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# Safe Extubation and Recovery of Trauma Patients in the Emergency Department

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## Citation

P A Ward, S Shah, S Qureshi. *Safe Extubation and Recovery of Trauma Patients in the Emergency Department*. The Internet Journal of Anesthesiology. 2014 Volume 33 Number 1.

## Abstract

Trauma patients are frequently intubated in the Emergency Department (ED) of Major Trauma Centres (MTCs) and some of these patients are subsequently extubated shortly afterwards whilst they remain in the ED. The 4th National Audit Project in Anaesthesia (NAP4) demonstrated that a high proportion of significant airway incidents occur in the ED and during the recovery phase following anaesthesia, findings which are particularly pertinent to this group of patients. Currently there are no specific guidelines governing the safe extubation and recovery of trauma patients in ED, and the aim of our study was to assess current practice, compare this with the universally applicable AAGBI guidelines for Immediate Post Anaesthesia Care and evaluate awareness of the Difficult Airway Society (DAS) Extubation Guidelines.

The study was undertaken at St Mary's Hospital, London between November 2012 and January 2013 with questionnaires completed by all staff undertaking the extubation and recovery of adult trauma patients in the ED. We received 15 completed questionnaires, which demonstrated that all extubations were performed by anaesthetists rather than ED staff, poor awareness of the DAS guidelines and numerous other areas for improvement when compared with the AAGBI guidelines. In particular, inconsistencies were identified in the duration of recovery of patients and the level of training and availability of staff recovering them. Whilst the ED environment in which patients were recovered met AAGBI standards, the absence of discharge criteria specific to this unique cohort of patients was identified as an area for future development. Attempts to raise anaesthetists' awareness of the DAS Extubation Guidelines have been made. A specific guideline for the extubation and recovery of trauma patients in the ED has been devised to improve patient safety and proposals have been made to address the variable staffing and training levels.

## INTRODUCTION

Trauma patients are frequently intubated before or on arrival at the ED of a MTC for a wide range of different reasons. A proportion of these patients are extubated shortly afterwards in the ED because their presenting condition has significantly improved, or the initial reason for intubation has resolved, or serious pathology that may require immediate operative intervention or continued management in intensive care has been excluded (usually following definitive imaging). In these circumstances, the reasons for initial intubation often include altered conscious level, combative behaviour and drug and alcohol intoxication, where severe traumatic brain injury, occult shock or other major injuries cannot be excluded on initial assessment.

The practice of safe successful "fast-track" extubation and recovery of these trauma patients whilst they remain in the ED results in fewer avoidable ICU admissions and reduces unnecessary prolonged intubation and ventilation together

with the associated patient morbidity. Theoretically, this also reduces overall length of hospital stay and costs.

Whilst there are several studies on the extubation and recovery of post-operative patients, there is very little data on the safety of extubating and recovering trauma patients in the ED. The findings of NAP4 confirmed that this is an area that justifies special attention however, with thirty percent of all the significant airway events reported occurring at the end of anaesthesia/recovery and at least one in four events occurring in the ED or ICU [1].

Furthermore, trauma patients are a particularly high risk group for extubation for some of the following reasons: The initial reason for intubation is often altered conscious level or agitation therefore emergence can be rather unpredictable; prior drug and alcohol consumption can affect the patients' ability to protect their own airway with a significant risk of aspiration on emergence in the context of

having full stomachs or delayed gastric emptying due to alcohol, drugs or pain; and these patients may be at risk of residual neuromuscular blockade where the time elapsed between initial intubation, negative imaging, and extubation is brief, or when repeated doses of muscle relaxant have been administered.

In addition, the ED differs greatly from operating theatres or the Post-Anaesthesia Care Unit (PACU) as a location for safely extubating and recovering patients (as identified by NAP4). It is usually less familiar to anaesthetists, and appropriate equipment may be less readily available, or at least its location less intuitive. It poses additional demands over a standard PACU due to the very different physical environment in which patients are recovered, the high turnover of challenging patients in the resuscitation room, altered staff availability and the varying range of staff competencies found there.

Crucially, there is currently no local hospital, NHS trust, MTC, Trauma Network or UK national guidelines on the safe extubation and recovery of trauma patients specifically, and no guidelines to govern these activities exclusively in the ED. There is however the 2013 AAGBI Immediate Post Anaesthetic Guidelines [2], which were designed to be applicable to the recovery of all post-anaesthetic patients, and applicable to all areas of the hospital. In addition, the DAS Extubation Guidelines [3] provide a framework for the safe extubation of all patients.

