Rapid Sequence Intubation in the Emergency Department

-Clinical Topic Review-

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This clinical topic review is entirely my own work

Introduction

A Clinical Scenario...

A trauma patient presents to the emergency department with significant head injuries and a falling Glasgow Coma Score. You intubate the patient as the anaesthetists are stuck in theatre with a major case. When the anaesthetists arrive to take the patient to theatre, they express concerns that the patient was intubated without anaesthetic input.

Rapid Sequence Intubation in the Emergency Department

Critically ill patients in the emergency department (ED) often require advanced airway management. Rapid sequence intubation (RSI) has been shown to have a higher success rate and fewer complications than alternative methods of intubation.[1-5] This is a technique employing drugs to facilitate endotracheal intubation in emergency cases. Anaesthetic or sedative agents are administered to pre-oxygenated patients, along with a fast-acting neuromuscular blocking agent, prior to intubation. Cricoid pressure is applied to reduce the risk of aspiration.

The ability to manage an airway is an important skill for any doctor involved in the management of critically ill patients. Approximately 1 in 800 patients attending the ED requires RSI; the equivalent of 20,000 patients per year in the UK.[6] This has traditionally been a service provided exclusively by anaesthetists.[1,7,8] Since the introduction of the Acute Care Common Stem (ACCS) training program, airway management has become a core competency for all UK trainees in emergency medicine.[9] However, several studies have shown that the minority (<20%) of RSIs in the UK are performed by emergency physicians (EPs).[6,10,11] This is in contrast to the US and Australia, where the majority of RSIs (89-93% in the US) are performed by EPs.[2,3]

Many studies have suggested that airway management outside the controlled environment of the operating theatre results in higher rates of complications and failed intubations.[6,7,12-14] Emergency surgical airways are required in approximately 1 in 200 cases in the ED.[13] Given the difficulties associated with RSI in the ED, many anaesthetists see themselves as the sole specialty appropriately trained to deliver RSI in these patients.[7,15] According to a UK survey by Walker et al (2000),[16] 36% of anaesthetists felt that ED registrars should not undertake RSI, without anaesthetic input, under any circumstances.

Despite the acknowledged difficulty of RSI in the ED, studies have shown that nearly half of ED RSIs are performed by unsupervised trainees,[6] and anaesthetists responding to calls for airway management are often relatively junior.[8,16,17] The Royal College of Anaesthetists recently identified inadequately trained staff as the cause of a significant number of complications related to RSI.[12,13] Waiting for anaesthetic input has also been shown to cause delays in the management of these critically ill patients.[8,11,18]

EPs are always present in the ED, are accustomed to managing acutely unwell patients, and are now routinely trained in advanced airway management. Several studies have shown agreement between anaesthetists and EPs regarding airway assessment and the need to intubate.[11,18] It does not seem unreasonable, therefore, that appropriately-trained EPs should take responsibility for airway management in the ED. However, it is imperative that this is done safely and successfully.

Methods

Clinical Question

The aim of this review is to answer the question:

Can emergency physicians (EPs) perform rapid sequence intubation (RSI) safely and successfully, in comparison to anaesthetists?

This was reformulated into a four-part question to facilitate a systematic literature search.

1) Problem	**Rapid sequence intubation** in the **emergency department**
2) Intervention	RSI by **emergency physicians**
3) Comparison	RSI by **anaesthetists**
4) Outcome	**Safe/successful** intubation

Key search terms generated from this question are highlighted in **bold**.

MEDLINE (1950 to June 2011), EMBASE (1980 to June 2011) and CINAHL (1981 to June 2011) were searched using the NHS Evidence healthcare databases advanced search. A large number of synonyms were identified for each of the key search terms. Appropriate MESH/thesaurus keywords for each database were identified for each of these terms. Free text and thesaurus search terms were combined to optimise the sensitivity of the search. The final search strategy is detailed in Appendix 1.

Search Results

Searches of MEDLINE, EMBASE and CINAHL databases returned a total of 161 references, after removal of duplicated results. Relevant articles were identified by examining abstracts and links to

full text articles. Seven studies were found relating directly to the four-part question (see Appendix 2)

A relevant Best Evidence Topic review[19], did not help identify any additional literature. Searches of the Cochrane database and British Library Electronic Table of Contents (Zetoc) revealed no relevant articles. References from relevant papers were also searched to make sure no important studies were omitted. There were concerns that the addition of “anaesthetist” as a search term may exclude important papers, but a search excluding this term (678 references from MEDLINE) revealed no additional relevant papers.

