Nasotracheal tube stenting by Nelaton catheter in paediatric dental surgery

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Background:

Nasotracheal intubation is associated with many complications such as epistaxis and nasal cavity injury. Stenting the endotracheal tube with appropriate sized nelaton catheter may decrease these complications. In this study we compared stenting the endotracheal tube by nelaton catheter with ordinary intubation technique.

Methods:

Eighty paediatric patients who were scheduled for elective dental surgery (restoration surgery) were randomly divided into two groups according to the nasotracheal intubation technique. In the first group endotracheal tube was stented with appropriate size nelaton catheter which was removed immediately after tube passage to the oropharynx. In the second group nasotracheal intubation was done by the ordinary technique without tube stenting. Evaluation of the resistance during nasal intubation, incidence and severity of epistaxis and nasal cavity injury were done.

Results:

Nasotracheal intubation was smooth in 80% of patients with stented tube compared to 40% in the non-stented tube. Epistaxis was found in 22.5% of patients with stented tubes compared to 85% of patients with non-stented tubes. Histopathology of tube contents after extubation showed blood cells in 32.5% in stented tubes and 92% in the non-stented ones. Adenoid tissue was found in5% of patients with stented tubes and 37.5% of patients with non-stented tubes.

Conclusion:

Stenting the endotracheal tube with nelaton catheter facilitates nasotracheal intubation and decreases the incidence and severity of epistaxis and nasal cavity injury.

Keywords: Paediatric dental surgery; nasotracheal intubation; stented endotracheal tube.

Introduction

Nasotracheal intubation is the commonest intubation technique indicated in paediatric dental surgery to secure and maintain the airway.[1,2] This technique may be accompanied by many complications such as epistaxis, avulsed adenoids, fractured turbinate, avulsed nasal polyps, mucosal injury and consequent sub mucosal tube passage.[3] Impaction of avulsed tissues in the tube and delivering it inside the trachea and lung effects ventilation and predisposes to postoperative chest infection.[4]

Many manoeuvers, including tube thermo softening, vasoconstrictor use, telescoping catheter technique, tube sheathing have been used to facilitate easy tube passage and reduce epistaxis associated with nasal intubation.[5,6]

We hypothesized that the above-mentioned complications might be decreased or prevented and passage of the tube through the nasal cavity might be smoother by using an appropriate sized nelaton catheter as a stent in the endotracheal tube. Accordingly, this study was conducted to compare incidence of complications using nelaton catheter

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as endotracheal tube stent and ordinary non-stented tube.

Patients and methods

After approval by the ethical committee at Faculty of Medicine, Ain-Shams University, Egypt the study was conducted in the Department of dental paediatrics. 80 children, aged 2-9 years with ASA physical status class I or II, scheduled for dental procedures under general anaesthesia were chosen. Exclusion criteria included patients with a history of recurrent epistaxis, coagulopathy, previous nasal surgery, history of nasal trauma.

In the operating room standard monitors were applied. Patients were randomly allocated into two groups, according to the nasotracheal intubation technique:

Group 1 - Intubation done after stenting the tube by an appropriate size nelaton catheter (Figure 1).

Figure 1: Stenting the endotracheal tube by appropriate size nelaton catheter.

Group 2-Intubation done by the ordinary technique without a nelaton catheter as a stent.

In both groups the tube size was determined by the equation (age/4+4). The bevel of the tube to be directed laterally with gentle rotation until it appears in the oropharynx.

Induction of general anesthesia for all cases was standardized. During induction the patient's nasal cavity was lubricated with 2% lidocaine jelly and cotton swabs with local vasoconstrictor applied in both nostrils. After nasotracheal intubation, a throat pack was inserted. At the end of surgery extubation was done after oral suctioning and removal of throat pack.

An independent anaesthesiologist who did not observe the tube insertion assessed the severity of epistaxis and presence of avulsed tissues using a laryngoscope, immediately after the tube was passed through trachea.

Assessment of the resistance of tube passage through the nasal cavity during intubation was done using three grades

1- Smooth (no resistance).
2- Small resistance (sense of friction).
3- Large resistance (sense of tissue resistance and avulsion).

Epistaxis was evaluated using four grades:

1- No epistaxis, no blood observed on either tube surface or the posterior pharyngeal wall.
2- Mild epistaxis, blood apparent on tube surface or posterior pharyngeal wall, partial staining of small gauze.
3- Moderate epistaxis, pooling of blood on the posterior pharyngeal wall, staining of more than one of small gauze.
4- Severe epistaxis, a large amount of blood in the pharynx impeding nasotracheal intubation and necessitating urgent orotracheal intubation.

After extubation any contents of the endotracheal tube were collected in a 5 ml syringe by using a sterile swab and sent for histopathology.

Evaluation was done of the contents from the tube by microscopy and histopathology as follows:

1- Secretions only.
2- Secretions, blood cells.
3- Secretions, blood cells and other tissue (Eg: adenoid, turbinate, pharyngeal mucosa).

