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Comparison of Hemodynamic Response and Complications in Patients with Difficult Airway Using Two Techniques-Retrograde and Fibreoptic Intubation

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Abstract

Objective: The Aim of this study was to identify the hemodynamic response and success rate to awake retrograde endotracheal intubation (REI) and fiberoptic bronchoscope (FOB) assisted endotracheal intubation in difficult airway situation and to validate whether the REI can attenuate the hemodynamic response to tracheal intubation compared with the FOB assisted intubation.

Design: Randomized Prospective Study.

Methods: 64 adults, ASA I-II scheduled for elective surgery requiring endotracheal intubation were randomly allocated to either the awake REI group (n=32) or the FOB group (n=32). Non-invasive blood pressure (NIBP), heart rate (HR) and Spo_2 were recorded. Time taken for intubation and success rate of intubation during the observation was also recorded.

Results: During awake intubation, the magnitude of change of both NIBP and HR was greatest in Group REI as compare to Group FOB. Time taken for intubation and success rate were better in FOB group, while complication like airway trauma was higher in awake retrograde intubation group (REI).

Conclusions: Awake Endotracheal intubation using FOB and REI in adult may cause increases in MAP and HR. However we observed maximum increase in heart rate and MAP occurred at the end of intubation in REI group than FOB, while time taken for intubation were lesser and success rate of intubation were superior in FOB as compare to REI group.

Keywords: Difficult airway; Fibreoptic intubation; Retro-grade intubation; Hemodynamic changes

Introduction

Direct laryngoscopy assisted intubation is most common method for tracheal intubation. In difficult airway, techniques for tracheal intubation are Fibreoptic Intubation, Retrograde Intubation and blind nasotracheal Intubation. For the anaesthesiologists most threatening situation is the inability to intubate the trachea when artificial ventilation is urgently required. Difficult endotracheal intubation with loss of airway is a leading cause of death in anaesthesia. Fibreoptic intubation is considered as the gold standard for difficult airway management

Fiberoptic intubation, though technically demanding is considered the safest and most effective method in cases of difficult intubation. Its main benefit is that it permits direct visual control of the intubation procedure so that a directional error is impossible. Fiberscope is sophisticated and expensive apparatus and handling requires expertise. It is not readily available at all health care facilities in developing countries. In case of non-availability of fiberscope awake retrograde intubation is an alternative technique for difficult intubation.

Retrograde intubation was first described by Butler and Cirillo [1] in 1960 to secure the airway in difficult intubation. In retrograde intubation endotracheal tube is advanced into trachea by railroad technique without direct visualization of trachea. Disadvantage of retrograde method of intubation, after withdrawal of the guidewire, endotracheal tube advancement may inadvertently slip into the esophagus [2] due to the short distance between the guidewire's entry point and the vocal cords.

The Aim of our study was to compare hemodynamic response, time taken and success rate of intubation following awake retrograde endotracheal and fiberscope assisted intubation (Figure 1).

Methods

After institutional ethical committee approval and informed written consent, 64 patients aged 25-60 yrs, ASA class I and II of either sex having difficult airway scheduled for elective surgery under general anaesthesia were randomly and equally placed in either of two groups.

Group-REI: Retrograde endotracheal intubation group

Group-FOB: Fiberoptic bronchoscope assisted intubation group

Patients with restricted mouth opening, mouth opening less than two finger and Mallampati class III and IV were included in the study. Patients with ASA physical status III and IV, cardiovascular disease, reactive airway disease, emergency surgeries, hypertension, use of

medications known to affect blood pressure (BP) and heart rate (HR) were excluded from the study.

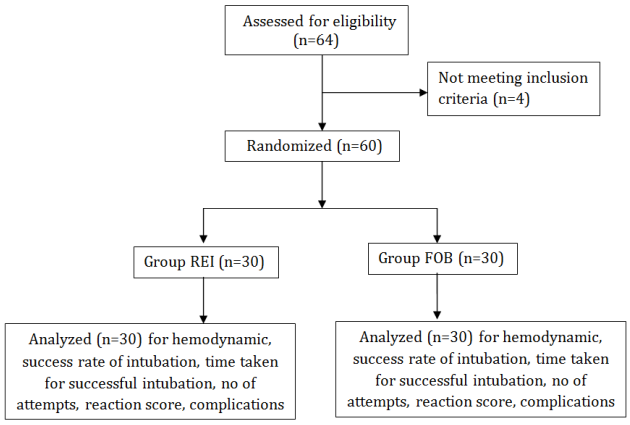

Figure 1: CONSORT flow diagram of patient recruitment, REI: Retrograde Intubation; FOB: Fibreoptic Intubation.

Operation Theater, intravenous access was secured routine monitors were attached including 5 lead ECG, noninvasive arterial blood pressure and pulse oximeter. Patients were randomly divided into two group REI (R group, n=32) and FOB (F group, n=32) by computer generated randomization technique.

