STUDENT PAPER

Trauma unit emergency doctor airway management

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Objectives. To audit indications for and practice (in terms of training/qualification) of definitive airway management compared with current UK practices.

Design. Consecutive observational study.

Setting. Tygerberg Academic Hospital Trauma Service, Western Cape.

Subjects. All trauma patients either arriving intubated or requiring intubation at the Trauma unit during the period 1 - 31 August 2006.

Outcome measures. A data collection proforma was completed either at the time of intubation or from medical records.

Results. Fifty-seven patients required definitive airway management. In the unit 32 patients (56%) were intubated by emergency medicine registrars or medical officers, with rapid-sequence intubations (RSIs) in all 32 (100%). Seven patients (12.3%) were intubated by paramedics pre-hospital, and 18 patients (31.6%) were intubated at referring hospitals by non-anaesthetists. Endotracheal intubation was successful in 55 patients (96.4%). Two patients (3.6%) could not be intubated and therefore underwent surgical cricothyroidotomy at the unit. Clinical outcomes included 12 patients (21%) extubated for ward transfer, 7 patients (12.3%) admitted to an intensive care unit (ICU), 21 patients (36.8%) taken for surgery, and 17 patients (29.8%) died.

Motor vehicle accident (MVA) was the predominant mechanism of injury, accounting for 30 (52.6%) patients, while 16 patients (28.1%) had penetrating injuries (gunshot and/or stab wounds), 6 patients (10.5%) had blunt trauma, and the remaining 5 patients (8.8%) suffered serious burns.

Conclusion. The most common indication for intubation was a Glasgow Coma Score (GCS) of less than 8, typically in the polytrauma patient with suspected head injury due to MVA. Emergency doctors managed 100% of definitive airway in-hospital, and RSI was the favoured method. This differs greatly from the UK where non-anaesthetists only perform between 31% and 56% of trauma intubations, with the rest performed by anaesthetists. Outcome was, however, similar to that described in the literature.

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Airway management is the single most important intervention in the emergency setting. Recognising the need for a definitive airway is life saving, and therefore identification of a problem with an airway is paramount. In recent years the responsibility for tracheal intubation has shifted from anaesthetists to emergency department doctors[1] who are in a better location (due to presence in the unit) to as rapidly and safely secure the airway as anaesthetists. With this change appropriate training has been required to ensure that doctors have the necessary skills and competency to manage the emergency airway. Trauma units receive a relatively high proportion of patients requiring definitive airway control, and this responsibility falls to the on-duty trauma doctors, unlike current UK practice where a significant percentage of trauma intubations are performed by anaesthetists. The purpose of this study was to ascertain current definitive airway management practices, to evaluate the primary indication for intubation given the mechanism of injury, and to report the outcomes.

Full-time medical officers manage the trauma resuscitation unit, while registrars in emergency medicine and general surgery rotate through the unit as part of their postgraduate training for the College Fellowships. All staff members are Advanced Trauma Life Support (ATLS)-trained. The attending emergency doctor is responsible for securing the airway of any patient requiring intubation, using individual discretion to determine the type of airway and method of intubation within recognised practices. Usually a senior trauma doctor with more experience will secure a difficult airway, and if endotracheal intubation is still unsuccessful, surgical cricothyroidotomy is performed, although this is rarely needed.

Standard equipment is available in the unit to manage the emergency airway. Trauma intubations performed in the unit are rapid sequence intubations (RSIs), utilising succinylcholine and etomidate, while midazolam is used for sedation. Other drugs are seldom utilised. Surgical cricothyroidotomy equipment is available if endotracheal control has not been secured. However, no other equipment is available to manage the difficult airway, such as laryngeal masks or fibre-optic

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bronchoscopes, and unlike in the UK, anaesthetists are rarely consulted. Laryngeal masks are not yet accepted as standard of care for trauma airway management, although these are optional devices.

Standard pre-oxygenation and monitoring are utilised as per ATLS recommendations. A 3-person trauma team perform intubation, routinely applying cricoid pressure to prevent gastro-oesophageal reflux and aspiration, and manual in-line cervical stabilisation is required throughout the intubation procedure since protective devices are removed routinely. Tracheal intubation is clinically confirmed by inspection, chest and epigastric auscultation and oxygen saturation, and position is checked on chest radiography. Following successful intubation a nasogastric tube is typically passed to decompress the stomach and limit gastric distension, and an oral pharyngeal airway is placed to prevent the patient biting down on the tube.[2,3]

Methods

Design and setting

A prospective observational study was undertaken during an undergraduate medical elective (1 - 31 August 2006) in an academic trauma service. Data were collected prospectively and captured on a proforma. The proforma forms were cross-referenced with administration records to ensure that no cases were neglected. Basic demographic details, mechanism of injury, initial Glasgow Coma Score (GCS) and observations, primary indication for intubation, type of definitive airway (oral versus nasal intubation versus surgical airway) and clinical outcome were captured. Discussion will focus on the highlighted differences between South African trauma medicine and current UK practices.

