Emergency Airway Management: A Look into the Practice, Rate of Success, and Adverse Events of 94 Endotracheal Intubations

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Abstract

Context: Endotracheal intubation in the critically unwell is a life-saving procedure, frequently performed in the emergency department (ED). The 4th National Audit Project (NAP4) of the Royal College of Anaesthetists and Difficult Airway Society, however, highlighted the deficiencies that could have led to serious harm. In direct response to NAP4, a 2018 guideline was published on the management of intubations in critically ill adults. Aims: This study describes the current practice of endotracheal intubation, in comparison to the published 2018 guideline. Settings and Design: A retrospective observational study in an ED of a district general hospital in Greater London. Subjects and Methods: Adult attendances from September 1, 2017, to September 1, 2018 (>18 years old) fulfilling the search criteria were reviewed, producing 1553 case notes. These cases were individually reviewed by the authors. Statistical Analysis Used: Mann–Whitney U-test. Results: There were 94 intubations, male to female ratio 1.8:1. The most common indication was for airway protection (n = 35), followed by respiratory failure (n = 23). There were 31 first-pass intubation successes. Intensivists performed most of the intubations (n = 66), followed by anesthetists (n = 13), and ED physicians (n = 10), but with no significant difference between the response rates of ED and external physicians (P = 0.0477). Propofol was the induction drug of choice (n = 37), with rocuronium the paralyzing agent of choice (n = 42). Altogether, there were eight complications reported. Conclusions: This study provides an overview of the intubation practices in a single-center ED. Non-ED physicians perform the majority of intubations, with a variety of induction and paralyzing agents being used. It adds to the growing call for better standardization and provision of care to patients with a deteriorating airway and the continued auditing of practice.

Keywords: Airway, intubation, rapid sequence induction

INTRODUCTION

Intubation forms an integral role in the treatment of the critically ill or injured patients presenting to the emergency department (ED) with a deteriorating airway. The acuity of their presentation may often necessitate a rapid placement of an endotracheal tube (ETT). There are many different strategies to achieve this; one such technique is the Rapid sequence induction (RSI), borne out of the need to minimize the risk of aspiration in patients who are inadequately starved, have impaired gastric emptying, or are known to have gastric reflux. The term “rapid sequence induction” emphasizes the use of a sequential technique in achieving an immediate placement of a tube in the trachea by minimizing the time delay from the moment airway reflexes are ablated.[1]

Sellick first described the “classical” RSI in 1961; however, there are considerable variations in its current modern-day use. A 2001 survey of the UK EDs revealed that decisions to perform RSI were made by ED physicians in 74% of cases, with a delayed response time of the RSI practitioner of over 10 min in 25% of cases. Majority were performed because the airway was deemed to be at risk rather than the need for ventilation due to hypoxia. Induction agents used varied from propofol to thiopentone, etomidate, halothane, and ketamine. One case involved the use of vecuronium as the paralyzing agent with the remainder using suxamethonium.[1]

Emergency intubations are not without the risk of complications, not least due to the emergency nature of the procedure. A high
level of skill and training is needed to facilitate a controlled, safe environment in which this can be performed. The 4th National Audit Project (NAP4) of the Royal College of Anaesthetists (RCoA) and Difficult Airway Society (DAS) was designed, in part, to look at airway management in the ED and highlight any deficiencies that could lead to serious harm. The analysis of cases highlighted gaps in care, showing poor or delayed recognition of at-risk or deteriorating patient, inadequate preparation, insufficiently trained staff, and inadequate equipment.

In direct response to NAP4, RCoA, DAS, the Intensive Care Society and the Faculty of Intensive Care Medicine published a 2018 guideline on the management of tracheal intubation in critically ill adults. The best practice dictates that emergency intubations be performed:

- In a timely manner once the need is identified
- By trained practitioners (and assistants) with a comprehensive understanding of the procedure and technical proficiency
- Using appropriate drugs and equipment that should be easily and readily accessible
- Following adequate planning and organization of individual roles
- While maintaining adequate levels of oxygenation throughout
- With a clear strategy for postintubation care (confirmation of tube placement, ongoing management [investigation, treatment, and transfer]); minimization of the risk of adverse events; and failed/difficult intubations.

An agreed comprehensive model for the identification and management of a deteriorating airway should be in place on a local level, taking into account the national recommendations as outlined above. This study thus describes the practice of endotracheal intubation in an ED of a district general hospital in Greater London following the publication of the above guidelines and reviews its compliance to it. The study also provides an updated look into the current UK practices in terms of staffing, medications used, and success rates. We further attempt to provide reasons for the change in trend observed.

**Subjects and Methods**

This study was a retrospective observational study conducted at a district general hospital in Greater London. Using the hospital’s electronic database, all attendances from September 1, 2017 to September 1, 2018 of adults (>18 years old) and fulfilling one of the following criteria were searched: (1) transferred to another hospital, (2) died in the ED, (3) referred to intensive care unit (ICU), and (4) admitted to ICU.

