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Management of the trauma airway

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Abstract

A priority for all trauma patients is rapid assessment and appropriate, prompt and effective management of the airway. Adequate ventilation and tissue oxygenation can prevent hypoxic injury, particularly within the central nervous system. Failure to secure the airway soon enough is a major cause of preventable death following significant injury (Ivatury and Guilford, 2008). Many controversial issues surround the management of the trauma airway including the effect of early tracheal intubation on morbidity and mortality, the variation in failed intubation rates for paramedics compared with physicians, and the use of manual in-line stabilisation and cricoid pressure during tracheal intubation. Studies have attempted to address these and other questions related to airway management in trauma patients. Unfortunately, many variables within the studies make interpretation of the results difficult. This review aims to summarise the key issues in relation to all of these controversies.

Keywords

Trauma, airway, prehospital, intubation

What is the problem?

In 2007, the National Confidential Enquiry into Patient Outcome and Death (NCEPOD, 2007) published a report detailing the provision of trauma care in the UK. Data were received from 183 hospitals, and included 795 patients with an injury severity score (ISS) > 16. Noisy or blocked airways were identified in 19.8% of patients on scene and 12.6% of patients on arrival at hospital. Prehospital intubation failed in more than 12% of patients. The findings indicate clearly that there is a scope for improvement in the airway management of trauma patients.

The 'trauma airway' differs in several ways from an airway encountered in routine hospital practice. Injuries sustained by the patient may cause anatomical disruption of the head and neck; blood and vomitus are present frequently in the mouth and airway. The prehospital scene is often noisy, access to the patient can be difficult, and space limited. Hazards such as petrol or diesel spillages, live cables or loose rubble need to be taken into consideration.

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Equipment may differ slightly from that available in hospital: whilst airway devices tend to be similar, smaller portable ventilators are relatively commonplace and require familiarisation. It is also probable that some equipment, such as fibrescopes, will not be available. These factors contribute to making the trauma airway potentially more difficult to manage than most airways encountered in the hospital environment.

Indications for tracheal intubation of the trauma patient

Common indications for early intubation of trauma patients include airway obstruction or injury, hypoventilation, severe hypoxaemia, Glasgow Coma Scale (GCS) score <9 or sustained seizure activity, cardiac arrest and severe haemorrhagic shock (Trauma.org, 2006). These indications can be considered further as either immediate or urgent, indicating the time critical nature of this intervention. Airway obstruction with life-threatening hypoxaemia, which cannot be relieved by simple means, and an inadequate facemask seal leading to insufficient ventilatory support, should be considered indications for immediate tracheal intubation. Other conditions such as haemodynamic compromise, low GCS and injury to the airway resulting in oedema, haematoma or laryngotracheal fracture are urgent indications (Cranshaw and Nolan, 2006).

Prehospital airway care

Preoxygenation

The main aim of prehospital airway management is to avoid hypoxaemia. Hypoventilation, shock and increased oxygen consumption contribute to a more rapid development of hypoxaemia in the prehospital environment than that observed during the routine administration of general anaesthesia in hospital. Unpublished data from animal studies suggest that a combination of inadequate administration of oxygen and major blood loss can lead to an arterial blood oxygen saturation of 70% within about 30 s of apnoea (Herff et al., 2009). Preoxygenation is useful to reverse initial hypoxaemia or to reduce the chances of it occurring whilst attempting to establish a definitive airway; adequate preoxygenation can be difficult to achieve in the field. When supplemental oxygen is administered for 4 min during routine anaesthesia in hospital, the PaO_2 will normally increase from 80 to 400 mmHg. The corresponding increase observed in unstable emergency patients is much lower, ranging from 67 to 104 mmHg (Mort, 2005). The stress of providing rapid and effective emergency airway management may push the intubator into providing inadequate preoxygenation.

