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ORIGINAL ARTICLE

Student paramedic rapid sequence intubation in Johannesburg, South Africa: A case series



L'intubation en séquence rapide pour les étudiants auxiliaires médicaux à Johannesburg, Afrique du Sud : série de cas

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ABSTRACT

Introduction: Pre-hospital rapid sequence intubation was introduced within paramedic scope of practice in South Africa seven years ago. Since then, little data has been published on this high-risk intervention as practiced operationally or by students learning rapid sequence intubation in the pre-hospital environment. The objective of this study was to describe a series of pre-hospital rapid sequence intubation cases, including those that South African University paramedic students had participated in.

Methods: A University clinical learning database was searched for all endotracheal intubation cases involving the use of neuromuscular blockers between 1 January 2011 and 31 December 2015. Data from selected cases were extracted and analysed descriptively.

Results: Data indicated that most patients were young adult trauma victims with a dominant injury mechanism of vehicle-related accidents. The majority of cases utilised ketamine and suxamethonium, with a low rate of additional paralytic medication administration. 63% and 72% of patients received post-intubation sedation and analgesia, respectively. The overall intubation success rate from complete records was 99.6%, with a first pass success rate of 87.9%. Students were successful in 92.4% of attempts with a first-pass success rate of 85.2%. Five percent of patients experienced cardiac arrest between rapid sequence intubation and hospital arrival.

Discussion: Students demonstrated a good intubation success and first pass-success rate. However, newly qualified paramedics require strict protocols, clinical governance, and support to gain experience and perform pre-hospital rapid sequence intubation at an acceptable level in operational practice. More research is needed to understand the low rate of post-intubation paralysis, along with non-uniform administration of post-intubation sedation and analgesia, and the 5% prevalence of cardiac arrest.

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ABSTRACT

Introduction: L'intubation en séquence rapide (ISR) pré-hospitalière a été introduite dans le champ d'activité des auxiliaires médicaux en Afrique du Sud il y a sept ans. Depuis, peu de données ont été publiées sur cette intervention à haut risque telle qu'elle est pratiquée de manière opérationnelle ou par des étudiants apprenant l'ISR dans l'environnement pré-hospitalier. L'objectif de cette étude était de décrire une série de cas d'intubation en séquence rapide pré-hospitalière, y compris des cas auxquels des étudiants ambulanciers des universités sud-africaines avaient participé.

Méthodes: Une base de données universitaire sur l'apprentissage clinique a été consultée afin d'identifier tous les cas d'intubation endotrachéale impliquant le recours à des inhibiteurs neuromusculaires entre le 1er janvier 2011 et le 31 décembre 2015. Les données de cas sélectionnés ont été extraites et analysées de manière descriptive.

Résultats: Les données indiquaient que la plupart des patients étaient de jeunes adultes victimes de traumatismes, le mécanisme de blessure dominant étant les accidents de la route. La majorité des cas utilisaient la kétamine et le suxaméthonium, et un faible taux d'administration de substances paralysantes.

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63% et 72% des patients ont respectivement reçu une sédation post-intubation et des analgésiques. Le taux de réussite global de l'intubation à partir des archives complètes s'élevait à 99,6%, avec un taux de réussite au premier passage de 87,9%. Les étudiants réussissaient dans 92,4% de leurs tentatives, avec un taux de réussite au premier passage de 85,2%. Cinq pour cent des patients ont été victimes d'un arrêt cardiaque entre l'intubation à séquence rapide et leur arrivée à l'hôpital.

Discussion: Les étudiants ont obtenu un bon taux de réussite à l'intubation et un bon taux de réussite au premier passage. Cependant, les auxiliaires médicaux jeunes diplômés ont besoin de protocoles strictes, d'une gestion clinique et de soutien pour acquérir de l'expérience et réaliser des intubations à séquence rapide pré-hospitalières à un niveau acceptable dans la pratique opérationnelle. Des études supplémentaires sont nécessaires pour comprendre le faible taux de paralysie post-intubation, parallèlement à l'administration non uniforme de la sédation et des analgésiques post-intubation, ainsi que la prévalence d'arrêt cardiaque de 5%.