Studies were included if they compared the performance of EPs and anaesthetists for RSI in the ED. Non-comparative studies (giving success and/or complication rates for EP RSI) were not included in the analysis (see discussion). Studies of paediatric and pre-hospital intubation were excluded, as were intubations in cardiac arrest, or other intubations not requiring drugs. Relevant papers were analysed, and graded according to the Oxford Centre for Evidence-Based Medicine levels of evidence table.[20]

Results

A two-year multicentre prospective observational study of RSI across seven Scottish EDs was collated by the Scottish Trauma Audit Group (STAG) and published by **Graham et al (2003)**.[21] This showed that anaesthetists (AN) had higher intubation success rates at first attempt (EP 83.8%, AN 91.8%, p=0.001) and achieved better initial views on laryngoscopy (Grade I or II: EP 89.3%, AN 94.0%, p=0.039) when compared with EPs. However, no difference was seen in the overall success rate: only one failed intubation requiring surgical airway was reported in each group.

RSI by EPs showed a tendency towards higher immediate complication rates (EP 12.7%, AN 8.7%, p=0.104) but this did not reach statistical significance. This may be because EPs were intubating sicker patients (Physiologically compromised patients: EP 91.8%, AN 86.1%, p=0.027) or it may be that the study was underpowered. No power calculation was performed.

An analysis of a subset of the same data, looking only at trauma patients, was also published by **Graham et al (2004).**[17] This also showed that anaesthetists had a higher rate of successful intubation on first attempt (EP 76.4%, AN 87.8%, p= 0.034), but did not show any significant difference in complication rates or quality of initial views on laryngoscopy.

The same data collection form was used by two other studies. **Stevenson et al (2007)**[22] looked at RSIs in a single district general hospital (DGH) over a 40-month period. They showed that EPs could successfully perform RSI in the DGH setting (successful intubation within 3 attempts: EP 97%, AN 97%) with no significant difference in complication rates (EP 22%, AN 20%). They mirrored the findings of Graham et al[21] that anaesthetists achieved better initial laryngoscopy views (EP 86%,

AN 95%, p=0.032) and had a tendency towards higher successful intubation rates at first attempt (EP 82%, AN 91%, p=0.056) though this did not reach statistical significance.

Simpson et al (2006)[23] used the STAG data collection form to look at trends in ED RSI. They collected data on complications of RSI in the ED of a Glasgow teaching hospital over a five-year period. They showed that the proportion of RSIs performed by EPs increased from 49% to 77% (significant increase for trauma RSI, but not for non-trauma). Complication rates for EPs over the same period fell from 32% to 9% (significant reduction for non-trauma RSI, but not for trauma). While these numbers look impressive, it is unclear whether the overall trends were statistically significant, with the trauma and non-trauma groups combined, as no p-value was given.

Anaesthetists had an overall complication rate of 20%, but showed marked variability in their yearly performance with no obvious trends over the five years. Unfortunately, the study used small numbers to draw these conclusions about trends in performance. The high rate of complications for anaesthetists is likely a reflection of their involvement in more difficult cases.

An interesting study design was presented by **Levitan et al (2004)**.[24] A 37-month study of all adult trauma patients requiring intubation in the ED. Patients were effectively randomised to intubation by anaesthetists or EPs: the specialties took turns on alternating days with responsibility for airway management. No significant difference was found in rates of failed intubation requiring cricothyroidotomy (EP 0.4%, AN 0%) or the number of attempts required to intubate (p=0.225). No major complications (clinically evident aspiration, critical hypoxia causing haemodynamic instability, or cardiac arrest related to airway management) were recorded.

However, there was a large difference in numbers between EP (n=460) and anaesthetist (n=198) groups. This is partially explained by the fact that patients who arrived with insufficient time for anaesthetists to respond were intubated by EP even if it was an "anaesthesia" day. Unfortunately, there is no record of how many patients this applied to. No attempts were made to differentiate between RSI and other forms of intubation.

In the discussion, these findings were compared with results of studies run simultaneously in theatres in the same hospital. There was no significant difference in the number of cases requiring ≥3 attempts to intubate (ED 2.9% (19/656), first theatre study 2.8% (177/6419), second theatre study 2.8% (49/1748)).

Bushra et al (2004)[25] presented what is at first glance a comparison of trauma intubations by anaesthetists and EPs. A single-centre prospective observational study compared intubations of adult trauma patients (n=673) in an American ED in two consecutive time periods (35 months and 12 months long). In phase one, intubations were supervised by the anaesthetic team. In phase two, supervision was provided by EPs. The study recorded rates of successful intubation (number of attempts required) and of failed intubation (requiring intubation by another service or cricothyroidotomy). Other complications were not recorded.