Securing the airway

One of the major controversies in the management of the prehospital airway is how the airway should be secured. Equivocal evidence has been provided by studies that have attempted to ascertain whether there is a reduction in morbidity and mortality associated with prehospital tracheal intubation. Most studies are retrospective in design and therefore have limitations intrinsic to these types of study, such as missing data or incorrect coding of patient outcome. Other factors include a varied casemix, differing skill levels of prehospital personnel, use of drugs, injuries sustained, recognition of failed intubation and the ability to provide a control or comparative group. The majority of studies have failed to show a reduction in morbidity and mortality following out-of-hospital tracheal intubation. Two studies have reported lower mortality rates associated with prehospital intubation following traumatic brain injury (Winchell and Hoyt, 1997; Suominen et al., 2000). However, in one study, the non-intubation group included patients in whom intubation had been attempted, but had failed (Winchell and Hoyt, 1997); this confounder is likely to have influenced the results. The second study included only a few patients ($n = 59$); the authors concluded that mortality was lower for those patients intubated in the field when compared with patients intubated in regional hospitals.

When the mortality rates for patients intubated in the field were compared with those for patients intubated at a Level 1 trauma centre, mortality was greater for the field intubation group (Suominen et al., 2000).

Does prehospital tracheal intubation improve survival?

In 2009, a Cochrane Review attempted to address whether tracheal intubation compared with other airway management methods reduces morbidity and mortality in acutely ill or injured patients who have real or anticipated problems in maintaining an adequate airway. Inconclusive evidence was obtained (Lecky et al., 2008). Three randomised controlled trials (RCTs) were considered eligible for inclusion in the review. Two trials focussed on non-traumatic out-of-hospital cardiac arrest in adults. The airway was managed by physicians in one RCT, and by paramedics in the other. Unfortunately, neither trial was powered sufficiently to provide conclusive data: in patients randomised to receive physician-operated intubation *versus* a Combitube, the relative risk of survival for the intubation group was 0.44 (95% CI 0.09–1.99; Rabitsch et al., 2003). The second trial reported a survival rate of 11.1% among those who were intubated by paramedics *versus* 12.9% among those were managed with an oesophageal gastric airway; the relative risk of survival following tracheal intubation was 0.86 (95% CI 0.39–1.90). Seventeen percent of patients did not receive the airway intervention to which they had been randomised (Goldenberg et al., 1986). The third RCT was a study of children requiring prehospital airway intervention. Results indicated no difference in survival (OR 0.82, 95% CI 0.61–1.11) or neurological outcome (OR 0.87, 95% CI 0.62–1.22) between paramedic intubation *versus* bag-mask ventilation (BMV) and later hospital intubation by emergency physicians; however, of the children randomised to paramedic tracheal intubation, only 42% were intubated. The remainder of this group received only BMV, or BMV following unsuccessful attempts at intubation (Gausche et al., 2000).

Airway management for general trauma. The Ontario Prehospital Advanced Life Support (OPALS) Major Trauma Study was a large multicentre prospective study in which were enrolled 2867 trauma patients who received either basic or advanced life support (ALS). Again, the study failed to demonstrate a decrease in morbidity or mortality following the implementation of ALS interventions, but did demonstrate an increased mortality in those patients receiving ALS; however, the results do not separate out the effect of intubation from other interventions, such as intravenous fluid therapy, included in the ALS group (Steill et al., 2008). One study conducted in a Level 1 trauma centre documented whether failure to intubate the trachea in the prehospital setting was associated with an increase in mortality. Failed intubation occurred in 63 (31%) of the 203 patients receiving prehospital airway management and, when assessed on arrival at hospital, the tube was found to be in the oesophagus in 25 cases (Cobas et al., 2009). Though the study did not demonstrate a statistically significant difference in mortality between the successful intubation and failed intubation groups, the relatively high failed intubation rate and frequency of unrecognised oesophageal intubation is concerning.

