SHORT REPORT

Intubation training in emergency medicine: a review of one trainee's first 100 procedures

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Emerg Med J 2007;**24**:654–656. doi: 10.1136/emj.2007.048678

A review was performed looking at the first 100 intubation procedures performed or solely supervised by one emergency medicine trainee. Over the 5 year period during which the procedures were performed the author performed 93 and supervised 7 procedures. There were 90 rapid sequence intubation procedures and 10 intubations without drugs. The intubation procedure was successful by the author on 94 occasions, 91 of these on the first attempt and 3 on a second attempt. There were 8 complications. These comprised 3 oesophageal intubations and 5 failures to achieve an adequate view. This study suggests that as a trainee gains experience in performing intubation procedures, the nature of the complications arising changes. Initial complications involved misplacement of the tube, whereas later complications involved not obtaining an adequate view, latterly in increasingly difficult airways. Truly difficult airways are not common and may not be experienced until much later in a trainee's career.

The question of when an individual becomes competent at performing a procedural skill such as intubation has been studied in the paramedic population; however, there is no clear consensus yet in the emergency medicine setting. In the USA, the National Paramedic Curriculum requires that a student performs five successful intubations to graduate.¹ Wang *et al* predicted that paramedics required 15 to 20 endotracheal intubations to attain baseline proficiency (predicted success of 90%),² and other studies have suggested even higher numbers are required to attain proficiency.^{3–6} Obviously once competency is attained it must be maintained. Again the question of how many procedures must be performed to maintain adequate skill levels has not yet been answered.

The US National Emergency Airway Registry (NEAR) database of emergency department intubation procedures reported an 83% first intubation success rate in emergency department residents (improving from 72% in postgraduate year 1 residents to 93% in postgraduate year 4+ residents) and a surgical cricothyrotomy rate of 0.9% for all residents.⁷ For all emergency department intubation procedures (including attending procedures), 2.7% required a rescue technique such as rescue rapid sequence intubation (RSI), use of an airway adjunct or a surgical cricothyrotomy (0.6% of all procedures).⁸

The aim of this study was to review the first 100 intubation procedures performed by an emergency medicine trainee in order to evaluate the process of skill acquisition.

METHODS

During a 5 year emergency medicine specialist registrar training programme between 2002 and 2007, the author, a trainee in emergency medicine, prospectively recorded all intubation procedures that he had either performed or was the most senior supervising doctor, for logbook purposes. Data were collected on the age of the patient, the indication for

intubation, whether the procedure was successful and on what number attempt, the grade of the procedure as defined by the operator who successfully completed the procedure, the anaesthetic agent used, what complications arose, and who was the most senior supervising individual present at each procedure. Complications were defined as such if they occurred secondarily to the intubation procedure. The author's personal intubation procedure protocol is summarised in table 1. The data were entered into Microsoft Excel and analysed.

RESULTS

During the study period, the author performed or was the most senior supervising doctor for 100 intubation procedures (table 2). Data were available for all of these procedures; however, some drugs used in year 1 are missing from the database. Specialised airway training during this period included a 6 month anaesthetic secondment and attendance on the Scottish Airway and Ventilation Emergency (SAVE) course at the Stirling Simulator Centre, both in year 1.

The author performed 93 and supervised 7 procedures. There were 90 RSI procedures and 10 intubations without drugs. For 77 procedures, a doctor with more airway experience supervised the author. This was an emergency medicine consultant in 23

Table 1 Summary of author's personal intubation procedure protocol incorporating Royal Infirmary of Edinburgh emergency department's airway protocol