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African relevance

- This study describes pre-hospital rapid sequence intubation cases in an urban, middle income setting.
- Pre-hospital rapid sequence intubation could improve airway management in populations with a high prevalence of trauma.
- This study highlights the role of student experience in pre-hospital rapid sequence intubation success rates.

Introduction

Airway management forms a critically important part of the skill set of paramedics. This includes both basic airway interventions and, at advanced life support level, more invasive forms of airway management. In many systems, endotracheal intubation (ETI) is practiced by advanced life support paramedics, frequently in the form of drug-assisted ETI with deep sedation using a benzodiazepine, other hypnotic agent, or rapid sequence intubation (RSI) [1].

In South Africa, RSI was approved for pre-hospital practice by the Emergency Medical Services (EMS) regulator, the Health Professions Council of South Africa, in November 2009. Prior to this, several different levels of advanced life support-qualified paramedics could only perform ETI facilitated by deep sedation with midazolam. The Health Professions Council of South Africa approved pre-hospital RSI only for University degree-qualified paramedics known as Emergency Care Practitioners (ECPs) and subject to a number of requirements, the most important of which was practice of RSI within a system of on-going case review and clinical governance.

Since the addition of RSI to ECP scope of practice seven years ago, little data has emerged about the practice of RSI by ECPs in South Africa [2]. Importantly, no data is currently available describing the practice of RSI by ECP students. This is true of RSI and ETI performed by paramedic students globally, with very little having been published in this area [3,4]. Although qualified and experienced paramedics are responsible for the delivery of emergency care in EMS systems, students represent the next generation of care provision and understanding of their clinical experiences is important in optimising the clinical learning environment.

This study aimed to describe a series of pre-hospital RSI cases involving student ECP participation over a five-year period.

Methods

This study was a retrospective record review of RSI cases performed by students in the Department of Emergency Medical Care at the University of Johannesburg between 1 January 2011 and 31 December 2015.

Data described in this study were collected by students during clinical learning. All students are required to complete a required number of pre-hospital clinical learning hours. During this time, students are also required to complete a specified number of clinical procedures. Students complete clinical learning in a number of different private and local authority EMS systems in and around Johannesburg, including the Department, which runs a primary response vehicle three days a week. Each case is documented as part of a clinical patient care record with the RSI reporting section of the record having been adapted from the National Association of EMS Physicians Recommended Guidelines for Uniform Reporting of Data from Out-of-hospital Airway Management [5]. All patient care records are entered by students into a custom-developed online patient care record database before the paper records are submitted to the Department.

Students first perform ETI in their second year of study during clinical learning in the operating room under the supervision of an anaesthesiologist. This is preceded by theoretical instruction, ETI practice, and documentation of procedural competence in a clinical simulation facility. Second year students are required to complete a minimum of 15 operating room ETIs. After having successfully completed theoretical and procedural assessment on pre-hospital RSI, third year students may participate in RSI cases during clinical learning under supervision. These students are required to perform a minimum of eight pre-hospital ETIs, three of which must be RSIs. Fourth year students are required to complete a further minimum of eight ETIs, all of which must be RSIs. Over the course of the four-year programme, a student would therefore typically be required to complete 35 ETIs, 11 of them RSIs.

A standardised approach to RSI is learned by students early in their third year of study. The emergency airway management text by Kovacs and Law [6] is prescribed for all students from second year, and students learn the RSI algorithm in this text. Drugs available for induction, paralysis, and post-intubation sedation and analgesia are those approved for pre-hospital RSI by the Health Professions Council of South Africa.

All records where ETI was performed pre-hospital that documented the use of a neuromuscular blocker (suxamethonium or rocuronium) between 1 January 2011 and 31 December 2015 were included. RSI cases identified using the criteria above were excluded from full analysis if any part of the RSI-related patient care record required for this analysis was incomplete. This included data on clinical parameters (systolic blood pressure, SpO₂, and heart rate) and ETCO₂ data. Only records with unambiguous ETCO₂ data (clearly indicating elevated or unelevated ETCO₂ levels or a peak ETCO₂ value) were included. Records indicating that ETCO₂ was used for verification of ETI success, without further details, were excluded. Duplicated records were excluded from analysis.