Intubation following traumatic brain injury. In theory, early intubation of traumatic brain-injured patients should reduce secondary brain injury associated with hypoxaemia and therefore improve outcome. Hypoxaemia is associated with an increase in mortality (Davis et al., 2004). However, most studies do not support prehospital intubation in these patients. In 2003, Davis et al. showed a significant increase in mortality and a lower incidence of good neurological outcome for patients undergoing paramedic rapid sequence induction (RSI) (using suxamethonium) and intubation. The study was prospective and all patients included in the study were matched to controls; criteria used for matching included the ISS and systolic blood pressure, but not the initial GCS. The authors suggest factors contributing to these poor results include transient hypoxaemia, which occurred in more than 50% of monitored patients, longer scene times associated with the RSI and intubation intervention, and inadvertent hyperventilation; 39% of patients had a $PaCO_2$ on arrival at hospital of less than 33 mmHg (Davis et al., 2003). A statistically significant link between hypocapnia and an increase in mortality has subsequently been demonstrated (Davis et al., 2004). A further study published by a group from the Shock Trauma Center in Baltimore agreed with the findings from the Davis group. Patients intubated in the field had lower arterial blood oxygen saturations before intubation (89% *vs.* 91%), and lower systolic blood pressures (105 mmHg *vs.* 111 mmHg) compared with those patients intubated in hospital; scene times were significantly longer for patients undergoing field intubation (Bochicchio et al., 2003). Another retrospective, registry-based study showed an increase in mortality with prehospital intubation (odds ratio, 0.36; 95% CI 0.32–0.42; $p < 0.001$; Davis et al., 2005).

Another study documented an increase in mortality rate for patients with a head/neck Abbreviated Injury Scale score of 3 when patients were intubated in the prehospital stage rather than in the emergency department, odds ratio 3.99 (95% CI 3.21–4.93). Attendance of air medical crews, with a flight paramedic, nurse and physician, was associated with an improved outcome. The major difference between these crews and ground crews is that the air medical crews carry neuromuscular blocking drugs, and a physician is present (Wang et al., 2004). The ability to intubate the trachea of a trauma patient without the aid of anaesthetic drugs requires profound depression of consciousness, which is likely to be associated with significant injury. It is widely considered that patients undergoing tracheal intubation without drugs generally have a poor outcome. Data obtained from the London Air Ambulance uphold this view. An observational study conducted in 2001 demonstrated that, of the 1480 trauma patients, 492 (33.2%) were intubated without drugs; only one patient survived, although follow-up data were missing for six patients (Lockey et al., 2001). A subsequent study from Denmark documented one survivor among 12 patients undergoing prehospital tracheal intubation without drugs (Christensen and Høyer, 2003). The authors do not comment on the neurological outcome of the patient. Tracheal intubation without drugs carries a risk of haemodynamic instability, stimulation of vomiting and an increase in intracranial pressure.

Tracheal intubation for out-of-hospital cardiac arrest. Two recent studies published in 2010 have added to the controversy. Both studies were relatively large, retrospective studies, which involved patients who had sustained out-of-hospital cardiac arrest. One study demonstrated a higher rate of return of spontaneous circulation (ROSC) and survival to hospital discharge in patients who did not undergo tracheal intubation (Studnek et al., 2010). Individuals with no intubation attempts were 2.33 (95% CI 1.63–3.33) times more likely to have ROSC and 5.46 (95% CI 3.36–8.90) times more likely to be discharged from the hospital alive compared with those who had been intubated successfully at the first attempt. The second study documented decreased survival to hospital discharge for those patients receiving tracheal intubation in the field compared with those undergoing BMV, or insertion of a Combitube, or oesophageal obturator airway (Hanif et al., 2010). The odds ratio for survival to hospital discharge for BMV versus tracheal intubation was 4.5 (95% CI 2.3–8.9; $p < 0.0001$).

Who should undertake prehospital intubation?

The majority of published studies raise the issue of provider skill level for tracheal intubation in the field. This reflects one of the other major controversies in prehospital airway management – who should perform it? Personnel with more experience should have fewer complications when performing advanced airway management and this is supported by several studies.