Thus, the aim of our study was to establish current practice in the extubation and recovery of trauma patients in the ED, and compare this practice with the universally applicable AAGBI Immediate Post Anaesthetic Guidelines and DAS guidelines, with the intention of proposing any potential improvements to our current practice in this unique patient cohort and clinical setting.

### METHODS

This service evaluation was registered and approved by the local hospital research and audit department. We undertook a retrospective study of all adult trauma patients who had undergone extubation and recovery in the ED at St Mary's Hospital, MTC, London, UK during a three month period (November 2012 to January 2013). We designed and distributed a questionnaire (Figure 1) to all members of staff that had personally extubated patients in the ED, with the questionnaires completed by themselves shortly after extubation and recovery of the patient (or at the latest, on conclusion of that working shift).

We propose that the 2011 DAS Extubation guidelines [3] are the gold standard for the safe extubation of these patients and that the 2013 AAGBI Immediate Post Anaesthetic Guidelines [2] are the gold standard for the recovery of these patients. The questionnaire specifically determined awareness of the DAS guidelines and we separately identified eight relevant directives from the thirteen that constitute the AAGBI guideline (which we have subdivided into Staffing/Training and Environmental/Situational aspects) for comparison with our current practice:

#### *Staffing/Training Criteria:*

1. "The removal of tracheal tubes is the responsibility of the anaesthetist"
2. "The anaesthetist must formally hand over the care of a patient to an appropriately trained and registered PACU practitioner"
3. "All patients must be observed on a one-to-one basis by an anaesthetist or registered PACU practitioner until they have regained control of their airway, have stable cardiovascular and respiratory systems and are awake and able to communicate";
4. "All registered practitioners should be appropriately trained in accordance with the standards and competencies detailed in the UK National Core Competencies for Post Anaesthesia Care";
5. "No fewer than two staff should be present when there is a patient in a PACU who does not fulfil the criteria for discharge to the ward";

#### *Environmental/Situational Criteria:*

1. "After general anaesthesia, all patients should be recovered in a specially designated area (PACU)";
2. "Patients dignity and privacy should be respected at all times"; and,
3. "Agreed, written criteria for discharge of patients from the PACU to the ward should be in place in all units".

### RESULTS

We received 15 completed questionnaires, and no patients were excluded from the study.

#### *Staffing/Training*

All 15 patients were extubated by the anaesthetist attending the patient (i.e. no extubations were performed by ED nursing staff or medical staff) in accordance with existing guidelines (Criterion 1). Seven (47%) of the anaesthetists performing these extubations were aware of the DAS guidelines for safe extubation.

Following successful extubation, 1 of the patients was recovered solely by the attending anaesthetist and 4 patients were recovered by ED nursing staff in combination with the

anaesthetic team, in accordance with the AAGBI directives (Criteria 2-5); 1 patient was recovered solely by an acute medical ward nursing staff member, 2 patients by ED medical staff, and seven patients by ED nursing staff, thus 10 out of the 15 patients (67%) were recovered by staff not specifically trained in Post Anaesthesia Care (in contravention of Criteria 2-4). In addition, the staff members assigned to the recovery of these ten patients may also have had additional clinical responsibilities in the ED to which to attend (an infringement of Criterion 3, which mandates one-to-one care) i.e. they were not specifically absolved of all other ED duties during this time. On subsequent follow-up, we confirmed that ED medical and nursing staff do not receive any mandatory training in airway management or Basic Life Support (i.e. some staff members had undertaken training courses in these areas independently, but competency was not universal or mandatory) and there is no specific training in Post Anaesthesia Care delivered to ED staff (Criteria 2-4) at present. The availability of a second staff member (Criterion 5) is variable, and no specific arrangements are currently undertaken to ensure this level of staffing is available in the ED, in contrast to a PACU.

