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# Comparison of North Pole (Ivory) V/S PVC Endotracheal Tube for Nasotracheal Intubation

Sanjay S Bule<sup>1\*</sup>, Sandhya A Bakshi<sup>2</sup>, Narendra Gupta<sup>3</sup> <sup>1,2</sup> Associate professor, <sup>3</sup>Senior resident

Government medical college Nagpur

# \*Corresponding Author:

**Dr. Sanjay S Bule** 

Department of anaesthesiology, Government medical college Nagpur

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## ABSTRACT

BACKGROUND: Nasotracheal intubation(NTI) is the preferred method of securing patient airway under anaesthesia for various intraoral, faciomaxillary and neck surgeries because of the advantage of good access to surgical field. Both Polyvinylchloride (PVC) endotracheal tube (nasal/oral) and preformed RAE (Ring Adair & Elwyn)endotracheal tube(ETT) is routinely used for nasotracheal intubation. we planned the present study to evaluate and compare the results of North pole ivory ETT and routinely used Polyvinylchloride( PVC) ET when used for nasal intubation.

Methods: Total 70 patients of either sex, ASA grade I and 2,of age group 18 to 60 years of normal nasal anatomy with mallampatti grade 1/2 airway posted for various elective surgeries, requiring general anaesthesia with nasal intubation. Vasoconstrictor Xylometazoline was instilled in both nostrils in all the patients. Induction was done with propofol and suxamethonium. Nasal intubation done with either north pole ivory tube (group S) OR portex PVC tube (group C). The various parameters noted and compared in two groups were, like ease of insertion, number of attempts, time required for successful intubation, incidence and severity of epistaxis, tube related problems and postoperative laryngopharyngeal morbidity.

**Result**: in the present study that the ease of intubation was significantly better in North pole ivory tube than that with PVC tube (p<0.05). The overall incidence of epistaxis was significantly less with North pole ivory tube 34.29% (mild epistaxis) than PVC tube (67.17%) (mild and moderate).

**Keywords:** Epistaxis, Nasotracheal intubation, north pole tube, xylometazoline

# **INTRODUCTION**

Franz Kuhn in 1902, first described the technique of nasotracheal intubation. It was further popularized by surgery<sup>1</sup>. intraoral Nasotracheal magill for intubation(NTI) is the preferred method of securing patient airway under anaesthesia for various intraoral, faciomaxillary and neck surgeries because of the advantage of good access to surgical field. Additional advantages like ease of fixation, greater patient comfort if intubation continued in postoperative period.

Different types of endotracheal tubes are used for nasal intubation. Various studies have described a variety of preferences regarding the choice of tube. The structure, shape, softness and flexibility of the endotracheal tube decides the success rate and complication rates<sup>2</sup>. Factors, such as tube lubrication, use of topical vasoconstrictors<sup>3,4,5,6,7</sup>, tube heating<sup>8,9</sup>, and the different designs of tip of tubes<sup>9,10</sup>, have also been used to reduce complications. The most common complication associated with nasotracheal intubation is epistaxis due to nasal abrasion, most commonly in

the anterior part of the nasal septum, which ranges from mild blood tinged mucus to massive epistaxis.

Both Polyvinylchloride (PVC) endotracheal tube (nasal/oral) and preformed RAE (Ring Adair & Elwyn) ET is routinely used for nasotracheal intubation. Modern preformed nasotracheal tubes made from synthetic materials like PORTEX North Pole tube (Ivory), by Smiths Medical International, Hythe, UK are specially designed for nasotracheal intubation during oral and maxillofacial surgeries<sup>11</sup>.

Considering the advantages and disadvantages of both the tubes and availability of both the tubes at our set up, we planned the present study to evaluate and compare the results of **North pole ivory** tube and routinely used **PVC** tube when used for nasal intubation in terms of Ease of insertion, Incidence & severity of nasal bleeding, Intraoperative tube related problems, and postoperative laryngopharyngeal morbidity.

#### Material and methods

It was a prospective randomized single blind study.

