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STUDY OF HEMODYNAMICS AND TIMES TO REACH LANDMARKS IN FIBEROPTIC NASAL AND ORAL INTUBATIONS BY ANESTHESIA TRAINEES IN ADULTS UNDER GENERAL ANESTHESIA – A PROSPECTIVE RANDOMIZED TRIAL.

Anesthesiology

Dr Sunil K Kamra* MD, DA, Assistant professor, Anesthesia, CCMMC, Kachandur durg, Chhattisgarh PIN 490024 *Corresponding Author

Dr Pratyush Tripathy MBBS, Resident, Dept. of Anesthesia, JLN Hospital & Research Centre, Bhilai

Dr Jayita Sarkar MD , Consultant, Dept. of Anesthesia, JLN Hospital & Research Centre, Bhilai, Chhattisgarh, INDIA PIN 490009

ABSTRACT

Times to reach various landmarks of fiberoptic guided oral and nasotracheal intubation clocked by 10 resident trainees in 60 adults under general anesthesia were studied. In group N (n=30), intubation was done with intubation fiberscope through nasal route and in group O (n=30), through oral route. Each trainee was given 6 intubations, 3 oral and 3 nasal, after instruction drill on intubating manikin. Times and intervals to intubate recorded in oral group were lower than nasal. A significant rise from baseline values was recorded in all hemodynamic parameters in both groups. However, rise in oral group was less severe and less sustained than in nasal group.

KEYWORDS

Fiberoptic Intubation; Oral; Nasal; Hemodynamic; Trainees

INTRODUCTION

Safe airway management is the prime focus of training under continuing medical education in anesthesia discipline. Despite advent of numerous airway devices, endotracheal intubation stays the gold standard for maintenance of airway patency. Since its first use in 1960s, fiberscope has emerged as a vital tool in clinical anesthesia. In today's anesthesia practice fiberscopes are used for airway examination and its evaluation, in positioning of endobronchial devices apart from endotracheal intubation in anesthetized as well as awake patients[1]. Fiberoptic intubation is no more the special skill acquired by selected specialists to practice. It is now felt that every trained specialist in anesthesiology should be performing safe and successful intubation using fiberscope in conscious and anesthetized patients using oral or nasal route. Fiberscope has all-important place in airway management also. Needless to say, to know and master the technique of intubation with fiberscope is essential for anesthesia trainees. This will be possible only if the technique is practiced under actual clinical situations. It is further advisable to impart training at an early stage of anesthesia residency programme.

It is understandable that time taken to intubate is an important factor to avoid hypoxia and its adverse effects. Basic technique of fiberscope needs coordination of hand and eye movements[2] and identification of anatomical structures on way to reach laryngeal orifice and the trachea. The techniques may vary by approach route, oral or nasal chosen in either awake or anesthetized patients. It is well understood from previous studies that success of fiberoptic intubation largely depends on the skill and experience of anesthesiologist[3-5].

We could not trace any reference that compared time intervals and circulatory responses during nasal and oral fiberoptic intubation by less experienced trainees in adult anesthetized patients. Though subjective variations may be wide, we decided to undertake a randomized prospective study of times taken by resident trainees for oral and nasal fiberoptic intubations and compare the two. Hemodynamic changes recorded during the procedures were also compared.

METHODS

After approval of ethical committee, the study was conducted in the department of Anesthesia, Jawaharlal Nehru Hospital and Research Centre, Bhilai from September 2016 to July 2017. Sixty ASA I and II patients aged between 18 and 60 years of either sex, having Mallampati grade I & II and undergoing elective surgery under general anesthesia in whom both oral and nasal intubation could be performed, were included in the study. Patients with anticipated difficult airway, active upper airway infection, oral or nasal pathology, inadequate oral or nasal passage, cardiovascular disease and coagulopathy were excluded from the study.

Sample size:

Based on previous study[5] using fleiss formula, sample size was calculated as following

P_1 = proportion of number of maneuvers to obtain adequate laryngeal view in case of nasal intubation = 40% = 0.40,

Q_1=1-P_1= 0.60

P_2 = proportion of number of maneuvers to obtain adequate laryngeal view in case of oral intubation = 4% = 0.04

Q_2=1-P_2= 0.96

By formula of Fleiss

$N = \{1.96*\sqrt{P'Q''}+0.84*\sqrt{(P1Q1+P2Q2)}/(P1-P2\}2$

Where P'= (P1+P2)/2 & Q'=1-P'

Hence minimum sample size N=20 in each group i.e. sample size could be ≥ 20 in each group.