A total of 1553 case notes were retrieved. Cases were individually reviewed by FF, SB, and EG to identify patients intubated in the ED. Of the 94 cases identified, the factors studied included; age and sex, indication for intubation, checklist used, any predefined safety measures documented if no checklist were used, drugs used, arrival time, and complications. The full criteria for the data collected on the performance of intubation can be seen in Figure 1.

Data were transferred into a Microsoft Excel spreadsheet. Calculations including Mann–Whitney U-test were done using the in-built algorithms on Excel. No ethical approval was sought, as per institutional guidelines.

**Results**

There were 94 intubations performed during the 1-year, averaging 1.8 intubations/week. The male to female ratio was 1.8:1. The mean age was 62 years, and the median was 65 (range 23–97 years). There were 54 intubations performed between the hours of 5 pm and 8 am (57.4%), classified as out of hours.

Indications for intubations are shown in Figure 2; the most common indication was for airway protection (n = 35), followed by respiratory failure (n = 23).

Medical conditions that led to patients requiring intubation are shown in Figure 3.

Checklists were only used in 15 cases. In the remaining 79 patients, no patients had all the predefined safety measures documented. Overall, eight complications were reported, all in the subset of patients where checklists were not used. There were three cases of severe hypotension (systolic blood pressure <90 mmHg), two desaturations (saturations <90%), one cardiac arrest, and two dental traumas.

All intubations were successful. There were 31 first-pass intubation successes, 26 of which were Cormack–Lehane Grade I and five of which were Grade II. Intensivists performed most of the intubations (66 patients), followed by anesthetists (13 patients) and ED physicians (10 patients). We

**Figure 1: Data collected on endotracheal intubations performed in the emergency department**

- Age and sex of the patient
- Date and time of intubation
- Indication for intubation
- Condition that led to the intubation
- Specialty of intubating practitioner
- The use of checklist. If no checklist used, any documentation of predefined safety measures as below
- Intravenous/intraosseous access, optimization of position, airway assessment, optimal preoxygenation, optimization of patient state, allergy assessment, application of monitors, checking of equipment, use of drugs, allocation of roles, and preparing for difficulty
- First-pass success rate
- Cormack-Lehane classification
- The response rate of intubating practitioner (arrival time - time contacted)
- Time from the decision made to intubate to successful placement of an endotracheal tube
- Medications used
- Complications
were unable to identify the intubating practitioner in five cases. Results are shown in Figure 4.

The mean response rate of intubating practitioner (from the time of referral to arrival to ED) was 10 min 16 s. ED physicians had a mean response time of 6 min 40 s while anesthetists responded on average at 2 min 13 s. Intensivists took on average 12 min 36 s. There was no significant difference between the response rates of ED and external physicians ($P = 0.0477$). The average time from the decision made to intubate to successful placement of an ETT was 19 min 9 s, with a median of 5 min.

The table for the choice of drugs can be seen in Figure 5. Propofol was the induction drug of choice ($n = 37$), followed by thiopentone ($n = 8$), etomidate ($n = 2$), and ketamine ($n = 2$); 22 patients did not have induction agents. Rocuronium was used in 42 cases, suxamethonium in nine, atracurium in two, and vecuronium in one; seventeen were not given a paralyzing agent. We were unable to verify whether the remaining 23 patients were given any medication.

**DISCUSSION**

**Checklists and documentation**

The aim of this study was to describe the current practice of intubations in the ED. These data identified that in only 15% of cases, a checklist was completed and that all complications occurred in the cases where a checklist was not utilized. Although we could not prove a direct correlation between lack of checklist use and the incidence of complications, evidence within the literature suggests that checklists are associated with a reduction in intubation-related complications. Checklists have been shown to cognitively offload the medical practitioner, reduce risks, and create an open environment for raising concerns.\(^{[4,6]}\)

Poor documentation of endotracheal intubations in the ED has previously been described in literature.\(^{[7]}\) Checklists have been found to improve documentation, but there are many barriers to implementation, including perceived lack of time, education, culture changes, and personal factors.\(^{[8]}\) Checklists in emergencies must be short enough to be used rapidly, to ensure adherence to safety standards but not carry unnecessary words or diagrams.\(^{[9]}\)

**Indications for intubation**

This study showed that the most common indication for intubation was for airway protection; these results reflect similar findings in the ED of trauma centers.\(^{[1]}\) It is of interest that in hospitals without high cases of major trauma (district general hospitals), airway protection still exceeds hypoxia as a need for intubation.

