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Assessing First Pass Success Rate with Low Dose Rocuronium during Rapid Sequence Intubation among Patients in an Emergency Department

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Abstract: ***Introduction: Rapid sequence intubation is defined as the administration of a potent induction agent immediately followed by a rapidly acting paralytic agent to induce unconsciousness and motor paralysis to facilitate endotracheal intubation easier and safer. Rocuronium and its first - pass success rates were primarily researched in western populations. There have been very few studies on the topic among the Indian population. Therefore, it is crucial to perform studies to assess first pass success rate when a low dose rocuronium is combined with an induction agent in RSI in adult patients presenting to the emergency department such that it can be implicated in an anticipated difficult airway. Methods: A cross sectional study was conducted at the ED of Amala Institute of Medical Sciences over a period of 1.5 years. Associations between qualitative variables were tested using Fischer's exact test and relation between qualitative and quantitative variables were tested using t test. P value <0.05 was assigned for statistical significance a priori. Results: In this study success rate of intubation in first attempt was tested using Fischer's exact test when low dose rocuronium (0.3mg/kg) was administered which was found to be statistically significant with a p value <0.001. Other factors like age, gender and comorbidities were found to have no significance with administration of low dose rocuronium. Conclusion: This study shows that with low dose rocuronium a good first pass success rate could be obtained, thereby reducing complications associated with neuromuscular blocking agents. Although the co factors were of no significance when attributed with low dose rocuronium.***

Keywords: Rapid sequence intubation, low dose rocuronium, first pass success

1. Introduction

The invasive procedure of endotracheal intubation can be extremely uncomfortable for the patient. To ensure that patients don't experience any pain, induction agent and a muscle relaxant are routinely administered [(1).] For the purpose of facilitating endotracheal intubation, RSI is defined as the injection of a powerful induction agent followed immediately by a rapidly acting paralytic agent. Preparation, pre - oxygenation, pretreatment, paralysis with induction, positioning, placement of the tube, and post - intubation patient management make up the six steps of the RSI method. [(2)] The purpose of emergency rapid sequence intubation is to make emergent intubation easier and safer, thereby increasing the success rate of intubation while decreasing the complications which include pulmonary aspirations, prolonged intubation with hypoxia, and precipitating a crash airway. 'Modified RSI' was introduced using rocuronium which is a non - depolarizing muscular blocking agent with a prolonged neuromuscular blockade. But the major disadvantage is that it later on lead to surgical airway in order to prevent hypoxemia due its delayed onset of recovery. Despite its effects on health and survival, research on endotracheal intubation and RSI has decreased over the past few years. Therefore, the study's primary focus is on the technique and methodology used in the RSI approach.

Interpersonal variability can affect the endotracheal intubation technique. They heavily rely on the RSI technique. Both their sensitivity and specificity vary greatly. Improper practice of the RSI is linked to failed resuscitation or death. In order to prevent pulmonary aspiration in patients who may be at risk, the airway must be quickly controlled. RSI is significant in this situation. Clinicians from a variety of medical specialties, such as critical care specialists, anesthesiologists, and emergency medical professionals, use this technique. Emergency medicine is increasingly utilizing RSI for saving lives. [(3 - 5).] The effectiveness of rocuronium in rapid sequence intubation is disputable. According to some studies, rocuronium has a higher first - pass success rate than other neuromuscular blocking medications. When employing rocuronium, a high success rate was seen when using a calibrated and exact dosage. Although rocuronium has many benefits, it also has significant drawbacks. As previously mentioned, its protracted activity can result in high blood pressure, an irregular heartbeat, and symptoms including a severe headache, blurred vision, a pounding in the neck or ears, anxiety, and confusion. These side symptoms can disguise the underlying problem and lead to a false diagnosis. It can occasionally cause allergies and respiratory problems. [(6 - 9)] Therefore, it is crucial to keep researching low - dose rocuronium and how it affects RSI.

As far as we are aware, there hasn't been much research on determining first pass success rate with low dose rocuronium during rapid sequence intubation. Rocuronium and its first - pass success rates were primarily researched in western populations. There have been very few studies on the topic among the Indian population. A risk - based approach for individuals with dire emergency conditions would benefit from an understanding of the variation, dosage, and profile of the drugs used in the RSI process. The quick and prompt assessment of their success rate of rocuronium in RSI will provide insight into handling emergencies. Therefore the primary goal of our study is to evaluate whether paralysis with low - dose rocuronium provides significant first - pass

success rates in patients requiring emergency rapid sequence intubation.