This study outlined the primary indications for tracheal intubation into three broad categories (detailed in Table I) as summarised in the Eastern Association for the Surgery of Trauma (EAST) practice management guidelines for 'Emergency Tracheal Intubation Immediately Following Traumatic Injury'.[4] The categories were: (*i*) failure to maintain or protect the airway; (*ii*) inadequate oxygenation or ventilation; and (*iii*) projected clinical course

The mechanism of injury was documented, and stratified into several categories: (*i*) motor vehicle accidents (MVA), typically polytraumas with suspected head injury; (*ii*) blunt and penetrating assault; and (*iii*) other traumatic injury (such as burns or falls).

All data were entered and analysed using Microsoft Excel 5.0 Software (Microsoft Corporation).

Results

During the study period 112 patients were admitted to the major resuscitation facility. Of the 112 patients, 92 (82.1%) had trauma-related injuries, and of those, 57 (62%) required intubation (Table II).

Table II summarises the demographic data, various mechanisms of injury, and GCS scores for the study group. Of the 57 intubated trauma cases 49 (86%) were male. The mean age was 33 years, but ranged from 2 years to 71 years. The mean GCS at time of intubation was 7.82, however cases covered the entire range from 3 to 15.

Table I records the primary indications for intubation. MVAs represented the largest single injury mechanism, in 30 patients (52.6%), of whom 22 had a GCS < 8, for which major traumatic brain injury was the primary indication for intubation. One MVA patient with a GCS of 10 was intubated due to deterioration of serial GCS measurements from 15 on-scene to 12 and then 10. The remaining 7 polytrauma patients all had significant chest injuries and pulmonary contusions affecting respiratory effort and oxygenation.

Table I. Primary indication for definitive airway

Criterion	No. of patients	Percentage of total
Failure to maintain or protect airway	40	70.3
Major traumatic brain injury	31	54.4
Airway inhalational burn injury	3	5.3
Upper airway trauma	1	1.8
Compression from haematoma in neck	5	8.8
Inadequate oxygenation or ventilation	15	26.25
Lung contusion with hypoxia despite oxygen	7	12.3
Chest injury with poor ventilatory mechanism	6	10.5
Profound hypotension or cardiac arrest	2	3.45
Projected clinical course	2	3.45
Moderate brain injury with potential deterioration	2	3.45

Sixteen patients (28.1%) sustained penetrating injuries; of these, 6 had major chest trauma affecting ventilation or oxygenation, 6 developed airway compromise from soft-tissue injury and swelling, 2 suffered traumatic brain damage, and 2 patients had traumatic arrests following significant blood loss and profound hypotension.

Seven patients (12.3%) were admitted having already been intubated by paramedics, 18 (31.6%) were referred intubated from surrounding secondary-care hospitals, and 32 (56.1%) were intubated in the unit. Endotracheal intubation was successful in 96.5% of cases, with only 2 patients (3.5%) unsuccessfully intubated despite several attempts by senior doctors, and therefore these patients underwent emergency surgical cricothyroidotomy.

Clinical outcomes reflecting the injury severity of the average case load include 12 patients (21%) weaned and extubated for ward transfer, 7 patients (12.3%) admitted sedated and ventilated to the intensive care unit (ICU), 21 patients (36.8%) taken to surgery, and 17 patient deaths in the resuscitation unit (29.8%). A further 3 patients died following surgery and 2 died in ICU, giving an approximate overall survival rate of 61.4%. The 2 ICU deaths were both MVA head injuries, GCS 3 and GCS 4, and a poor prognosis was expected.

Two patients died following traumatic cardiac arrest on the operating table, 1 with a gunshot wound to the abdomen and 1 with a stabbed chest (thoracotomy), GCS 3 and GCS 12 respectively. A further postoperative death occurred in an MVA driver with a GCS of 7 – a computed tomography (CT) scan of the brain demonstrated injury incompatible with life. When pre-intubation GCS levels are compared with the mortality for head injuries, it is noted that those with a GCS level ≤ 5/15 (33% of all head injuries) had a high mortality (50% of all head injury-related mortality), compared with those who had a GCS level ≥ 6/15 (3/32 = 9% mortality).

Table II. Demographic data

	No. of patients	% of total
Gender		
Male	49	86
Female	8	14
Adult: age > 18 yrs		
18 - 65	50	87.7
> 65	2	3.5
Paediatric: age < 18 yrs		
< 1 (infant)	0	0
1 - 12 (child)	2	3.5
13 - 17 (teenager)	3	5.3
GCS		
3	17	29.8
4 - 8	19	33.3
9 - 12	10	17.5
13 - 15	11	19.3
Mechanism of injury		
MVA	30	52.6
Blunt injury	6	10.5
Penetrating injury	16	28.1
Other (fall, burns)	5	8.8

GCS = Glasgow Coma Score; MVA = motor vehicle accident.

