

TITLE

PRE-HOSPITAL ANAESTHESIA BY A PHYSICIAN AND PARAMEDIC
CRITICAL CARE TEAM IN SOUTHWEST ENGLAND

RUNNING HEAD

PRE-HOSPITAL ANAESTHESIA BY A PHYSICIAN AND PARAMEDIC
CRITICAL CARE TEAM

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CONFLICTS OF INTEREST

Until October 2011 Jonathan Benger was the medical and governance lead for the service described.

ABSTRACT

Objectives

Pre-hospital anaesthesia using rapid sequence induction (RSI) is carried out internationally and in the UK despite equivocal evidence of clinical benefit. It is a core skill of the pre-hospital critical care service established by the Great Western Ambulance Service NHS Trust (GWAS) in 2008. This retrospective analysis of the service's first 150 pre-hospital RSIs describes intubation success rates and complications, thereby contributing to the ongoing debate regarding its role and safety.

Methods

Within the GWAS critical care team RSI is only done in the presence of a qualified physician and critical care paramedic (CCP). The role of the intubating practitioner is interchangeable between physician and CCP. Data were collected retrospectively from RSI audit forms and electronic patient monitor print-outs.

Results

GWAS physician and CCP teams undertook 150 prehospital RSIs between June 2008 and August 2011. The intubation success rate was 82%, 91% and 97% for first, second and third attempts respectively. Successful intubation on the first attempt was achieved in 58 (85%) and 64 (78%) of patients for physicians and CCPs respectively. RSI complications included hypoxaemia (10.2%), hypotension (9.7%) and bradycardia (1.3%).

Conclusion

Pre-hospital RSI can be done safely, with intubation success rates and complications comparable to RSI in the Emergency Department. The variation in intubation success rates between individual practitioners highlights the importance of ongoing performance monitoring, coupled with high standards of clinical governance and training.

KEYWORDS (MeSH)

Intubation, intratracheal

Prehospital emergency care

Paramedics

Anaesthesia

INTRODUCTION

Rapid sequence induction of anaesthesia and tracheal intubation (RSI) is the gold standard for definitive airway management in critically unwell patients in hospital, and is sometimes used by trained clinicians practicing pre-hospital care in the United Kingdom (UK). While initial early studies supported this practice,[1, 2] later publications raised concerns about the safety and benefits of pre-hospital RSI.[3-5] This controversy has continued, with publications showing benefits, harms or no impact for pre-hospital RSI in different patient groups.[6-8] A Cochrane review in 2009 concluded that current evidence was insufficient to make recommendations for or against pre-hospital tracheal intubation in traumatic brain injury.[9]

The question of which practitioner should do pre-hospital RSI has also become a focus of attention. RSI by paramedics has been subject to considerable scrutiny after a high incidence of complications and increased mortality were reported in the San Diego Rapid Sequence Intubation Trial.[5, 10] Although this trial has been criticised subsequently, on the grounds that participating paramedics received only eight hours formal training,[11] many emergency medical services (EMS) have severely restricted or banned RSI undertaken by paramedics.[12] A meta-analysis from 2010 found no statistically significant difference in success rates for RSI between ground paramedics and physicians using pooled data (94.8% and 93.9% respectively).[13]

In Europe, where more physicians practice pre-hospital medicine compared to the North American EMS system, studies have looked at intubation success rates amongst different clinical specialities and training grades. Not surprisingly, anaesthetists and more senior grades have significantly higher first pass intubation success rates during pre-hospital RSI compared to non-anaesthetists and junior grades.[14, 15] However, the clinical significance of this remains unclear, since the number of intubation attempts is not associated with pneumonitis or mortality.[16] Hypoxia and hyperventilation have been shown to have negative effects on outcome in traumatic brain injury patients undergoing pre-hospital RSI,[17] but are rarely reported.[18] One recent study of anaesthetists performing pre-hospital RSI in Scandinavia found that desaturation occurred in 10.9% of patients.[11] This is comparable to hypoxia rates during Emergency Department (ED) RSI,[19] and much lower than the 57% of patients who experienced hypoxaemia during paramedic intubation in the San Diego trial.[10]