2. Methods

Study Design: Cross sectional study

Study Setting: This study was conducted in the Emergency Department of Amala institute of Medical Sciences, Thrissur.

Study Period: Commenced after ethic committee clearance was obtained from March 2021 to December 2022.

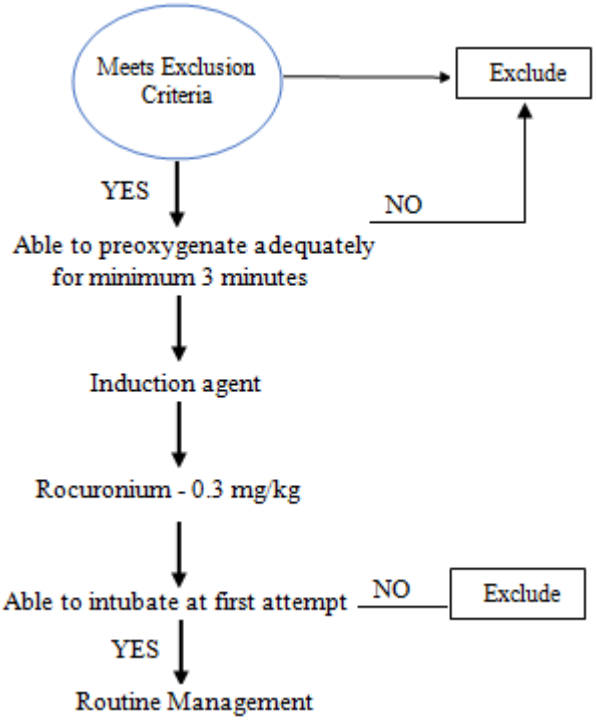
Inclusion Criteria:
- Age > 18 years
- Patients presenting to the Emergency Department with indications for endotracheal intubation:

For airway protection
To optimize oxygenation and/or ventilation
Anticipated clinical course - clinical deterioration, safe transport, impending airway compromise

Exclusion Criteria
- Patients brought in cardiopulmonary arrest were excluded from this study.
- Patients with anticipated difficult airway/ crash airway who did not require RSI/ low dose rocuronium were excluded from the study.

3. Methodology

- All adult patients coming to the emergency department vitals were monitored and triaged accordingly. Unstable patients received basic resuscitative measures. Those patients fulfilling the inclusion criteria and exclusion criteria are grouped.
- Standardized data collection form that included the patient age, sex, comorbidities and others were collected.
- Prior to conduct of the study, informed consent was obtained from each subject or bystanders, which also includes an explanation of the procedure.
- Airway management strategy was discussed with the team. Set up IV access, cardiac monitor, oximetry. Physiologic status and airway difficulty were assessed.
- Equipment, suction, and potential rescue devices which includes appropriate endotracheal tube, airway devices were arranged.



Sample Size Calculation:
Sample size was calculated using the formula -

$$n = \frac{\sum (1 - \alpha/2)\ 2xpxq}{d2}$$

where, α= significance level - 5% (1.96)
p= Proportion success rate (0.60) ([10])
q= 1 - 0.5
d= relative precision, 20% p
n= 64 (sample size n= 64 was considered adequate)

Sampling Method: Consecutive sampling

Study Tool: Questionnaires and proformas

Statistical Analysis:
The data was entered into Microsoft excel worksheet and analysis performed using SPSS 23. Quantitative variables were expressed in mean and standard deviation or median value and qualitative variables in proportions. Associations between qualitative variables were tested using Fischer's exact test and relation between qualitative and quantitative variables were tested using t test. P<0.05 was considered significant.

4. Results

The study was conducted in 66 individuals. Quantitative variables were expressed in mean and standard deviation or median value and qualitative variables in proportions. Associations between qualitative variables were tested using Fischer's exact test and relation between qualitative and quantitative variables were tested using t test. P<0.05 was considered significant.

Age
Mean age of the study population was 64.38 years with SD 14.491. The minimum and maximum age in the study

population was 24 and 87 respectively. The median age was 66 years.