An intubation attempt is defined as a student placing a laryngoscope blade beyond a patient's lips with the intention of visualising the glottis. Successful intubation is defined as self-reported tracheal positioning of the endotracheal tube confirmed by either quantitative or waveform capnography. First pass success is defined as successful intubation within a single attempt. Hypoxemia is defined as a SpO₂ less than 90% and hypotension is defined as a systolic blood pressure less than 90 mmHg. Paediatric patients are defined as those less than 18 years of age.

Data were extracted from the patient care record database (Microsoft SQL Server 2008, Microsoft Corporation, Redmond, WA). All data extraction was performed by the author, who has a postgraduate qualification in Computer Science, using Structured Query Language statements. Extracted data were exported to an electronic spreadsheet application for further descriptive analysis.

This study was approved by the Faculty of Health Sciences Research Ethics Committee at the University of Johannesburg.

Results

A total 26,682 patient care records were identified as having been completed by students during the five-year data collection period. Of these, 948 (4%) involved airway interventions, and 367 patient care records (1% of total patient care records, 39% of airway interventions) met the RSI inclusion criteria given above. Excluded and included cases are shown in Fig. 1. Data on overall intubation success were available for both complete and incomplete records

and are reported for both groups, however, no further analysis was conducted on incomplete records, as they did not contain data on all of the study variables.

Pre-hospital patients selected by students for RSI during clinical learning were predominantly young (median age 34) adult males (n = 163, 73%), though a small proportion of children (n = 16, 7%) were also included in the sample (Table 1). Trauma was far more prevalent than non-trauma, with trauma-related RSIs making up three quarters of the sample (Table 1).

Reasons selected by students for performing RSI were mostly related to abnormal primary survey data (n = 135, 61%) and less commonly (n = 88, 39%) related to a predicted clinical course requiring invasive airway management (Table 2).

Adjuncts were used in order to improve laryngoscopic view or facilitate endotracheal tube placement in 140 cases (63%) and during 194 individual intubation attempts. Of these, external laryngeal manipulation (n = 56, 40%) and cricoid pressure (n = 41, 29%) were most frequently utilised (Table 2).

Success for all RSI cases was 99.7% (350/351). For RSI cases with complete data, the overall (student and supervising practitioner) success rate was 99.6% (222/223) and the first pass success rate was 87.9% (196/223). For students only, without supervising practitioner intervention, the success rate was 92.4% (206/223) and the first pass success rate was 85.2% (190/223). All paediatric RSI attempts were successful. Details of intubation attempts are given in Table 2.

In 11 cases recorded as successful RSIs (but counted in the student unsuccessful group), students only entered electronic data