After years of research, the harms and benefits of pre-hospital RSI remain unclear, and a recent European initiative included advanced airway management in the top-five research priorities for physician-provided pre-hospital care.[20]

In 2008 Great Western Ambulance Service NHS Trust (GWAS) established a pre-hospital critical care service in Southwest England. This service is provided by a team of senior physicians and specially trained “critical care paramedics” with advanced knowledge and skills. Pre-hospital RSI has been

a core skill since the service's inception, operating within a formal system of clinical governance. This retrospective analysis of the service's first 150 pre-hospital RSIs describes intubation success rates and complications, thereby contributing to the ongoing debate regarding the role and safety of this procedure.

METHODS

The Pre-Hospital Critical Care Service

The GWAS critical care team attends all pre-hospital emergencies including medical, trauma and paediatric cases. The service is delivered using a combination of helicopter transport (provided by the Great Western Air Ambulance) and fast response road vehicles, covering approximately 2.4 million people in a mixed urban and rural area of 3,000 square miles. For roughly 80% of shifts the critical care team consists of one physician (senior trainee or consultant in Emergency Medicine, Critical Care or Anaesthesia) and one 'Critical Care Paramedic' (CCP) with extended training and competencies. If no physician is available, two CCPs can form the team, however in this case RSI is not permitted unless a team physician can be called to attend the scene.

All physicians participating in the pre-hospital critical care team work primarily in local hospitals, and undertake hospital-based emergency anaesthesia in the operating theatre, intensive care unit or emergency department as a core component of their usual work. This ensures that their emergency anaesthetic

skills are maintained. To undertake pre-hospital work the physicians complete a training programme with specified competencies and mentored practice, coupled with theoretical and simulation training. Critical care paramedics are experienced paramedics who have completed a university-based theory and practical training course with mentoring and supervised experience, followed by the successful completion of a comprehensive qualifying assessment.

Prehospital RSI

Within the GWAS critical care team RSI is performed according to a detailed standard operating procedure (SOP). RSI is only performed in the presence of a qualified physician and CCP. If the physician has not yet achieved consultant status then discussion with the duty pre-hospital consultant is mandatory before RSI. Indications for RSI fall broadly into three categories: airway impairment, inadequate breathing or anticipated clinical course, which includes humane reasons. The SOP emphasises the importance of thorough preparation of location, patient, equipment and the team, utilises a pre-RSI checklist and follows recognised national guidelines.[21] Etomidate, Ketamine or Propofol are used for induction and Suxamethonium or Rocuronium for neuromuscular blockade. The role of the intubating practitioner is interchangeable between physician and CCP, and the decision as to which team member should assume this role is agreed prior to each RSI. If tracheal intubation fails initially, further attempts are only undertaken if intubating conditions can be improved, which may include a change of the intubating practitioner. No more than three attempts at intubation should be undertaken. The SOP mandates the use of quantitative end-tidal CO₂ for confirmation of

correct tracheal tube placement, and the use of an intubating bougie is standard. After each prehospital RSI the attending physician fills out an audit form, accompanied by an automated printout of the patient observations (pulse rate, non-invasive blood pressure, respiratory rate, oxygen saturation and end tidal carbon dioxide) obtained during the procedure. The clinical lead consultant reviews every RSI and provides feedback to the team. Complications or difficulties are discussed at monthly clinical governance meetings.

Data Collection

Data from the first 150 consecutive RSIs performed by the GWAS critical care team between June 2008 and August 2011 were collated retrospectively from audit forms filled out by the attending physician: these forms are usually completed and submitted to the service clinical lead on the day that the RSI is completed. Cases of intubation without drug assistance (e.g. in cardiac arrest) were not included in this data set. Data collection included patient demographics, practitioners present, consultant involvement, scene time and RSI characteristics. Recorded were number of intubation attempts and complications such as oesophageal intubation, pulmonary aspiration, hypoxaemia, hypotension and bradycardia. The last three parameters were crosschecked for each RSI with print-outs from the patient monitor and defined as an RSI-related complication if they occurred within 2 minutes of RSI. Hypoxaemia was defined as a fall in peripheral oxygen saturation (SpO_2) below 92% or a fall of more than 10% if SpO_2 before RSI was below 92%.

