Adverse Events in Failed First-Pass Intubation vs. Successful First-Pass Intubation in the Emergency Department - An Analytical Hospital-Based Study

Devendra Prasad K.J.[1], Biju Shekar[2]

[1]Department of Emergency Medicine, Sri Devaraj Urs Academy of Higher Education and Research, Kolar, Karnataka, India. [2] Department of Anaesthesiology, Malabar Institute of Medical Sciences, Kozhikode, Kerala, India.

ABSTRACT

BACKGROUND

First-pass success is the successful intubation on the first attempt. It is the desired goal of emergency intubation and failure to achieve it may increase the risk of adverse effects. With failure of first pass intubation, life-threatening complications occur, commonly in critically ill patients. The aim of this study is to determine the association between the success of first-pass intubation and frequency of adverse events during endotracheal intubation.

METHODS

A cross sectional analytical study was done in a tertiary care hospital between October 2016 and October 2017**.** 100 failed first-pass intubation cases and 100 successful first-pass intubation cases were evaluated for factors associated with failed first-pass intubation and frequency of adverse events following intubation.

RESULTS

The groups were matched with respect to gender, induction agent use, fentanyl use and type of laryngoscope used. Mean age in failed first-pass intubation group was 5.61 years higher than subjects in successful first-pass intubation group (P = 0.016). Proportion of subjects with difficult airway was 19 % in failed first-pass intubation group and 3 % in successful first-pass intubation (P < 0.001). Failed first-pass intubation cases had higher frequency of adverse events like oesophageal intubation (9 % vs. 0 %), aspiration (7 % vs. 1 %), cuff leakage (2 % vs. 0 %) and hypotension (7 % vs. 1 %) compared to successful first-pass intubation cases.

CONCLUSIONS

The frequency of adverse events was high in failed first-pass intubation. Older age and presence of difficult airway were factors significantly associated with failed first-pass intubation.

KEYWORDS

First Pass Intubation, First-Pass Success, Adverse Events, Emergency Department, Failed First Attempt, Endotracheal Intubation

Corresponding Author:
Dr. Biju Shekar,
Senior Consultant,
Department of Anaesthesiology,
Malabar Institute of Medical Sciences,
Govindapuram, Kozhikode – 673016,
Kerala, India.
E-mail: dr_2bju@rediffmail.com

DOI: 10.18410/jebmh/2021/55

How to Cite This Article:
Prasad KJD, Shekar B. Adverse events in failed first-pass intubation vs successful first-pass intubation in the emergency department - an analytical hospital-based study. J Evid Based Med Healthc 2021;8(06):283-287. DOI: 10.18410/jebmh/2021/55

Submission 11-09-2020,
Peer Review 18-09-2020,
Acceptance 21-12-2020,
Published 08-02-2021.

BACKGROUND

Critically ill and injured patients usually require intubation in emergency department in order to maintain airway, ventilation and oxygenation.[1-3] First-pass success is the successful intubation on the first attempt. Intubation in the emergency department is regularly associated with the concept of first-pass success.[4] It is the desired goal of emergency intubation. Airway management in the emergency is a life-saving procedure. But it may be associated with severe complications. Subjects who are critically ill and injured, presenting to the emergency department, are more often in need of intubation to maintain airway, ventilation and oxygenation.

Intubation is associated with complications, which can occur during insertion or after insertion or during extubation. They may range from malposition, trauma to the airway, laryngospasm, hypertension, hypoxia to negative pressure pulmonary oedema.[5-8]

As far as successful or failure of first pass intubation is considered, there is no standard definition. Two clinical parameters generally used are 1. Five-point auscultation which includes hearing of breath sounds over epigastric region and lung fields 2. Capnography (end tidal CO_2 monitoring). With failure of first pass intubation, life-threatening complications occur commonly in critically ill patients.[9-12]

There is not enough evidence in the literature to show the association between the failure of first-pass intubation and adverse events in an emergency department setting. Hence, the present study was carried out to determine whether the frequency of adverse events increased during failed first-pass endotracheal intubation.