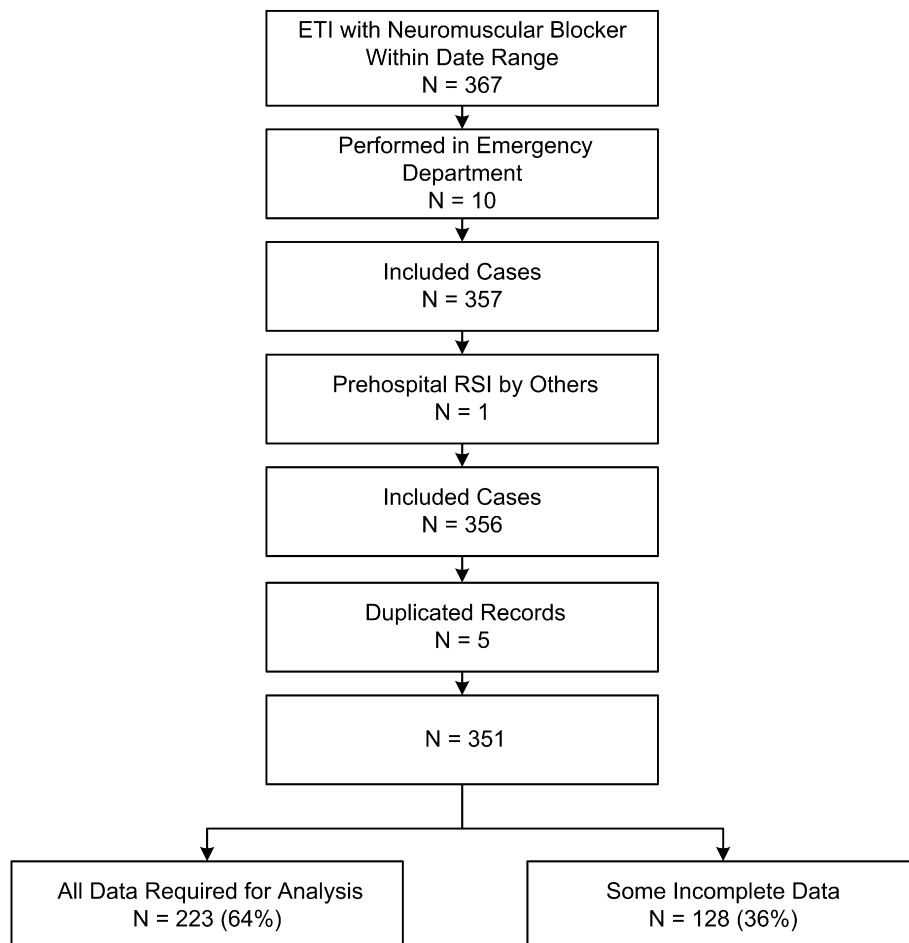


Fig. 1. Rapid sequence intubation cases: inclusion and exclusion data flow diagram. ETI, endotracheal intubation; RSI, rapid sequence intubation.

on their own attempts and not subsequent attempts by others on the scene. The original patient care records were located and other attempt data were obtained from these records: in nine cases ETI was successful within one additional attempt and in two cases two additional attempts were required. These attempt data were added to the total in Table 2.

Ketamine was the more commonly used induction agent overall ($n = 142$, 64%), together with suxamethonium, which was used as a primary neuromuscular blocker in almost all cases ($n = 213$, 96%). In a handful of cases either midazolam was used as an induction agent ($n = 7$, 3%), or no induction agent was recorded ($n = 9$, 4%). Secondary neuromuscular blockade (i.e. after a first dose of neuromuscular blocker and once tube position is confirmed) was rarely used ($n = 48$, 22%), while post-intubation midazolam and morphine were used in 63% ($n = 140$) and 72% ($n = 160$) of cases, respectively. A median of 600 ml of intravenous fluid was recorded across all cases (Table 3).

Clinical parameters recorded at baseline and before handover to hospital are shown in Table 4. Median baseline heart rate, systolic blood pressure and SpO₂ were not remarkably abnormal. Systolic blood pressure and SpO₂ showed small improvements by the end of the pre-hospital phase of care, while heart rate remained unchanged. At baseline, 36 patients (16%) were hypotensive and 76 (34%) were hypoxaemic. At handover, this had changed to 26 (12%) still hypotensive and 27 (12%) still hypoxaemic. Two of these cases (1%) at handover were both hypotensive and hypoxaemic.

Complications reported for student RSIs included three cases of tube dislodgement that were subsequently detected and corrected. Ten RSI cases (5%) were associated with cardiac arrest; seven related to trauma and three non-trauma. In all of these cases, cardiac arrest followed RSI either at the scene or during transfer to the emergency centre. In eight out of the ten cardiac arrest cases, both the time of drug administration and the time of first rhythm analysis after diagnosis of cardiac arrest were documented. In one of these eight cases, cardiac arrest occurred immediately after drug administration. In the remaining seven cases the time intervals between drug administration and cardiac arrest were 11 min

Table 2

Reasons for rapid sequence intubation, intubation attempts, adjuncts and success.

Reasons for RSI	n (%)
Abnormal primary survey	135 (61)
Predicted course	88 (39)
Total	223 (100)
Adjuncts used ($n = 140$ cases)	n (%)
Extra-laryngeal manipulation	56 (40)
Cricoid pressure	41 (29)
Head lift ^a	40 (29)
Bougie	20 (14)
Blade change	11 (8)
Bimanual laryngoscopy ^b	10 (7)
Intubation attempts	n (%)
1 Attempt	196 (88)
2 Attempts	21 (9)
3 Attempts	6 (3)
Total	223 (100)

RSI, rapid sequence intubation.

