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Original Research Article.

Comparison of Standard Polyvinyl Chloride Tube and Flexometallic Tube For Orotracheal Fiberoptic Intubation in Adults Under General Anaesthesia

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ABSTRACT

Aims: This study was carried out to compare Polyvinyl Chloride (PVC) and flexometallic endotracheal tube during oral fiberoptic intubation in terms of difficulty in passage of endotracheal tube, fiberoscopy time, intubating time, no. of attempts, post operative sore throat and any adverse effects.

Methods: The study was conducted on 100 patients of either gender aged between 18-60 years with ASA physical status I or II scheduled for elective surgeries under GA who were randomly divided into two groups. In group-I oral fiberoptic intubation was done by using Polyvinyl Chloride Endotracheal Tube and in group-II flexometallic endotracheal tube was used. After induction of general anaesthesia, the fiberoscope was advanced till the bifurcation trachea and endotracheal tube was railroaded. If there was any resistance in the passage of tracheal tube, the tube was manipulated, patient's neck flexed and external laryngeal manipulation was done. Grade of difficulty in passing the tube, number of attempts, fiberoscopy time (starting fiberoscopy (T_0) to the tip of the fiberoscope reaching carina) and intubating time (starting from fiberoscopy (T_0) to withdrawing the fiberoscope from the mouth after endotracheal tube insertion) was recorded and compared.

Results. Our study showed statistically significant difference between group I and group II. (p value 0.001) when the grades of difficulty in passing endotracheal tube were compared.

Conclusion: During oral fiberoptic intubation, the use of the flexometallic tube results in significantly lesser difficulty and lower chances of repeated attempts in passing the endotracheal tube through glottis as compared to a PVC endotracheal tube.

Key words: Endotracheal, Flexometallic, Oral Fiberoptic, Intubation.

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INTRODUCTION

Fiberoptic Intubation is an effective technique for establishing airway access with both anticipated and unanticipated difficult airways. Fiberoptic orotracheal intubation may be more difficult to perform under general anaesthesia as induction of general anaesthesia causes the soft palate, tongue and epiglottis to approximate to the posterior pharyngeal wall and little air space is left in the oropharynx for manoeuvring the tip of the fiberoscope to locate the glottis in oral fiberoptic intubation.[1,2] Also, there can be difficulty in insertion of an endotracheal tube (ETT) over the fiberoscope into the trachea. There are chances of failed tracheal intubation despite successful insertion of a fiberoscope into the trachea.

Impingement of the tracheal tube during fiberoptic intubation is an important concern as it can cause trauma to the larynx and bleeding in the airway and can eventually result in failed intubation. The important aspects of ETT design which effect the passage through glottis are the shape of the bevel, the material of ETT, and the ability of the tube to conform to the shape of fiberoscope.[3]

While attempting to railroad the tracheal tube over the fiberoscope, the natural curve of the tube is aligned sagittally with respect to the patient, so bevel faces patient's left. With this orientation of the tube, the rate of successful intubation at the first attempt ranges from 10-11% to 77%.[4] The low success at the first attempt causes patient discomfort and decrease in patient's oxygenation. Many studies have suggested this failure is because of impingement of tube on right arytenoid cartilage which is frequently relieved by a 90-degree anticlockwise rotation of the tube. Directing the bevel of the tube posteriorly during first attempt at railroading increases the success rate.[3,4]

Several studies have compared different designs of tracheal tubes for fiberoptic intubation in an attempt to identify a design that would minimize the problem. The choice of ETT depends upon the clinical situation and tube availability. The design of an ETT has been shown to influence the passage of tube though glottis during fiberoptic intubation.

Michael S. Kristensen et al in 2003 compared the Parker Flex Tip (PFT) tube versus a standard tube for orotracheal fiberoptic intubation and concluded that PFT tube is associated with greater success of passage as compared to a standard tube.[5]

On comparison of PVC tube with a standard bevel and a newly designed silicon tube with a bevel of different shape by Greer et al, silicon tip tube was better than PVC tube in oral fiberoptic intubation.[6]

However, no clear data exists on comparison of Polyvinyl Chloride (PVC) and flexometallic ETT on orotracheal fiberoptic intubation. Hence a randomized and controlled clinical study was conducted to compare polyvinyl chloride and flexometallic ETT in patients undergoing orotracheal fiberoptic intubation under general anaesthesia with the primary objective to compare the difficulty in passing the endotracheal tube through the glottis.