Both groups of patients were nebulized with 4 ml of 2% lidnocain for 5 min. After waiting for desired level of oral anaesthesia, cricothyroid membrane was identified and local anaesthetic was infilitrated followed by instillation of 4 ml of 2% lidnocaine. Patients were asked to cough to spread local anaesthetic in different part of airway. Before airway manipulation each patient received a bolus dose of fentanyl 1 µg/kg over 30 s.

For retrograde endotracheal intubation, a guide wire of central venous catheter was introduced to cricothyroid membrane via 16 G hypodermic needle, the needle/catheter was advanced at a 45° angle in cephalad direction, once guide wire reached oral cavity or nasal cavity it was taken out with the help of maggil forcep, a endotracheal tube (7-7.5 mm) was rail roaded over the guide wire and gently pushed into vocal cord. Placement of endotracheal tube was confirmed by capnogram and guide wire was pulled out through lumen of endotracheal tube.

For Fiberoptic intubation 5 mm flexible fiberoptic bronchoscope was used, tracheal tube was mounted on fibreoptic bronchoscope which was inserted through the nostril and passed into the trachea until the carina was visualized when endotracheal tube was passed into carina FOB was withdrawn. Tube placement was confirmed by end-tidal carbon dioxide ($ETCO_2$) waveform on the monitor.

After endotracheal intubation, general anaesthesia was induced using propofol+fentanyl+rocuronium and isoflurane, then surgery was allowed to proceed. Patients from both groups were ventilated with a mixture of 50% nitrous oxide in oxygen and 1% isoflurane. Anaesthetist who was blinded to the method of intubation recorded the following parameters.

- Hemodynamics including heart rate, systolic blood pressure, diastolic blood pressure as well as oxygen saturation.
- Success rate of intubation
- Time taken for successful intubation
- Number of attempts taken for successful intubation
- Airway trauma like laryngeal stridor or spasm, bleeding were noted.
- Reaction Score

Statistics

Data was analyzed using statistical software (SPSS Inc., Chicago, USA). Demographic and clinical data from the two groups were compared using the two tailed t test and chi-square test. Comparison of vital parameters was done with paired-t-test. Intergroup comparision of success rate of intubation was done with chi-square test. Intergroup comparision of vital parameters and time taken for successful intubation was done with ANOVA test and. All quantitative data were expressed as mean ± standard deviation (SD). A P-value of less than 0.05 was considered statistically significant.

Result

Demographic profile of patients in two groups was comparable and non-significant (Table 1).

Baseline Mean heart rate before intubation, in retrograde and fiberoptic group was 75.23 ± 8.178 and 78.37 ± 10.371 respectively and at the end of intubation (5 min) increase in mean heart rate was noted which was 102.55 ± 9.67 in group REI and 103.75 ± 9.605 in group FOB. This increase was statistically significant as compared to baseline. After intubation mean heart rate decreased 92.40 ± 9.73 in group REI and 86.50 ± 11.640 in group FOB (Table 2).

Table 3 shows Mean arterial pressure before intubation, in retrograde group it was 84.20 ± 5.013 and in fiberoptic group it was 85.33 ± 7.466. During end of intubation (third 2 minutes) there was maximum increase in mean arterial pressure and mean were 94.32 ± 5.91 in group REI and 97.50 ± 3.697 in group FOB, which was statistically significant compare to baseline. After intubation in both group with mean of 90.27 ± 5.90 and 87.83 ± 7.42 respectively (Table 2).

Groups	Number	Age (yr)	Weight (kg)	Gender (M:F)
REI	30	35 ± 8.1	62 ± 12.2	15:15
FOB	30	38 ± 10.12	64 ± 10.41	18:12

Table 1: Demographic profile.

Mean SpO_2 before intubation in both group was 98.83 ± 1.177. Maximum Decrease in mean Spo2 during end of intubation (third 2 minutes) was 88.95 ± 3.139 which was highly significant as to compare before intubation. Paired-t-test result showed t=5.902 and p<0.05 which was significant.

As shown in Table 3, In Retrograde group, out of 30 patients 20 patients (66.7%) were intubated successfully.

In Fibreoptic group, out of 30 patients 28 patients (93.3%) were intubated successfully. Percentage of airway trauma were higher in group REI (76.7%), >65%present with sore throat and complications was not any life threatening.

Group	Before intubation	Time in Minutes during Intubation			After intubation
		1 min	3 min	5 min (end of intubation)	
Group REI					
HR (bpm)	75.23 ± 8.17	81.97 ± 8.53	90.83 ± 9.18	102.55 ± 9.67*	92.40 ± 9.73
MAP	84.20 ± 5.01	90.93 ± 5.29	90.00 ± 5.83	94.32 ± 5.91*	90.27 ± 5.90
Spo_2	98.83 ± 1.17	96.47 ± 1.63	93.17 ± 1.96	88.95 ± 3.13*	94.87 ± 2.86
Group FOB					
HR	78.37 ± 10.37	87.03 ± 10.64	94.60 ± 8.37	103.75 ± 9.60*	86.50 ± 11.64
MAP	85.33 ± 7.46	92.27 ± 7.12	91.20 ± 7.39	97.50 ± 3.69	87.83 ± 7.42
Spo_2	98.23 ± 1.50	95.50 ± 2.55	91.33 ± 3.47*	87.75 ± 1.50*	96.73 ± 2.47
*p-value<0.05 is statistically significant as compared to base line value in both group.					