1. Patient identified requiring intubation procedure
2. On-call anaesthetist or emergency consultant called
3. Patient assessed using LEMON method
4. Procedure performed by author with on-call anaesthetist or emergency consultant present, unless emergency procedure required and no senior help available
5. Anaesthetic drugs chosen by author in consultation with on-call anaesthetist or emergency consultant
6. Pre-procedure checks performed
7. End tidal CO₂ monitor routinely placed in anaesthetic circuit before procedure and given enough time to warm up
8. Fentanyl routinely used as pre-treatment
9. Stylet routinely placed in endotracheal tube
10. Gum elastic bougie present but not routinely used
11. Pre-oxygenation if possible for 3 min
12. Collar removed if present, and manual in line stabilisation performed.
13. Cricoid pressure applied routinely by member of resuscitation room nursing staff
14. Suxamethonium used unless contraindications
15. Procedure attempted
16. If unsuccessful attempt, failed intubation drill performed. Discussion with on-call anaesthetist or emergency consultant present regarding nature of complication and decision made by on-call anaesthetist or emergency consultant present as to who should attempt further procedure

LEMON = Look, Evaluate, Mallampatti, Obstruction, Neck mobility.

Abbreviations: NEAR, US National Emergency Airway Registry; RSI, rapid sequence intubation; SAVE, Scottish Airway and Ventilation Emergency

Table 2 Summary of intubation procedures for one emergency medicine trainee

	SpR Training Year 1	SpR Training Year 2	SpR Training Year 3	SpR Training Year 4	SpR Training Year 5	Totals
Procedures	20	21	28	14	17	100
Author successful	18	20	28	13	15	94
Author successful 1st attempt	16	19	28	13	15	91
Author successful 2nd attempt	2	1	0	0	0	3
Author failed intubation	2	1	0	1	2	6
Grade 1	19	20	27	9	15	90
Grade 2	1	0	1	4	0	6
Grade 3	0	1	0	1	2	4
Grade 4	0	0	0	0	0	0
No drugs	1*	1	1	5	2	10*
Etomidate	0*	6	10	4	0	20*
Thiopentone	0*	6	15	3	13	37*
Propofol	1*	6	1	1	0	9*
Midazolam	0*	0	1	0	2	3*
Suxamethonium	18	20	27	9	14	88
Rocuronium	1	0	0	0	1	2
Neck immobilised	1	6	7	1	8	23
No neck immobilisation	19	15	21	13	9	77
Pre-hospital procedure	0	0	0	0	1	1
ED consultant present	0	5	9	3	6	23†
Anaesthetic Reg present	11	12	11	5	7	46†
Anaesthetic Cons present	7	0	0	0	1	8†
Author sole operator	2	4	7	5	2	20†
Author supervising intubation	0	2	3	1	1	7†
Complications‡	4§	1	0	1	2	8
Oesophageal intubation	3	0	0	0	0	3
Indication: respiratory	3	0	5	2	0	10
CVA/SAH/meningitis/sepsis	5	7	9	2	4	27
Head injury	1	8	7	1	5	22
Cardiac arrest/post-arrest	2	1	0	4	4	11
Toxicology	2	4	6	5	2	19
Trauma/burns	0	1	1	0	2	4
Emergency theatre	7	0	0	0	0	7

Cons, consultant; CVA, cerebrovascular accident; ED, emergency department; Reg, registrar; SAH, subarachnoid haemorrhage.

Male 70:29 Female (1 no data), mean age 51.4 years, median age 52.9 years.

*Drugs not known in 21 procedures.

†Some procedures may have both anaesthetic and ED staff present, therefore numbers do not add up to 100.

‡Failed intubation by author, oesophageal intubation, episodes of desaturation ($\text{SaO}_2 < 90\%$) post-procedure, cardiac arrest post-procedure, hypotension post-procedure requiring treatment, trauma to airway, vomiting or regurgitation secondary to the intubation procedure or a requirement for a surgical airway.

§One failed intubation was also an oesophageal intubation.

procedures, an anaesthetic consultant in 8 procedures and an anaesthetic registrar in 46. In the other 23 procedures, the author operated either alone, with a doctor with less airway experience (that is, anaesthetic SHO) or supervised the procedure without any senior supervision. There was one pre-hospital procedure.