The study showed no significant difference in rates of successful intubation within 2 attempts (EP 95.1%, AN 94.6%, OR 1.109 (95%CI 0.498-2.522)) or total failed intubation (EP 1.9%, AN 3.4%, OR 0.558 (95%CI 0.156–1.806)). This is perhaps unsurprising when you realise that the majority of intubations in both phases (81.2% versus 98%) were performed by EPs, the only difference being

the supervising team. Interpretation of results is further hampered by differences in intubation method between the two phases, with EPs favouring RSI (EP 85.0%, AN 67.7%, OR 2.697 (95%CI 1.723–4.239), while the anaesthetists were more likely to intubate without medications. Furthermore, during the study period, the number of ED attendances increased from 39000 to 50000 patients, raising questions about the comparability of the two phases.

A similar study by **Omert et al (2001)**[26] compared intubations before and after a policy change in which EPs took over responsibility for trauma intubations from anaesthetic teams. Data on EP RSI was collected prospectively after the change. Data for the anaesthetists was collected retrospectively from case notes. Again, the majority of intubations in the anaesthetic group were actually done by ED residents (61/101), making comparisons less meaningful. Minor differences were shown in the number of attempts required for intubation, but no confidence intervals or p-values were given to determine statistical significance. There was no significant difference in complications rates between the two groups and no mortality was reported. High complication rates (EP 33.3%, AN 37.6%) were seen in this study, but no reasons were given for this.

Personal Work

Addenbrooke's Hospital, Cambridge, is a large teaching hospital where EPs have been performing RSI since 2005. I performed a service evaluation of RSI in the ED to document our success and complication rates, and to compare our results with published data. A prospective evaluation of all ED RSIs over a period of 27 months (2008-2010) was performed using the College of Emergency Medicine RSI audit tool.[9]

Results

A total of 200 RSIs were reported during the study period: an average of 7.4 intubations per month. 95.5% of RSIs were performed by EPs. All the intubations were successful (first pass 86.5%, second pass 11.5%). No surgical airways were recorded. The most common (62.5%) indication for performing an RSI was the predicted clinical course (high probability of obstruction, aspiration or respiratory failure). 84% of intubations were recorded as "successful and uneventful". Complications were recorded in 35 cases (17.5%), but only 15 (7.5%) of these were in cases reported as "eventful".

Limitations

Data collection for this study was dependent on forms being completed at the time of intubation. No attempts were made to identify missed cases. There is a potential for selection bias. There were also concerns about the design of the form: some questions were open to interpretation and there was no dedicated space to record details of all staff present or the total number of intubation attempts.

Conclusion

The majority of RSIs in our ED are performed by EPs. Success and complication rates are comparable to published data.

Discussion

Summary of Results

Seven studies comparing the performance of EPs and anaesthetists for ED RSI were analysed. No significant differences were seen in the rates of successful intubation or complication rates. Few surgical airways were required in either group (EP 0-1.0%, AN 0-2.8%). Two studies showed that anaesthetists achieved better views (Grade 1 or 2) at initial laryngoscopy (EP 86.0-89.3%, AN 94.0-95.2%), and had a tendency towards better intubation success rates at first attempt (EP 73.7-86.4%, AN 77.2-91.8%).

Study Weaknesses

RSI is not an intervention that lends itself well to randomisation, blinding or controlled trials. Most patients are critically unwell and in need of urgent intervention. It is of no surprise, therefore, that the published data is largely limited to observational studies.

Observational studies may suffer from bias due to differences in the populations intubated by EPs and anaesthetists. Anaesthetists are often called for anticipated difficult intubations, and EPs may have to intubate critically ill patients when anaesthetists are not immediately available. All of the studies presented here rely upon the prospective completion of data forms. Unreported cases may be a source of selection bias, though most studies tried to identify missed cases to minimise this effect. Reporter bias may result from incomplete recording of intubation attempts and complications.[2]

Several studies include an element of retrospective data collection: in some cases to provide retrospective data following a change in practice, in others to provide data for missed cases. Mechanisms for identifying patients may be unreliable (sampling bias), and poor documentation may result in incomplete data collection.

No power calculations were presented for any of the studies. No justification was given for the study sample sizes. There is the danger therefore that statistically significant results are missed.