^a Head lift with the intubator's right hand, together with varying degrees of atlanto-occipital extension.

^b Bimanual laryngoscopy involves the use of the intubator's left and right hands in applying longitudinal traction on the laryngoscope handle.

($n = 2$), 12 min ($n = 3$), 14 min ($n = 1$), and 15 min ($n = 1$). Return of spontaneous circulation occurred after resuscitation in nine cases, though all of these patients were declared dead in the emergency centre after arrival.

The single case of unsuccessful RSI involved a 53-year-old male patient who had sustained 70% partial- and full-thickness burns in an attempted suicide, including severe inhalation burns. The patient received ketamine and suxamethonium via an intraosseous line followed by three unsuccessful intubation attempts (one attempt by a student). This was followed by a surgical cricothyroidotomy shortly after which the patient went into cardiac arrest. Resuscitation was not successful and the patient was declared dead at the scene.

Table 1

Patient demographics and injury mechanisms.

Age group	n (%)
Adult	207 (93)
Child	16 (7)
Total	223 (100)
Age range (years) [*]	Years
Adult ($n = 163$)	18–90
Child ($n = 15$)	4–17
Age (years) [*]	Median (IQR)
Adult ($n = 163$)	34 (27–45)
Child ($n = 15$)	8 (7–13)
Gender	n (%)
Male	163 (73%)
Female	60 (27%)
Total	223 (100)
Mechanism of injury ($n = 168$)	n (%)
Motor vehicle accident	65 (39)
Pedestrian-vehicle accident	50 (30)
Burns	14 (8)
Other vehicle accident	12 (8)
Fall	7 (4)
Assault	6 (4)
Shooting	5 (3)
Stabbing	3 (2)
Blast	1 (1)
Crush injury	1 (1)

IQR, interquartile range.

^{*} Confirmable age data were only known for 163/207 of adults (79%) and 15/16 (94%) of children.

Discussion

This study describes the practice of pre-hospital RSI by University paramedic students during clinical learning, and provides some additional data on pre-hospital RSI in South Africa. Most patients encountered in this sample were typical of a group comprised mostly of trauma-related emergencies: young males. The leading causes of injury, vehicle-related accidents, is similar in proportion to that described in another South African study on pre-hospital RSI [2].

The success rate of RSI reported in this series was high, at 99.6%. This, together with the overall first pass success rate of 87.9%, is among the higher end of such rates for non-physician RSI reported in the literature [2,7–10]. Only three studies involving paramedic RSI could be found with a higher success rate [2,9,10]. Only one of these reported a first-pass success rate, which was 81% [9]. Reasons for the 11.7% difference between first pass and overall success are not clear from the available data. However, experience is likely to play a role, as it is thought to in other practitioner groups [11].

Post-intubation paralysis was administered to 27% of patients in this series, when combining the numbers of patients receiving either primary (10, 5%) or secondary (42, 19%) rocuronium and vecuronium (6, 3%) (Table 3). The RSI protocol currently in use does not make routine administration of a long-acting neuromuscular blocker post-intubation to all patients mandatory, only when required to facilitate effective ventilation. Post-intubation analgesia, in the form of morphine, was administered to 72% of patients

Table 3
Rapid sequence intubation drugs, post-intubation drugs and fluids.

Induction drugs used	n (%)
Etomidate	65 (29)
Ketamine	142 (64)
Midazolam	7 (3)
None	9 (4)
Total	223 (100)
Neuromuscular blockers used	n (%)
Suxamethonium	213 (96)
Rocuronium (Primary)	10 (5)
Total	223 (100)
Rocuronium (Secondary)	42 (19)
Vecuronium	6 (3)
Total	48 (22)
Post-intubation drugs used ^a	
Midazolam	140 (63)
Morphine	160 (72)
Fluid administered (mL)	Median (IQR)
	600 (388–1000)

IQR, interquartile range.

^a Post-intubation drugs are still relevant to the student unsuccessful group, as a clinical supervisor was successful in intubating all but one of these cases.

