control is obviously more feasible if prehospital times are short. A long transit time may prompt prehospital intubation, but also delays definitive therapy and may increase mortality rates.

Although ISS remains the most commonly used descriptor for anatomic severity of injury, its interpretation is difficult for victims of penetrating trauma. These patients generally have injury to one body area, and multiple injuries in that area are not counted separately when computing an ISS.

Therefore, true severity of injury often is underrepresented for victims of penetrating trauma. As expected, the need for prehospital airway placement serves as a marker for significant injury, as reflected in the higher ISS for such patients.

Several groups previously have examined the utility of prehospital cricothyroidotomy as a rescue airway maneuver. Other groups have used surgical airway placement as the initial airway of choice. Given appropriate training, EMS providers have been shown to be capable of safely and consistently placing a surgical airway. Our data suggest that performing a prehospital cricothyroidotomy in a victim of penetrating trauma is rare; of interest, its use is associated with a lower mortality rate than in patients who have undergone standard endotracheal intubation. Again, the indication for airway management is not available in the NTDB data. If cricothyroidotomy is being used primarily as a rescue airway after failed endotracheal intubation, one would suspect a much higher mortality rate. Rather, some cricothyroidotomies more likely are being placed in patients with an anatomic indication for airway management, such as a gunshot wound to the neck. A patient with an isolated wound to the neck who requires placement of a cricothyroidotomy often would have a lower ISS when compared with a patient who required standard intubation. In addition, any EMS provider capable of performing a cricothyroidotomy likely has received advanced prehospital training, which may account for the lower mortality rate for their patients. Whatever the reasons are, it is evident that prehospital cricothyroidotomy can be associated with reductions in mortality rates when performed on appropriately selected patients. Our analysis of nationwide aggregate data are consistent with smaller, previously published series. These results support the continued education of prehospital personnel in advanced airway maneuvers, including placement of a surgical airway. Although the technical aspects of airway placement certainly are significant, instruction regarding appropriate indications for airway placement is equally important—particularly when discussing victims of penetrating trauma.

The limitations of our study are a reflection of the data available in the NTDB. As described earlier, transit times and indications for intubation were not accessible. In addition, the anatomic locations of the penetrating wounds were not examined. Given the retrospective nature of the data, care must be taken not to infer a causal relationship between prehospital intubation and mortality. Rather, the need for a secure field airway after penetrating trauma likely reflects a patient in physiologic extremis or with an anatomic indication for intubation (ie, gunshot wound to the head or neck). In either case, health providers at the destination hospital should realize that need for a prehospital airway after penetrating trauma predicts a mortality rate of 70%. As such, a low threshold should be maintained for early transfer of these patients to the operating room or angiography suite.

References


Discussion

Dr Daniel Margulies (Los Angeles, CA): Dr Rajani and his colleagues performed a retrospective review of over 56,000 adult patients who sustained penetrating trauma by analyzing NTDB data. Nearly one fourth needed intubation at some point and, of these, 14% were intubated before arrival at the hospital. Comparing those intubated in the field to those intubated in the prehospital setting, the authors found a higher mortality, nearly 70% in those intubated in the prehospital setting.

My first comment is that clearly these 2 groups are not the same. Although there was no gender or age difference between the groups, the ISS is higher in the group that needed intubation in the field—I think it was 25 compared to an ISS of 11 for the others.

Therefore, one must be very wary of assigning causation to the difference in mortality. All one can really conclude is that intubation in the prehospital setting is associated with a higher mortality, not that mortality is higher because of the intubation. Of those 1,925 patients that were intubated in the field, had they not been intubated in the field, would their mortality have been better or worse? These data do not answer that question. The authors recognize and acknowledge this and also point out the limitations of NTDB.

In order to really know why these patients fared worse or had such a high mortality, we need to know more about them, in particular we need to know what the patients’ injuries were. I have 3 questions for the authors: Did you find any other differences between these groups that might explain the higher mortality? For instance, was their frequency of head injury higher? Certainly, penetrating injury to the cranium will carry a high mortality and will also be likely associated with prehospital intubation. Secondly, did you perform a regression analysis of the variables that you did identify as that might help you find out whether prehospital intubation was an independent predictor of mortality? If so, please share these results. And, lastly, armed with this knowledge, what do you suggest we do with it going forward? Should we treat patients differently in some way after arrival to the hospital?

I’d like to congratulate the authors on an excellent study and an excellent presentation.

Dr Rajani: Just a comment on the questions. The ISS difference, we did talk about it in the manuscript, but I did not bring it up in the presentation today. I think there are limitations in the ISS system for victims of penetrating trauma. Certainly, if you have 2 injuries to one body system, it tends to underestimate the severity of the injury. The differences in ISS between the 2 groups, I do not know what to make of that. Certainly, it seems like the people who received prehospital airways were sicker, as you would expect. We did not do the study in order to confer causality; I do not think it is fair to say that the people who got intubated died as a result of their intubation; I think it would be a very hard thing to culled from a big national retrospective database. There were no other differences that we looked at. I am sure they are there in the NTDB, but we did not cull all variables. We did not do a regression analysis of the variables. That is something that we could do, looking forward. And in terms of what to do with these data, I think like I said earlier, the big take-home message is that any patient who requires prehospital air replacement after penetrating trauma has a very high mortality approaching 70% and I think you have to go into your patient encounter with a high sense of potential danger.

Dr Ron Stewart (San Antonio, TX): I will echo Dr Margulies. I think you should really strike the whole cricothyrotomy surgical airway from your conclusions. It is the NTDB database, and all those limitations make it impossible to draw any meaningful conclusions—a prehospital service might look at those data and say, “it is safer to do
surgical airway rather than do endotracheal intubation.” This may lead to more aggressive cricothyrotomy use in the field, when this is really not justified from the data presented.

**Dr. Rajani:** Thanks. We had no intention of suggesting that surgical cricothyroidotomy is safer for all patients. The other thing that comes out of this is what percentage of those patients that had cricothyroidotomy as a primary airway maneuver versus as a rescue maneuver because of failed intubation (i.e., if you have exposed trachea from a penetrating wound), it is pretty easy to stick a tube in someone through that, but if you have to do that because you cannot pass an endotracheal tube from above, then that is a different matter.