Reported complication rates particularly vary widely between studies (EP 10.0-33.3%, AN 8.7-37.6% in this analysis). Unfortunately, direct comparisons between studies are difficult due to differences in study population (adults, paediatrics, trauma), staff involved (intubating doctor, supervising specialty, presence of anaesthetic backup), study methods (RSI or other intubation methods) and outcome measures (definitions of an intubation “attempt”; thresholds for desaturation or hypotension). Characteristics of the study population and severity of illness are likely to impact heavily on rates of success and complications of RSI. Furthermore, training and experience vary between individual physicians and departments.

It is for the same reasons that studies of rates of success and complication are only applicable to the population and environment from which they were derived (poor external validity). Much of the published data comes from the US, where both the training and ED environment are significantly different. The remainder of the data presented here comes from a small number of linked Scottish studies. It is questionable whether these results can be applied to patients in the UK.

Non-comparative Studies

A large number of non-comparative observational studies have reported success and complication rates of ED RSI by EPs, mainly from the US. Unfortunately, while anaesthetists remain the gold standard for RSI in the ED, there is little reliable data on their performance against which these results can be compared. The significance of these results is therefore difficult to gauge. As discussed above, the external validity of these studies is questionable. It is for these reasons that they were not included in this review. However, non-comparative studies may still be helpful in defining a standard of acceptable practice.

The National Emergency Airway Registry (NEAR) is an ongoing project that prospectively collects data on all intubations performed across more than 20 EDs across several countries. Sagarin et al (2005)[2] presented a large study of NEAR data collected from 29 US and Canadian centres over a 58 month period. 4513 RSIs were performed by ED residents, with an 85% (95%CI 84-86%) success rate at first attempt, and a 91% (95%CI 90-92%) success rate by the first intubator. Only 0.6% proceeded to surgical airway. These results are comparable to other studies from the US. The rates of success in this study improved significantly over the first 3 years of residency, and success rates with RSI were found to be higher than with other methods. Unfortunately, no data on complications of RSI was reported.

A search of the literature revealed only one non-comparative study from the UK. Butler et al (2001)[11] presented a prospective multicentre study of RSI in UK EDs. This survey of a small sample of 60 patients revealed no failed intubations and a complication rate of 10% (6/60).

The Royal College of Anaesthetists and The Difficult Airway Society recently published the results of their 4th national audit project (NAP4),[12,13] the most comprehensive audit of airway management in the UK to date. Data on major complications (defined as death, brain damage, emergency surgical airway or unanticipated ICU admission) of airway management were collected over a 12-month period (Sept 2008- Aug 2009) from all UK hospitals. A total of 184 major complications were recorded. Only 15 complications were in the ED, and 11 of these were in cases managed by an anaesthetist. No attempt was made to calculate the incidence of events in the ED or the number of unreported cases.

Implications for Practice

The presented evidence has its weaknesses, but shows that EPs can perform RSI in the ED with success and complication rates comparable to those of anaesthetists. Several papers suggest that anaesthetists are more successful at intubating at the first attempt, and achieve better views at initial laryngoscopy.[17,21,22] These are targets that EPs should strive to emulate, but are not reason enough to abandon EP RSI.

The NAP4 study[13] made several recommendations to improve outcomes from RSI. A high proportion of complications occurred out-of-hours and without consultants present. Improving consultant cover may improve outcomes as well as improving training. They also recommended the use of capnography for all patients, routine use of intubation checklists, and standardised management procedures for intubation. This should include plans for difficult airways[14] and provision of training and equipment to deal with failed intubations.

Issues of training and skill maintenance are likely to be a significant challenge in coming years.[7,16,27] The amount of training necessary to undertake RSI safely has always been a contentious issue.[28] Walker et al[16] reported that only 52% of anaesthetists felt that 6 months training would be sufficient. UK trainees currently spend 1 year training in anaesthetics and intensive care as standard. There is also concern that the level of exposure to airway problems in the ED, especially in departments with large numbers of trainees, may not be enough to maintain these skills. Benger et al[6] suggested that 1 in 800 ED patients requires RSI: in an average ED (60000 patients per year), an RSI will be required only once every five days.

Close collaboration and joint training of EPs and anaesthetists has been recommended.[12,13,28] Regular interdepartmental reviews of problem cases could help improve communication and practice. Experience of RSI could potentially be supplemented with further secondments in theatres.

There are an increasing number of airway training courses available in the UK: these include the National Emergency Airway Management course, simulator-based training such as the Scottish Airway and Ventilation Emergency (SAVE) course and courses run by the Difficult Airway Society. These will play an important part in training and skills maintenance.[7,28,29]

RSI activities will need to be audited, and EPs should maintain personal logbooks, to show that they are performing RSI safely and successfully, and can maintain their skills in the long term. The College of Emergency and Royal College of Anaesthetists have together developed a data collection form for this purpose. There are plans to centralise collection of this data as a national

registry of RSI activities. This will help to define standards of acceptable practice in airway management.