Sample size calculation: Using PASS program setting alpha error at 5% and power at 80%. Assuming that epistaxis is not present in 2% of traditional group compared to 25% of modified group, the needed sample is 40 cases per group. (80 total).

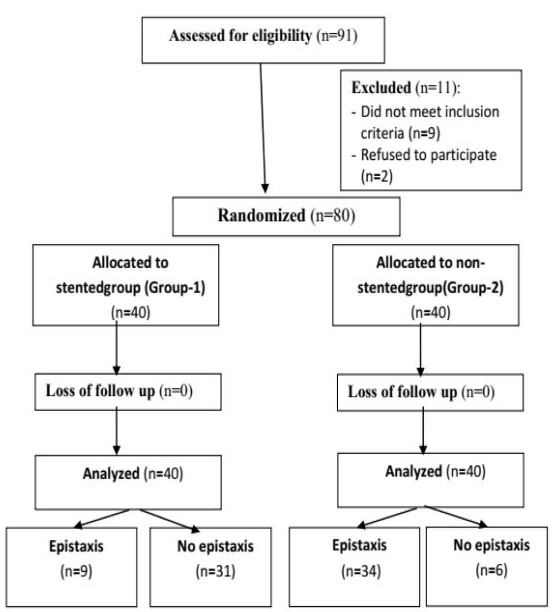
Statistical methods
The collected data were coded, tabulated, and statistically analyzed using IBM SPSS statistics (Statistical Package for Social Sciences) software version 22.0, IBM Corp., Chicago, USA, 2013

Descriptive statistics were done for quantitative data as minimum and maximum of the range as well as mean±SD (standard deviation) for quantitative normally distributed data, while it was done for qualitative data as number and percentage.

Inferential analyses were done for quantitative variables using Shapiro-Wilk test for normality testing, independent *t*-test in cases of two independent groups with normally distributed data. In qualitative data, inferential analyses for independent variables were done using Chi-square test for differences between proportions and Fisher's Exact test for variables with small expected numbers. The level of significance was taken at P value < 0.050 is significant, otherwise is non-significant.

Results
A total of 80 patients were enrolled and completed the study, patients were divided blindly into two groups 40 patients for each (Figure 2).

Figure 2: Consort diagram of the study



Both groups were matched with regard to their demographic data, there were no statistically significant differences between the two groups with regard to duration of surgery, nostril side, size of used tube, type of surgery and ASA physical status (Table 1).

Table 1: Demographic and basal characteristics of the studied groups

Variable	Measures	(Group-1) Stented (n=40)	(Group-2) Non-stented (n=40)	*p*
Age (years)	Mean±SD	5.2±1.6	5.6±1.8	^0.397
	Range	3.0–9.0	3.0–9.0	
Sex (n, %)	Male	24 (60.0%)	22 (55.0%)	#0.651
	Female	16 (40.0%)	18 (45.0%)	
BMI z-score	Mean±SD	-0.01±0.06	-0.02±0.07	^0.736
	Range	-0.14–0.11	-0.13–0.14	
ASA (n, %)	I	38 (95.0%)	37 (92.5%)	§1.000
	II	2 (5.0%)	3 (7.5%)	
Indication	Restoration	40 (100.0%)	40 (100.0%)	--
Tube size (mm) (n, %)	4.5	10 (25.0%)	11 (27.5%)	#0.896
	5.0	10 (25.0%)	12 (30.0%)	
	5.5	13 (32.5%)	12 (30.0%)	
	6.0	7 (17.5%)	5 (12.5%)	
Nostril Side (n, %)	Right	27 (67.5%)	24 (60.0%)	#0.485
	Left	13 (32.5%)	16 (40.0%)	
Duration of operation	Mean±SD	101.1±18.8	105.7±16.6	^0.255
	Range	59.0–133.0	65.0–148.0	

^Independent *t*-test, #Chi square test, §Fisher's Exact test

In Group II resistance during intubation was found in 60% of patients, while smooth intubation was found in 40% of patients. In Group I, smooth intubation was found in 80% of patients while resistance during intubation was found in 20% of patients only (Table 2).

There was a statistically significant difference between the two groups regarding the incidence of epistaxis. Epistaxis was observed in 85% of patients in group II, (mild 45%, moderate 35% and severe 5%) while 15% of patients had no epistaxis during intubation. While in group I 77.5% of patients had no epistaxis and epistaxis was observed in only 22.5% of patients, of them; 17.5% mild 5% moderate and 0% severe (Table 3).