Aim

To compare the frequency of adverse events in failed first-pass endotracheal intubation group and successful first pass intubation group.

Null Hypothesis

"There was no significant difference in the frequency of adverse events between failed first pass intubation on comparison with successful first pass intubation group in endotracheal intubation".

METHODS

Study Design, Sample Size and Settings

A cross sectional analytical study of observational nature was done on 200 subjects presenting to the emergency department, who underwent intubation at a tertiary care hospital between October 2016 to October 2017, after obtaining clearance from the institutional ethics committee. Out of the 200 subjects, 100 were cases of failed first-pass intubation and 100 were the control group, who had successful first-pass intubation. Convenient sampling was used.

Inclusion Criteria

All the subjects falling in the timeframe of the study were included. Hence the entire sampling frame was included in the study. For convenience, the sample size was rounded off to 100 in each group at the end of recruitment.

Exclusion Criteria

Already intubated patients undergoing re-intubation, patients with a documented history of difficult airway, trauma patients with facial bone and cervical spine involvement, patients with penetrating neck injuries in the neck were excluded from the study.

After obtaining the informed written consent from patients or the guardian, the intubation was performed by a trained clinician. They were given the option of quitting from the study if so desired by them. No element of compulsion was exerted. All data was kept confidential.

After each intubation, the following parameters were recorded using a pre-defined proforma. The collected details include

1. The basic sociodemographic profile such as age and gender
2. Airway assessment
3. Presence or absence of facial trauma
4. Presence or absence of full stomach
5. Respiratory and haemodynamic status of the patient including Glasgow Coma Scale (GCS)
6. Indication for intubation
7. Method of intubation
8. Attempts and time taken
9. Paralytic agent used
10. Adverse events such as cuff leak, esophageal intubation, dental trauma, hypotension, aspiration, pneumothorax, accidental estimation and cardiac arrest.

Statistical Analysis

Successful first-pass intubation or failed first attempt and adverse events were considered as the outcome variables. The paralytic agent and method of intubation used, use of induction agent, the presence of difficult airway, an indication of intubation, fentanyl use, type and size of device selected were considered as explanatory variables. Demographic age and gender were other explanatory variables. Quantitative variables with normal distribution were expressed as mean with standard deviation. In case of non-normal distribution, median with interquartile range was used. Qualitative variables were expressed as proportion along with their frequency.

The study variables were analysed for significant difference between the two groups – successful first-pass intubation and failed first-pass intubation with special focus on comorbidities. Student t Test was used for testing the difference between quantitative variables while chi-square test was used for testing the association between qualitative variables. P-value of less than 0.05 was considered

statistically significant. Data entry and screening was done in Microsoft excel. There was no missing data. International Business Machines Statistical Package for the Social Sciences (IBM SPSS) version 22 was used for statistical analysis.[13]

Ethical Consideration

We followed the guidelines set by the EQUATOR Network. institutional ethics committee clearance was obtained before starting the study (ECR / 301 / INST / KL / 2013).

RESULTS

The final analysis included 100 cases of failed first-pass intubation and 100 subjects with successful first-pass intubation. Table 1 shows that both the groups were comparable with respect to gender, indication of intubation, method of intubation, paralytic agent used, use of induction agent, device selected, fentanyl use and size of the device.

There was statistically significant difference in mean age between the two groups (5.61 years) as shown in table 1. Only 3 % had difficult airway in successful first attempt group compared to 19 % in failed first attempt people and this difference was statistically significant.