Conclusions

Despite a lack of good-quality randomised controlled trials, published evidence suggests that EPs can perform RSI in the ED with overall success and complications rates comparable to anaesthetists. Several papers suggest that anaesthetists are more successful at intubating at the first attempt, and achieve better views at initial laryngoscopy. These are targets that EPs should strive to emulate, but are not reason enough to abandon EP RSI.

It is perhaps time to end the debate over whether EPs should be performing RSI, and concentrate instead on ensuring that EPs are appropriately trained and given enough opportunity to develop and maintain their skills.

Appendix 1: Search Strategy

#	Search Term	Search Hits		
		Medline	EMBASE	CINAHL
1	("rapid sequence intubat*" OR "rapid sequence induction*").ti,ab	711	875	263
2	("drug facilitated intubat*" OR "drug assisted intubat*").ti,ab	10	11	8
3	("tracheal intubat*" OR "endotracheal intubat*").ti,ab	9985	11937	1093
4	("emergency intubat*" OR "emergent intubat*").ti,ab	264	335	64
5	(airway ADJ manag*).ti,ab	2969	3634	883
6	MESH/Thesaurus Search for "RSI" (see below)	26378	28828	4986
7	**1 OR 2 OR 3 OR 4 OR 5 OR 6**	32147	34408	5711
8	("emergency room*" OR "emergency department*" OR "emergency physician*" OR "emergency doctor*" OR "accident and emergency").ti,ab	47682	56156	18663
9	MESH/Thesaurus search for "ED" or "EP" (see below)	45367	50107	20897
10	**8 OR 9**	72858	79618	30394
11	(safe* OR success* OR unsuccess* OR fail* OR complicat* OR difficult* OR "adverse event*" OR outcome*).ti,ab	2612970	3045409	352342
12	MESH/Thesaurus search for "Complications" (see below)	11399	49	22847
13	**11 OR 12**	2619496	3045445	368152
14	(anaestheti* OR anestheti* OR anaesthesiol* OR anesthesiol*).ti,ab	159025	179580	8920
15	MESH/Thesaurus search for "anaesthetist" (see below)	14833	20082	658
16	**14 OR 15**	166771	188911	9300
17	(prehospital OR pre-hospital OR out-of-hospital OR helicopter*).ti	6132	7240	2911
18	(paediatric* OR pediatric* OR child* OR infant* OR neonat*).ti	760370	844972	131779
19	**17 OR 18**	766226	851896	134527
20	7 AND 10	1199	1649	507
21	7 AND 10 NOT 19	936	1309	379
22	7 AND 10 AND 13 NOT 19	678	717	203
23	7 AND 10 AND 13 AND 16 NOT 19	101	112	26

Papers containing "prehospital" and "paediatric" search terms (17 and 18) were only excluded if these words appear in the title.

Thesaurus Search Terms

The free text search terms were augmented with MESH/thesaurus key words to improve the sensitivity of the search. As each of the health databases has a different thesaurus structure, appropriate search terms had to be found for each database. These are shown in the table below.

	Medline	EMBASE	CINAHL
RSI	AIRWAY MANAGEMENT/ INTUBATION, INTRATRACHEAL/	ENDOTRACHEAL INTUBATION/	AIRWAY MANAGEMENT/ INTUBATION, INTRATRACHEAL/
ED or EP	exp EMERGENCY MEDICINE/ exp EMERGENCY SERVICE, HOSPITAL/	EMERGENCY MEDICINE/ EMERGENCY PHYSICIAN/ EMERGENCY WARD/	exp EMERGENCY SERVICE/ exp PHYSICIANS, EMERGENCY/
Complications	INTUBATION, INTRATRACHEAL/ae,co, mt,mo,st,sn,td [ae=Adverse Effects, co=Complications, mt=Methods, mo=Mortality, st=Standards, sn=Statistics & Numerical Data, td=Trends]	ENDOTRACHEAL INTUBATION/co [co=Complication]	exp ADVERSE HEALTH CARE EVENT/
Anaesthetists	exp ANESTHESIOLOGY/	ANESTHESIST/ ANESTHESIOLOGY/	exp ANESTHESIOLOGISTS/