Gender

Two third (66.7%) of the study population were males.

Table 1: Gender distribution

Gender	Frequency	Percentage
Male	44	66.7
Female	22	33.3

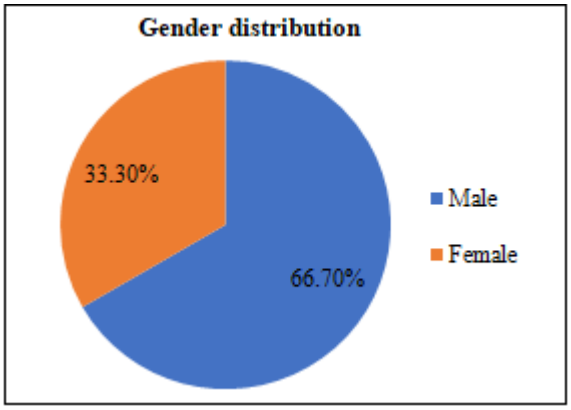


Figure 1: Gender distribution

Weight

Mean weight of the study population was 67.95 kg with a SD of 12.210

Presenting complaints

Most common presenting complaint in the study population was breathing difficulty (48.5%), followed by decreased response (28.8%).

Table 2: Distribution of study population based on presenting complaints

Presenting complaint	Frequency	Percentage
Weakness	6	9.1
Breathing difficulty	32	48.5
Decreased response	19	28.8
Others	9	13.6

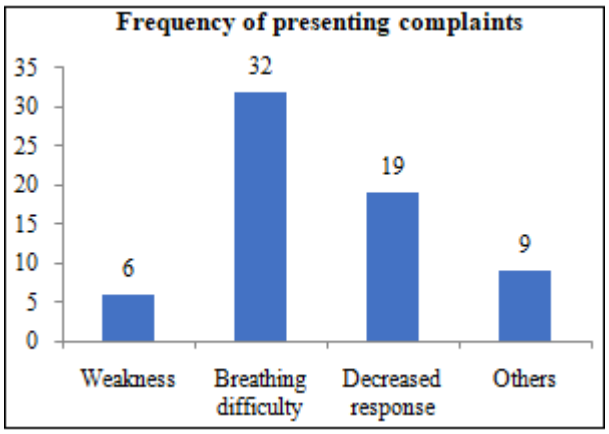


Figure 2: Distribution of study population based on presenting complaints

History of comorbidities

Majority (84.8%) of the patients had 1 or more comorbidities.

Table 3: Distribution of study population based on history of comorbidities

Comorbidity	Frequency	Percentage
Present	56	84.8
Absent	10	15.2

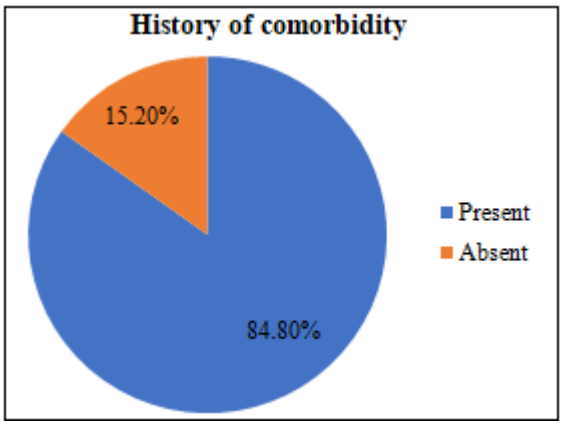


Figure 3: Distribution of study population based on history of comorbidities

Hypertension was the most common (53.0%) comorbidity present followed by diabetes mellitus (45.5%) and coronary artery disease (31.8%).

Table 4: Distribution of different comorbidities in the study population

Comorbidity	Frequency	Percentage
Hypertension	35	53.0
Diabetes mellitus	30	45.5
Coronary artery disease	21	31.8
COPD or Bronchial asthma	19	28.8
Chronic kidney disease	13	19.7
Cancer	4	6.1

