Original Article

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Rapid Sequence Intubation: Current Practices in the Pediatric Emergency Department of a Tertiary Care Pediatric Teaching Hospital

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Abstract

Advanced airway management in the pediatric emergency department is the first line of management in a critically ill child. Clinical condition of the patient, skills of ER (emergency room) personnel, influence outcome of this procedure. This prospective study describes the success rates, immediate complications and the environmental, patient and physician factors that influence complication rates of rapid sequence intubation (RSI) in the Pediatric Emergency Department of a tertiary care Pediatric Hospital, over a period of 1year, Of the 64 intubations, 39% were in infants, 43.7% had pre-existing illness, 28% required bag and mask ventilation for preoxygenation. Most common complication was right bronchus intubation. Majority were intubated at the first attempt. Success at first attempt, and complications correlated with the experience of doctors.

Conclusion: ER doctors are highly competent in performing RSI with acceptable complication rates. The need for using bag valve mask during RSI is not uncommon. Every paediatrician should be trained in RSI for securing the airway of a critically ill child.

Keywords: Rapid sequence intubation; Intubation; Bag valve mask.

Introduction

Airway compromise is the most common cause of death and severe morbidity in acutely ill and injured children. Pediatric emergency endotracheal intubation (ETI) is a lifesaving technique which all emergency physicians should be familiar with. Poor airway visualization, distorted anatomy, limited pre-treatment, gastric distension, or cardiovascular instability may make ETI difficult and hazardous. Adverse effects of the intubation procedure itself include increased intracranial pressure (ICP), airway trauma, pain, bradycardia, tachycardia, gastric regurgitation, aspiration, hypoxemia, arrhythmias, and death. These adverse effects can be circumvented with the use of the rapid sequence intubation (RSI) technique. RSI is the administration of a potent intravenous induction agent followed immediately by a rapidly acting neuromuscular blocking agent to induce unconsciousness and motor paralysis for tracheal intubation.[1,2] By providing unparalleled access to the airway, and superior protection against adverse effects such as aspiration, RSI is the fastest and safest way of securing a definitive airway.[1] Advanced airway management in the pediatric emergency department is the first line of management in a critically ill child. A number of factors such as clinical condition of the patient, skills of the ER personnel and the ER set up influence the execution and outcome of this procedure

Aims and Objectives

1. To describe the current practice of RSI in the Pediatric Emergency department of a tertiary care Pediatric Hospital.
2. To determine the success rates, to quantify the immediate complications of

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RSI and to assess the contribution made by environmental, patient and physician factors to the overall complication rates

Materials and Methods

Study design

Prospective Observational Study

Inclusion criteria

Patients aged 1 month to 18 years, undergoing Rapid sequence intubation in the ED of Kanchi Kamakoti CHILDS Trust Hospital, Chennai between August 2009 and August 2010.

Exclusion criteria

Age less than 31 days.

Intubated patients received in emergency room.

Methodology

All doctors who intubated patients in the ED were adequately trained to perform the procedure. Decision regarding necessity for intubation was taken by the doctor on duty in ED. For each intubation, the intubation team consisted of 3 doctors (one for each of the following - airway/cricoid pressure/monitoring) and 2 nurses (one for arranging instruments and administering drugs and the other for suctioning).

All equipment and medications for advanced airway management are available at all times in our emergency room. A standardized form was completed by the intubating doctor before and immediately after confirmation of intubation. Vitals such as heart rate, perfusion, blood pressure, respiratory rate and SpO2 were recorded just prior to administration of premedication and immediately (within 15 mins) post endotracheal intubation. Medications used, complications, attempts at intubation, pre-existing illness, designation of intubating person etc. were documented.

Cervical spine precautions were taken wherever indicated. An attempt at intubation was defined as placement of a laryngoscope into the patient's airway followed by the insertion of an endotracheal tube through the glottic opening. Failed attempt was defined as inability to pass the endotracheal tube through the vocal cords. Difficult intubation for this study was defined as either an intubation requiring more than two attempts or requiring help by intensivist or anaesthesiologists or the usage of alternative intubation techniques. The methods for confirmation of endotracheal intubation were direct visualization of an endotracheal tube passing through the vocal cords, five-point auscultation and X-ray chest post-intubation. Carbon dioxide detecting devices were not available during the study period.

Table 1: Conditions precipitating the need for RSI (diagnosis at admission)

Variables	No. of patients	%
A) Medical Causes		
1. Status epilepticus	12	18.75%
2. Acute CNS infection/ Encephalopathy	7	10.93%
3. Pneumonia/Bronchiolitis	12	18.75%
4. Status Asthmaticus	3	4.68%
5. Septic shock	6	9.37%
6. Dengue shock	10	15.62%
7. Cardiac failure	2	3.12%
8. Miscellaneous	6	9.37%
B) Trauma	3	4.68%
C) Poisoning	2	3.12%
D) Foreign body aspiration	1	1.56%

Results

Sixty four patients aged between 37 days to 15 years who had complete documentation of RSI as per our study protocol were our study group.

