



Clinical paper

An observational study of paediatric pre-hospital intubation and anaesthesia in 1933 children attended by a physician-led, pre-hospital trauma service



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ABSTRACT

Introduction: Trauma accounts for 16–44% of childhood deaths. The number of severely injured children who require pre-hospital advanced airway intervention is thought to be small but there is little published data detailing the epidemiology of these interventions. This study was designed to evaluate the children who received pre-hospital intubation (with or without anaesthesia) in a high volume, physician-led, pre-hospital trauma service and the circumstances surrounding the intervention.

Methods: We conducted a 12 year retrospective database analysis of paediatric patients attended by a United Kingdom, physician-led, pre-hospital trauma service. All paediatric patients (<16 years of age) that were attended and received pre-hospital advanced airway intervention were included. The total number of pre-hospital intubations and the proportion that received a rapid sequence induction (RSI) were established. To illustrate the context of these interventions the ages, injury mechanisms and intervention success rates were recorded.

Results: Between 1 January 2000 and 31 October 2011 the service attended 1933 children. There were 315 (16.3%) pre-hospital intubations. Of those intubated, 81% received a rapid sequence induction and 19% were intubated without anaesthesia in the setting of near or actual cardiac arrest. Nearly three quarters of the patients were in the age range of 6–15 years with only 3 patients under the age of 1 year. The most common injury mechanisms that required intubation were Road Traffic Crashes (RTC) and 'falls from height'. These accounted for 79% of patients receiving intubation. Intubation success rate was 99.7% with a single failed intubation during the study period.

Conclusion: Pre-hospital paediatric intubation is not infrequent in this high-volume trauma service. The majority of patients received a rapid sequence induction. The commonest injury mechanisms were RTCs and 'falls from height'. Pre-hospital paediatric intubation is associated with a high success rate in this physician-led service.

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1. Introduction

Trauma accounts for a large proportion of childhood mortality and is the leading cause of death in those aged 1–44 years.^{1–3} Despite this, the exposure of individual emergency responders to severely injured children is relatively infrequent.^{3,4}

Although airway and ventilation problems have been identified as key issues in severely injured patients, few children sustain injuries severe enough to require pre-hospital tracheal intubation and anaesthesia.^{1,5–8} Furthermore, several studies have suggested

that simple airway manoeuvres are usually adequate to treat early airway compromise in children.^{6,8}

The perception that pre-hospital paediatric Rapid Sequence Induction (RSI) of anaesthesia is rarely required and challenging to deliver safely,^{2,6} may contribute to the scarcity of publications on the subject. A safety guideline published by the Association of Anaesthetists of Great Britain and Ireland (AAGBI) recommends that pre-hospital anaesthesia in children should only be performed by a skilled, anaesthetic-trained practitioner, where simple airway manoeuvres and oxygen therapy have failed to provide a patent airway and adequate oxygenation.⁶ The guideline suggests that even in relatively advanced systems, the threshold for pre-hospital paediatric intubation and anaesthesia should be relatively high.⁶ However, it is likely that in a small number of patients intubation is required to provide and maintain a definitive airway and can

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be lifesaving in critically injured children if delivered rapidly and safely.^{3,5,6}

Recent studies in the United Kingdom (UK) have identified a lack of comprehensive data on advanced airway management, particularly pre-hospital anaesthesia in acutely injured children.^{4,6,9} Although several studies have addressed pre-hospital airway management in adults,^{10–12} trauma patterns in children^{1,3} and pre-hospital interventions in children,^{2,13} few have specifically evaluated pre-hospital paediatric intubation and anaesthesia.⁵ This may be because few services attend sufficiently high numbers of paediatric trauma patients to accumulate meaningful samples of patients to report. The lack of published data on this subject has stimulated various authorities to suggest that this subject is a priority area in pre-hospital research.⁹

This study was therefore conducted to report on key issues surrounding paediatric pre-hospital intubation and anaesthesia in the setting of a high volume, pre-hospital trauma service and to answer the following questions:

What is the frequency of paediatric pre-hospital intubation in a high volume trauma service?

How many children who were intubated received an RSI and how many were intubated without drugs?

What is the demographic profile of children who receive pre-hospital intubation?

Are the interventions required at particular times of the day?

Which injury mechanisms are commonly associated with paediatric intubation?

What are the on-scene times when children receive intubation?

What is the pre-hospital intubation success rate in a high volume, physician-led service?