Discussion

A hypotensive patient may survive many hours untreated but an apnoeic patient will die within minutes, therefore the most important aspect of trauma care is maintaining airway patency.

Trauma doctors in South Africa are ordinarily expected to manage all emergency intubations for which RSI is standard practice. Literature supports RSI as the safest and most reliable method of intubation in the trauma patient, associated with significantly fewer complications than other intubation techniques.[5-8] Studies also support the use of neuromuscular blockade[9] and of etomidate[10] for RSI in the emergency department setting. Although airway management by non-anaesthetists is the recognised practice for most trauma intubations in South Africa, 2 recent UK studies[11,12] report that emergency department doctors perform only 31% and 56% of RSIs, while anaesthetists are still relied on for the remaining cases. These cases tend to include anticipated problematic airways, which are not a rarity in trauma, as demonstrated in this study, where at least 6 patients were intubated for threatened airway obstruction. Training is given to all emergency department doctors to equip them with the skills and experience to manage even difficult airways, and countries like the UK now recognise the merit in having specialist training for doctors to conduct RSIs in the emergency department.[13] Training emergency doctors to intubate when indicated, rather than requesting an anaesthetist's assistance, is crucially time saving and therefore life saving. Butler *et al*.[11] reported a greater than 5-minute wait for an anaesthetist to arrive at 17 of the 35 cases to which they were called. Furthermore it has been noted that often the anaesthetist responding to the emergency call for airway assistance is relatively inexperienced,[14] whereas in South Africa the majority of emergency doctors have background training in anaesthesiology and are given the opportunity to regularly enhance these skills in the trauma setting.

This study found that an average of 1 patient per day required intubation by emergency doctors during the study period; extrapolation suggests that each year over 360 patients need intubation on site. This does not include those intubated at the scene or transferred from referring hospitals. This is a significant caseload compared with the UK where 1 study[15] including 735 RSIs over a 2-year period represented only 31 intubations per consultant per year in the emergency department. South African trauma doctors experience abundant exposure to critical airway management. Unfortunately for UK non-anaesthetists, it is possible that acquired skills will deteriorate without regular application.

South African trauma doctors deal with more intubations, and also a greater severity of injury. Statistics report that for the year 2000, 22 000 murders occurred in South Africa, of which 49% were firearm-related. Furthermore, firearms were the leading cause of fatal injury in males aged 15 - 65+.[16] This study reports 11 gunshot wounds resulting in intubation, of which 7 ultimately ended in fatality. However, the mechanism of injury prompting the significant majority of intubations (52.6%) was MVAs, with suspected traumatic brain injury, clinically indicated by GCS < 8. The GCS is an integral part of head injury assessment in the trauma setting and has been validated in a multicentre comparison for use in trauma triage.[17] The present study recorded 32 head-injury patients with a GCS ≤ 8, accounting for 15 of the 22 deaths. Raw data from 1 study[18] suggest that death is a highly probable outcome in patients with a GCS < 5, furthermore a comparison study[19] between field and arrival GCS levels demonstrated a similar correlation in the prediction of outcome. While 3 of the deaths appear to be out of line with these findings, re-assessment of GCS at 24 - 48 hours is of higher value in predicting outcome, which is not appropriate for this study. The American National Emergency Airway Registry (NEAR)[20] documented 3 342 emergency department intubations, of which 39.1% were indicated for head injury. Of all intubations, 82.7% underwent RSI, with etomidate and succinylcholine as the drugs of choice, further supporting current South African practice.

While the clinical decision-making process for endotracheal intubation of the acute trauma patient is largely evidence-based, occasions arise where the professional judgement of the clinician is more heavily relied on. For example, moderate traumatic brain injury (GCS 9 - 12) is conventionally not an indication for a definitive airway, however progressive neurological deterioration may well be sufficient persuasion for intubation. A clear history of neurological decline was documented from the time of injury to the point of intubation in only 1 of the 57 intubations in this study. The challenge is to assess whether such clinical decisions are appropriate.

The NEAR study[20] also documented the relative minority of surgical airways required, in keeping with the findings of this study, due to a high percentage (96.5%) of successful endotracheal intubations. The study by Graham *et al*.[15] involving 735 RSIs documented an 83.8% success rate for emergency department doctors, which further supports the necessity for continued skill implementation.

A prospective study over a longer period would be ideal, but this was not possible. This study did not assess immediate complications of intubation, or attempt to draw comparisons between pre-hospital and in-hospital-based intubations as this was beyond the scope of this project. The study is purely a descriptive report of the intubation practices at Tygerberg Academic Hospital trauma unit, and as such cannot be applied generally to the whole of South Africa. Patients were selected on a consecutive basis for a limited 1-month period and therefore no allowance was made for seasonal variations that the department may experience.