To increase reliability and power of the study, we recruited 60 patients into our study with 30 patients in each group. The patients were randomly allocated using computer generated numbers to two groups:

Group N comprised of 30 patients undergoing fiberoptic nasal intubation.

Group O comprised of 30 patients undergoing fiberoptic oral intubation.

Intubations using KARL STORZ Intubation Fiberscope 5.2 x 65 having 110^0 angle of view were performed by ten anaesthesia trainees of 2nd and 3rd year clinical anesthesiology residency who were adequately trained in airway management. The trainees had minimal or no prior experience of fiberoptic intubations in clinical situations. A training session of 5 hours was conducted where trainees were taught basic fundamentals and skill of fiberoptic intubation. All trainees were allowed to practice fiberoptic intubation techniques on an intubating manikin until intubation times of less than 30 seconds were achieved on the model. After this each resident performed six fiberoptic intubations (three on each route), allocated in a randomized fashion, under guidance of an anesthesiologist, who is an expert in fiberoptic intubation.

All patients were pre-medicated with oral Alprazolam 0.5 mg and Ranitidine 300 mg on the night before surgery. On the morning of surgery, patients were brought to operation theatre and after attachment of multipara monitor, initial hemodynamics (Systolic Blood Pressure, Diastolic Blood Pressure, Mean Arterial Pressure, Heart Rate, Oxygen Saturation) were recorded. These values were considered as the pre-intubation baseline values. After placement of an appropriate sized intravenous cannula, patients received Fentanyl 2 µg/kg IV and Glycopyrrolate 4µg/kg IV. Pre-oxygenated patients were then induced with Inj Etomidate 0.3 mg/kg IV. Having confirmed adequate mask ventilation, muscle relaxation was achieved by

Vecuronium 0.08-0.1 mg/kg IV to facilitate tracheal intubation. Patients were ventilated with 2 % Sevoflurane in Oxygen. Level of muscle relaxation was monitored and once ulnar nerve response to train of four stimuli disappeared, intubation was attempted.

In group N, size of the endotracheal tube (ETT) was decided according to patient's nasal patency. Nasal preparation was done and pre-lubricated ETT was threaded over the fiberscope. The operator trainee standing at the head end of the patient introduced the fiberscope through the more patent nasal passage. Once in the oropharynx first landmark, the epiglottis was identified. The scope was then advanced to the second landmark, the laryngeal opening to obtain complete midline view of vocal cords and further to view third landmark, the tracheal bifurcation. ETT was then advanced into the trachea over the scope and fiberscope was removed gently through the endotracheal tube looking for position of the ETT. The breathing circuit was then connected to the endotracheal tube inlet and ventilation was confirmed by appearance of normal square wave capnogram on monitor. time

In group O, the fiberscope loaded with a well lubricated appropriately sized endotracheal tube was introduced through a bronchoscope insertion tube into the oropharynx and advanced as in nasal approach till carina was visible and placement of endotracheal tube was confirmed by appearance of normal square wave capnogram on monitor.

Two attempts were allowed for intubation and second attempt started afresh at time zero. Intubation by either technique was considered a failure if intubation time exceeded 3 minutes or oxygen saturation decreased to less than 90%. In either of these circumstances, the lungs were ventilated by mask again and intubation was reattempted using alternative technique. Those patients were excluded from the study. During the observation, a third person noted the time intervals using a digital stopwatch. Time zero was, when the fiberscope was picked up by the trainee performing intubation. Then four separate intervals were recorded on command of operator by third person using lap function on the stopwatch.

Time for first epiglottis view (T^{EG})- The time taken from picking up of fiberscope to first view of epiglottis.

Time for first glottic view (T^{G})- The time taken from picking up of fiberscope to placement of fiberscope tip over glottis with a complete midline view of vocal cords.

Time for first bifurcation view (T^{TB})- The time taken from picking up of fiberscope to first view of bifurcation of trachea.