### *Environment/Situation*

All 15 patients were recovered in randomly allocated Major Resuscitation bays (of which there are four), assigned upon availability on the patients' arrival in the ED. There is no specially assigned trauma bay or specially designated area for post anaesthesia recovery (Criterion 6). All bays are separated from each other by a curtain, which can be closed around the individual bay to maintain patient dignity and privacy (Criterion 7). There are no specific written criteria for discharge of trauma patients that have been extubated in the ED (Criterion 8), or any recommendations regarding the duration of the recovery period in ED. The length of time spent by the anaesthetist with the patient in ED between the decision to extubate and actual extubation ranged from 5 minutes to 2 hours (mean 56 minutes), and the time spent recovering the patient in ED after extubation varied from 5 minutes to 1 hour (mean 19 minutes). Our hospital does have PACU discharge criteria for operating theatres, but these criteria have not been adopted by the ED.

## **DISCUSSION**

The findings of NAP4 [1] have prompted urgent review of all airway practices across the UK, particularly in ICU with respect to end tidal carbon dioxide monitoring and tracheostomy management, and in the ED with respect to

improved provision of airway anaesthetic equipment and the importance of early involvement of airway specialists. However, we believe we have identified an area of anaesthesia and emergency medicine that requires further attention. Although none of the patients investigated in this particular study had any complications, a significant proportion of airway incidents have been shown to occur on emergence/in recovery and in the ED [1]. We believe that the extubation of trauma patients in the ED requires particular scrutiny because these patients pose additional risks at extubation, making this practice even more hazardous. This is particularly relevant with the advent of major trauma centres where there is a high throughput of trauma patients requiring intubation, and subsequent trials of extubation.

Unfortunately, the study numbers are very low, which is partially a product of the short period of recruitment, but mainly reflects poor questionnaire completion by the anaesthetic registrars, as this was a significant underestimate of the numbers of trauma patients being intubated and extubated in our ED during that period. Despite the low numbers however, we have clearly identified that several aspects of our current management do not adhere to best practice, in accordance with the AAGBI guidelines<sup>3</sup> for recovery of patients after anaesthesia. We feel that this alone justifies further investigation and implementation of changes to improve patient safety. Furthermore, whilst this study was only undertaken at a single centre, the findings are likely to be applicable to all Major Trauma Centres nationally. We contacted all of the other London Major Trauma Centres (St George's Hospital, King's College Hospital and the Royal London Hospital) who confirmed that they too do not employ any specific extubation and recovery guidelines for trauma patients in ED. Similarly, they do not have any specially designated bays for recovering post-extubation trauma patients and they too employ a varying mix of anaesthetists, ODPs, critical care nursing and ED nursing staff to recover patients. Additionally, none of the London MTCs currently utilise any specific criteria for the subsequent discharge of these patients from ED.

### *Staffing/Training*

Unlike in the USA where extubations are often performed by ED staff, extubation in the UK very clearly remains the sole responsibility of the anaesthetist [3,4] and pleasingly all extubations in our study followed this directive with no complications reported. However, rather worryingly, awareness of the DAS guidelines for extubation was

particularly poor (at 47%) despite their publication in 2011. Fulfilment of our other roles as an anaesthetist was also variable at best – specifically our duty to care for the patient in recovery if appropriately trained staff are not available. This study found that ED staffing levels and experience is extremely inconsistent, but in the event of inadequate staff availability or training, the AAGBI guidelines suggest that it is the anaesthetist that should recover the patient until suitable for discharge [2]. This is currently difficult for the anaesthetists to undertake at our hospital due to responsibilities in theatre and other clinical areas. Indeed, in at least 40% of the trauma cases investigated the delivery of anaesthetic services elsewhere in the hospital were adversely affected, including emergency operating theatre cases being delayed.

We have immediately addressed the lack of awareness of the DAS extubation guidelines by presenting the study findings at an anaesthetic trainee teaching session, circulated the guidelines to the anaesthetic department via email and displayed posters of the guidelines in the anaesthetics meeting room. We have also presented the study findings at the anaesthetic department morbidity and mortality meeting to increase overall awareness of the main issues and uptake of our proposals.