Table 2: Hemodynamics and SpO_2.

Variables	Group REI (n=30)		Group FOB (n=30)	
	No.	%	No.	%
Success rate of intubations	20	66.7	28	93.3
*Airway Trauma	23	76.7	11	36.7
*Airway trauma defined as bleeding, laryngeal edema and laryngospasm.				

Table 3: Success rate and airway trauma.

As shown in Table 4, in group REI minimum and maximum time required for intubation were 2 min and 6 min respectively with mean of 5.10 ± 1.155. In Fibreoptic group the minimum and maximum time required for intubation were 1 min and 6 min respectively with mean of 2.83 ± 1.621.

Variables	REI	FOB	p value
Time taken for intubation (SD) in minutes	5.10 ± 1.155	2.83 ± 1.621	0.000*
No. of attempts (Mean ± SD)	2.10 ± 0.845	1.60 ± 0.724	0.018*
*Reaction Score	2-4	1-3	
*Discomfort/Reaction score to placement of ETT on the scale of 1-5, where 1=no reaction 2=slight grimacing, 3=severe grimacing, 4=verbal objection, 5=defensive movement of head/hand.			

Table 4: Duration for intubation.

Discussion

Management of difficult airway is improving day by day. Difficulty or failure in airway management is still important factors in morbidity and mortality related to anaesthesia. Wilson and Kopf [3] noted that during routine anaesthesia the incidence of difficult tracheal intubation is 3-18%. In our study we compared tracheal intubation done through two different techniques that is retrograde tracheal intubation and fiberoptic assisted tracheal intubation.

In Present study, we observed that endotracheal intubation using REI in one group and FOB in other group caused significant increase in blood pressure and heart rate compared to baseline values ($p<0.05$). Maximum increase in heart rate and mean arterial blood pressure was at the end of endotracheal intubation (Table 2). Our results are in consistence with the results of Singh et al. [4], Finfer et al. [5] and Xue et al. [6] which showed significant rise in heart rate and blood pressure during and after nasotracheal intubation.

However, this was in contrast to study done by Sun et al. [7], Smith et al. [8] which showed no significant difference in blood pressure and heart rate between the two groups ($p=0.13$). This inter study difference may be related to their use of intravenous sedation prior to intubation which causes decrease in rise of mean arterial pressure and heart rate.

A study done by Lee et al. [9] to evaluate the change of blood pressure, heart rate and oxygen saturation in patients intubated with fibreoptic showed no significant change in heart rate, blood pressure and oxygen saturation during and after intubation which was in contrast to our study.

In present study there was reduction in oxygen saturation in both groups. There is significant change in oxygen saturation during intubation at 1 minute, 3 minute, and 5 minute on comparing with pre-intubation values (Table 2).

There was no study available which compared the total average time taken during intubation by using Retrograde and Fibreoptic technique. Our study demonstrates that endotracheal intubation facilitated by FOB required lesser time compared to retrograde intubation (Table 4), this is favourable for patient as prolonged intubation time can induce hypercarbia, increases in blood pressure and heart rate. However, study done by Finfer et al. [10] comparing direct laryngoscopy and fibreoptic intubation showed total time taken for intubation was significantly longer with the fiberoptic bronchoscope.

On comparing the success rate of intubation in both groups, our study showed that in FOB group out of 30 patients 28 patients were

successfully intubated (93.3%) while in REI group 20 patients out of 30 patients were intubated successfully (66.7%).

In REI group 23 patients (76.7%) out of 30 suffered upper airway trauma whereas in FOB group 11 patients out of 30 patients (36.7%) had airway trauma this difference was statistically significant ($p<0.001$). Intubation associated airway complication were similar in a study done by Sun et al. [7]. In a study done by Woodall et al. [10] showed out of 180 subjects 20 had upper airway trauma during Fibreoptic intubation (10%). Airway trauma was not seen in patients who were intubated in less time and number of attempts taken to intubate were less.

REI is an alternative technique in difficult situation where blood and secretion within oral cavity and unavailability or expertise restricts the use of fiberoptic equipment [11]. This technique is relatively easy and safe, and should be considered in difficult airway management.

Conclusion

We conclude that there is greater hemodynamic changes, greater time taken and low success rate in the technique of retrograde endotracheal intubation in comparison of fibreoptic intubation. Retrograde endotracheal intubation technique should be practiced in difficult airway situations only when fibreoptic is unavailable or it fails to intubate the trachea.

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Nil

Conflicts of Interests

None

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