The 92% SpO₂ cut-off for hypoxaemia was chosen according to the GWAS SOP as the value below which re-oxygenation would be required, and is similar to the value of SpO₂ 90% used to define hypoxaemia in previous research.[11] Hypotension was defined as a fall in systolic blood pressure (SBP) below 90mmHg or a fall in SBP of greater than 10mmHg if SBP was below 90mmHg prior to RSI. Bradycardia was defined as a fall in heart rate below 60 beats per minute. Data were entered into an Excel™ spreadsheet and analysed using simple descriptive statistics.

The study was classified as a service evaluation since it analysed routinely collected anonymised patient data to understand and improve the service provided. Therefore, ethics committee approval was not required.

RESULTS

GWAS physician and CCP teams performed 150 prehospital RSIs between June 2008 and August 2011. During this time the service was provided by a total of 18 physicians (comprising nine consultants and nine senior trainees) and eight CCPs.

Patient Population

The mean age of patients undergoing prehospital RSI was 43 years with a range of two to 84 years and a median of 42 years. Included in this population were nine cases (6%) of paediatric RSIs, defined as age less than 16 years. See table 1 for further information on patient demographics.

Rapid Sequence Induction

The primary indications for RSI are listed in Table 2. Consultants were present in 83 cases. Of the 67 cases where a senior trainee was present, 64 discussed the case with the on-call consultant prior to performing RSI. Induction drugs used were Etomidate (42.7%), Propofol (29.3%) and Ketamine (23.3%). Suxamethonium was used as the primary neuromuscular blocker in 97.3%.

Intubation Success

The intubation success rate was 82%, 91% and 97% for first, second and third attempts respectively. Two cases (1.3%) of failed intubation were successfully ventilated with a supraglottic airway device, two others (1.3%) were successfully intubated on a fourth attempt. No surgical airways were required. Of the 150 RSIs, 68 had a physician as primary intubating practitioner, whilst in 82 cases intubation was first attempted by a CCP. Successful intubation on the first attempt was achieved in 58 (85%) and 64 (78%) of cases for physicians and CCPs respectively. The number of attempted intubations as well as success rates varied between individual physicians and paramedics as demonstrated in Figure 1 and Figure 2.

Complications

RSI complications included hypoxaemia in 10.2%, hypotension in 9.7% and bradycardia in 1.3%. Self reported complications were oesophageal intubation (8.7%: all immediately recognized), endobronchial intubation (2.7%), aspiration (2.0%) and dental damage (0.7%). Cardio-respiratory arrest

occurred in six cases, of which two were patients with VF arrest pre-RSI suffering a second VF arrest post RSI. In the other four cases cardio-respiratory arrest occurred more than ten minutes after RSI was completed, and was thought to be due to the severity of the patient's underlying illness (all massive blunt trauma).

DISCUSSION

In 2009 the Association of Anaesthetists of Great Britain and Ireland (AAGBI) published guidelines for pre-hospital anaesthesia.[21] These state that 'prehospital anaesthesia is a desirable intervention in relatively few patients but can result in unnecessary morbidity and mortality if performed poorly.' These guidelines emphasise that pre-hospital RSI should be performed only by adequately trained practitioners with standards of practice equal to those for in-hospital anaesthesia. The use of a clinical governance structure with standard operating procedures, airway management algorithms, audit and a clinical lead is recommended. The GWAS critical care team closely follows these guidelines.

Of particular note in this study are CCPs undertaking RSI under physician supervision. The first attempt success rate for CCPs in this study was close to but slightly lower than that for physicians (78% vs. 85%). We did not perform a statistical analysis of these data since the allocation to physician or CCP intubation was not randomized. Indeed, it is possible that physicians tended to identify and attempt the more difficult intubations, which would act as a

confounding factor, but our data does not provide information on this. While no direct comparison between CCP and physician intubation success rates can be made, the results show that both groups are capable of successfully and safely completing pre-hospital RSI. GWAS CCPs receive extended theoretical and practical airway management training and work closely with senior physicians on a daily basis, performing RSI under their direct supervision. This is in marked contrast to the San Diego trial of paramedic intubation,[17] and a high level of success is therefore expected. Concurrent and retrospective physician oversight has been shown to improve RSI-related cognitive skills in paramedics, but not intubation success rates.[24] Recent reports of paramedic first attempt intubation success rates for RSI range from 64% to 89%,[24, 25] but perhaps more important is the substantial variation in first attempt success rates for both physicians and paramedics shown in Figures 1 and 2. This suggests that the professional group of the intubating practitioner may be less important than their individual ability, and has highlighted individuals where additional targeted training has been useful in improving performance.