Baseline characteristics

More than 50 % (n=35) of intubations were performed after 4 pm. Male to female ratio was 1.2:1. Thirty nine percent (n=25) of RSI were performed in the patients in the age 1 month to 1 year. Twenty eight patients (43.7%) had pre-existing illness like cerebral palsy, asthma, congenital heart disease (VSD) congenital hydrocephalus and others. Most common indication for RSI was respiratory failure, low Glasgow Coma Scale (GCS), shock and upper airway obstruction in one patient (Table 1). Majority of the intubations were done by senior post-graduates (Table 2).

Outcomes

Eighty four percent (n=54) were successfully intubated in the first attempt, 12.5 % (n=8) and 3.1% (n=2) in the second and third attempts, respectively. There were no failed attempts of intubation. No patient required emergency cricothyrodotomy or nasopharyngeal intubation. Success rate for first attempt at intubation by consultant, PICU fellow and registrar was 100%, and a success rate of 81%, 93%, 73% and 70% for a third year post-graduate, second year post-graduate, first year post-graduate and senior house officer respectively. Complication rate and intubation mishaps were more common during intubations by a first year postgraduate and a senior house officer (Table 2). Twenty eight percent (n=18) required bag and mask ventilation to pre-oxygenate. Sellicks manouver was always used. The pre-medication, sedative, induction agent and the neuromuscular blocking agents most commonly used for RSI in this study were atropine (52/64), midazolam (49/64), fentanyl (51/64) and vecuronium (59/64). The mean time from the decision making to successful tracheal intubation was 20 minutes. Atropine/ midazolam/ fentanyl /vecuronium were the most common combination used. Facilitated RSI (RSI without the use of neuromuscular blocking agent) was used in 6.2 % (n=4) patients. Bradycardia was observed when atropine was not used as a premedication in 1.6% of patients. Hypoxia was observed in three with difficult intubation (Table 3). It was not determined if a particular medication contributed to a particular complication as a combi-

Table 3: Complications during RSI

Events	Number (%)
Bradycardia	1 (1.6)
Cardiac arrest	2 (3.1)
Hypotension	2 (3.1)
Hypoxia(Desaturation)	4 (6.3)
Pneumothorax	0
Dental and Oral Trauma	2 (3.1)
Vomiting& aspiration	0
Right Bronchus	5 (7.8)
Oesophageal intubation	2 (3.1)
None	52 (81.3)

Table 2: Complication rate and difficulties in RSI according to level of experience of intubating doctor

Intubating Doctor	Number of intubations (n=64)	Number of occasions requiring more than one attempt	Success rate for intubation in first attempt	Complications	Intubation mishaps
Registrar	5 (7.8%)	0	100%	0	0
3rd year PG	21 (32.8%)	4	81%	0	3
2nd year PG	13 (20.3%)	0	93%	2	1
1st year PG	11 (17.2%)	3	73%	3	2
SHO	10 (15.6%)	3	70%	2	1
PICU Fellow	3 (4.7%)	0	100%	1	0
Consultant	1(1.6%)	0	100%	0	0

SHO, Senior health officer; PG, Post-graduate

nation of medications were used. Nasogastric tube was inserted in majority of the patients prior to intubation. None of the patients developed vomiting and aspiration during the procedure.

Discussion

This prospective observational study describes the demographic profile of the patient, common indications, drugs used, skills of intubating doctors and complications of 64 intubations.'

There are no published studies available describing Pediatric ED intubation practices in India. The extensive studies on RSI in western countries on adults have compared skills of anaesthesiologists with the emergency physicians and the benefits of RSI with sedation-only or awake intubations. This study helps us get a better understanding of current practice of rapid sequence intubation in pediatric ED's in India.

Demographic profile

A significant proportion (50%, n=35) of RSI in our study were done after 4 pm as sick patients are referred from distant towns and neighbouring states to our tertiary care centre. Similar observations have been reported in an observational survey of RSI in the ED.[3]

Most of the intubations (40%, n=25) were required in patients aged 1 month to 1 year, probably due to the unique anatomical characteristics of the airway, thorax and musculature with added poor functional residual capacity in this age group.[2-5] Pediatric population forms only 4.4%-5.9% in studies on RSI and data on RSI in infants is not available.[3,4,5] In our study of the 64 patients intubated, 43.7 % (n=28) had pre-existing illness like cerebral palsy, asthma, congenital heart disease (VSD), Congenital hydrocephalus etc.

