Field Intubation of Trauma Patients: Complications, Indications, and Outcomes

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Neither the success nor the complication rate for field intubation of trauma patients is known with any certainty. A retrospective audit of 94 severely injured patients who required field intubation was undertaken. Fifty percent (13 of 26) of survivors and 67% (37 of 71) of nonsurvivors were successfully intubated in the field (not significant). Mechanism of injury was similar in both groups, but survivors were younger (27 *v* 60 years, $P = .049$) and less critically injured, as reflected by their Injury Severity Scale scores, their Trauma Scores, and their field Glasgow Coma Scale scores (22.1 *v* 30.8, $P = .0035$; 7.7 v 4.2, $P < .0002$; and 6.3 *v* 3.3, $P < .0001$). When compared with previously published studies of medical patients with cardiac arrest, the success rate was lower in our trauma patients. When compared with patients having similar injuries intubated at the trauma center, field intubation was three times more likely to be associated with the development of nosocomial pneumonia than was hospital intubation. (Am J Emerg Med 1996;14:617-619. Copyright © 1996 by W.B. Saunders Company)

American College of Surgeons guidelines require Trauma Centers to monitor the effectiveness of prehospital airway management,[1] but the complication rate is not known with any certainty. Some research has been done on the intubation of trauma patients in the hospital,[2-4] but very little has been written about success or complication rates. Data from our own registry, and from one published report,[5] suggest that more than 20% of intubated trauma patients have the procedure done in the field. To determine whether the outcome in trauma patients intubated in the field was any different from that of patients with similar injuries intubated at our hospital, we conducted a retrospective study of 94 successive trauma patients for whom field intubation was required.

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MATERIALS AND METHODS

University Medical Center of Las Vegas is a Level II Trauma Center with a catchment area of more than 10,000 square miles. It is the only Trauma Center in Southern Nevada, and it also serves parts of Arizona, California, and Utah. The Center receives more than 4,000 patients each year. One emergency medical services (EMS) agency serves all of Southern Nevada and the surrounding desert regions. Within Las Vegas a dual response system is used; however, only one ambulance company provides advanced life support (ALS) services in the Las Vegas Valley, and the paramedics working for that company are required to record detailed information about all patients who need intubation. The paramedic record includes details about the number of attempts and the measures taken to verify tube placement. These records are reviewed daily by a paramedic quality improvement (QI) officer employed by the ambulance company. In cases of unsuccessful intubation the paramedics involved were contacted by the QI officer, usually with 48 to 72 hours, and attempts were made to ascertain the reasons for failure. At the time this study was undertaken, there was no protocol in place for multiple intubation attempts, nor was a formal instrument used to assess causes of failure. Data for this study were derived from the records of 94 successive trauma patients with attempted intubation, transported by paramedics during a 1-year period beginning July 1, 1993. At the time this study was undertaken, internal review board approval for retrospective QI chart reviews was not required.

Information about all transported patients is entered into a database (Foxpro®, Microsoft) maintained by the ambulance company. Code numbers identifying the ambulance unit are also entered on trauma patients' charts at the time of arrival at the hospital. Those data, in turn, are entered into the hospital's computerized trauma registry (Hospital Trauma Registry, HTR®, running on dBase IV). By combining data from the hospital and the ambulance company's data bases, it was possible to identify every trauma patient requiring field intubation and then identify the team of paramedics responsible for care in the field. Completeness of the data was insured by the fact that all trauma patients are transported by the same ambulance company to the same trauma center. Records from both the ambulance company and the trauma center were cross-checked to insure that all intubated trauma patients, regardless of site of intubation, were included in the study. Data regarding complication rates, for both in- and out-of-hospital intubations, were derived from the trauma registry.

Data were analyzed using a combination of parametric (analysis of variance [ANOVA]) and nonparametric techniques (Mann-Whitney *U* test). The chi-square test was used to test for differences in intubation success rate between attempts in the different groups

and to compare nosocomial infection rates among field and hospital intubated patients. P values of less than .05 were considered significant.