The frequency of pre-hospital RSI, at approximately one per week, is relatively low. This reflects patient case mix and the fact that the service is not yet established over a 24-hour period. It also suggests a high degree of case selection, to ensure that only the patients most likely to benefit undergo the procedure. This is further supported by immediate access to consultant advice for trainees, which was achieved in >95% of cases. Low case numbers have important implications for skill maintenance. Figures 1 and 2 highlight the

variation of exposure to pre-hospital RSI between different practitioners over the time period studied. As physician staffing of the critical care team is largely voluntary some physicians only work a few shifts per month, resulting in very low numbers of pre-hospital RSIs for these individuals. It is therefore mandatory for all physicians in the team to undertake in-hospital emergency RSI on a regular basis. The low numbers of intubation attempts for CCPs 6 to 8 in Figure 2 are attributable to a shorter period of time spent working in the pre-hospital critical care team. The use of a smaller CCP cohort means that experience is concentrated within a relatively small pool of individuals which aids skill retention (CCP1 to CCP5 in Figure 2). All CCPs receive additional ongoing training in local emergency and anaesthetic departments. This is further supported by an established system of clinical governance to consistently promote high standards of care.

Complications of hypoxaemia (10.2%) and hypotension (9.7%) during pre-hospital RSI found in our study are comparable to previously described complication rates.[11, 23] Nakstad et al found a hypoxaemia rate of 10.9% in 122 pre-hospital RSIs performed by anaesthetists in a Scandinavian EMS.[11] Similarly, Newton et al reviewed 244 pre-hospital RSIs in the London HEMS over a one year period and found hypoxaemia and hypotension to occur at a frequency of 18.3% and 13% respectively.[23] Our study is the third publication describing relatively low complication rates for pre-hospital RSI performed by dedicated pre-hospital teams which are regularly dispatched to major trauma or critical medical conditions. The complication rates of pre-hospital RSI in our and the two studies above are comparable to those

previously described for RSI in the ED within the UK.[19, 22] Bowles et al reported hypoxaemia and hypotension in 6% and 12% of 52 RSIs in the ED.[19] Reid et al showed an overall incidence of 16.9% for hypoxaemia, hypotension or bradycardia during 77 RSIs in the ED.[22] Of note, both studies examining RSI undertaken in the ED relied on self reporting of complications, whereas the pre-hospital RSI studies used records from patient monitors. Given the lack of consistent evidence of clinical benefit of pre-hospital RSI,[9] it is encouraging that we are able to achieve similar results to RSI undertaken in the ED, but at an earlier point in the patient pathway.

Limitations

This is a retrospective study of the success rates and complications of pre-hospital RSI. It cannot answer the question as to whether this procedure provides clinical benefit to patients. A number of the complications were self-reported, rather than being independently verified, and may have been underestimated. Due to the nature of the data collection process we were not able to analyse complication rates in groups defined by the intubating practitioner (CCP or physician). However, the prevention, recognition and management of complications during RSI are complex and multifactorial and as such may be a measure of team performance rather than individual performance.

Conclusion

Pre-hospital RSI can be performed by appropriately trained physicians and paramedics under medical supervision with good results. In the absence of

clear evidence of benefit or harm every effort should be made to perform the procedure as safely as possible. Careful patient selection, with a strong supporting system of clinical governance, is essential for success.

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LEGENDS FOR ILLUSTRATIONS

Figure 1: Number of successful and unsuccessful intubation attempts for individual physicians (P1 to P18)

Figure 2: Number of successful and unsuccessful intubation attempts for individual critical care paramedics (CCP1 to CCP8)