MATERIALS AND METHODS

After approval from the institute ethical committee and registration in the clinical trials registry of India (CTRI/2019/10/021743), this prospective randomized study was conducted on 100 patients of either gender aged between 18-60 years with ASA physical status I or II scheduled for elective surgeries under GA. They were divided into 2 groups of 50 patients in each group. The random assignment of a particular patient in a specific group was done using computer generated random numbers. Exclusion criteria includes Age<18 yrs, ASA physical status >II, any difficulty in ventilation or intubation, non-fasting patients, patients with known pathology in mouth, pharynx, larynx. A written informed consent was obtained from each patient after explaining the technique prior to inclusion in this study in their own vernacular language.

In group-I oral fiberoptic intubation was done by using Polyvinyl Chloride Endotracheal Tube and in group-II flexometallic endotracheal tube was used. Standard monitoring during induction and maintenance included electrocardiogram, pulse oximetry, non-invasive blood pressure, end tidal CO_2. The fiberoptic scope (OlympusBF-PE2 with 4.9mm outer diameter) was prepared, connected to camera and closed-circuit television monitor, focused and loaded with ETT. Endotracheal tube with internal diameter 7.0 and 8.0 was used for female and male patients respectively. Patients were anaesthetized and paralysed before the start of fiberoscopy and tracheal intubation. Anaesthesia was induced with inj. glycopyrrolate 0.2mg IV, inj. butorphanol 20mcg/kg and inj. propofol 2.0 to 2.5 mg/kg. Muscle relaxation was achieved with inj. succinylcholine 1.5 mg/kg and patients were ventilated with 1.5% isoflurane in O2 for 1min. After removing the facemask, Berman airway placed into patient's mouth to act as a route guide for the fiberoscope. The stopwatch was started and this time was taken as (T_0). The assistant applied firm jaw thrust, keeping the patient's mouth open and the operator (experienced in fiberoptic intubation) then advanced the fiberoscope into the mouth along the dorsum of the tongue. Then the fiberoscope was advanced till the bifurcation of trachea. If there was any resistance in the passage of tracheal tube, the tube was manipulated, patient's neck flexed and external laryngeal manipulation was done. The difficulty in passing tube was assessed by using three-point scale.

Grade 1: no difficulty in passing the tube.

Grade 2: obstruction to passing the tube relieved by withdrawal and 90-degree anticlockwise twist.

Grade 3: obstruction requiring more than one manipulation or external laryngeal manipulation.

Number of attempts required to perform intubation and any difficulties during intubation were recorded. Fiberoscopy time (start of fiberoscopy (T_0) to the tip of the fiberoscope reaching carina) was recorded and endotracheal tube was passed through glottis under vision. Intubating time (starting from fiberoscopy (T_0) to withdrawing the fiberoscope from the mouth after endotracheal tube insertion) was recorded.

In case of failed intubation and decrease in SpO2, attempt was abandoned, and the patient was ventilated with 100% O2. Second attempt was taken after improvement of saturation. If manipulations didnt help, rigid laryngoscope was used. Any blood on tube at extubation and incidence of post operative sore throat at the time of discharge from postoperative recovery room was also noted. Heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, saturation was recorded during preoxygenation, every minute after introduction of fiberoscope and then every minute after introduction of endotracheal tube upto 5 minutes.

The data was recorded in the proposed performa and the final result was analysed statistically. The data was coded and entered into Microsoft Excel spreadsheet. Analysis was done using SPSS version 20 (IBM SPSS Statistics Inc., Chicago, Illinois, USA) Windows software program. Descriptive statistics included computation of percentages, means and standard deviations. The unpaired t test was used for quantitative data comparison of all clinical indicators. Chi-square test was used for qualitative data whenever two groups were used to compare. Level of significance was set at $P \leq 0.05$.

Table 1: Demographic Parameters (Age and Gender)

GROUP	Group I	Group II	P value	Significance
Age (years)	40.68 ± 11.01	39.08 ± 11.48	0.47	NS
Gender (F/M)	37/13	35/15	0.65	NS

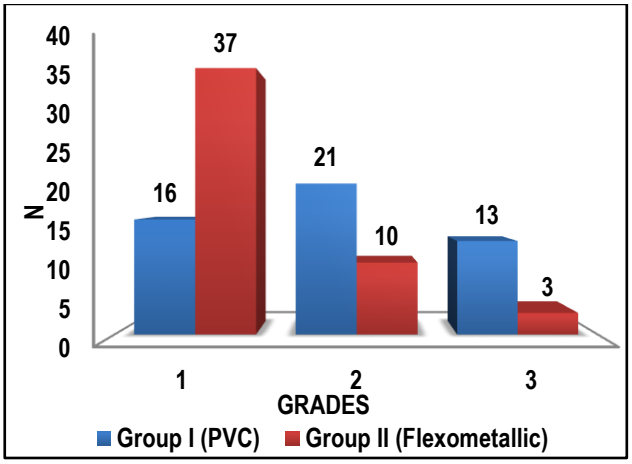

Fig 1: Difficulty of Passage of Tube Through Glottis

Table 2: Difficulty of Passage of Tube Through Glottis

Grades	Group I (PVC)		Group II (Flexometallic)	
	n	%	n	%
1	16	32	37	74
2	21	42	10	20
3	13	26	3	6
Total	50	100	50	100
p value	0.001 (S)			

