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Original Article

Effectiveness of Rapid Sequence Intubation Versus Non-Rapid Sequence Intubation In Traumatic Brain Injury Patients In Emergency Department

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ABSTRACT

Objective: To compare the success of intubation and complications associated with performing rapid sequence intubation (RSI) versus non-rapid sequence intubation (NRSI) in patients with traumatic brain injury (TBI) presenting in the emergency department of a tertiary care hospital.

Study Design: Quasi experimental study

Place and Duration of Study: Department of Accident and emergency, Pak-Emirates Military Hospital Rawalpindi, Pakistan from May-Dec 2022

Methodology: The RSI group was intubated as per international RSI protocol with Injection Midazolam 0.1 mg/kg as the sedative agent and Injection Suxamethonium 2 mg/kg as the paralytic agent. Standard Macintosh blade of appropriate size according to patient parameters was used for intubating the trachea. Intubation done by the non-RSI method included intubation by Injection Midazolam 0.1 mg/kg alone without the use of any paralytic agent.

Results: When analyzing the primary outcomes of intubation success between both groups and number of attempts to achieve success, results showed success of intubation at first attempt in 89(84.8%) and on second attempt in 09 (8.6%) patients in the RSI group with an overall success rate in 98(93.3%) and intubation failure in 07(6.7%) patients (p<0.001). In comparison success of intubation in the non-RSI group revealed success at first attempt in 85(81%) patients with 07(6.7%) patients intubated in the second attempt with overall success in 92(87.6%) and failure in 13(12.4%) of the patients (p<0.001).

Conclusion: We conclude that rapid sequence intubation be considered as first-line intubation method for TBI when no contraindication for paralytic agent is present.

Keywords: Intubation, non-RSI, RSI, traumatic brain injury (TBI).

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INTRODUCTION

Traumatic brain injury remains one of the most challenging, debilitating, and critical condition presenting in the emergency department requiring urgent resuscitation[1]. With an estimated 10 million people affected annually in South-East Asia alone, TBI is the leading cause of morbidity and mortality in trauma patients[2]. In Pakistan, road traffic accident remains the leading cause of TBI[3]. With the evaluation of Glasgow coma scale for initial assessment of these patients[4], more than 90% with a score of <8 require an emergency intubation to prevent hypoxemia and permanent brain injury and many may require an intubation due to gradual deterioration due to brain injury in the next 48 hours[5, 6].

Rapid sequence intubation (RSI) requires a sedative agent along with a paralyzing agent with a swift onset of action to secure the airway in the minimum time possible[7]. Suxamethonium remains the drug of choice to induce immediate paralysis due to its easy availability and cost-effectiveness for emergency intubations in the emergency department especially in the developing world8. However, in case of TBI patients, its role remains guarded and controversial especially in patients with severe TBI. Various studies link an increased morbidity and mortality associated with its use due to hyperkalemia and increased intra-cranial pressure in TBI patients warranting other safer methods for intubation[9]. Rocuronium has now been offered as a safer substitute, however, its availability in the developing world is still scarce and its prolonged duration of action warrants expert hands in case intubation failure occurs since its reversal agent is not easily available[8,10].

Non-rapid sequence intubation (NRSI) refers to securing the airway without the use of a paralyzing agent using only a sedative or using no drugs at all and proceeding with intubation[7]. However, it may pose a difficulty in intubation due to patient agitation and difficult airway anatomy due to less muscle

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relaxation but can be considered as an alternative where the adverse effect profile of paralytic agent is not warranted.

This study aimed to compare the success of intubation and complications associated with performing rapid sequence intubation (RSI) versus non-rapid sequence intubation (NRSI) in patients with traumatic brain injury (TBI) presenting in the emergency department of a tertiary care hospital.

METHODOLOGY

This prospective observational study was carried out at the Department of Accident and Emergency, Pak-Emirates Military Hospital from May-Dec 2022. A total of 210 patients were included in the study calculating sample size with the WHO calculator keeping the confidence interval at 95%, margin of error at 5% keeping the population proportion of emergency department intubation for TBI at 16%[11].

Inclusion Criteria: Patients aged 15-70 years presenting to the emergency department with a traumatic brain injury (TBI) requiring tracheal intubation due to any of the conditions including GCS <8, hypoxia with SpO2 <88% despite oxygen with rebreather at 15 liters per minute, aspiration of gastric contents, severe tachypnea with respiratory rate >30 breaths per minute and heart rate >150 beats per minute were included.