**Drugs**

The most commonly used neuromuscular relaxant was found to be rocuronium (45% of cases), in contrast to studies in 2001 and 2008, which described suxamethonium (98% and 99% of cases respectively) as the drug of choice.\(^{[1,10]}\) Despite previous concerns over anaphylaxis, April et al. showed that there was no documentation of medications

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**Figure 2: Indications for intubation, as identified in 94 cases**

| Indications for intubation | n/total (%) |
|---------------------------|-------------|
| Airway protection (failure of airway maintenance; or protection - at risk from burns, secretions, vomiting, bleeding, trauma) | 35/94 (37) |
| Respiratory failure (failure to oxygenate or ventilate - hypercapnia or hypoxia), high/low work of breathing | 23/94 (24) |
| Minimize oxygen consumption and optimize oxygen delivery (e.g., sepsis) | 2/94 (2) |
| Reduced Glasgow Coma Scale, terminate seizure, prevent secondary brain injury | 21/94 (22) |
| Temperature control (e.g., serotonin syndrome) | 0/94 (0) |
| For humanitarian reasons (e.g., cardioversion, bronchoscopy) and safety during transport | 13/94 (14) |

**Figure 3: Medical conditions requiring intubation, as identified in 94 cases**

| Medical condition | Number of patients |
|-------------------|--------------------|
| Cardiac/respiratory arrest | 40 |
| Intracranial pathology | 20 |
| Sepsis | 12 |
| Respiratory failure | 7 |
| Status epilepticus | 7 |
| Overdose/alcohol intoxication | 7 |
| Hypothermia | 4 |
| Endocrine emergencies (e.g., DKA) | 2 |
| Cardiogenic shock | 1 |

DKA: Diabetic ketoacidosis

**Figure 4: Proportion as a percentage of practitioners performing intubations in the emergency department**

| Practitioner intubating | n/total of 94 cases | As percentage of total cases |
|-------------------------|----------------------|-----------------------------|
| Emergency doctor | 10 | 11 |
| Anesthetist | 13 | 14 |
| Intensive care doctor | 66 | 70 |
| Unable to identify | 5 | 5 |

**Figure 5: Choice of drugs for rapid sequence induction**

| Drug | Number of cases (percentage of total) |
|------|--------------------------------------|
| Propofol | 37 (39) |
| Thiopentone | 8 (8) |
| Etomidate | 2 (2) |
| Ketamine | 2 (2) |
| No induction agent | 22 (23) |
| Rocuronium | 42 (45) |
| Suxamethonium | 9 (10) |
| Vecuronium | 1 (1) |
| No paralyzing agent given | 17 (18) |
| No documentation of medications | 23 (24) |
no difference in first-pass success or adverse outcomes with rocuronium verse suxamethonium.\textsuperscript{[11,12]} This combined with the release of its antidote, sugammadex, could have led to the described increased use of rocuronium.\textsuperscript{[13]}

**Physician factors**

The average response time was 10 min 16 s, with no significant difference seen between emergency, anesthetists, and intensive care physicians. The majority of intubations were carried out by intensive care physicians with an ED physician intubating in a smaller proportion of cases. Based on the number of cases identified per year, this translates to <10 opportunities to perform endotracheal intubations per year for an emergency physician, not allowing for shift work or skills of supporting colleagues.

This number is lower than previously reported and thus brings into question if this indicates a change in the UK practice. Concerns may rise over the quality of training and maintenance of skills required to perform endotracheal intubation among emergency physicians.\textsuperscript{[14]}

**Strengths and limitations**

The study has its strengths; it allowed a retrospective outlook of real-world practice on a large number of undifferentiated patients presenting to ED. Retrospective studies are, however, open to biases, with a potential preferential recording of events. Missing data were also common, with the potential to reduce the size and power of the study. The data were not independently verified, and data extraction was heavily reliant on legible handwriting on scanned copies of ED notes. There was no follow-up done on patients.

This is a single-center study, performed in a district general hospital in Greater London. The most UK ED-based studies on intubations were published more than 10 years ago;\textsuperscript{[1,14,15]} hence, this study provides an update on the intubating practices of one unit. It is unclear whether the trend seen in this study is seen nationwide, but the standardization of training for doctors in the UK mean that practices should be consistent.

Due to the nature of the retrospective collection of data, the study is unable to prove causation between lack of checklist and complications. What harm could be inflicted on patients in the absence of a checklist is difficult, if not impossible, to quantify with a retrospective study. However, designing a prospective randomized study where a subset of patients would be denied the use of a checklist to assess the potential harm would be unethical, given the potential outcome of death. In a world of growing medicolegal risk, documentation for life-saving procedures is essential, and this is not restricted to written notes. Smith et al. used a video recording of intubations in the ED to monitor compliance.\textsuperscript{[16]}

**Conclusions**

This study provides an overview of the intubation practices in a single-center ED. Non-ED physicians perform the majority of intubations, with a variety of induction and paralyzing agents being used. It adds to the growing call for better standardization and provision of care to patients with a deteriorating airway and the continued auditing of practice.

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**Conflicts of interest**

There are no conflicts of interest.

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