Parameter	Study Group: Successful First Attempt (N = 100)	Study Group: Failed the First Attempt (N = 100)	Statistical Test Value	P-Value
Age (Mean ± SD) in years	55.49 ± 16.7	61.1 ± 15.99	NA	0.016#
Gender				
Male	64 (64 %)	68 (68 %)	0.357	0.550†
Female	36 (36 %)	32 (32 %)		
Indication of intubation				
Low GCS	44 (44 %)	42 (42 %)	‡	‡
Respiratory failure	37 (37 %)	38 (38 %)		
Cardiac arrest	18 (18 %)	20 (20 %)		
Emergency OT	1 (1 %)	0 (0 %)		
Method of Intubation				
Rapid sequence intubation	78 (78 %)	81 (81 %)	‡	‡
Awake oral intubation	1 (1 %)	0 (0 %)		
Crash intubation	21 (21 %)	19 (19 %)		
Paralytic Agent Used				
None	20 (20 %)	12 (12 %)	‡	‡
Succinylcholine	80 (80 %)	87 (87 %)		
Others	0 (0 %)	1 (1 %)		
Use of Induction Agent				
None	21 (21 %)	19 (19 %)	0.127	0.938†
Yes	73 (73 %)	75 (75 %)		
No	6 (6 %)	6 (6 %)		
Device Selected				
Direct Laryngoscope	98 (98 %)	99 (99 %)	0.338	0.561†
Video Laryngoscope	2 (2 %)	1 (1 %)		
Fentanyl				
Yes	79 (79 %)	81 (81 %)	0.125	0.724†
No	21 (21 %)	19 (19 %)		
Presence of Difficult Airway				
Yes	3 (3 %)	19 (19 %)	13.07	< 0.001†
No	97 (97 %)	81 (81 %)		
Size of the device	7.92 ± 0.28	7.97 ± 0.22	NA	0.164#

Table 1. Factors Associated with Failure of First Pass Intubation (N = 200)

independent sample t test, † chi square test, ‡ No statistical test was used due to 0's in cells, NA-Not Applicable

Table 2 shows the comparison of adverse events experienced by the study groups. There was a significant difference between the groups with respect to adverse events such as oesophageal intubation, aspiration and hypotension as shown in Table 2. The frequency of adverse events was higher in failed first pass attempt group compared to successful first pass group.

In the study group with failed first attempt, there was a higher frequency of aspiration (7 % vs. 1 %) compared to successful first pass group. In the study group with failed first attempt, there was a higher frequency of cuff leak (2 % vs. 0 %) compared to successful first pass group. In the study group with failed first attempt, there was a higher frequency of hypotension (7 % vs. 1 %) compared to successful first pass group.

Parameter	Study Group: Successful First Attempt (N = 100)	Study Group: Failed the First Attempt (N = 100)	Statistical Test Value	P-Value
Oesophageal Intubation				
Yes	0 (0 %)	9 (9 %)	9.424	0.003†
No	100 (100 %)	91 (91 %)		
Aspiration				
Yes	1 (1 %)	7 (7 %)	4.688	0.031†
No	99 (99 %)	93 (93 %)		
Cuff Leak				
Yes	0 (0 %)	2 (2 %)	2.020	0.497†
No	100 (100 %)	98 (98 %)		
Hypotension				
Yes	1 (1 %)	7 (7 %)	4.688	0.065†
No	99 (99 %)	93 (93 %)		
Accidental Extubation				
Yes	0 (0 %)	0 (0 %)	‡	‡
No	100 (100 %)	100 (100 %)		

Table 2. Comparison of Frequency of Adverse Events in the Study Groups (N = 200)

† Fisher's exact test, ‡ No statistical test was used due to 0's in cells

DISCUSSION

The frequency of adverse events was higher in failed first pass attempt group compared to successful first pass group in the present study. Older age and presence of difficult airway were factors significantly associated with failed first-pass intubation.

In the present study, the commonest indication of intubation was low GCS followed by respiratory failure. The accepted gold standard for airway management in the emergency department is tracheal intubation.[14] It may be performed by both anaesthetists and emergency physicians (EPs), with or without drugs. Rapid sequence intubation is the most common method of intubation as the success rate is high when compared to nasotracheal intubation.[15] Park L et al.[7] in their review from a total of 42,081 intubations estimated the first-pass success (FPS) rate to be 84.1 %. This success of first-pass intubation is affected by several factors.