There was no correlation between pre-existing illness and occurrence of complications as concluded by other studies[5], though hypoxemia has been reported in patients with pre-existing respiratory or cardiovascular conditions.[6] The most common indication for RSI was respiratory failure 40.6 %(n=26), low GCS 32.4% (n=22) and shock 23.4 %(n=15). This observation can be attributed to the fact that poor respiratory reserves and anatomical characteristic contribute to respiratory failure as final common path way to a wide array of critical illness in children. Our results are similar to findings reported previously in which the common indications for intubation were shock and poor GCS.[3,5] The most common diagnosis in children requiring RSI in our ED were status epilepticus in 18.7 % (n=12), respiratory conditions such as pneumonia and bronciolitis in 18.7 % (n=12) and dengue shock in 15.6% (n=10)(Table 1), while encephalopathy, respiratory conditions and septic shock have been reported by others.[4,6]

Of the 64 intubations 84.37 %(n=54) were successful in first attempt, while 12.5 %(n=8) and 3.1 % (n=2) were successfully performed on the second and third attempts, respectively. There were no failed attempts of intubation. No patients required emergency cricothyrotomy or nasopharyngeal intubation. This was similar to other observations.[5,6] Failed attempts for intubation were noted in 0.9% of intubations by sagarin *et al.*[7] The mean time for successful tracheal intubation was 20 minutes as reported by J M Butler *et al.*[3] Dufor *et al*, observed that the median time for successful intubation was 12 minutes, much lesser in comparison to our study.[8] Four children (6%) had difficult airway, who were successfully intubated by ED consultant (1/4) and PICU fellows (3/4). All these patients were less than 1 year of age. Gencorelli FJ *et al*[9] reported difficult intubation in only 1.7% because all the intubation in this study was done by anaesthesiologists.

In our study, the success rate for intubation at the first attempt was 73%, 93%, 81% by postgraduates in their first, second and third year of postgraduate course and 100% by registrars who had completed their post-graduation almost similar to other results.[7]

Bag and mask ventilation was required to pre-oxygenate 28% (n=18) of patients, due to

apnoea or bradypnoea at admission and/or had difficulty in maintaining adequate saturation with 100% oxygen. In all patients the Sellicks manoeuvre was used. Nasogastric tube was inserted and gastric contents emptied in most of patients (except in trauma) after premedication and sedation, prior to intubation, and none of the patients developed vomiting or aspiration during the procedure. It also helped prevention of gastric distension in children who needed BVM ventilation. Atropine was the most common pre-treatment drug used, midazolam was the most common sedative, fentanyl was the most common analgesic agent used and vecuronium was the only neuromuscular blocking agent used. Similar to other observations,[10] however etomidate and propofol and succinylcholine were commonly used by others.[11,12]

Facilitated RSI (RSI without the use of neuromuscular blocking agent) was used in 4 patients (6%) who at admission were apnoeic or developed apnoea on giving induction agents and those with some underlying neuromuscular disorder. The complication rate noted in our study was (25%) which is higher in comparison to the observations of S M Fathil *et al* (15%) and the S. Trakulsrichai *et al* (11%).

The most common complication noted in our study was right bronchus intubation 7.8% (n=5) which contributed to an overall increase in the rate of complications and each patient could have had more than one complication. There was no association found between pre–existing illness and occurrence of complications. Hypoxemia and oesophageal intubation were commonly reported by others, the next common being hypotension.[13]

Limitations of our study

More number of cohorts and longer duration of study would have helped validate our conclusions. Duration of complications which would probably influence outcome like hypoxemia, hypotension etc. were not recorded. There was no blinding of data. It could not be ascertained if medications contributed to the complications as the procedure itself could contribute to complications like desaturation and bradycardia. Using other medications recommended in RSI, like morphine, etomidate, thiopentone and succinylcholine would probably have influenced our results in many ways.

Conclusion

- Requirement for Intubations in the ED can be anticipated more in critically ill children less than 1 year of age.
- ED doctors and personnel should be trained adequately in the technique of RSI as a good proportion of patients at tertiary level pediatric hospitals require RSI after 4 pm, when the number of skilled personnel is minimal.
- ED doctors have high competency levels in RSI with acceptable complication rates.
- Need for using the Bag valve mask during RSI is not uncommon.
- Intubation into the right bronchus is the most common complication in the pediatric ED.
- Pre- existing illness does not influence the occurrence of complications of RSI.

The lack of internationally accepted definitions of complications of RSI means that studies of emergency airway management (in any setting) cannot be compared on an equivalent basis. Standardised definitions would permit national and international comparisons in future.

Recommendations

Every paediatrician should be trained in RSI which will help in securing the airway of a critically ill child, under ideal intubating conditions. Every emergency department catering to pediatric patients should have monitoring facilities, medications, equipment, paramedical and medical personnel for RSI. Awake intubations should be avoided, unless other-

wise indicated.

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