2. Methods

2.1. Study setting

In order to describe the system in which this study was based, the 'Fixed system variables' for uniform reporting of data from advanced airway management in the field, identified by an international expert consensus group are described.¹⁴

The study was carried out in an urban, physician-led, pre-hospital trauma service, serving a daytime population of up to 10 million people in an area approximately 5000 km².

The operational team (doctor and paramedic) is delivered to incidents by helicopter in the daytime and by fast response car at night. Tasking is by flight paramedics who are stationed in the ambulance control room and only dispatch the service to trauma patients, specifically those with severe injury. This allows seamless integration with the ambulance service from a tasking and operational perspective. As a result, access to the service is straightforward and early requests are made from the ground ambulances. Deployment is rapid and flight times across London are short. Consequently many injured patients are accessed by the service that might otherwise have been taken to local hospitals. The operational team are always dispatched in addition to the standard land ambulance response. The service attends an average of 5–6 trauma patients per day.

Scene time is logged by the control room when the helicopter lands on the ground or the rapid response vehicle arrives at the incident. Departure from the scene is similarly radioed to the control room when the transport vehicle (land ambulance or helicopter) departs carrying the patient. This entire time period (encompassing de-bussing from the vehicle, transport to the actual incident from the helicopter landing site, handover from the ground crew, extrication (as necessary), patient assessment, treatment,

intubation/RSI, packaging and loading) constitutes the recorded scene time. It is thus a gross estimate of total time on the scene and an inaccurate reflection of time spent actually delivering medical care or performance of medical procedures.

Triage decision-making is the responsibility of the operational team. Patients are delivered direct to specialist centres as appropriate thus avoiding delays to definitive treatment and lengthy secondary transfer times. Secondary transfer rates for patients attended by the service are typically extremely low.

Doctors are experienced anaesthetists or emergency physicians with a minimum of 6 months of in-hospital anaesthetic experience. Most doctors have some prior pre-hospital training and experience. Further, in-post training is provided in a 4–6 week induction period under the guidance and supervision of pre-hospital care consultants. Weekly case review, audit and clinical governance meetings and intermittent consultant supervision ensures consistency with service protocols and maintenance of service standards. Flight paramedics have specific in-service training to equip them as members of the pre-hospital anaesthesia team.

Pre-hospital anaesthesia is carried out in line with UK recommendations on pre-hospital anaesthesia⁶ and according to local standard operating procedures (SOP). Indications for pre-hospital RSI are: (1) actual or impending airway compromise; (2) ventilatory failure; (3) unconsciousness or profound cerebral agitation; (4) anticipated clinical course; and (5) humanitarian reasons. The local service SOP for RSI is robust and has been practiced for over 10 years. It has seen the performance of over 7000 pre-hospital RSIs with a high intubation success rate.¹¹ A standardised and reproducible anaesthetic technique is used and the on-scene doctor has a limited number of treatment choices to make. In the study period etomidate was used to induce anaesthesia and suxamethonium was used for initial muscle relaxation. Intubation is carried out by the doctor with the routine use of an intubating catheter (Cook Medical, Frova airway intubating catheterTM). When patients are in established or impending cardiac arrest intubation is conducted without drug assistance. Equipment for failed intubation includes a supraglottic airway device and equipment for surgical cricothyroidotomy. Correct tube placement is confirmed by the use of colourimetry and digital capnography. A mechanical ventilator is available to ventilate patients after intubation (Dräger Oxylog 2000TM).

The SOP allows for a maximum of two initial attempts at intubation after drug administration. A set of operator drills to improve laryngoscopy when difficulty is encountered are followed if there is failure at the first attempt. Further failure to intubate leads the practitioner down a pathway to either placement of a supraglottic device (laryngeal mask airway) or a surgical airway. A third alternative (bag-valve-mask ventilation while transport to hospital is conducted) exists for patients in whom a surgical airway is undesirable or impossible. At least two good attempts at intubation must be performed. All members of the service are drilled in the procedure and regularly practice in a low fidelity simulation environment. In keeping with the AAGBI guidelines, the SOP emphasizes that the threshold for paediatric anaesthesia is higher than that for adult pre-hospital anaesthesia and only be conducted when absolutely necessary.⁶ Where possible, prior to performing paediatric anaesthesia, the decision is discussed with an on-call consultant. This is to discuss equivocal cases or to assist with determining risk/benefit analysis where the risk is felt to be extremely high or the benefit to be limited. This aspect of clinical governance and oversight is felt to be desirable when on-scene conditions are especially challenging.

2.2. Study design

Standard patient data on patients attended by the service is prospectively recorded on a Microsoft ACCESSTM database by the

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