Traditionally, prehospital care in the UK and the US has been undertaken by paramedics but, in the UK, physicians are increasingly working alongside paramedics. Guidelines published by the Association of Anaesthetists of Great Britain and Ireland in 2009 recommend that prehospital airway management should be provided by appropriately trained and competent practitioners working in a properly structured prehospital environment. In addition, they suggest that prehospital healthcare personnel should have the same level of training and competence that would enable them to perform unsupervised RSI and tracheal intubation in the emergency department (AAGBI, 2009). A recently published UK study revealed that 75% of paramedics undertake one or no intubations each year and suggested paramedics receive insufficient training and practice to maintain intubation skills at an adequate level (Deakin et al., 2009). It is likely that most physicians working in prehospital care perform many more intubations than this (Harris et al., 2010). There are few data addressing directly the question of who should perform prehospital intubation. Most published studies of prehospital intubation document a significant complication rate. A study of severely head-injured patients who underwent paramedic-led drug-assisted intubation in the field documented that 57% of patients had arterial blood oxygen saturations below 90% for a median duration of 160 s (Dunford et al., 2003). Of these patients, 19% demonstrated marked bradycardia. Perhaps one of the more alarming aspects of this study is that the intubation was described as 'easy' in 26 of the 31 patients in whom oxygen saturation decreased below 90%. A more recent study documented a successful intubation rate of 84.2%, which the authors used to support the argument for paramedic-led intubation (Ochs et al., 2002). Many would argue that an intubation failure rate of more than 15% is far from acceptable? Some may attribute these significant failure rates to the fact that drug-assisted intubation is relatively uncommon in paramedic practice; however, one study documented a failed intubation rate of 76% when drugs (midazolam or ketamine) were used (Jacoby et al., 2006).

When undertaken by physicians, documented intubation failure rates are generally lower. In a prospective study from Germany a researcher at the scene reviewed out-of-hospital intubations undertaken by emergency physicians over a 5-year period. The emergency physicians participated in 1 or more days of emergency medical services duties per month. The rate of undetected oesophageal intubation was 10.7%, and endobronchial intubation was 6.7%. The patients were intubated by the primary emergency physicians who then confirmed the tube position using clinical examination. A more experienced physician then checked the position of the tube using a combination of direct laryngoscopy, end-tidal carbon dioxide monitoring and clinical examination. All tube misplacements were successfully detected (Timmerman et al., 2007). A study from the London Helicopter Emergency Medical Service (HEMS) documented the rates of failed intubation when RSI and tracheal intubation was undertaken by anaesthetists and compared them with those achieved by emergency physicians; no significant difference was found between the two groups. The failure rates for the groups were 1–2.5% (Mackay et al., 2001). A study from of a German HEMS (comprising a trauma anaesthetist and a flight paramedic) documented successful intubation rates of 100%; three intubation attempts were required in 1.5% of cases (Helm et al., 2006).

Drugs

There is ongoing debate about the best choice of drug for prehospital RSI. Patients who have sustained major trauma may have significant cardiovascular instability and should ideally be managed with an induction drug which is less likely to worsen this situation. Consequently, much interest is focused currently on both ketamine and etomidate. Ketamine has been used in the prehospital setting for several years and has a prominent role in military anaesthesia and analgesia. It is a versatile drug that can be given by several different routes including the intravenous, intraosseous and intramuscular routes, with few side effects (Svenson and Abernathy, 2007). A recent prospective study reviewing the use of ketamine to facilitate emergency intubation both in and out of hospital found no statistically significant reduction in heart rate or mean arterial pressure; the intubating dose of ketamine was approximately $1\,mg\,kg^{-1}$ (Sibley et al., 2010). Another much larger study describing ketamine use for prehospital procedural sedation and analgesia did not report any airway complications: 0.7% of patients experienced a decrease in oxygen saturations but the authors considered this to be unrelated to ketamine (Bredmose et al., 2009).