After written, valid informed consent, 70 Patients of age group 18-60 years, ASA Grade 1/2,Mallampatti grade 1/2,posted for elective oral/maxillofacial surgery under general anaesthesia with nasotracheal intubation were included in the study and equally divided randomized into two equal groups Group S-North pole ivory endotracheal tube(ETT) used and Group C-PVC ETT used .Patients with bleeding disorder, nasal trauma, nasal obstruction, atypical nasal anatomy, history of epistaxis/uncontrolled hypertension were excluded.

After preanesthetic checkup and fitness, nasal endoscopy by ENT surgeon and breathing test for Nasal Patency<sup>12,13</sup> done as i)Occlusion test: By asking the patients own assessment of nasal airflow during occlusion of each contralateral nostril in sitting position.And ii)Spatula test:patient breathed onto a spatula held 1 cm below the nostrils in sitting position if the area of condensation of one side had a diameter of 1 cm greater than that of the other then that side was regarded as clearer.

Patients were kept NBM for 8 hours prior to operation. On table, baseline pulse rate, BP, SPO2, ECG was recorded and I.V line was secured and Ringer lactate drip started .Xylometazoline 0.1% drops was installed in both the nostrils 5 minute before induction as a vasoconstrictor. After routine premedication with IV Ranitidine 2mg/kg, IV Glycopyrrolate 4 $\mu$ g/kg,IV Midazolam 0.03mg/kg and fentanyl 2mcg/kg, preoxygenation was done in all the patients for 3- 5 minutes. Patients were induced with IV Propofol 2mg/kg and IV Suxamethoniumchloride 2 mg/kg was given. A senior anaesthesiologist, with at least 3 years of experience of nasal intubation performed nasal intubation with either PVC(group C) or north pole IVORY (Group S) ETT as per group allotment. Intubation was done through patent nostril, If there was no difference in both the nostrils, right nostril was preferred for intubation.<sup>14</sup>

Endotracheal tube of internal diameter 7mm was used for males and 6.5 mm size for females for intubation after lubrication with lignocaine jelly before insertion. If some resistance was encountered during intubation then following manipulation like Gentle cephaled distraction of the tube or Slight withdrawl. and then reinsertion with minimal pressure and rotatory movement of the tube to negotiate the resistance.<sup>11</sup>. If it was not possible to negotiate the tube through patent nostril, then intubation was tried through another nostril or by orotracheal route as and when required. These patients were excluded from the study .Once the tube was beyond the nasal cavity then laryngoscopy was done and the tube will be directed towards the cords with or without the help of magills forceps as per the requirement . If some difficulty or resistance was encountered at glottis opening then manipulations like External laryngeal compression (to facilitate the entry of the end of the tube into the glottis)<sup>11,15</sup> Or rotation of the tube by  $180^{\circ}$  to negotiate it through glottis opening. Correct placement of tube was confirmed by chest inflation, auscultation of breath sounds and by ETCO2 tracing on monitor.Patient maintained on O2+N<sub>2</sub>O+sevoflurane and intermittent vecuronium. Following parameters were noted, during intubation,

**Ease of intubation** by observing,1)Passage of tube from nose to pharynx-i)smooth or ii)impingned

2)Manipulation required during passage of tubei)from nose to pharynx,ii)through glottic opening

3) Number of attempts for intubation as first, second and more than two

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4)Time required for intubation i.e.from picking up ETT to confirmed air entry by auscultation and  $ETCO_2$ 

5)Successful or not successful

A)Overall ease of intubation was graded as, Grade I-Easy without any manipulation. Grade II-Possible with manipulation. Grade.III-Not,possible.

**B**) Incidence and severity of nasal bleeding-The incidence and severity of bleeding was noted during laryngoscopy at the time of intubation and throat packing. It was graded<sup>11</sup> as follows,

a)Nil: No bleeding, b) Mild: Blood stained mucus in oropharynx, c) Moderate: Slight trickle /clot in oropharynx, d) Severe: Continuous trickle requiring nasal pack

Intraoperative monitoring of pulse rate, blood pressure, ECG,SPO2 was done.

C)Any critical incidence and intraoperative tube related problems were noted like Dislodgement of tube, Kinking or obstruction of tube, and Accidental extubation.