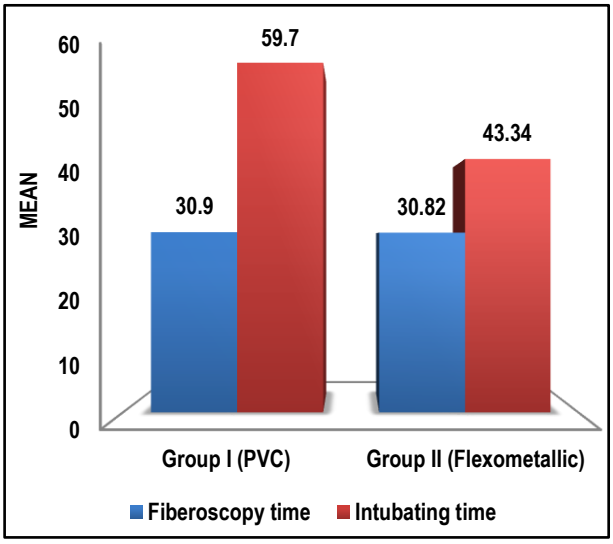

Fig 2: Fiberoscopy and Intubating Time

Table 3: Fiberoscopy and Intubating Time

Time(sec)	Group I(PVC)		Group II (Flexometallic)		p value
	Mean	SD ±	Mean	SD±	
Fiberoscopy time	30.9	3.808	30.82	3.205	0.91 (NS)
Intubating time	59.7	18.703	43.34	6.17	0.00 1 (S)

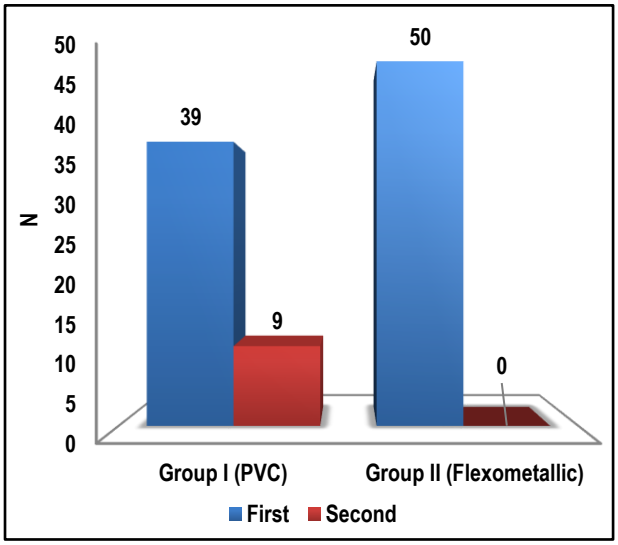

Fig 3: Number of Attempts

Table 4: Number of Attempts

Grades	Group I(PVC)		Group II (Flexometallic)	
	n	%	n	%
First	39	78	50	100
Second	9	18	0	0
Total	50	100	50	100
p value	0.001 (S)			

RESULTS

Demographic parameters were comparable in both the groups (table 1). We observed that the difficulty in passage the tube through glottis was significantly less with flexometallic tube. The difference in grade of difficulty in passage of ETT was statistically significant between group I and group II ($p < 0.05$) (fig 1, table 2). The fiberoscopy time was comparable in both the groups. The intubating time was significantly less in group II in comparison to group I. The intubating time was 59.7 ±18.70 sec in group I and 43.34 ±6.17 sec in group II. (fig 2, table 3) In Group I, out of 50 patients, 39 (78%) patients were intubated with first attempt and 9 (18%) patients with second attempt and 2 patients could not be intubated in second attempt also. In Group II, all 50 (100%) patients were intubated with first attempt. (fig 3, table 4). Post operative sore throat and hemodynamic parameters (HR, SBP, DBP, MAP, SpO2) were statistically comparable between the two groups.

DISCUSSION

The present prospective randomized and controlled study was conducted on 100 patients to compare PVC and flexometallic tube in oral fiberoptic intubation. Our primary goal was to assess the difficulty in passing endotracheal tube through glottis. Fiberoscopy time, intubating time, post operative sore throat, blood on tube at extubation and hemodynamic parameters were also assessed and compared in both the groups. Our study shows statistically significant difference between group I and group II (p value 0.001) when the grades of difficulty in passing endotracheal tube were compared. The difficulty in passing the tube through glottis was significantly less with flexometallic tube indicating flexometallic tube can modify the direction more easily helping in easier fiberoptic intubation.