Time for successful intubation (T^{I})- Total duration of time from picking up of fiberscope to observation of square wave end-tidal capnogram on monitor.

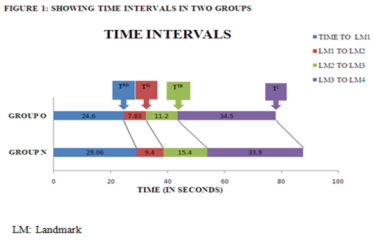
Times intervals between epiglottis to glottis ($T^{G} - T^{EG}$), glottis to tracheal bifurcation ($T^{TB} - T^{G}$) and tracheal bifurcation to appearance of square wave end-tidal capnogram on monitor ($T^{I} - T^{TB}$) were calculated. Systolic blood pressure, Diastolic blood pressure, Mean arterial pressure, Heart rate and Oxygen saturation were monitored by multipara monitor and recorded at an interval of one minute for the first five minutes after intubation. Patients were observed for any complications like bronchospasm, trauma, bleeding etc. Times, intervals and hemodynamics recorded in two groups were compared. Any event of complication was also recorded.

Qualitative data were analyzed using Chi Square Test. Quantitative data were analyzed using Percentage, Mean, Standard Deviation and T test using statistical software SPSS 16.0. *P* value of < 0.05 was considered statistically significant.

RESULTS

Demographics of the two groups were similar. The comparative demographic data between the two groups showed that maximum number of patients in both groups were between 20 to 30 years of age. Mean age, weight and male female ratio of two groups were comparable.

Successful fiberscope guided intubation was achieved with first attempt in all patients except 3 patients in oral and 4 in nasal group who required second successful attempt at intubation. Residents took significantly less time to reach first landmark, the epiglottis T^{EG} (24.6±6.34 seconds in oral vs 29.06±9.89 seconds in nasal), second landmark, the full midline view of glottis T^{G} (32.47±9.16 seconds in oral vs 38.47±12.73 in nasal) , third landmark, the tracheal bifurcation T^{TB} (43.67±9.09 in oral vs 53.86±13.64 in nasal) and finally successful intubation T^{I} (78.23±17.06 in oral vs 87.83±17.25 in nasal) in oral group as compared to nasal group. Accordingly time intervals calculated, $T^{G} - T^{EG}$, $T^{TB} - T^{G}$ were lower in oral group than in nasal group whereas $T^{I} - T^{TB}$ interval of the two groups were of equal measure. (Figure 1)



LM: Landmark

Mean preintubation values of hemodynamic parameters, systolic blood pressure, diastolic blood pressure, mean arterial pressure and heart rate were comparable. Intubation resulted in significant increases in systolic blood pressure, diastolic blood pressure and mean arterial pressure compared to baseline values in both groups. When compared with fiberoptic oral intubation, fiberoptic nasal intubation resulted in more severe and sustained presser responses. Blood pressure values were significantly higher in nasal group

than oral group at all points of observation. In the oral group blood pressure values reverted to baseline levels by the 3rd minute post intubation where as in nasal group, SBP remained significantly higher than baseline values till 5th minute post intubation while DBP and MAP were significantly higher till 4th min after intubation. (Table 3)

Table 3: Showing comparison of hemodynamic response in the two groups

	BASELINE; MEAN(SD)	POST INTUBATION				
		1 min	2 min	3 min	4 min	5 min
SBP; mmHg						
GROUP N	121.53(8.01)	158.03(14.87)*	153.97(17.31)*	139.90(11.89)*	132.13(10.54)*	125.5(9.88)*
GROUP O	123.50(8.97)	147.80(17.31)*^	133.23(13.21)*^	124.40(11.01)^	121.60(10.5)^	117.23(8.12)*^
DBP; mmHg						
GROUP N	73.10(8.69)	101.9(11.1)*	91.87(11.30)*	82.53(12.3)*	77.79(10.59)*	72.24(10.06)
GROUP O	70.73(6.19)	91.27(7.76)*^	78.23(8.93)*^	69.50(7.7)^	68.67(7.8)^	68.57(7.76)
MAP; mmHg						
GROUP N	91.07(8.73)	120.57(11.39)*	113.17(12.15)*	103.43(11.13)*	96.27(10.01)*	92.40(12.96)
GROUP O	89.50(7.22)	113.03(10.55)*^	98.77(10.03)*^	89.57(8.29)^	88.00(8.37)^	86.17(7.54)^
HR; min-1						
GROUP N	93.10(10.84)	90.60(7.59)	110.53(10.57)*	112.53(10.6)*	104.37(13.46)*	98.10(12.54)*
GROUP O	92.00(7.29)	101.30(8.48)*^	105.70(9.95)*	100.93(9.87)*^	95.90(8.84)^	95.10(9.06)
SPO2;%						
GROUP N	98.73(1.17)	99.17(0.75)	99.47(0.63)	99.83(0.38)	99.83(0.38)	99.77(0.5)
GROUP O	98.97(1.07)	99.13(0.9)	99.33(0.76)	99.57(0.68)	99.70(0.6)	99.60(0.67)