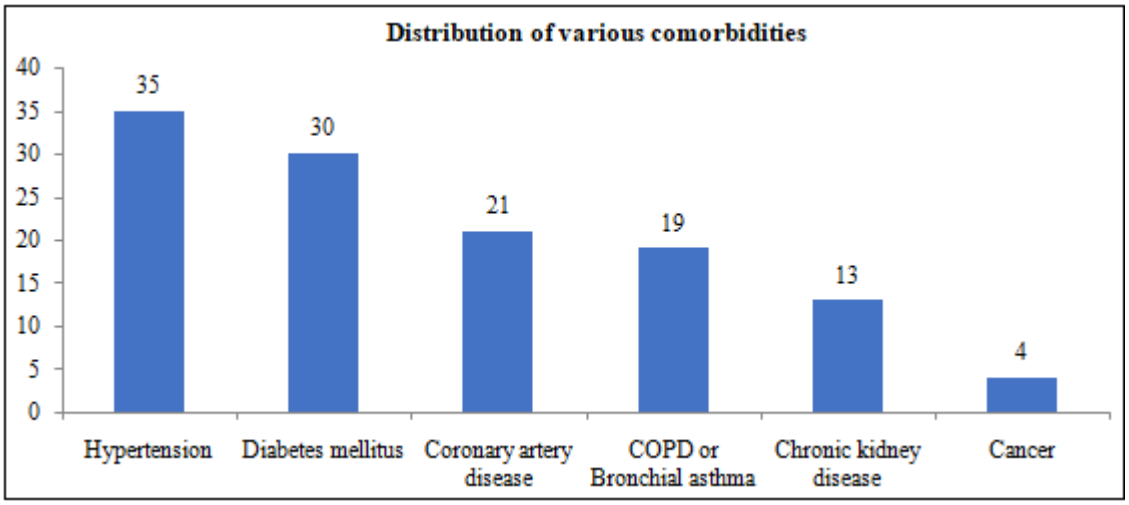


Figure 4: Distribution of different comorbidities in the study population.

Pulse rate

Mean pulse rate of the study population was 100.36 beats per minute with SD 25.841. The median pulse rate was 100 beats per minute.

Respiratory rate

Mean respiratory rate of the study population was 24.30 with SD 6.696. The median respiratory rate was 24.

Blood pressure

Mean SBP of the study population was 152.48 mm of Hg with SD 47.239. The median SBP was 154.5 mm of Hg.
Mean DBP of the study population was 84.86 mm of Hg with SD 25.412. The median DBP was 85.5 mm of Hg.

Table 5: Mean and Median values of vital signs

Vitals	Median	Mean	SD
Pulse rate (bpm)	100	100.36	25.841
Respiratory rate	24	24.30	6.696
SBP	154.5	152.48	47.239
DBP	85.5	84.86	25.412

SpO2

SpO2 level was found to be low in 43.9% of the study participants.

Table 6: Distribution based on level of SpO2

SpO2	Frequency	Percentage
≥94%	37	56.1
<94%	29	43.9

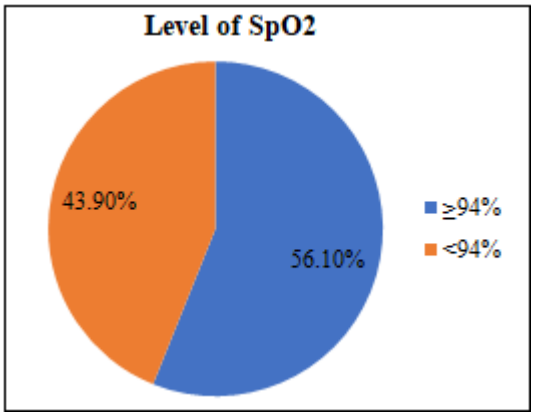


Figure 5: Distribution based on level of SpO2

Mode of Oxygen delivery

36.4% patients were not given O2 therapy as they were maintaining saturation in room air. O2 was delivered to rest by using various methods like O2 mask, NRBM and NIV.