Appendix 2: Summary of Papers

Summary of Results

Citation	Number of cases	Initial view (Grade I or II)	Attempts =1	Attempts <=2	Attempts <=3	Surgical airway	Complication rate
Bushra et al, 2004, USA	EP 206, AN 467		EP 74.8%, AN 80.7% (NS)	EP 95.1%, AN 94.6% (NS)	EP 98.5%, AN 96.4% (NS)	EP 1.0%, AN 2.8% (NS)	
Graham et al, 2003, UK	EP 377, AN 355	**EP 89.3%, AN 94.0% (p=0.039)**	**EP 83.8%, AN 91.8% (p=0.001)**			EP 0.3%, AN 0.3%	EP 12.7%, AN 8.7% (p=0.104)
Graham et al, 2004, UK	EP 152, AN 242	EP 86.4%, AN 95.2% (p=0.051)	**EP 76.4%, AN 87.8% (p=0.034)**		100%	None	EP 10.0%, AN 10.6% (p=1.0)
Levitan et al, 2004, USA	EP 460, AN 198		EP 86.4%, AN 89.7% (p=0.225)*	EP 97.4%, AN 96.4% (p=0.225)*	EP 2.6%, AN 3.6% required >=3 attempts (p=0.225)*	EP 0.4%, AN 0% (p=0.225)*	No major immediate complications
Omert et al, 2001, USA	EP 99, AN 101		ED resident 73.7%, AN 77.2%		ED resident 87.9%, AN 98%	EP 0%, AN2.0%	EP 33.3%, AN 37.6%
Simpson et al, 2006, UK	Mean= 51 ED RSI/yr						EP fell 32% to 9%, AN 20%
Stevenson et al, 2007, UK	EP 88, AN 111	**EP 86%, AN 95% (p=0.032)**	EP 82%, AN 91% (p=0.056)	EP 95%, AN 95%	EP 97%, AN 97%	None	EP 22%, AN 20%

Statistically significant results are highlighted in **bold**
AN= anaesthetist, ED=emergency department, EP= emergency physician, NS= non-significant
*p-value quoted is the result of Wilcoxon Mann-Whitney test comparing the number of intubations and cricothyrotomy for EPs versus AN

Literature Review

Citation	Patient Group	Study Type and Quality	Key Results	Study Weaknesses
Bushra et al, 2004, USA	Adult trauma patients intubated in a US teaching hospital ED over 46 months (n=673)	Single-centre prospective observational study comparing intubations before and after a change in departmental practice (Responsibility for RSI changed from AN to EP) (Level 2b)	- Intubation within 2 attempts: EP 95.1% (196/206), AN 94.6% (442/467), OR 1.109 (95%CI 0.498-2.522) - Total failed intubation: EP 1.9% (4/206), AN 3.4% (16/467), OR 0.558 (95%CI 0.156–1.806) - Surgical airways: EP 1.0% (2/206), AN 2.8% (13/467)	- Majority of intubations in both groups done by EP (81.2% in AN group) - Study included intubation by any method (AN RSI 67.7% (314/467), EP RSI 85% (175/206)) - No record of complications other than failed airway. - ANs include certified registered nurse anaesthetists (CRNAs) - Wide confidence intervals for OR - No power calculation - No attempt to identify missed cases - ED attendances increased from 39000 to 50000 patients during the study period.
Graham et al, 2003, UK	All adult patients intubated in the ED across 7 Scottish urban teaching hospitals over 2 years (n=1631 of which 735 RSI)	Multicentre prospective observational study comparing EP and AN (Level 2b)	- Grade I or II view at laryngoscopy: EP 89.3% (316/354), AN 94.0% (298/317), p=0.039 - Intubation at 1st attempt: EP 83.8% (316/377), AN 91.8% (326/355), p=0.001 - Surgical airways: EP 0.3% (1/377), AN 0.3% (1/355) - Complications: EP 12.7% (48/377), AN 8.7% (31/355), p=0.104	- Cardiac arrest at RSI recorded (EP 3, AN 1), but not commented on, and no p-value calculated. - No power calculation.
Graham et al, 2004, UK	All adult trauma patients intubated in	Multicentre prospective	- Grade I or II view at laryngoscopy: EP 86.4% (89/103), AN 95.2% (99/104),	- No power calculation This paper presents a subset of the