***p <0.05 compared with baseline values. ^p <0.05 comparison between the two groups.**

SBP: Systolic Blood Pressure, DBP: Diastolic Blood Pressure, MAP: Mean Arterial Pressure, HR: Heart Rate, SD: Standard Deviation

In the nasal group, mean Heart rate value at 1st min after intubation, was comparable with baseline value. Thereafter, values were significantly higher than basal values till the 5th minute post intubation. In the oral group, significantly higher values of HR compared to baseline values were noted till the 3rd min after intubation with values returning to baseline levels by 4th min post intubation. In comparison to fiberoptic oral intubation, mean HR values in fiberoptic nasal intubation was significantly lower in the 1st min, comparable in the 2nd min and significantly higher in the 3rd and 4th min post intubation.(Figure 2/ table 3)

Arterial oxygen saturation was comparable between the two groups at all points of observation and no patients desaturated to < 90% during the procedures in either group. No incidence of adverse event was recorded during the observed period in either group.

DISCUSSION

Fiberoptic intubation, oral and nasal, in awake and anesthetized patients are four separate intubating techniques that require separate skills and generate separate physiological responses. So it is not hard to understand that the time taken for intubation as well as hemodynamic response of the patient to fiberoptic intubation will vary from trainees to experts. A number of studies have been conducted to assess the learning process of fiberoptic intubation by trainee residents[3,4,5] but few have compared ease and safety of fiberoptic intubation techniques by oral and nasal routes by trainee residents. C Johnson et al. in 1989 published "Clinical competence in the performance of Fiberoptic Laryngoscopy and Endotracheal Intubation: A Study of Resident Instruction[3]" and concluded that after the tenth intubation, the mean time was 1.53±0.76 minutes down from 4.00±2.91 and the percent success on the first attempt at intubation was greater than 95%.

In our study in adults residents took significantly less time to obtain first view of the first landmark, the epiglottis, through oral route. Similarly the view of further landmarks i.e. glottis, tracheal bifurcation and time taken for successful intubation were faster through the oral route. The calculated time intervals between the landmarks were lower in oral group than in nasal group whereas time taken for successful intubation after view of tracheal bifurcation in both the groups was of equal measure. The consumption of more time for epiglottis view through nasal route can be explained by the longer path traversed by fiberscope though nasal cavity to reach the epiglottis as compared to oral route. Moreover using bronchoscope insertion tube for oral intubation facilitated the passage of fiberscope through the oral cavity up to oropharynx[6].Alternatively, greater familiarity of trainees with the oral and oropharyngeal anatomy as compared to the nasal and nasopharyngeal anatomy may also be a reason for shorter intubation times in oral group. However N Jagannathan et al [5] reported no difference in intubating times between nasal and oral routes (median of 39 and 42 seconds respectively) in children less than 2 years of age for experts while for less experienced trainees, intubation times were shorter with nasal route (median of 62 seconds against 117 seconds for oral). This was explained by the fact that anatomical features of this age include a more cephalad larynx, floppy epiglottis, large tongue that make intubation more difficult through the oral route [7–9]. The nasal approach may potentially overcome these challenges by allowing a straighter pathway to the larynx [9–11]. Previous studies on fiberoptic guided intubations where intubations were performed by experts registered shorter mean intubation times. FS Xue et al[12] reported mean intubation time of 53.2±8.5 seconds in adults during fiberoptic guided nasal intubation. Similarly, average timing of fiberoptic guided oral intubation in adults by experts was 34.5±8.9 seconds. Both these timings were significantly shorter than the average timings clocked by trainees in our study. Same authors reported mean intubation timings of 39.9±12.8 seconds and 42.4±13.3 seconds for fiberoptic nasal intubation in children performed by two expert anesthesiologists[13]. Fiberoptic guided oral intubation in children were completed with average timings of 35.1±13.1 seconds and 37.8±13.7 seconds by experts. These time intervals were also significantly shorter as compared to our results.