Exclusion Criteria: Patients less than 15 years of age, patients with severe maxillofacial trauma, already intubated patients and presenting as an in-hospital cardiac arrest due to TBI were excluded from the study.

The study method included all patients as per the inclusion criteria furnished. The patients were randomly allocated into two groups (RSI versus non-RSI group) by randomized consecutive sampling once they presented to the ER. Ethical permission was taken from the ERB of the institute (vide letter no A/28/145 Dated 05 May 2022)

Standard monitoring including blood pressure, heart rate, ECG, pulse oximetry and ETCO2 analyzer were attached. The RSI group was intubated as per international RSI protocol with Injection Midazolam 0.1 mg/kg as the sedative agent and Injection Suxamethonium 2 mg/kg as the paralytic agent. Standard Macintosh blade of appropriate size according to patient parameters was used for intubating the trachea. An emergency resident with at least 2 years of experience in the ER with log entries of at least 100 successful intubations were allowed to perform the procedure. In case of failure at second attempt, failure of intubation was recorded and intubating bougie and expert help was sorted while ventilating the patient via bag-mask method. Failure of attempt was regarded as unable to correctly pass the endotracheal tube in the trachea due to failure to see the vocal cords on laryngoscopy or esophageal intubation. Success of intubation was regarded as confirmation of tube placement in the trachea by auscultation and subsequent confirmation by ETCO2 (end-tidal CO2) analyzer.

Intubation done by the non-RSI method included intubation by Injection Midazolam 0.1 mg/kg alone without the use of any paralytic agent. Rest of the criteria for intubation procedure and success was the same as the RSI group. (Figure)

Primary variables measured were success at the first and second attempt and complications associated while performing the procedure. Demographic data were statistically described in terms of mean and SD, frequencies, and percentages when appropriate. The Chi-square test was used to compare statistically significance between both groups. A p value of <0.05 was considered statistically significant. All statistical calculations were performed using Statistical Package for Social Sciences 26.0.

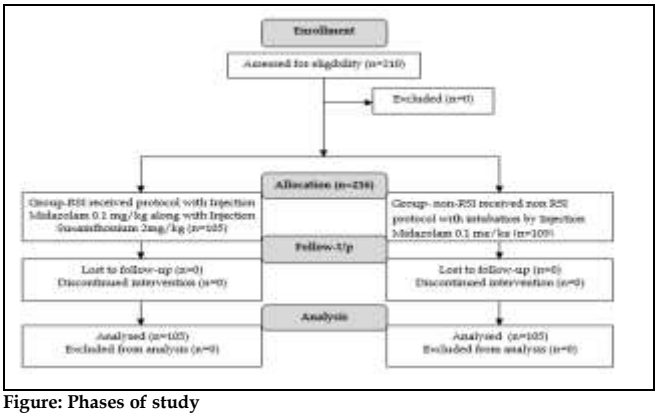

Figure: Phases of study

RESULTS

A total of 210 patients were included in the study. They were divided into the RSI group (n=105) and non-RSI group (n=105). Mean age of patients under study in the RSI group was 33.16±10.9 years versus 33.87±11.8 years in the non-RSI group. Both the groups were comparable for age. Gender distribution revealed a pre-dominantly male presentation, comprising of 93(88.6%) in the RSI group versus 92(87.6%) in the non-RSI group (Table-I). Road traffic accident

remained the major cause of TBI presentation with 92(87.6%) patients affected in the RSI and 91(86.7%) affected in the non-RSI group (Table-I).

Table-I: Demographic Variables (n=210)

Variable (s)	RSI Group (n=105)	Non-RSI Group (n=105)
Age (Mean Years)	33.16±10.9	33.87±11.8
Gender	n (%)	n(%)
Male	99(94.3)	93(88.6)
Female	06(5.7)	12(11.4)
Cause of TBI		
Road Traffic Accident	92(87.6)	91(86.7)
History Of Fall	07(6.7)	08(7.6)
Other Causes	06(5.7)	06(5.7)

TBI: Traumatic Brain Injury, R SI: Rapid Sequence Intubation, NRSI: Non-Rapid Sequence Intubation

When analyzing the primary outcomes of intubation success between both groups and number of attempts to achieve success, results showed success of intubation at first attempt in 89(84.8%) and on second attempt in 09(8.6%) patients in the RSI group with an overall success rate in 98(93.3%) and intubation failure in 07(6.7%) patients (p<0.001). In comparison success of intubation in the non-RSI group revealed success at first attempt in 85 (81%) patients with 07(6.7%) patients intubated in the second attempt with overall success in 92(87.6%) and failure in 13(12.4%) of the patients (p<0.001) (Table-II).