**D**) Postoperative laryngopharyngeal morbidity in the form of, Sore throat, Change of voice, Difficulty in breathing was observed upto 48 hours by follow up of patient.

All the observational data present in the study was subjected to statistical analysis. Continuous variables were compared between 2 groups by performing unpaired t-test. Categorical variables were variables compared by using Pearson's chi-square test. Fisher's exact test was applied wherever applicable. P<0.05 was considered as statistically significant.

# Results

In the present study nasotracheal intubation is successfully done in all the patients. It was observed that ease of insertion of tube from nose to pharynx was smooth in (82.29%) and impingne (17.14%) with Portex North pole ivory tube where as in PVC tube it was smooth in 57.14% and impingne in 42.85%. This difference was statistically significant(p<0.05)(table1). Manipulations required for negotiation of PVC tube from nose to pharynx for negotiation in 42.85% and in Portex North pole ivory tube in 17.14% which was also statistically significant.(p<0.05). Also, significant number of

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28.57% with PVC patients tube required manipulation to negotiate the tube at glottis opening as compared to only 8.57% patients of Portex North tube. pole ivory This was statistically significant(p<0.05).We found 25.71% patients in PVC group required manipulation both at nose to pharynx as well as at glottis opening and in Portex North pole ivory tube only 5.71% patient required which statistically the same was significant.(p<0.05).Almost all the patient from both the groups were intubated in first attempts except one patient in PVC group and attemptwise both the groups were statistically comparable. The mean time required in Portex North Pole ivory tube Group S was 73.57±11.98 and in PVC Group C was 79.86±16.89 which was comparable.(p>0.05). It was observed that the ease of intubation was significantly better in North pole ivory tube Group S than that with PVC tube (p<0.05). This was significant.

In the present study, the overall incidence of epistaxis was significantly less with North pole ivory tube 34.29% (mild epistaxis), whereas with PVC tube it was 67.17%(mild and moderate) which was statistically significant.(p<0.05) (table2).None of the patient in the intraoperative period has any critical incidence in the form of dislodgement, accidental extubation except in 2 cases of PVC Group there is kinking of tube which was not statistically insignificant.(p>0.05).The larygopharyneal complications observed in present study was sore throat which was 37.14% there in patients of North pole ivory tube and 34.14% in PVC. The sore throat mild clinically is and not significant statistically.(p>0.05).

One patient had incidence of change in voice in PVC group for short period and none in North pole ivory tube and statistically not significant (p>0.05).

### Discussion

Nasotracheal intubation (NTI) is the preferred method of securing patent airway under anaesthesia for various intraoral, faciomaxillary and neck surgeries. Polyvinylchloride (PVC) endotracheal tube (nasal/oral) with bevel 45°side bevelled, distal tip is routinely used for nasotracheal intubation as it is easily available, cheap, retains the curvature which is necessary for the ease of nasotracheal intubation and easy suctioning through it .However it has certain disadvantages like bleeding due to trauma to nasal

oral pathway and vocal cord because of stiffness of the tube and risk of kinking and obstruction.

Modern preformed nasotracheal tubes made from synthetic materials like portex North Pole tube (Ivory), by Smiths Medical International, Hythe, UK alternative good for nasotracheal is a intubation<sup>11</sup>.Thev are specially designed for nasotracheal intubation during oral and maxillofacial surgeries. Amongst the available preformed PVC tubes, they are most malleable for nasal passage and also retains their curvature which is required for ease of laryngeal intubation. These tubes are made from velvet soft plastic material by addition of greater amount of plasticizerdioctylphthalate which makes them soft and atraumatic and nonkinkable<sup>2</sup>. Velvet soft PVC material in combination with the springiness of these tube makes them ideal for nasal intubation<sup>2, 11</sup>. The design of the tube also enables the surgeons to access maxilla manipulations and facial symmetry during maxillofacial surgery. The advantage of curve of the tube is that it helps to keep breathing system connections away from surgical field and prevents endobronchial intubation also. However, curve of the tube also makes suction through them difficult. The tubes are costly and not easily available hence not possible to use at every set up. Seeing the advantages of preformed tube and availability of the tubes at our set up, the study was planned to use it for nasal intubation to know the advantages if any over routinely used PVC tubes.