Brull SJ et al compared flexible tracheal tube with standard preformed endotracheal tube in fiberoptic orotracheal intubation and found that a flexible wire-reinforced tube was superior than the standard tube (rate of impingement of the tube upon entering larynx being 1/20 in flexible wire-reinforced tube versus 13/20 in standard tube.[7] The results were similar to our study.

However, Connelly NR et al in the study to compare ease of insertion of wire reinforced tube with warmed standard tube for fiberoptic intubation, found no significant differences in ability to advance the tracheal tube between the two groups.[8] It was essentially due to prewarmed standard endotracheal tube use while we didn't use prewarmed polyvinyl chloride endotracheal tube.

We compared fiberoscopy time (starting fiberoscopy to the tip of the fiberoscope reaching carina) and intubating time (starting from

fiberoscopy to withdrawing the fiberoscope from the mouth after endotracheal tube insertion) in both the groups and there was no significant difference in fiberoscopy time between two groups. However, the intubating time was significantly less 43.34 sec in group II (flexometallic) in comparison to group I (PVC) 59.7 sec.

Michael S Kristensen et al studied the parker flex-tip (PFT) tube versus a standard tube for fiberoptic orotracheal intubation. While using the standard tube, some manipulation was needed (grade 1 or 2) to pass the tube in 34 (89%) patients. The number of patients requiring manipulation for PFT was 11(29%). Also, in the PFT group the time for passing the tube into the trachea (intubation time) was significantly shorter than the standard tube.[5,9]

Hakala et al compared tracheal tubes for orotracheal fiberoptic intubation. The rates of impingement were 20 out of 30 with the standard tube, 12 out of 30 with the warmed standard tube and 8 out of 20 with both spiral tubes with sharp and obtuse tip. There was no statistically significant difference between groups in fiberoscopy or intubation time.[4] As far as intubating time is concerned, we used polyvinyl chloride versus flexometallic endotracheal tubes whereas P Hakala et al studied four groups of standard tube, warmed standard tube, spiral tube with sharp tip and spiral tube with obtuse tip, so our result doesn't coincide with this study in terms of intubating time, reason being warmed standard tube was used by P. Hakala et al in their study.

In our study, in the patients randomized to the PVC endotracheal tube,78% (39/50) of first attempts to advance endotracheal tube through glottis were successful. In the patients randomized to the flexometallic endotracheal tube, 100% (50/50) of first attempts were successful ($p<0.001$). Out of 11 PVC endotracheal tubes that were not advanced on the first attempt, 9 were passed on second attempt and 2 could not be passed via fiberoscope in second attempt also.

Similarly, Brull SJ et al found that fiberoptic oral intubation with flexible spiral-bound tracheal tube was successful in the first attempt in 95% (19/20) patients which was significantly higher than the success rate in patients intubated using standard preformed tracheal tube 35% (7/20). Flexible wire reinforced tube was found to be superior to a standard tube.[7] A flexometallic endotracheal tube can change direction more easily and thereby lead to easier fiberoptic intubation. However, Connelly et al found similar ease of advancement with a flexible reinforced tubes and warmed standard tubes.[8]

Our data shows that the use of flexometallic endotracheal tube results in a significantly lesser difficulty in passage of endotracheal tube over the fiberoscope through glottis and it is more likely to successfully enter the trachea on first attempt as compared to PVC endotracheal tube during oral fiberoptic intubation. We propose that flexometallic tube being bendier and with posterior facing bevel in the neutral position in comparison with left facing bevel of standard PVC endotracheal tube, has a clinical advantage during fiberoptic intubation.

Our study entails two major limitations. First, all intubations were attempted by experienced users, and our results may not necessarily apply to less experienced personnel. Second, the fact that operator performing the fiberoptic intubation was not blinded to endotracheal tube and all data was recorded by unblinded observers may be a possible source of bias.

CONCLUSION

The study was aimed to evaluate the difficulty in passage of endotracheal tube through glottis using Polyvinyl Chloride endotracheal tube versus flexometallic endotracheal tube during oral fiberoptic intubation. The use of the flexometallic tube resulted in significantly lesser difficulty and lower chances of repeated attempts in passing the endotracheal tube through glottis as, compared to a PVC endotracheal tube. Hence, flexometallic tube may be used as a first choice for orotracheal fiberoptic intubation and may be helpful when PVC tube fails to pass through first attempt, thereby adding an important skill set in the armamentarium of an anaesthesiologist.

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