Table-II: Comparison of Primary Outcome Variables among Groups (n=210)

Variable(s)	RSI Group (n=105) n (%)	Non-RSI Group (n=105) n (%)	*p*-value
Success Rate on Attempts			
Success At 1st Attempt	89(84.8)	85(81.0)	<0.001
Success At 2nd Attempt	09(8.6)	07(6.7)	<0.001
Overall Success Rate	98(93.3)	92(87.6)	<0.001
Overall Failure Rate	07(6.7)	13(12.4)	<0.001

RSI: Rapid Sequence Intubation, NRSI: Non-Rapid Sequence Intubation

Main complication seen in the RSI group was regurgitation of gastric contents in 04(3.8%) of the patients whereas dental trauma in 06(5.7%) and esophageal intubation in 06(5.7%) patients were seen as the major complications in the non-RSI group (Table-III).

DISCUSSION

The present study demonstrates that rapid sequence intubation is associated with improved airway management outcomes in patients with traumatic brain injury, supporting its role as a preferred initial approach in the emergency setting. As with various studies carried out in the emergency departments[12], our study was in line with RSI offering better chances of success at intubation in both the first and second attempts at intubation[13]. This was translated into an overall better success rate for RSI as confirmed by various studies[14]. This was also in line with a study carried out by Goto et al15. Considering the failure rate for intubation, risk for complete failure was considerably less in the RSI group (6.7% to 12.4%). This was also in line with a study carried out by Dolerenzo *et al*[13]. This can be attributed to ease offered with the use of paralytic agent offering better abducted view of the airway, good muscle relaxation, absence of cough reflex and overall ease of laryngoscopy[16].

Table-III: Comparison of Complications Between Groups (n=210)

Variable(s)	RSI Group (n=105) n (%)	Non-RSI Group (n=105) n (%)
No Complications	91(86.7)	90(85.7)
Dental Trauma	03(2.9)	06(5.7)
Esophageal Intubation	03(2.9)	06(5.7)
Bronchial Intubation	03(2.9)	01(1.0)
Regurgitation	04(3.8)	01(1.0)
Cardiac Arrest	01(1.0)	01(1.0)

RSI: Rapid Sequence Intubation, NRSI: Non-Rapid Sequence Intubation

Studies suggest no comparable difference between the complication rate seen in both groups[17]. However, our study showed a comparable difference in the incidence of complications between both groups. Dental trauma and esophageal intubation were more in the non-RSI group. This is attributed to difficulty in opening and visualizing the airway without relaxation with a paralytic agent. However, the chances of regurgitation were more in the RSI group possibly due to decrease in the lower esophageal sphincter tone[8, 18].

Road traffic accident remained the main reason of patient presentation with TBI in our setup. Most common mode was motorcycle accidents with many patients not wearing safety helmets. This is a cause of grave concern and a reason for the increased presentation of TBI in the younger age group.

RECOMMENDATION

We recommend that RSI remains the gold standard method for securing the airway. However, in

cases where paralytic agents are contraindicated, non-RSI methods with sedative agents can be considered for life saving scenarios.

CONCLUSION

The present study demonstrates that rapid sequence intubation is associated with improved airway management outcomes in patients with traumatic brain injury, supporting its role as a preferred initial approach in the emergency setting. Rapid sequence intubation should be considered as the preferred first-line technique for airway management in patients with traumatic brain injury, provided there are no contraindications to the use of neuromuscular blocking agents

LIMITATION OF STUDY

The limitations are that the study is single center only. A multi-center study would result in a wider demographic area with more confirmative results.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

SMHK & MMTS: Data acquisition, data analysis, critical review, approval of the final version to be published.

AB & SZ: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

ZUH & HMA: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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