Etomidate has become less popular since it has been associated with an increased mortality in the intensive care setting secondary to adrenal suppression (Annane, 2005; Morris and McAllister, 2005; Bloomfield and Noble, 2006). In 2009, a large RST demonstrated adrenal insufficiency in 86% of patients receiving etomidate for prehospital emergency airway management compared with 48% who received ketamine. The study includes patients requiring emergency airway management for many reasons, including trauma, sepsis, poisoning, cardiogenic shock and acute respiratory failure, so distinguishing the effects of a single dose of etomidate in trauma patients is not possible; it did not demonstrate an increase in mortality (Jabre et al., 2009). Hildreth et al. studied specifically trauma patients who underwent emergency RSI using etomidate and reported significant depression of cortisol values four to 6 h following induction. The study also suggested that etomidate was associated with an increased length of ventilation and intensive care unit and hospital stay (Hildreth et al., 2008). A review of the literature published in 2010 reported suppression of cortisol levels between 1 and 4 h post-induction using a single bolus dose of etomidate, with a subsequent recovery of the adrenocortical axis after 8 h post-induction. The overall effect of etomidate was an increase in the odds of death by 14%, which was not statistically significant (Holh et al., 2010).

Equipment

Guidelines from the Association of Anaesthetists of Great Britain and Ireland (AAGBI, 2009) include standards for equipment and monitoring that should be available to all providers of prehospital anaesthesia. A survey conducted the same year revealed several shortcomings among aeromedical services in the UK; important equipment that was lacking included cricothyroidotomy devices and capnography (Schmid et al., 2009). Failure to use end-tidal carbon dioxide ($ETCO_2$) monitoring has been linked conclusively with an increase in undetected misplaced intubation. Silvestri et al. (2005) reported no unrecognised misplaced intubations with continuous $ETCO_2$ monitoring, compared with unrecognised tube misplacements in 23% of cases during which no capnography was used.

The use of a supraglottic airway as a rescue device during a failed intubation situation is widely recognised, and generally successful (Deakin et al., 2005; Grier et al., 2009). The use of supraglottic devices in this scenario is recommended in current guidelines from the AAGBI (2009) and Difficult Airway Society (DAS, 2006). Many different devices are available including the Proseal laryngeal mask airway (LMA), i-gel and intubating LMA (ILMA). Use of the Combitube is waning, and in many countries it is being replaced with the laryngeal tube.

Airway management in the Emergency Department

Patients arriving at the emergency department without definitive airway care or those with a deteriorating clinical condition may require RSI and intubation in the emergency department. A recent large study documented that 9.9% of trauma patients required early intubation, within 2 h of arrival at a Level 1 trauma centre. Of these, 56% of patients required intubation for airway obstruction, hypoventilation, severe hypoxaemia, severe cognitive impairment (GCS 8 or less), cardiac arrest and severe haemorrhagic shock. The remaining 44% of patients were intubated for facial injury, altered mental status, combativeness, respiratory distress, intoxication and preoperative management. The most common indication for intubation was altered mental status (24.8% of patients; Sise et al., 2009). Another smaller study of emergency department RSI found that 32% of patients were intubated because of a reduced GCS (8 or less; Butler et al., 2001). The complication rates for major and minor complications associated with these studies were 11.6% (Sise et al., 2009) and 10% (Butler et al., 2001), respectively. Two of the 1000 patients included in the Sise study had failed intubations resulting in cricothyroidotomy (Sise et al., 2009).

Emergency department RSI should be conducted as recommended in the DAS (2006) guidelines for emergency intubation. One of the major differences between prehospital and in-hospital airway management is the wider availability of expertise and equipment; in-hospital intubations are carried out by emergency physicians or anaesthetists. However, emergency RSI should be similar whether it is performed in or out of hospital. Careful attention must be paid to calculation of drug doses, patient positioning, preoxygenation, where appropriate manual in-line stabilisation of the cervical spine (MILS) and cricoid pressure may be applied. Rescue devices should be readily available. It is likely most centres will use a classic LMA or Proseal as rescue devices; occasionally, some of the more recently developed devices may be available. It is the responsibility of all personnel who may be involved in emergency RSI to be familiar with the equipment and its location. There may be similar problems to those experienced in the prehospital setting, such as blood, vomitus and oedema in the airway, which make laryngoscopy more difficult; fibreoptic intubation may become impossible (Cranshaw and Nolan, 2006). The surgical airway is used as a last resort in a 'can't intubate, can't ventilate' scenario. It may be considered at an earlier stage in patients with extensive maxillofacial injury. The establishment of a surgical airway may be very difficult is there is restricted neck extension, laryngotracheal disruption, subcutaneous emphysema or anatomical distortion (Cranshaw and Nolan, 2006), all of which can be present in trauma patients.