In the present study, with regards to the factors affecting the first pass success, only the mean age of the subjects and presence of difficult airway (classified by Mallampati scoring) were the factors significantly associated with failed first-pass intubation. The mean age of subjects in the failed first-pass intubation group was 5.61 years higher than subjects in a successful first attempt group and the difference was statistically significant (P = 0.016).

In the present study, both the groups were comparable with each other with respect to other factors such as gender

distribution, use of induction agent, fentanyl use and type of laryngoscopy done. Sakles JC et al.[16] in their study observed that both the groups were comparable with respect to mean age and use of sedatives such as ketamine / propofol. Lascarrou JB et al.[17] had observed that, on comparison with direct laryngoscopy, there was no advantages in first-pass orotracheal intubation rates with video laryngoscopy. On the contrary, it had higher rates of severe life-threatening complications.

In our study, 19 % of subjects had difficult airway in failed first-pass intubation group compared to only 3 % in a successful first attempt group and this difference was statistically significant (P < 0.001). Similar to our study, Sakles JC et al.[16] also observed a higher rate of difficult airway in failed first-pass intubation group compared to the successful first attempt group. Jung W et al.[4] in their study on emergency endotracheal intubation, reported restricted mouth opening and neck extension along with swollen tongue as independent predictors of first-pass failure.

Complications associated with intubation may range from malposition, trauma to the airway, laryngospasm, hypertension and hypoxia to negative pressure pulmonary oedema.[5,6] In critically ill subjects, tracheal intubation can be very difficult. They may go into hypoxia or hypotension. They also cope poorly with induction and neuromuscular blockade. These subjects are often at risk of adverse events. There is an increase in the rate of occurrence of adverse events with failed first-pass intubation.

In our study, subjects in failed first-pass intubation group had higher frequency of adverse events like oesophageal intubation (9 % vs. 0 %), aspiration (7 % vs. 1 %), cuff leakage (2 % vs. 0 %) and hypotension (7 % vs. 1 %) compared to the control group. This difference was statistically significant with respect to adverse events like aspiration and hypotension. Sakles JC et al.[16] in their study recorded that the incidence of one or more adverse events (AEs) was only 14.2 % if intubation was successful on the first attempt compared to 47.2 % in cases requiring two attempts. Multivariable logistic regression in their study showed that more than one attempt at tracheal intubation was a significant predictor of one or more AEs.

They also observed that increased number of attempts was associated with increase in the number of adverse events, similar to our study. Park L et al.[7] in their review stated the incidence rates of commonly reported adverse events as hypoxia (6.4 %), hypotension (3.0 %), oesophageal intubation (3.5 %) and peri-intubation cardiac arrest (0.6 %). Simpson GD et al.[18] in their study reported that severe hypoxaemia (SpO2 less than 80 %) occurred in 22 % cases, severe hypotension (systolic arterial pressure less than 80 mm Hg) in 20 % and oesophageal intubation in 2 %. Since in our study, there was zero in one of the cells, we could not find the statistical significance of oesophageal intubation as an adverse event as reported by them.

The reasons for increased risk of adverse events in subjects with failed first pass attempt could be due to emergency, lack of preparation time, full stomach, lower physiological reserves and associated respiratory, haemodynamic decompensation.

CONCLUSIONS

Intubation is associated with complications that can occur during insertion or after insertion or during extubation. Recognition of risk factors is a safe approach in intubation to avoid complications. The frequency of adverse events was high in failed first-pass intubation group compared to successful first-pass intubation group. Patients suffered significantly more adverse events, when more than one attempt was required. Prior recognition of risk factors can help in predicting challenges in achieving a clear view of the glottis and maintaining optimal oxygenation. They can help in deciding on induction strategies capable of facilitating intubation and avoiding clinical deterioration.