Circulatory response to airway stimulation may vary with site and duration. It has been demonstrated that there are significant differences in circulatory response to airway stimulation at different sites[14]. Reports have shown that simple nasopharyngeal airway insertion produces a significant hypertensive response compared to oropharyngeal airway[15]. Fiberoptic nasal intubation is a more time-consuming and more invasive airway procedure than fiberoptic oral intubation because both the tracheal tube and fiberscope have to be inserted through the nasal passage[12,13]. As a result, fiberoptic nasal intubation can precipitate greater circulatory responses than fiberoptic oral intubation. The relationship of longer intubation time with higher stress response is explained by the fact that longer intubation time is more likely to produce hypercapnia, which can result in hypertension and tachycardia[16], more sympathetic activity[17] and waning anesthetic effect of intravenous anesthetic agent in addition to hypoxia and hypercarbia. JE Smith et al in 1988[18] compared fiberoptic orotracheal intubation to intubation by Macintosh laryngoscope and showed that time taken for fiberoptic intubation was significantly longer with more severe cardiovascular responses than those which followed intubation effected with a Macintosh laryngoscope. Shibata et al[19] demonstrated that in adults, the circulatory responses to fiberoptic nasal intubation were more severe than those to fiberoptic oral intubation and recommended use of fiberoptic oral intubation in patients with coronary artery disease.

Our study showed similar results. Post intubation both nasal and oral group resulted in significant increases in systolic, diastolic and mean arterial pressures compared to baseline values. When compared with fiberoptic oral intubation, nasal intubation resulted in more severe and sustained presser response. Blood pressure values were persistently higher in nasal group than in oral group at all points of observation. In contrast, the study done by FS Xue et al[12] showed that both FOI and FNI caused significant increases in blood pressure, heart rate and rate pressure product compared to baseline values. But there were no significant differences in blood pressure, heart rate and rate pressure product at any of the measuring points or in their maximum values during the observation between the two groups.

However the study was done by experts and they used nasal tube made of latex rubber with a soft texture which may have alleviated mechanical stimuli to the nasal cavity, nasopharynx, larynx and trachea.

In our study, the heart rate changes following intubation showed a different trend to that of presser response. The heart rate associated with nasal fiberoptic intubation was significantly less than that of oral fiberoptic intubation during the first minute after intubation. In the 2nd minute, the heart rate values were comparable and 3rd minute onwards up to 5th minute values of nasal intubation group were significantly higher than the oral group. JE Smith and MS Grewal[20] also found that the tachycardia associated with nasal intubation was significantly less than that of oral intubation during the first minute after intubation. FS Xue et al[12] also demonstrated a less severe tachycardic response to nasal fiber optic intubation. This slower heart rate during the first minute after intubation in the nasal group may be mediated by baroreceptor reflexes in response to a more rapid increase in arterial pressure during nasal intubation. Alternatively, it may be the result of the influence of the nasocardiac reflex[20]. This trigeminovagal reflex arc is analogous to the more widely recognized oculocardiac reflex, and has been implicated in the development of profound bradycardia following intranasal instrumentation[20-22].

From our study we could infer that after targeted training drill resident trainees could successfully complete first attempt tracheal intubation with fiberscope in about 90% paralyzed patients. Oral route of fiberscope guided intubation was easier as they clicked lower times to reach various landmarks of fiberoptic intubation than through nasal route. This was the primary outcome of our study. That fiberoptic orotracheal intubation generates less severe hemodynamic response thereby causing less stress to heart and thus stands as the better choice of fiberscope guided intubation by resident trainees, is the secondary outcome. We also feel times to reach first landmark, the epiglottis and time interval between view of tracheal bifurcation and confirmed tracheal intubation ($T^{I} - T^{TB}$) are more likely to improve with time and experience of operator.

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