Cervical spine management

MILS has been practised for trauma patients for several decades. The incidence of cervical spine injury associated with major trauma is 2–5% but it is 10% in comatose patients (Demetriades et al., 2000; Ollerton et al., 2006); up to 14% of these injuries will be unstable (Ollerton et al., 2006). The rate of missed cervical spine injury is reported as 0.01% for all types of cervical spine injury (Kwan and Bunn, 2005). Given that the largest forces applied to the cervical spine are likely to occur during the initial trauma, the incidence of subsequent neurological deterioration is also very low following subsequent airway manipulation (Muckart et al., 1997). Much interest has been focussed on the use of MILS whilst attempting intubation. The intended benefit of MILS during direct laryngoscopy is prevention of damage to the spinal cord. The problem is that attempts to intubate the trachea of adults with the head in the neutral position may worsen the laryngoscopic view and increase the difficulty of intubation. The authors of a Cochrane review concluded that, 'as airway obstruction is a major cause of preventable death in trauma patients, and spinal immobilisation, particularly of the cervical spine, can contribute to airway compromise, the possibility that immobilisation may increase mortality and morbidity cannot be excluded' (Kwan et al., 2007).

Several studies have been conducted in an attempt to determine whether MILS makes intubation more difficult. One study demonstrated that, in comparison with the optimal intubating position, the combination of MILS and cricoid pressure reduced laryngeal views by at least one Cormack and Lehane grade in 45% of patients. A grade 3 view was found in 21.6% of patients compared with 1.3% in the optimum position ($p < 0.001$; Nolan, 1993). In many cases, the application of cricoid pressure probably contributed to the poor view obtained during laryngoscopy, but in-line stabilisation is also likely to have contributed significantly. More recently, Santoni and colleagues performed sequential laryngoscopies and intubations with and without MILS in anaesthetised patients. The glottic view with MILS was worse in six patients and unchanged in three patients. Without MILS, all patients were intubated successfully; an oesophageal intubation occurred in the MILS group. Using a pressure-sensing laryngoscope blade, the authors were able to demonstrate an increase in work of intubation with MILS applied ($p = 0.008$), and the intubation took longer in this group. There was an association between deterioration in glottic view with MILS and increase in maximally applied laryngoscope pressure ($p = 0.030$; Santoni et al., 2009). An increase in pressure and force at laryngoscopy is likely to be transmitted to the cervical spine and may worsen any pre-existing injury.

Cricoid pressure

The application of cricoid pressure during RSI and intubation is supported by surprisingly few data. The rationale for its use is to prevent regurgitation of gastric contents with subsequent aspiration into the lungs during intubation. In the severely injured patient, the upper airway is frequently contaminated with blood rather than gastric contents (Lockey et al., 1999), and cricoid pressure may be of little benefit in these patients.