Limitations and Recommendations

This is a single centre study. Groups could not be matched for age. The mean age was 5 years higher in failed first pass group compared to the successful first pass group. This could have also contributed to the increased number of adverse events. The lack of statistical significance of many of the differences between the study groups may be attributed to the smaller sample size. There is a need for large-scale multicentric studies, to enhance the quality of available evidence on the Indian population. We also recommend a nation-wide emergency department airway registry in order to track the outcomes in future.

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.
Financial or other competing interests: None.
Disclosure forms provided by the authors are available with the full text of this article at jebmh.com.

REFERENCES

[1] Bernhard M, Bax SN, Hartwig T, et al. Airway management in the emergency department (The OcEAN-Study) - a prospective single centre observational cohort study. Scand J Trauma Resusc Emerg Med 2019;27(1):20.
[2] Kovacs G, Sowers N. Airway management in trauma. Emerg Med Clin North Am 2018;36(1):61-84.
[3] Mosier JM, Joshi R, Hypes C, et al. The physiologically difficult airway. West J Emerg Med 2015;16(7):1109-1117.
[4] Jung W, Kim J. Factors associated with first-pass success of emergency endotracheal intubation. Am J Emerg Med 2020;38(1):109-113.
[5] Sklar MC, Detsky ME. Emergent airway management of the critically ill patient: current opinion in critical care. Curr Opin Crit Care 2019;25(6):597-604.
[6] Cook TM, MacDougall-Davis SR. Complications and failure of airway management. Br J Anaesth 2012;109(Suppl 1):i68-i85.
[7] Park L, Zeng I, Brainard A. Systematic review and meta-analysis of first-pass success rates in emergency department intubation: creating a benchmark for

emergency airway care. Emerg Med Australas 2017;29(1):40-47.
[8] Brown CA 3rd, Bair AE, Pallin DJ, et al. Techniques, success and adverse events of emergency department adult intubations. Ann Emerg Med 2015;65(4):363-370.
[9] Griesdale DEG, Bosma TL, Kurth T, et al. Complications of endotracheal intubation in the critically ill. Intensive Care Med 2008;34(10):1835-1842.
[10] Jaber S, Amraoui J, Lefrant JY, et al. Clinical practice and risk factors for immediate complications of endotracheal intubation in the intensive care unit: a prospective, multiple-center study. Crit Care Med 2006;34(9):2355-2361.
[11] Natt BS, Malo J, Hypes CD, et al. Strategies to improve first attempt success at intubation in critically ill patients. Br J Anaesth 2016;(117 Suppl 1):i60-i8.
[12] Mort TC. The incidence and risk factors for cardiac arrest during emergency tracheal intubation: a justification for incorporating the ASA Guidelines in the remote location. J Clin Anesth 2004;16(7):508-516.
[13] IBM Corp. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp., Released 2013.
[14] Stevenson AG, Graham CA, Hall R, et al. Tracheal intubation in the emergency department: the Scottish district hospital perspective. Emerg Med J 2007;24(6):394-397.
[15] Okubo M, Gibo K, Hagiwara Y, et al. The effectiveness of rapid sequence intubation (RSI) versus non-RSI in emergency department: an analysis of multicenter prospective observational study. Int J Emerg Med 2017;10(1):1.
[16] Sakles JC, Chiu S, Mosier J, et al. The importance of first pass success when performing orotracheal intubation in the emergency department. Acad Emerg Med 2013;20(1):71-78.
[17] Lascarrou JB, Boisrame-Helms J, Bailly A, et al. Video laryngoscopy vs direct laryngoscopy on successful first-pass orotracheal intubation among ICU Patients: a randomized clinical trial. J Am Med Assoc 2017;317(5):483-493.
[18] Simpson GD, Ross MJ, McKeown DW, et al. Tracheal intubation in the critically ill: a multi-centre national study of practice and complications. Br J Anaesth 2012;108(5):792-799.