Table 4
Baseline and final clinical parameters.

Variables	Median (IQR)
Baseline	
Heart rate (beats/minute)	102 (85–120)
Systolic blood pressure (mmHg)	112 (96–137)
SpO ₂ (%)	94 (87–98)
Final measurement	
Heart rate (beats/minute)	102 (86–119)
Systolic blood pressure (mmHg)	120 (100–140)
SpO ₂ (%)	98 (94–100)
Baseline	n (%)
Systolic blood pressure <90 (mmHg)	36 (16)
SpO ₂ <90 (%)	76 (34)
Final measurement	
Systolic blood pressure <90 (mmHg)	26 (12)
SpO ₂ <90 (%)	27 (12)

IQR, interquartile range.

and sedation with midazolam to 63%. A number of factors may have influenced clinical parameters associated with decisions to administer analgo-sedation including the duration of transport, prevalence of hypotension, and the administration of ketamine in two thirds of RSIs, which may have provided some analgesia in the shorter term [12,13]. The data presented here signal a need for more detailed analysis of the circumstances surrounding post-intubation care and whether changes are required to protocols used during this phase.

Data on blood pressure, SpO₂ and heart rate suggested some improvement in these parameters between baseline and the last measurements, however a number of patients remained hypotensive and hypoxemic on arrival at the emergency centre with a 4% reduction in hypotension and a 22% reduction in hypoxemia. Other studies on pre-hospital RSI documenting the prevalence of hypoxemia and hypotension have produced a range of results, some lower [9,14,16], and some higher [15,17–20] than the current data. Direct comparison with these studies is difficult because the time frames often vary, with many studies assessing hypotensive or hypoxemic episodes before or immediately after RSI, which differs from the data presented here. One other South African study with a smaller sample reported lower rates of both hypoxemia and hypotension on arrival at the emergency centre [2].

Many factors other than airway management involving RSI and subsequent ventilation may influence SpO₂, blood pressure, and heart rate in a population of patients such as that described in this study. These include injury severity and other forms of treatment administered concomitantly, such as intravenous fluid. The prevalence of hypoxemia and hypotension after RSI in the current study deserves future prospective interrogation in order to establish and corroborate these findings and understand their cause and interactions.

Cardiac arrest prevalence in this series was higher than that reported in several retrospective pre-hospital RSI studies [15,21,22], but similar to that reported in two others, both prospective [23,24]. The time frames between drug administration and cardiac arrest suggest that RSI may be causally associated with eight of the cardiac arrests, with the remaining two not having confirmable time frames.

Two of the 10 cardiac arrest cases occurred during RSIs performed by students during clinical learning time on the University's primary response vehicle and both were reviewed by an anaesthesiologist before discussion at a Departmental morbidity and mortality meeting. Both cases involved severe polytrauma from motor vehicle accidents, one with entrapment and one after a rollover. The other eight cases occurred in other EMS systems and were subject to review and governance within those systems.

In most of the RSI cases in this series (92%), students were successful in placing an endotracheal tube. Compared to other data on ETI success rates of paramedic students, the data reported here suggest greater ETI proficiency. Wang et al. [3] found a student ETI success rate of 75% in the pre-hospital environment and Warner et al. [4] documented 88% (and 68% first-pass success) in paramedic students with pre-hospital RSI cases. In both of these studies, learning curves were presented showing incremental increases in ETI success rate with increased student experience. Taking this relationship into consideration, and the number of ETIs typically encountered by students in the current program, the data presented here corroborate the importance of ETI practice by students during clinical learning in an authentic environment.

In some cases, students were allowed to attempt ETI after a first failed attempt and were then successful. In other cases it is obvious that clinical supervisors had a lower threshold for intervention, giving students only a single attempt before taking over ETI (Table 2). In practice, this decision is left up to the supervisor and no data are available to indicate what may have motivated those decisions. Although it is extremely valuable for students to practice actions that should be undertaken if a first ETI attempt does not succeed, it is questionable whether this should be done in a critically ill or injured patient. Practice in this particular area, as in the area of a failed airway, may be best suited to high-fidelity simulation rather than clinical practice. A standard operating procedure to guide clinical supervisors in these decisions would be beneficial.