Citation	Patient Group	Study Type and Quality	Key Results	Study Weaknesses
	the ED across 7 Scottish urban teaching hospitals over 2 years (n=439 of which RSI=233)	observational study comparing EP and AN (Level 2b)	p=0.051 - Intubation at 1st attempt: EP 76.4% (84/110), AN 87.8% (108/123), p= 0.034 - No failed intubations (100% success within 3 attempts) - Complications: EP 10.0% (11/110), AN 10.6% (13/123), p=1.0	data presented in another paper by Graham
Levitan et al, 2004, USA	All adult patients intubated in ED in a US trauma centre over a 37-month period (n=658)	Unblinded quasi-randomised controlled trial (intubation by AN or EP on alternating days) (Level 2b, Jadad score 1)	- Intubation at 1st attempt: EP 86.4% (394/456), AN 89.7% (174/194) - No significant difference, between ED and anaesthetists, in number of intubation attempts (p=0.225) - Failed intubation (cricothyroidotomy) rate: EP 0.4% (2), AN 0% (0). - No immediate major complications	- Large difference in numbers between EP (460) and AN (198) groups - EP intubated patients where there was insufficient time for AN to respond. Likely to introduce difference between groups. - No clear distinction between methods of intubation (nasal intubations excluded) - No attempt to identify missed cases - If study is considered an RCT, then large crossover and not analysed on intention to treat basis
Omert et al, 2001, USA	Trauma patients intubated in a US trauma centre ED over 23 months (11 month prospective, 12 months retrospective) (n=200)	Single-centre observational study, comparing retrospective data on AN intubation with prospective data on EP intubation (Level 2b)	- Intubation at 1st attempt: EP 73.7% (73/99), AN 77.2% (78/101) - Intubation within 3 attempts: ED residents 87.9%, AN 98% - Surgical airways: EP 0% (0/99), AN 2.0% (2/101) - Complications: EP 33.3% (33/99), AN 37.6% (38/101). "No significant	- Data for AN group collected retrospectively - No attempt to identify missed cases in prospective group - Majority (61/101) of patients in AN group intubated by ED residents - GCS and Revised Trauma Score significantly higher in AN group

Citation	Patient Group	Study Type and Quality	Key Results	Study Weaknesses
			difference" - No deaths occurred.	- No clear distinction between methods of intubation - No p-values given for performance data, so unable to assess significance of findings
Simpson et al, 2006, UK	All patients undergoing RSI in ED in a Glasgow teaching hospital over 5 years (n=255, mean=51RSI/year)	Single-centre prospective observational study (Level 2b)	- Proportion of RSI done by EP increased from 49% (25/51) to 77% (44/57) over the 5 years (significant for trauma, but not for non-trauma RSI) - Complication rates for EP fell from 32% (8/25) to 9% (4/44) (significant for non-trauma, but not for trauma RSI) - Overall complication rates for anaesthetists showed no obvious trends: 20% (15/75)	- Overall success and complication rates not presented. - Small numbers used to draw conclusions about trends in performance. - Yearly complication rate for anaesthetists showed marked variability. - p-values given separately for trauma and non-trauma patients
Stevenson et al, 2007, UK	All patients (incl paeds) intubated in ED of a Scottish DGH over 40 months (n=234 intubations of which RSI=199)	Single-centre prospective observational study comparing EP and AN (Level 2b)	- Grade I or II view at laryngoscopy: EP 86% (68/79), AN 95% (98/103), p=0.032 Intubation at 1st attempt: EP 82% (72/88), AN 91% (101/111), p=0.056 - Successful intubation within 3 attempts: EP 97% (85/88), AN 97% (108/111) - No surgical airways - Complications: EP 22% (20/88), AN 20% (22/111)	- Majority of paeds cases intubated by AN (15/18). - Higher number of SHO intubations in AN group. - No power calculation

Papers graded according to the Oxford CEBM levels of evidence table.[20] Jadad score calculated for paper by Levitan et al (quasi-randomised trial).

Appendix 3: Personal Work

Service Evaluation of RSI in the ED 2008-2010

Objectives

Addenbrooke's Hospital, Cambridge, is a large teaching hospital where EPs have been performing RSI since 2005. A service evaluation of RSI in the ED was performed to document success and complication rates, and to compare these findings with published data.

Method

A prospective evaluation of all ED RSIs over a period of twenty seven months between 08/09/2008 and 14/11/2010 was performed. The RSI audit tool from the College of Emergency Medicine was used to collect data. Forms were completed at the time of intubation for every RSI in the ED.

Results

Demographics

200 RSIs were reported during the study period: approximately 7.63 intubations per month. There was an even gender distribution (100 male, 97 female, 3 unrecorded). Mean age was 57.3 years (Median age 60.5 years, Range 13-95 years). 92 (46%) patients were admitted out of hours.