Table 2: Evaluation of tube insertion among the studied groups

Evaluation	**(Group-1) Stented (n=40)**	**(Group-2) Non-stented (n=40)**	***p***
Smooth	32 (80.0%)	16 (40.0%)	**§<0.001***
Small resistance	6 (15.0%)	19 (47.5%)	
Large resistance	2 (5.0%)	5 (12.5%)	
Value of stenting in getting smooth insertion			
Items	**Value**	**95% CI**	
Rate in study group	80.0%	48.2%–69.2%	
Rate in control group	40.0%	30.8%–48.2%	
Rate elevation	40.0%	16.4%–58.5%	
Efficacy	50.0%	24.0%–65.5%	
Relative Rate	2.00	1.32–2.90	
Number needed to treat	2.5	1.7–6.1	

§Fisher's Exact test, *Significant

Table 3: Epistaxis among the studied groups

Evaluation	**(Group-1) Stented (n=40)**	**(Group-2) Non-stented (n=40)**	***P***
No epistaxis	31 (77.5%)	6 (15.0%)	**§<0.001***
Mild	7 (17.5%)	18 (45.0%)	
Moderate	2 (5.0%)	14 (35.0%)	
Severe	(0.0%)	2 (5.0%)	
Value of stenting in preventing epistaxis			
Items	**Value**	**95% CI**	
Rate in study group (Group-1)	77.5%	73.8%–92.7%	
Rate in control group (Group-2)	15.0%	7.3%–73.8%	
Rate elevation	62.5%	40.0%–78.0%	
Efficacy	80.6%	60.4%–91.5%	
Relative Rate	5.15	2.53–11.76	
Number needed to prevent	1.6	1.3–2.5	

§Fisher's Exact test, *Significant

Microscopy and histopathology of tube contents revealed that there was no statistically significant difference between the two groups with regard to secretions (100% of patient had secretions in the tubes). Blood cells was seen in the contents in 92% of patients in group II and only 32% of patients in group I. 37.5% of patients of group II had tissues in their tube contents mainly adenoid tissue. In group I, about 5% of patients had tissues mainly adenoid. (Table 4).

Table 4: Histopathology findings of the studied groups

Findings	**(Group-1) Stented (n=40)**	**(Group-2) Non-stented (n=40)**	***p***	**RR (95% CI)**
Secretions	40 (100.0%)	40 (100.0%)	--	--
Blood cells	13 (32.5%)	37 (92.5%)	**#<0.001***	0.29 (0.18–0.47)
Tissue	2 (5.0%)	15 (37.5%)	**#<0.001***	0.20 (0.05–0.73)

#Chi square test, *Significant, RR: Relative rate, CI: Confidence interval

Discussion

Epistaxis is a common complication of nasal intubation, blood in the airway can interfere with the laryngoscopy view and can lead to aspiration.[7,8,9,10] Partial or complete obstruction of the tube can occur by avulsed tissues as adenoid, plop, turbinate and blood clot.[11,12]

In this study, tracheal tubes stented with appropriately sized nelaton catheter were associated with smooth intubation and minimal resistance than standard non-stented tubes, this may be due to decreasing the surface of the sharp edge of the tube which acts as a shaver. According to the smooth intubation and minimal resistance, incidence of epistaxis was lower in stented tubes rather than standard ones.

Stenting the endotracheal tube increased the value of getting smooth intubation and the efficacy was increased by about 50% compared to the non-stented tubes.

Also the value of stenting in preventing epistaxis was increased by about 62.5% with 80% efficacy compared to the non-stented group.

We suggest that the nelaton catheter acts as a trocar that prevent the friction between the tube and pharyngeal wall and makes smoother passage of the tube along the curve of the nasopharynx.

Obliteration of the distal end of the endotracheal tube with the distal end of the catheter was associated with little or no impaction of the avulsed tissues in the tube end, this finding was approved by histopathology of the collected tissues after extubation.

In agreement with our results, Morimoto *et al*[13] found that using a curve-tipped suction catheter to guide the nasotracheal tube passage decreased the frequency of nasal bleeding. Morimoto *et al* used one size of nelaton catheter and the tip of the catheter protruded from the tube end by about 10cm. In our study we used different sizes of nelaton catheters, and the catheter tip was at the same level of the distal end of the tube.

Watt *et al.* showed that telescoping the endotracheal tube with a red rubber catheter decreased the incidence and severity of nasal bleeding during nasotracheal intubation.[14]
Suk Seo *et al* found that the use of oesophageal stethoscope to obturate the endotracheal tube was effective in reducing epistaxis during and after nasotracheal intubation.[15]
In agreement with our results, Kazuna *et al* reported that a styletted tracheal tube with posterior facing bevel reduces the incidence of epistaxis during nasotracheal intubation, the only difference between the two studies is that in our study stenting the tube was done by a soft malleable nelaton catheter while in Kazuna's study a metal stylett was used to control the direction of the tube bevel during intubation.[16]

In our study we found that ordinary nasal intubation is associated with more tissue trauma which may adhere to tube wall, this was proven by microscopy and histopathology of the tube contents after extubation, more blood cells and solid tissues as adenoid and turbinate was found, stenting the tube with nelaton catheter lowered tissue injury and avulsion and subsequent tube impaction. Kazuna *et al* studied epistaxis only, but we studied also the microscopy and histopathology of tube contents.

In conclusion, stenting the endotracheal tube with appropriate size nelaton catheter represents a simple, cheap and practical method for smooth nasotracheal intubation and decreasing the incidence and severity of nasal bleeding and injury.

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