The primary aim of RSI is to successfully and safely place an endotracheal tube. However, there are a multitude of factors before, during, and after RSI, all of which can have a significant impact on patient wellbeing. These factors are important to review as part of a governance system for patient safety purposes. From a student's perspective, these can also play an important role in learning and improving practice. Students are required to routinely debrief all calls with clinical supervisors shortly after completion. It is likely that students would benefit from additional, more detailed feedback and discussion of RSI cases, particularly those not considered to be routine.

Currently, the RSI case review and clinical governance processes are not adequately integrated into training. This is mainly because of the difficulty in doing so when students are involved in performing RSI across a number of different services, each with its own

processes. Even within the University, case review and related morbidity and mortality meetings have not been seen as a learning activity involving students, but rather a quality improvement activity. It is likely that students would benefit from being included in these processes and would learn significantly from them both about RSI and about the importance of clinical governance, and ways should be explored to do this.

Although the student RSI success rates and first-pass success rates appear comparable to what would be expected, given their ETI exposure [3,4], these are not yet at the level required or expected in operational practice. Given a solid experiential foundation, a strict protocol, and rigorous clinical governance, students at this level would be expected to improve with additional experience. It is important for EMS systems with newly qualified ECPs practicing to provide a supportive and safe environment that is capable of providing this growth without placing patients at greater risk.

The transition from newly qualified to more experienced ECP is thus a critically important one. Little is known about this period, nor how and how rapidly RSI proficiency changes with operational exposure. In addition to a system of governance with respect to pre-hospital RSI, other structured support systems such as an internship period for newly qualified ECPs may play a role in facilitating safe practice and ongoing feedback that optimises the learning curve for this important but inherently high-risk intervention.

This study has several limitations. RSI success, and all other variables described here, were self-reported. Students were required to have these cases signed off by a clinical supervisor and in this way it could be argued that there was some degree of verification of facts. However the process of data collection was still, by its nature, that of self-reporting. In addition, data extraction was performed by a single person (the author), meaning that there was no other opinion on inclusion decisions or quality of data abstraction. These two facts may raise questions of bias in reporting on the part of students or clinical supervisors, or in data extraction, particularly regarding negative events or complications of RSI. More than a third of the RSI cases originally extracted from the clinical learning database were excluded from full analysis. Cases were excluded from this study if they did not have all of the variables included in analysis. In particular, a low threshold for exclusion of cases based on ambiguous ETCO₂ data was followed. Despite this, the availability of 64% of the originally selected cases increases the risk of bias in the results presented above. The success rates presented in this study are influenced in some cases by the fact that clinical supervisors intervened after one or more unsuccessful intubation attempt. Had students been allowed to attempt intubation again in cases where clinical supervisors intervened, success rates may have been different. The RSI cases reported on here involved students from a single University and the results reported here may not be generalisable to all other settings and students.

In this retrospective series of pre-hospital RSI cases, students demonstrated a good ETI success and first pass success rate. Other clinical data from these RSI cases indicated that hypotension was slightly reduced between pre-RSI measurement and emergency centre handover, while hypoxaemia was more than halved. More investigation is needed to better understand the non-uniform administration of post-intubation sedation and analgesia, and the 5% prevalence of cardiac arrest.

Despite comparatively good student ETI success, this was not observed to be at a level suitable for operational practice. Both students, and perhaps more importantly newly-qualified ECPs, require a strict protocol, rigorous clinical governance and a supportive environment in order to safely gain the experience

required to improve their practice of pre-hospital RSI. More research is needed to fully understand the challenges faced by students attempting to gain experience in this high-risk procedure, and how to balance the acquisition of experience with patient safety.

Conflicts of interest

The author reports no conflicts of interest.

Dissemination of results

An abstract based on this care series was presented at the 2016 Emergency Care Society of South Africa Conference.

Author contribution

CS provided all contribution to the conception and design of the work; the acquisition, analysis, and interpretation of data for the work; drafting the work and revising it critically for important intellectual content; approval of the final version to be published; and agree to be accountable for all aspects of the work.

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