Of the 100 procedures, the author was successful on 94 occasions, 91 of these on the first attempt and 3 on a second attempt. There were 8 complications of the procedure, which included 6 failed intubations by the author. These are detailed in table 3. All complications occurred during intubation procedures with drugs. There were 90 grade 1 intubations, as defined by Cormack and Lehane,⁹ 6 grade 2 intubations, and 4 grade 3 intubations. There were no episodes of desaturation ($\text{SaO}_2 < 90\%$) post-procedure, cardiac arrest post-procedure, hypotension post-procedure requiring treatment, trauma to airway, vomiting or regurgitation secondary to the intubation procedure or a requirement for a surgical airway in any of the procedures.

DISCUSSION

As the author gained experience the complications arising from the procedures changed in nature. Oesophageal intubations occurred on procedures 1, 7 and 12. All oesophageal intubations were immediately recognised and corrected. There were no further oesophageal intubations in any of the next 88 procedures. The other 5 complications were all a failure to achieve an adequate view. In procedures 4, 27, 71, 97 and 99 the

author was unable to gain an adequate enough view to allow simple intubation. In the first three of these, the second person performing the procedure was able to gain a better view simply with their intubation technique. No alternative manoeuvres or airway adjuncts were used. In the last two procedures, numbers 97 and 99, the author was only able to obtain a grade 3 view. On both of these occasions, a more experienced practitioner was unable to gain a better view. Both of these patients were then intubated using a blind bougie technique, placing the curved bougie tip in an anterior facing direction just behind the epiglottis and advancing, aiming to pass the bougie through the cords. Both of these patients were successfully intubated on the next attempt using this technique. All patients were routinely assessed using the LEMON method.¹⁰ Patient 97 had no adverse airway characteristics. Patient 99 had a reduced thyromental distance, but had no other characteristics suggestive of a difficult airway and no alternative arrangements were made before intubation.

The US NEAR studies have reported a trainee first intubation failure rate of 17%, a trainee failure rate of 10% and a rescue surgical cricothyrotomy rate of 0.9% for all residents.⁷ Comparative intubation grade data from operating theatres shows that while Cormack and Lehane grades vary between populations, relative frequencies of grades 1 to 4 are about 68–70%, 28–30%, 1.5–2.0% and 0.1%.^{11 12}

It is interesting to note that despite the author being a fairly experienced operator by the later procedures, a true grade 3

Table 3 Summary of the 8 complications during the trainee's first 100 procedures

Complication	Procedure number	Complication details
1	1	Oesophageal intubation recognised by the author 70-year-old male. Left ventricular failure. Intubation with drugs. Drugs not known
2	4	Author unable to gain adequate enough view. Patient intubated on next attempt by anaesthetic registrar and classified as a grade 1 view 68-year-old female. Isolated head injury, GCS 4. Intubation with drugs. Drugs not known
3	7	Oesophageal intubation recognised by the author. Patient intubated on next attempt by anaesthetic registrar and classified as a grade 1 view 40-year-old female. Overdose. Intubation with propofol and suxamethonium
4	12	Oesophageal intubation recognised by the author. Patient intubated by author on next attempt and classified as a grade 1 view 48-year-old female. Overdose. Intubation with drugs. Drugs not known
5	27	Author unable to gain adequate enough view. Patient intubated on next attempt by anaesthetic registrar and classified as a grade 2 view 50-year-old male. Head injury. Intubation with thiopentone, fentanyl and suxamethonium
6	71	Author unable to gain adequate enough view. Patient intubated on next attempt by anaesthetic registrar and classified as a grade 1 view 52-year-old female. Overdose. Intubation with etomidate and suxamethonium
7	97	Author unable to gain adequate enough view. Anaesthetic registrar failed on second intubation attempt. Patient intubated on third attempt by anaesthetic registrar with a blind bougie and classified as a grade 3 view 71-year-old male. Post-cardiac arrest. Intubation with midazolam, fentanyl and suxamethonium
8	99	Author unable to gain adequate enough view on view 1. Emergency consultant failed on second intubation attempt. Patient intubated on third attempt by emergency consultant with a blind bougie and classified as a grade 3 view 60-year-old male. Massive cerebrovascular accident. Intubation with thiopentone, fentanyl and suxamethonium

GCS, Glasgow Coma Score.

intubation was not experienced until procedures 97 and 99, and the author did not have an occasion to resort to a difficult airway algorithm until this point. This has several implications for training. Until the operator has experience in managing difficult airways then a more experienced operator should always be available to call upon. As a trainee, one should always have a senior colleague, either an emergency physician or anaesthetist, present or available to call on in case of problems, and ideally emergency department consultants should also have a colleague nearby to help out if necessary.