Conclusion

In summary, the trauma unit deals with an extensive caseload and intubations are frequently difficult. Definitive airway management is a fundamental practical skill for trauma doctors, especially given the variety of injury mechanisms and indications for intubation. A good knowledge of evidence-based practice is essential for making the correct decision to intubate, which has been demonstrated by Tygerberg doctors. Comparative skills may still be lacking outside the anaesthesia environment in other countries due to relatively less extensive training and patient numbers, since the anaesthetist rather than the non-anaesthetist performs most trauma intubations, although movement towards similar airway management training is anticipated, given the development of emergency medicine as a specialty worldwide.

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References

1. Sakles JC, Laurin EG, Rantapaa AA, Panacek EA. Airway management in the emergency department: a one-year study of 610 tracheal intubations. *Ann Emerg Med* 1998; 31: 325-332.
2. Walls R. Airway 1 - 5. In: Marx JA, ed. *Rosen's Emergency Medicine, Concepts and Clinical Practice.* 5th ed. St Louis: Mosby, 2002.
3. Talucci RC, Shakih KA, Schwab CW. Rapid sequence induction with oral endotracheal intubation in the multiply injured patient. *Am Surg* 1988; 54: 185-187.
4. The Eastern Association for the Surgery of Trauma (EAST) Clinical Practice Guidelines. www.east.org/tpg/intubation.pdf (last accessed 15 June 2006).
5. Walls RM, Gurr DE, Kulkarni RG, *et al*. 6293 Emergency department intubations: Second report of the ongoing National Emergency Airway Registry (NEAR) II Study. *Ann Emerg Med* 2000: 36: S51.
6. Li J, Murphy-Lavoie H, Bugas C, *et al*. Complications of emergency intubation with and without paralysis. *Am J Emerg Med* 1999; 17: 141-144.
7. Vijayakumar E, Bosscher H, Renzi FP, *et al*. The use of neuromuscular blocking agents in the emergency department to facilitate tracheal intubation in the trauma patient: Help or hindrance? *J Crit Care* 1998; 13: 1-6.
8. Dronen SC, Merigian KS, Hedges JR, *et al*. A comparison of blind nasotracheal and succinylcholine-assisted intubation in the poisoned patient. *Ann Emerg Med* 1987; 16: 650-652.
9. Norwood S, Myers MB, Butler TJ. The safety of emergency neuromuscular blockade and orotracheal intubation in the acutely injured trauma patient. *J Am Coll Surg* 1994: 179: 646-652.
10. Laurin EG, Sakles JC, Prosser B, *et al*. The safety of etomidate for rapid sequence intubation (Abstract). *Acad Emerg Med* 1996; 3: 527.
11. Butler J, Clancy M, Robinson N, *et al*. An observational survey of emergency department rapid sequence intubation. *Emerg Med J* 2001; 18: 343-348.
12. Beale JP, Graham CA, Thakore SB, *et al*. Endotracheal intubation in the accident and emergency department (Abstract). *J Accid Emerg Med* 2000; 17: 439.
13. Bush S, Gray A, Mcgowan A, Nichol N. Rapid sequence intubation (Letter). *J Accid Emerg Med* 2000; 17:309.
14. Walker A, Brenchley J. Survey of the use of rapid sequence induction in the accident and emergency department. *J Accid Emerg Med* 2000; 17: 95-97.
15. Graham CA, Beard D, Oglesby AJ, *et al*. Rapid sequence intubation in Scottish urban emergency departments. *Emerg Med J* 2003; 20: 3-5.
16. Matzopoulos R. A Profile of Fatal Injuries in South Africa 2000: Second Annual Report of the National Injury Mortality Surveillance System. Violence and Injury Surveillance Consortium. (2001). *Injury and Safety Monitor* 2002; 1(1): 3-4.
17. Al-Salamah M, McDowell I, Stiell IG, Wells GA, Nesbitt L. Multicenter comparison of the predictive value of the Revised Trauma Score and the Glasgow Coma Scale. *Acad Emerg Med* 2003; 10: 476-477.
18. Arbabi S, Jurkovich G, Wahl W, *et al*. A Comparison of prehospital and hospital data in trauma patients. *J Trauma* 2004; 56: 1029-1032.
19. Davis D, Serrano J, Vilke G, *et al*. The predictive value of field versus arrival Glasgow Coma Scale score and TRISS calculations in moderate-to-severe traumatic brain injury. *J Trauma* 2006; 60: 985-990.
20. Brown CA, Walls RM. National Emergency Airway Registry (NEAR III): An initial report of 3 342 emergency department intubations. *Acad Emerg Med* 2004; 11: 491.

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