RESULTS

Ninety-four patients were entered in the study, 26 (27%) of whom survived to hospital discharge. Mechanism of injury in survivors and nonsurvivors was similar; 61% of the survivors and 53% of nonsurvivors had sustained blunt trauma (not significant [NS]). The mechanism of injury is shown in Table 1. Survivors were much younger than nonsurvivors (27 *v* 60 years, $P = .049$), and they were less critically injured, as reflected by their Injury Severity Scale (ISS) scores, their Trauma Scores, and their field Glasgow Coma Scale (GCS) scores (22.1 *v* 30.8, $P = .0035$; 7.7 *v* 4.2, $P < .0002$; and 6.3 *v* 3.3, $P < .0001$). Blood pressure was a significant predictor of outcome. All of the survivors had palpable pulses (carotid, radial, or femoral) at the time they were intubated. By contrast, 35% of the patients who died had no palpable pulse ($P = .01$).

Most of the survivors were victims of auto-pedestrian (24%) or motor vehicle accidents (38%). The other large group of survivors (38%) had been shot. The most common mechanism in the nonsurvivors was gun shot wound (34%), followed by auto-pedestrian accidents (16%) and motor vehicle accidents (14%). The types of injury sustained by survivors and nonsurvivors are listed in Table 2. All of the survivors had sustained either head or facial injuries. More than a third of the nonsurvivors had severe truncal injuries (aortic disruptions, penetrating heart injuries, crushing chest and larynx injuries, etc).

Explanations for unsuccessful intubation were the same in survivors and nonsurvivors. The reason most often mentioned by paramedics was patient gagging or combativeness (38% of survivors and 32% of nonsurvivors). The second most common cause for failure was blood or vomitus in the airway (23% of survivors and 16% of nonsurvivors). Other explanations are listed in Table 3. Nearly a third (30 of 94) of the patients in the study died in the resuscitation area and were never even admitted to the hospital. Of the remaining 64 patients, 13 died within 2 days of admission, and 8 others died after hospital stays of 3 to 12 days. Nosocomial pneumonia developed in 9 of the 51 of the patients who survived for more than 2 days (18%). Other complications observed in the survivors were anoxic encephalopathy in 1 (1.9%), atelectasis requiring bronchoscopy in 2 (3.9%), and illeus of prolonged duration in 1 (1.9%).

TABLE 1. Mechanism of Injury

	Survivors (n = 28)	Deaths (n = 66)
Gun shot wound	36%	34%
Motor vehicle accident	36%	14%
Auto-pedestrian	24%	16%
Stabbing	—	3%
Hanging	3%	1%
Falls from heights	—	7%
Assaults	—	—
Other	1%	25%

NOTE: Survivors were more likely to have been injured in motor vehicle accident than nonsurvivors. Penetrating trauma was equally common in both survivors and nonsurvivors.

TABLE 2. Comparison of Injuries Sustained by Trauma Patients Requiring Field Intubation

	Survivors (n = 28)	Nonsurvivors (n = 66)
Closed head injury	7 (26%)	12 (18%)
Skull fracture with bleed	6 (21%)	12 (18%)
Subdural hematoma	9 (18%)	3 (4%)
Cerebral contusion	3 (11%)	6 (9%)
Facial injuries	2 (7%)	3 (5%)
Intracerebral bleed	1 (4%)	10 (15%)
Blunt chest/flail chest	—	6 (9%)
Cardiac injury	—	4 (6%)
Aortic disruption	—	3 (4%)
Ruptured kidney/spleen/liver	—	3 (4%)
Penetrating chest wound	—	3 (4%)
Crushed larynx	—	1 (2%)

NOTE: All survivors had head and/or facial injuries. Patients with truncal injuries requiring field intubation did not survive.

Data from the field study were compared with data elements from our hospital trauma registry describing 223 other trauma patients who were intubated in our hospital during the same time interval in 1993-1994. The characteristics of patients with intubation (successful or unsuccessful) in the field were then compared with the characteristics of patients intubated in the hospital (resuscitation area, operating room, or intensive care unit [ICU]). Comparisons showed that patients intubated in the field were significantly younger than patients intubated in the hospital (26.3 years *v* 35.8 years, $P = .016$), and had much lower GCS scores (5.9 *v* 9.9, $P = .0001$). However, injury severity was comparable in both groups (ISS scores were 22.1 for field patients *v* 23.2 for patients first intubated in the hospital [NS]). The nosocomial pneumonia rate for patients intubated in the hospital was 5.3% (12 patients out of 223).