The question of how many procedures are required before competence is obtained is obviously difficult and varies from

individual to individual. From the author's experience the complication of oesophageal intubation did not disappear until after procedure 12. One could also argue that the author was not able to obtain a view that was classified as grade 1 by an anaesthetic registrar on procedure 71 and therefore sufficient competence had still not been attained. By procedures 97 and 99 the view the author was obtaining was not improved upon by either an anaesthetic registrar or a consultant in emergency medicine. The complication rate improved notably after about 30 procedures in this small study.

The author accepts that one trainee's experience may not be generalisable to emergency trainees in general. In order to see whether a similar pattern of complications is present in all trainees and to determine recommendations for emergency medicine trainees, this study should be performed on a much larger group of trainees. Obviously the action of intubation is only one part of performing an RSI procedure. Information about other skills required for the process, such as choice of suitable patient, equipment preparation and team leadership for example, were not assessed in this study.

CONCLUSIONS

As a trainee gains experience in performing intubation procedures, the nature of complications arising changes, with oesophageal intubation complicating the first 20 procedures and difficulty obtaining an optimum view complicating later procedures. The complication rate seems to improve after about 30 procedures. Truly difficult airways are not common and may not be experienced until much later in a trainee's career.

Competing interests: None declared.

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Accepted 31 May 2007

REFERENCES

- 1 **National Highway Traffic Safety Administration.** Emergency medical technician paramedic: national standard curriculum (EMT-P). <http://www.nhtsa.dot.gov/people/injury/ems/EMT-P> (Accessed 9 March 2007).
- 2 **Wang HE, Yealy DM.** Out-of-hospital endotracheal intubation: where are we? *Ann Emerg Med* 2006;**47**:532-41.
- 3 **De Oliveira Filho GR.** The construction of learning curves for basic skills in anesthetic procedures: an application for the cumulative sum method. *Anesth Analg* 2002;**95**:411-6.
- 4 **Konrad C, Schupfer G, Wietlisbach M, et al.** Learning manual skills in anaesthesiology: is there a recommended number of cases for anesthetic procedures? *Anesth Analg* 1998;**86**:635-9.
- 5 **Mulcaster JT, Mills J, Hung OR, et al.** Laryngoscopic intubation learning and performance. *Anesthesiology* 2003;**98**:23-7.
- 6 **Tiah L, Wong E, Chen MF, et al.** Should there be a change in the teaching of airway management in the medical school curriculum? *Resuscitation* 2005;**64**:87-91.
- 7 **Sagarin MJ, Barton ED, Chng YM, et al.** National Emergency Airway Registry Investigators. Airway management by US and Canadian emergency medicine residents: a multicenter analysis of more than 6,000 endotracheal intubation attempts. *Ann Emerg Med* 2005;**46**:328-36.
- 8 **Bair AE, Filbin MR, Kulkarni RG, et al.** The failed intubation attempt in the emergency department: analysis of prevalence, rescue techniques, and personnel. *J Emerg Med* 2002;**23**:131-40.
- 9 **Cormack RS, Lehane J.** Difficult intubation in obstetrics. *Anaesthesia* 1984;**39**:1105-11.
- 10 **Murphy MF, Walls RM.** Ch.5. The difficult and failed airway. In: Walls RM, ed, *Manual of emergency airway management*. Lippincott Williams and Wilkins, 2000:31-9.
- 11 **Yentis SM, Lee DJH.** Evaluation of an improved scoring system for the grading of direct laryngoscopy. *Anaesthesia* 1998;**53**:1041-4.
- 12 **Cattano D, Panicucci E, Paolicchi A, et al.** Risk factors assessment of the difficult airway: an Italian survey of 1956 patients. *Anesth Analg* 2004;**99**:1774-9.