Table 7: Distribution based on mode of Oxygen delivery

Mode of Oxygen delivery	Frequency	Percentage
Room air	24	36.4
O2 mask	23	34.8
NRBM	8	12.1
NIV	11	16.6

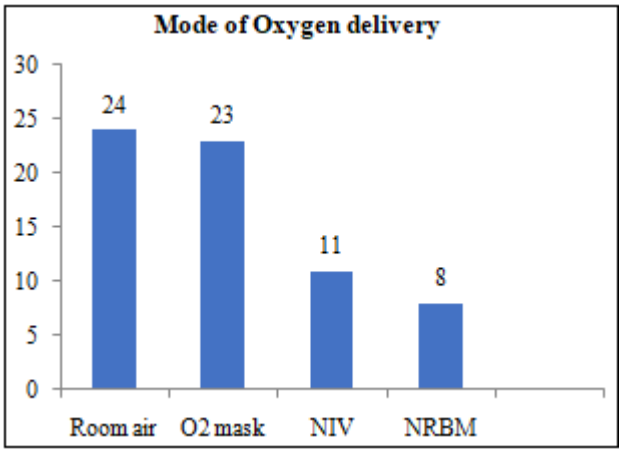


Figure 6: Distribution based on mode of Oxygen delivery

Induction agent

Most commonly (69.7%) used induction agent was Etomidate.

Table 8: Distribution based on induction agent used

Induction agent	Frequency	Percentage
Etomidate	46	69.7
Fentanyl	7	10.6
Ketamine	10	15.2
Propofol	1	1.5
Midazolam	2	3.0

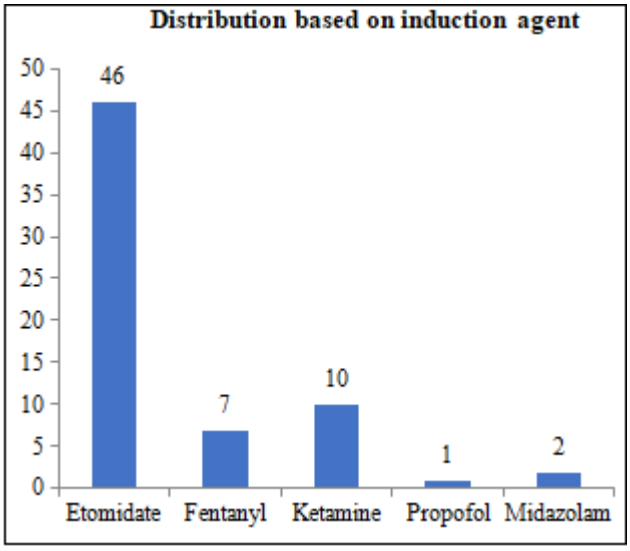


Figure 7: Distribution based on induction agent used.

Rocuronium dose

Mean dose of rocuronium used in the study population was 22.48 mg with SD 7.780. The median dose used was 20 mg. The mean dose of rocuronium used per kg of body weight was 0.3346 mg/Kg with SD 0.12221. The median dose of rocuronium used per kg of body weight was 0.3077 mg/Kg.

First pass success rate of intubation

Intubation was successful in 86.4% of patients in 1st attempt.

Table 11: Success rate of intubation in 1st attempt

Intubation in 1st attempt	Frequency	Percentage
Success	57	86.4%
Failed	9	13.6%

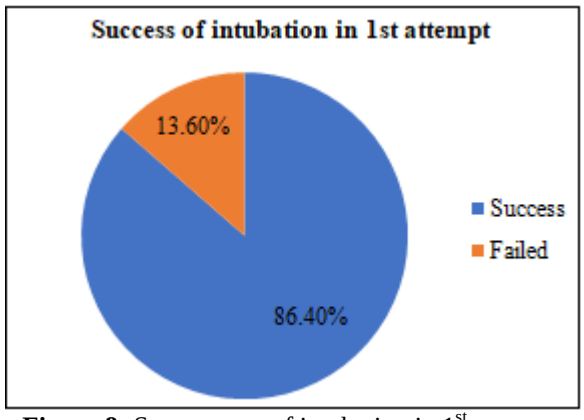


Figure 8: Success rate of intubation in 1st attempt.