The use of cricoid pressure was first described by Curry in 1796 who described use of a backwards, downwards pressure on the cricoid cartilage in order to compress the oesophagus posteriorly. The first death from aspiration during anaesthesia was reported by Simpson (1848). Little is reported in the literature after this, until Mendelson (1946) identified aspiration in 0.15% (66 of 44,016) women undergoing face-mask anaesthesia for labour and delivery in 1946. Sellick conducted small, observational studies in the early 1960 s which resulted in cricoid pressure being incorporated into emergency RSI. In 1961, Sellick identified 26 patients undergoing general anaesthesia, who were considered to be at high risk of aspiration. Each patient had cricoid pressure applied at induction; regurgitation occurred in three patients following release of the pressure after tracheal tube placement. Sellick (1961) also described radiographical evidence of complete occlusion of a tracheal tube placed in the oesophagus of an anaesthetised patient, following the application of cricoid pressure. The second study in 1962 involved one patient undergoing an oesophagectomy. The oesophagus was filled with a saline solution to a pressure of 100 cm H_2O with cricoid pressure applied; no regurgitation occurred (Sellick, 1962). Since the publication of these studies in the early 1960 s, anaesthetic practice has changed; different drugs or drug doses are used, patients are routinely starved before elective procedures, and intubating positions have changed. Over subsequent years, evidence to support the use of cricoid pressure for emergency intubation has remained limited and large published review articles have reached ambiguous conclusions (Neilipovitz and Crosby, 2007). Several studies challenge the benefit of cricoid pressure (Schwartz and Cohen, 1995; Thibodeau et al., 1997; Harris et al., 2010). A recent prospective observational study of women undergoing general anaesthesia for caesarean section documented an incidence of aspiration of 0.8% with cricoid pressure applied compared with 0.3% without cricoid pressure; the difference was not statistically significant (Fenton and Reynolds, 2009).

It is recognised that the application of cricoid pressure may contribute to difficulty in ventilating the patient. In a recent review ten studies were identified that documented the effects of cricoid pressure on ventilation; each study demonstrated reduced tidal volumes, increased peak inspiratory pressure, or prevention of ventilation following the application of cricoid pressure (Ellis et al., 2007). Cricoid pressure can cause a deterioration of the view obtained at laryngoscopy (Nolan, 1993), and will make it harder to position a supraglottic airway because of compression of the hypopharyngeal space (Brimacombe et al., 1993). A recent prospective observational study of prehospital intubation following traumatic injury included 400 patients who were intubated orally. Cricoid pressure was removed in 22 patients (0.06%) during intubation. There was an improvement in laryngoscopic view by at least one grade on the Cormack and Lehane scale in 50% of patients. Release of cricoid pressure facilitated successful intubation in all but one patient (Harris et al., 2010). Repeated attempts at laryngoscopy, which may be necessary because of the cricoid pressure, are associated with an increased risk of aspiration (Mort, 2004).

The anatomical rationale of cricoid pressure has also been questioned. The theory suggests that direct pressure on the cricoid cartilage should compress the oesophagus against the posteriorly placed vertebral body. However, the oesophagus does not lie directly behind the cricoid cartilage but begins just below it. Radiological studies have demonstrated lateral displacement of the oesophagus in approximately 50% of subjects without cricoid pressure applied; with cricoid pressure, there was increased incidence and degree of oesophageal displacement, as well as incomplete occlusion of the oesophagus (Smith et al., 2002, 2003).

One alternative to the use of cricoid pressure may be head-up intubation. Studies carried out in 1959 describe the benefit of head up intubation over cricoid pressure, with only one case of aspiration among 1260 patients (Hodges et al., 1959; Snow and Nunn, 1959). As well as the potential to reduce gastric reflux, this position has other benefits such as the maintenance of functional residual capacity and a longer time before hypoxaemia occurs after the onset of apnoea; intubation and ventilation of obese and pregnant patients should also be improved (Gobindram and Clarke, 2008).

Cricoid pressure is operator dependent and can obscure the view of the airway. For this reason, current practice appears to be selective use of cricoid pressure in high-risk patients (Vanner, 2009), with a lower threshold for removing cricoid should intubation or ventilation be impaired.

The future

The lack of standardisation in prehospital airway management is one of the major factors making interpretation of studies, and the development of evidence-based practice, difficult. Recently, attempts have been made to address this problem with the publication of an Utstein-style template for documenting and recording management. The template has been designed for use for any patient in whom the insertion of an advanced airway device or ventilation is attempted (Sollid et al., 2009). Resources for prehospital airway management should be focused on training a limited number of people, ensuring increased exposure and experience for this group (Fakhry et al., 2006).

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