Indications

Apnoea/Respiratory Arrest	11 (5.5%)
Obstructed airway where basic care is ineffective	49 (24.5%)
Respiratory failure requiring invasive support	57 (28.5%)

High probability of obstruction/aspiration/respiratory failure	125 (62.5%)

More than one indication was recorded in 40 cases (20%)

Urgency

Immediate	38 (19%)
Urgent	135 (67.5%)
Not Apparent	24 (12%)
Not recorded	3 (1.5%)

43 patients deteriorated necessitating greater urgency of intubation

Speciality Intubating

ED	191 (95.5%)
Anaesthetic	3 (1.5%)
ITU	4 (2%)
Other	1 (0.5%)

Intubation Grade (view on first attempt)

Grade 1	142 (71%)
Grade 2	40 (20%)
Grade 3	7 (3.5%)
Grade 4	3 (1.5%)
Not recorded	7 (3.5%)

Number of Attempts

1	173 (86.5%)
2	23 (11.5%)
3	4 (2%)

Use of Glidescope (video laryngoscope) was recorded in 13 cases (6.5%)

Outcome

168 cases (84%) were reported as "successful, uneventful intubation", 32 cases (16%) as "successful, but eventful intubation". No unsuccessful intubations (abandoned, or requiring surgical airway) were reported.

Complications

	All cases	**Uneventful**	**Eventful**
Oesophageal intubation	3 (1.5%)	0 (0%)	3 (9.4%)
Endobronchial intubation	6 (3%)	5 (3.0%)	1 (3.1%)
Aspiration during procedure	0 (0%)	0 (0%)	0 (0%)
Vomiting/regurgitation	3 (1.5%)	0 (0%)	3 (9.4%)
Critical desaturation	9 (4.5%)	3 (1.8%)	6 (18.8%)
Cardiac arrest	2 (1%)	0 (0%)	2 (6.3%)
Systolic BP<90	11 (5.5%)	9 (5.4%)	2 (6.3%)
Dental Trauma	1 (0.5%)	1 (0.6%)	0 (0%)
Pneumothorax	3 (1.5%)	0 (0%)	3 (9.4%)
Other	6 (3%)	2 (1.2%)	4 (12.5%)

Complications were recorded in 35 cases (17.5%), but most of these were cases where intubation was described as “successful and uneventful”. It is unclear whether these complications were clinically significant, or whether they were anticipated based on the patients’ condition (eg patients who were hypotensive before induction).

Of the “successful, but eventful intubations”, only 15 cases had recorded complications. This corresponds to an overall complication rate of 7.5%. 15 cases were recorded as “eventful” because more than one intubation attempt was required. It is unclear why the remaining 2 cases were described as “eventful”

Time to Intubation

Times were recorded (arrival and intubation times) for 105 cases. Average time to intubation was 55 minutes (Median time to intubation: 30 minutes, Range 0-270 minutes)

Limitations

This study was designed to record all RSIs performed in the ED, but was dependent on the doctors performing RSI remembering to complete a form. There is likely to be a significant number of unrecorded RSI. No attempts were made to identify or quantify these missed cases.

Problems also arise from the design of the audit form. Many of the questions are ambiguous or open to interpretation. Guidance for completing the form is available on the College of Emergency website, but few of the doctors completing the audit forms will have read these in detail. As a result, there were suggestions of a large degree of inter-observer variability. There was insufficient space in some cases to record details of all staff present, or the total number of intubation

attempts.

Suggestions for Future Audit

This audit could be improved by identifying missed cases and completing forms retrospectively, and by additional departmental training on the use of the audit tool. A pre-intubation checklist has been introduced to the department since the beginning of this audit. It is hoped that this will improve outcomes, and will be worthy of further audit. Future audits could include collection of additional data, though this would involve redesigning the audit form, which may be impractical given that it this is a national audit tool. It would be useful to know the clinical setting in which patients were intubated (sepsis, trauma, poisoning, intubated for CT scan). Space could be made to record pre-intubation observations, and to record the time at which the decision to intubate was made, so that the time to intubation (from time of decision making) could be calculated.

Conclusion

The majority of the RSIs in our emergency department are performed by EPs. The success and complication rates are comparable to other published data.

Glossary of Abbreviations

- 95%CI: 95% Confidence Interval
- AN: Anaesthetist
- DGH: District General Hospital
- ED: Emergency department
- EP: Emergency physician
- NAP4: 4th National Audit Project of the Royal College of Anaesthetists
- NEAR: National Emergency Airway Registry
- OR: Odds ratio
- RSI: Rapid Sequence Intubation

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