Addressing the problem of appropriately trained staff in ED to recover patients and the multitude of conflicting commitments our anaesthetists are exposed to is far more challenging. One potential solution is to transfer these intubated patients to PACU for a trial of extubation, and subsequent recovery by appropriately trained staff. This practice would involve transferring ventilated patients to another area of the hospital which would carry with it the additional risk associated with any critical care transfer. It would also inevitably lead to an increased workload for PACU and cause disruption of the existing recovery service provided for post-operative patients from theatres. There would also be a loss in the continuity of care provided for these patients by the ED and trauma team, with potentially adverse sequelae. Therefore we propose to arrange for the ED nursing staff to rotate through PACU to learn basic airway management and safe recovery of patients post-anaesthesia, with the intention that they will become more useful assistants to the anaesthetist in the ED. They will be trained to anticipate common problems and how to assist the anaesthetists in dealing with them. It is not our intention to train ED staff to the level of PACU nurses, as ultimately, we believe the safest option is that the anaesthetist recovers the

patient in ED with the help of the Trauma ODP. This will inevitably involve more predictable additional commitment from the anaesthetists, and to address this we propose employing a dedicated Trauma Fellow whose sole responsibility will be to provide care for these patients right from admission through to extubation and recovery if appropriate.

To ensure safe extubation and recovery of these patients we have devised a specific guideline (Figure 2) to govern this process in our ED. This clearly defines the roles of the anaesthetist and other staff in the process of extubation and recovery, identifies the minimum requirements of staff availability and level of training before trial of extubation should be considered, ensures appropriate preparation of the patient and equipment before undertaking safe extubation, and provides a detailed and step-wise structure to the whole process. This guideline has been presented at multiple multidisciplinary trauma meetings attended by representatives from the ED, Trauma, ICU and Anaesthesia services at St Mary's Hospital, and we are currently trialling this guideline in our ED.

### *Environment/Situation*

Whilst clearly not as spacious as a PACU, the ED bays are adequately set up (and fully equipped) for the recovery of individual patients, and the appropriate standards of dignity and privacy set out by the AAGBI guidelines are currently being attained.

Unfortunately there are currently no specific ED discharge criteria for this unique cohort of patients. This is an important safety issue for discharge of patients to the wards following extubation and recovery, as post-general anaesthesia patients may require additional levels of monitoring compared with standard ED patients. Just as for emergency and elective post-operative patients, discharge criteria is essential to minimise complications and patient harm, and whilst our existing PACU discharge criteria are not directly applicable to this unique patient group, it is our intention to adapt our current PACU discharge checklist so that it can be adopted by the ED in the future.

## **CONCLUSION**

Despite the low numbers of questionnaires completed, extubation of trauma patients in the ED is occurring regularly in Major Trauma Centres, with both recovery from anaesthesia and ED location identified by NAP4 as areas of high patient risk. This study has demonstrated that

awareness of the DAS extubation guidelines is poor and that there are several aspects of the AAGBI guidelines for recovery of patients that our current practice is not attaining. We have increased awareness of the DAS extubation guideline and have devised a specific guideline for the extubation and recovery of these patients in the ED, which we are currently trialling. It is anticipated that this, along with changes to anaesthetic staffing numbers, ED nurse training, and the proposed discharge criteria checklist, will improve patient safety.

**Figure 1**  
Questionnaire for Extubation & Recovery of Adult Trauma Patients in ED

**EXTUBATION & RECOVERY OF TRAUMA PATIENTS IN ED**

Please complete a separate questionnaire for each patient you have extubated in A&E

1. Designation of personnel undertaking extubation of patient \_\_\_\_\_

2. Are you aware of any local/national/international guidelines governing safe extubation?

Yes  please give details \_\_\_\_\_  
No

3. Regarding the extubation of your patient:

a) Once the decision was made to attempt extubation, how long did you have to wait before safely extubating?  
please give details \_\_\_\_\_ (mins/hours)

b) Once successfully extubated, how long did you stay with the patient in A&E?  
please give details \_\_\_\_\_ (mins/hours)

c) Was there any impact on Main Theatres during these periods of time?  
please give details \_\_\_\_\_

d) Once the patient had been successfully extubated, who recovered the patient?  
Anaesthetic team   
A&E Nursing staff   
A&E Medical staff   
Other   
please give details \_\_\_\_\_