Association of various factors with success rate of intubation in 1st attempt

Association of gender with success rate of intubation in 1st attempt

Table 12: Association of gender with success rate of intubation in 1st attempt

		Intubation in 1st attempt		P value
		Success	Failure	
Gender	Male	39 (88.6%)	5 (11.4%)	0.467
	Female	18 (81.8%)	4 (18.2%)	

Association of comorbidities with success rate of intubation in 1st attempt

Table 13: Association of comorbidities with success rate of intubation in 1st attempt

		Intubation in 1st attempt		P value
		Success	Failure	
History of comorbidity	Present	47 (83.9%)	9 (16.1%)	0.334
	Absent	10 (100%)	0 (0%)	

Association of level of SpO2 with success rate of intubation in 1st attempt

Table 14: Association of level of SpO2 with success rate of intubation in 1st attempt

		Intubation in 1st attempt		P value
		Success	Failure	
Level of SpO2	≥94%	32 (86.5%)	5 (13.5%)	1.000
	<94%	25 (86.2%)	4 (13.8%)	

Relationship between age and success rate of intubation in 1st attempt

Table 19: Relationship between age and success rate of intubation in 1st attempt

		Number of participants	Mean weight	Standard deviation	't' value	'p' value
Intubation in 1st attempt	Success	53	63.46	15.057	-1.309	0.195
	Failure	9	70.22	8.643		

Relationship between weight and success rate of intubation in 1st attempt

Table 20: Relationship between weight and success rate of intubation in 1st attempt

		Number of participants	Mean weight	Standard deviation	't' value	'p' value
Intubation in 1st attempt	Success	57	68.07	12.527	0.192	0.848
	Failure	9	67.22	10.592		

5. Discussion

This study was to analyse if low - dose rocuronium reduced its duration of action, yet gave acceptable intubation success rate on first attempt and the associating factors that contribute to first pass success rate. There have been fewer studies on low dose rocuronium and intubating conditions and those studies had been done in different clinical scenarios using varying induction agents and neuromuscular blocking agents. The most commonly used induction agent in our study was etomidate followed by ketamine, fentanyl and propofol.

In our study association of gender with success rate of intubation in 1st attempt was tested using Fischer's exact test. Males had more success rate than females but the difference was not significant. Relationship between age and success rate of intubation in 1st attempt was tested using t test. Mean age of the patients who had successful intubation in 1st attempt was low compared to those who failed in 1st attempt. But this difference was not statistically significant. In contrary, a study conducted by *Matias Vested et al*

concluded that administration of rocuronium 0.3 mg/kg only one third reached a train - of - four count of 0 and excellent tracheal intubating conditions were only found in approximately 20% of the patients, suggesting that a dose of 0.3 mg/kg may be insufficient for facilitating tracheal intubation in elderly patients. (11)

Relationship between weight and success rate of intubation in 1st attempt was tested using t test. Mean weight of the patients who had successful intubation in 1st attempt was higher compared to those who failed in 1st attempt. But this difference was not statistically significant. The association of comorbidities with success rate of intubation in 1st attempt was tested using Fischer's exact test. Intubation was successful in the 1st attempt in all patients without any comorbidity, while those who had comorbidities had 16.1% failure rate. The difference found was not statistically significant.

There was no statistically significant association of level of SpO2 with success rate of intubation in 1st attempt. The success rate was seen more in patients who maintained an SpO2 ≥94% compared to those who had low SpO2.

The relation between dose of rocuronium and various factors of intubation were tested using t test. Mean dose of rocuronium was significantly low in patients who had successful intubation at 1st attempt compared to those who failed in 1st attempt (p=0.033). But this difference was not statistically significant.

6. Conclusion

The purpose of this study was to assess intubating conditions, the success rate on first attempt and the associating factors that contribute to the first pass success rate with low dose rocuronium.

Rocuronium in a dose of 0.3mg/kg also provided acceptable laryngeal relaxation, hence improving the first pass success rate and minimize the straining after tracheal intubation. Therefore, the choice of a neuromuscular blocking agent with a short onset time can also obtain a high proportion of optimal intubation conditions. Multiple attempts to achieve tracheal intubation are associated with increased risk of clinical deterioration in both intensive care units (ICUs) and emergency departments which included desaturations, hypotension, bradycardia, vomiting and oesophageal intubation.

In addition, this study also contemplated the effectiveness of low dose rocuronium with regard to other factors including age, gender and comorbidities of the patients. Based on the analysis, it can be concluded that there are no equivalent significant statistical evidence.

7. Limitation

The following were the limitations of the study

1) The study was conducted in a single centre and consist of a small population which may not be representative.
2) In view of less expertise as an emergency medicine resident, occasional help of an emergency physician was taken for endotracheal intubation and their findings were recorded in the study.
3) Our data may not generalize to patients who were excluded from our trials, namely those undergoing tracheal intubation for cardiopulmonary arrest.

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