DISCUSSION

The intubation success rate reported here is significantly lower than has been observed in other studies of paramedic field intubation. Steward et al[6] reported a 90% success rate; however, the patients in that study were all "patients found in cardiac arrest or in deep coma without gag reflex," and it is not clear how many, if any, were trauma victims. On the other hand, the statistics in our registry are in surprisingly

TABLE 3. Reasons for Failure to Intubate in Survivors and Nonsurvivors

	Survivors (n = 13)	Nonsurvivors (n = 19)
Gagging or combative patient	5 (38%)	6 (32%)
Blood/vomitus in airway	3 (23%)	3 (16%)
Facial trauma	2 (15%)	1 (5%)
Trismus	1 (8%)	3 (16%)
Unknown	2 (15%)	5 (26%)

NOTE: Because of the relatively small sample, no significant differences could be inferred, nor was it possible to identify any area where skill seemed to be deficient.

good agreement with an earlier, much smaller study where more than 20% of trauma intubations were also done in the field.[5] Given the fact that so many trauma victims are intubated in the field, and given the proven effectiveness of field intubation,[6-8] it is surprising that so little attention has been paid to performance improvement.

Nearly one third of our patients could not be intubated in the field. This is a disappointing result, but the benchmark success rate for field intubation of severely injured patients has never really been determined in ground-based systems, and it is difficult to know just what failure rate to expect. A failure rate of 10% has been reported in one helicopter-based system,[9] but whether success rates in ground- and air-based systems can reasonably be compared is not known. Concerted efforts at improvement are needed, but what those efforts should be is not at all clear. Interviews with the responsible paramedics disclosed that failure was most likely from gagging or combative patients, but blockage of the airway with blood or vomitus was responsible for failure in nearly a quarter of the patients who survived to hospital, and facial trauma was responsible in two other cases.

Patients requiring field intubation were younger (26 *v* 35 years) and more obtunded (GCS score 5.9 *v* 9.8) than trauma patients intubated in hospital. Survival was reliably predicted by the patient's Trauma Score recorded on scene. Survivors, even though critically injured (ISS = 22), had average trauma scores of 7.7, compared to a mean of 4.2 in the 73 nonsurvivors. Nonsurvivors had such low scores because they had such low blood pressures. All of the survivors, on the other hand, had detectable blood pressure on scene. Our findings confirm previously published studies that question the value of resuscitating trauma victims who are pulseless on scene.[10]

We were surprised to find that patients who survived to hospital discharge were much more likely to develop nosocomial pneumonia. Pneumonia is generally considered the most frequent infectious complication in trauma patients, but there is very little agreement on what the respiratory infection rate is, or even what it should be, either in the field or in the hospital. The difficulties are explained by the absence of any agreement on what constitutes pneumonia in a trauma patient. The presence of fever, leuckocytosis, and new infiltrate is generally considered diagnostic for pneumonia, but the definition of fever and leuckocytosis varies from center to center, and reported rates have varied from 8%[11,12] to 44%,[3] or even higher.

The criteria for the diagnosis of pneumonia at our center include (1) temperature of >38°C, (2) a white blood cell count greater than 14,500/μL, and (3) the presence of a new infiltrate in a previously untraumatized area of the lung. Using that definition, 5.3% of our hospital-intubated patients, admitted to our trauma ICU, develop pneumonia. A much higher rate of 18% was observed for the patients intubated in the field, suggesting that this group is at increased risk. Risk analysis of pooled patient data from other Trauma Centers has shown that increasing age, the presence of shock on admission, significant head injury, and surgery to the head and chest are all predictors for the development of pneumonia in trauma patients.[13] The high ISS scores (22) and the low Trauma scores (7.7) of the survivors intubated in the field place them squarely in the group at higher risk for pneumonia. Whether improved technique might reduce the pneumonia rate in these patients is not clear, but the possibility is surely worth investigating.

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