In the present study, in both the groups right nostril was preferred for nasotracheal intubation especially when both nostrils patent. were T.Sanuki, M.hirokane, and J.katoni (2010)<sup>14</sup> and Boku.A,HanmotoH,HiroseY,Kudo C (2014)<sup>18</sup>,also recommended that right nostril should be preferred for nasal intubation because of less epistaxis and faster intubation. The standard method followed for nasal patency in present study was as per the other J.E.Smith, A.P.Reid(2001)<sup>12</sup>, Cattleya studies of Thongrong $(2018)^{13}$ .

In the present study, xylometazoline nasal drops were used 5 minutes before induction of the patients. It is a sympathomimetic which causes systemic vasoconstriction, thereby decreased nasal bleeding and easing nasal congestion.O Hanlon J,Harper KW(1994)4,Z.A.EL- Seilfy, A.M.Khattab, A.A.Shaaban(2010)5,Shahbaz Hussain, Farrukh Afzal, Lalarukh Bangash,Tanveer Butt, Khawar Ali,Abdul Qayyum(2014)6 also JaegyokSong(2017)7 observed xylometazoline drops to be very effective in reducing epistaxis when they compared the epistaxis with or without use of xylometazoline.

It was observed that the passage of tube from nose to pharynx was smooth (82.29%) and impinge (17.14%) with PORTEX North pole ivory tube as compared to routinely used PVC tube was 57.14% and 42.85% respectively. Thus the passage of tube was significantly more smooth with Portex ivory tube than PVC tube when compared.(p<0.05).Also the incidence of impingned was more with PVC tube than portex North pole ivory tube. This was a statistically significant finding in the present study.(p<0.05).Significant number of patients (42.85%) when PVC tube was used for nasal intubation required manipulations for negotiation from nose to pharynx as compared to (17.14%) Portex North pole tube. This was observed to be statistically significant(p<0.05). Also manipulation at glottis opening required with PVC tube(28.57%) as compared to only (8.57%) patients from the Portex North pole tube (p<0.05).And 25.71% patients in PVC group required manipulation at nose to pharynx as well as at glottis opening. However ,the requirement was significantly less (5.71%) when Portex North pole tube was used which was also statistically significant(p<0.05). This can be attributed to stiffness of PVC tube ,material of tube and personal technical variation as compared to soft Portex North pole tube. The PVC tube was not softened by thermo-softening in the present study. Kihara S. Komatsuzaki T, Brimacombe JR(2003)<sup>15</sup>, also reported more manipulations at pharyngeal and tracheal phase of nasotracheal intubation by PVC RAE tube as compared with silicone wire reinforced tube(47 vs 56 p=0.04) and (43 vs 55 p=0.05).

Lee, Jong Hwan, MD, Kim Chang Hee, Bahk, Jae-Hyon, Park, Kum-Suk (2005)<sup>9</sup>, also reported the significant higher incidence of requirement of manipulation for negotiation of PVC tube to be higher i.e. 60% when it was not thermo-softened. However the requirement was 28% when the PVC tube was thermo-softened. Intubation was successful in all the patient of both the groups. Mean time required for the intubation was in Group S was  $73.57\pm11.98$  and in PVC group C was  $79.86\pm16.89\%$  which was also comparable(p>0.05)similar to Kihara S, Komatsuzaki T, BrimacombeJR(2003)<sup>15</sup> when they compared silicone wire reinforce tube with PVC RAE tube and Simon Prior, Jarom Heaton, Kris R. Jatana, and Robert G. Rashid,(2010)<sup>10</sup>,when they compared the parker flex tip with standard tip endotracheal tube.

When the overall ease of intubation was compared between 2 groups, the ease of was grade I(Intubation without possible any manipulation)in 26 patients(74.28%) as compared to 10 patients(28.57%) in group C patients(table1) . Whereas significant number of patient 25 i.e.(71.42%) required manipulation for successful intubation. Thus, the ease of intubation was significantly better with Portex endotracheal North polar tube (Group S)p<0.05.Ahmet Selim ozkan,SedatAkbas (2018)<sup>11</sup>,in their study also observed that Portex North polar tube when used for nasotracheal intubation was easy with minimal manipulation when he compared it with spiral tube. He attributed it to velvet soft PVC material of the tube.