**Figure 2**  
Guideline for Extubation of Adult Trauma Patients in ED

GUIDELINE FOR EXTUBATION OF TRAUMA PATIENTS IN ED	
<p><b>SUITABILITY FOR EXTUBATION</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Anaesthetist &amp; Trauma ODP present</li> <li><input type="checkbox"/> Trial of extubation agreed by Trauma Team Leader (TTL)</li> <li><input type="checkbox"/> All essential interventions completed</li> <li><input type="checkbox"/> No airway concerns</li> </ul>	<p><b>Clinical parameters:</b> SpO<sub>2</sub> &gt; 92% FiO<sub>2</sub> 0.2 (PEEP &lt; 5), adequate gas exchange on ABG HR &lt; 100, SBP &gt; 100; Normothermic; No clinically significant anaemia No significant metabolic or electrolyte disturbance <b>Essential interventions:</b> Immediate surgery not indicated All necessary diagnostic &amp; therapeutic procedures completed <b>Discharge criteria (A&amp;E/ED):</b> Patient not a difficult intubator; Patient not expected to be a difficult extubation</p>
<p><b>PREPARATION FOR EXTUBATION</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Orogastric tube to empty stomach; Oropharynx suctioned</li> <li><input type="checkbox"/> Muscle relaxant fully reversed</li> <li><input type="checkbox"/> Anaesthesia/sedation discontinued; High flow oxygen</li> <li><input type="checkbox"/> Re-intubation equipment at bedside</li> </ul>	<p><b>Also consider:</b> Suctioning ETT with bronchial catheter Inserting bite block Tilting patient up at 45 degrees (unless contraindicated) Nerve stimulator assessment of neuromuscular activity (4 twitches on TOF)</p>
<p><b>READINESS FOR EXTUBATION</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Anaesthesia/sedation worn off</li> <li><input type="checkbox"/> Patient co-operative</li> <li><input type="checkbox"/> Muscle power fully recovered</li> <li><input type="checkbox"/> Protective airway reflexes restored</li> <li><input type="checkbox"/> Spontaneous breathing trial</li> <li><input type="checkbox"/> Plan for extubation agreed</li> </ul>	<p><b>Discharge criteria (A&amp;E/ED):</b> Able to follow simple commands; Opens eyes, squeezes hand <b>Discharge criteria (ICU):</b> Able to raise arm against gravity for 15 secs; Strong tongue protrusion Spontaneous breathing trial: Oxygen free; Strong cough on suctioning <b>Spontaneous breathing trial:</b> RR &lt; 30, SpO<sub>2</sub> &gt; 92%, PaCO<sub>2</sub> &lt; 50Pa, undisturbed breathing pattern <b>Plan for extubation:</b> Plan for immediate extubation Plan for care after successful extubation, including 1:1 staff patient care Second anaesthetist or ICU physician available if required</p>
<p><b>AWAKE EXTUBATION</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Performed by anaesthetist only, assisted by trauma ODP</li> </ul>	<p><b>Also Consider:</b> Non-invasive ventilation Nebulisers</p>
<p><b>CARE AFTER EXTUBATION</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> 1:1 recovery of patient (anaesthetist + ODP/ED staff)</li> <li><input type="checkbox"/> Minimum 30 minutes recovery in ED</li> <li><input type="checkbox"/> Formal handover between TTL, anaesthetist &amp; ED staff</li> <li><input type="checkbox"/> Extubation documented in patient notes</li> </ul>	<p><b>Continuous monitoring (A&amp;E/ED):</b> SpO<sub>2</sub>, RR, HR, BP, temp, sedation &amp; pain scores <b>Included in handover:</b> Plan for discharge from ED Clear plan in event of complications, including contact name and bleep</p>

**Figure 1**

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 please give details \_\_\_\_\_ (mins/hours)

c) Was there any impact on Main Theatres during these periods of time?  
 please give details \_\_\_\_\_

d) Once the patient had been successfully extubated, who recovered the patient?  
 Anaesthetic team   
 A&E Nursing staff   
 A&E Medical staff   
 Other   
 please give details \_\_\_\_\_

**Figure 2**

Guideline for Extubation of Adult Trauma Patients in ED

GUIDELINE FOR EXTUBATION OF TRAUMA PATIENTS IN ED	
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<p><b>PREPARATION FOR EXTUBATION</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Orogastric tube to empty stomach; Oropharynx suctioned</li> <li><input type="checkbox"/> Muscle relaxant fully reversed</li> <li><input type="checkbox"/> Anaesthetic/sedation discontinued; High flow oxygen</li> <li><input type="checkbox"/> Re-intubation equipment at bedside</li> </ul>	<p><b>Also consider:</b>                  Suctioning ETT with bronchial catheter                  Inserting bite block                  Tilting patient up at 45 degrees (unless contraindicated)                  Nerve stimulator assessment of neuromuscular activity (4 twitches on TOF)</p>
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