Most common complications of nasotracheal intubation is abrasion of nasal mucosa during its passage posteriorly resulting in epistaxis .This usually occurred from damage to kiesselbachsplexsus in littles area in the anterior part of the nasal septum<sup>11</sup>. The most likely causes of this are use of oversized tube, use of excessive force<sup>16</sup>, repeated attempts, inadequate vasoconstriction.<sup>4,5,6</sup>,tube ,stiffness of the tube,material<sup>2,11</sup> design<sup>8,9</sup> and pathway of tube.In the present study, the overall incidence of epistaxis was (34.29%) mild epistaxis with Portex North pole ivory tube and 67.17% mild to moderate epistaxis with PVC tube(table2). When compared it was observed that the incidence of epistaxis was significantly (p<0.05)less with the North pole tube which may be because of the soft material and design of the tube which was responsible for the easy negotiation of tube without applying any manipulation and force.

None of the patient in the present study, from both the groups had severe grade of epistaxis requiring any intervention. T.Sanuki,M.hirokane,andJ.katoni(2010)<sup>14</sup> observed more frequent and severs epistaxis when left nostril used for nasotracheal intubation (44.4%) and (11.1%) respectively when right nostril was used. Simon prior, Jarom Heaton, KrisR. Jatana, and Robert G.Rashid(2017)<sup>10</sup> reported significantly less trauma and bleeding with parker flex tip as compared to standard tip tube .According to them the change in tube design of parker flex tip helps to glide the tube over the mucosal surface and rather than scraping it. Lee, JongHwan, MD, Kim Chang Hee,Bahk,Jae-Hyon, Park, Kum-Suk (2005)<sup>9</sup>, observed that with thermosoftening epistaxis decreases stastically significantly in both magill tip(11/25 to 4/25) and murphy tip(3/25 to 1/25). This observation correlates this study where mild to moderate incidence of epistaxis was seen in(67.17%) patients when PVC murphy eye tube was used without thermosoftening.

Proper selection of patients preoperatively, use of adequate dose of vasoconstrictor, proper lubrication of tube, preference of right nostril, experience of the person performing nasotracheal intubation are the various factors which have contributed for less incidence of epistaxis in the present study.

It was observed that the incidence of intraoperative tube related problems was almost nil in both the groups except 2 patient in Group C had kinking which was not significant(p>0.05).

The postoperative laryngopharyngeal morbidity in the form of sore throat, change in voice and difficulty in breathing was negligible in both the groups

#### Conclusion---

In the present study we when North pole ivory tube and PVC tubes were compared for nasotracheal intubation, it was concluded from the present study that,

1)Ease of intubation was significantly better with preformed North pole ivory endotracheal tube.(p<0.05).

2)Incidence and severity of epistaxis was significantly less with North pole ivory tube(p<0.05).

3) Introperative tube related problems were negligible in both the groups(p>0.05)

4) Incidence of postoperative laryngotracheal morbidity was comparable in both the groups (p>0.05). Hence the study recommends that North pole ivory endotracheal tube should be preferred over

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routinely used PVC tube to have easy insertion and minimal epistaxis.

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EASE OF	NUMBER OF PATIENTS (%)			
	Group S	Group C	PVALUE	
Grade I	26(74.28)	10(28.57)	0.0001	
Grade II	9(25.71)	25(71.42)	0.0001	
Grade III	0	0		
Total	35(100%)	35(100%)		
P value=0.001				

### Table No.1 Distribution of patient according to overall ease of intubation

### Table No.2 Distribution of patient according to severity of nasal bleeding

Incidence and Severity of Nasal Bleed	No. of Patients (%)			
	Group S	GROUP C	P VALUE	
Nil	24(68.57)	12(34.29)	0.0041	
Mild	11(31.42)	20(57.14)	0.0303	
Moderate	0(0)	3(8.57)	0.0767	
severe	0(0)	0(0)		
Overall incidence of nasal bleeding	11(31.43%)	23(65.71%)	0.0041	
Total	35(100)	35(100)		
P Value:0.015,fishers exact:0.012				