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 in 5% 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 manoeuvres, 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
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).

**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                     | 0.3 |
|                | Range    | 3.0–9.0                  | 3.0–9.0                     |     |
| Sex (n, %)     | Male     | 24 (60.0%)               | 22 (55.0%)                  | 0.6 |
|                | Female   | 16 (40.0%)               | 18 (45.0%)                  |     |
| BMI z-score    | Mean±SD  | -0.01±0.06               | -0.02±0.07                  | 0.7 |
|                | Range    | -0.14–0.11               | -0.13–0.14                  |     |
| ASA (n, %)     | I        | 38 (95.0%)               | 37 (92.5%)                  | 0.0 |
|                | II       | 2 (5.0%)                 | 3 (7.5%)                    |     |
| Indication     | Restoration | 40 (100.0%)         | 40 (100.0%)               |     |
| Tube size (mm) | 4.5      | 10 (25.0%)               | 11 (27.5%)                  | 0.8 |
|                | 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   | Right    | 27 (67.5%)               | 24 (60.0%)                  | 0.4 |
|                | Left     | 13 (32.5%)               | 16 (40.0%)                  |     |
| Duration of operation Mean±SD | 101.1±18.8 | 105.7±16.6 | 0.2 |
| 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) | ρ     |
|---------------------|--------------------------|-----------------------------|-------|
| Smooth              | 32 (80.0%)               | 16 (40.0%)                  | $<0.01$* |
| 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        |

$Fisher's$ $Exact$ $test,$ $*Significant$

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) | ρ     | 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. Partial or complete obstruction of the tube can occur by avulsed tissues as adenoid, plop, turbinate and blood clot.

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 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. 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. 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.

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.

References
1. Schroth R.J, Quinonez C, Shwart L, et al. Treating early childhood caries under general anesthesia: A national review of Canadian data. Journal of the Canadian Dental Association 2016; 82, article no. g20. PMid:27548666
2. Holt RD, Chidiac RH, Rule DC. Dental treatment for children under general anaesthesia in day care facilities at a London dental hospital. British Dental Journal 1991; 170: 262–266. https://doi.org/10.1038/sj.bdj.4807504 PMid:2025459
3. Williams AR, Burt N, Warren T. Accidental middle turbinectomy: a complication of nasal intubation. Anesthesiology 1999; 90: 1782-4. https://doi.org/10.1097/00000542-199906000-00039 PMid:10360881
4. Sim WS, Chung IS, Chin JU, et al. Risk factors for epistaxis during nasotracheal intubation. Anaesth Intensive Care 2002; 30: 449-52. PMid:12180583
5. Agarwal A. Warming the tracheal tube and kinking. Can J Anesth 2004; 51: 96. https://doi.org/10.1007/BF03018568 PMid:14709484
6. Delgado A, Sanders J. A simple technique to reduce epistaxis and nasopharyngeal trauma during nasotracheal intubation in a child with factor IX
deficiency having dental restoration. Anesth Analg 2004; 99:1056–1057.
doi:10.1213/01.ANE.0000133914.26066.99.
https://doi.org/10.1213/01.ANE.0000133914.26066.99

7. Hall CE, Shutt LE. Nasotracheal intubation for head and neck surgery. Anaesthesia 2003; 58:249-56.
https://doi.org/10.1046/j.1365-2044.2003.03034.x
PMid:12603455

8. Paul M, Dueck M, Kampe S, et al. Intracranial placement of a nasotracheal tube after transnasal transphenoidal surgery. Br J Anaesth 2003; 91:601–604
https://doi.org/10.1093/bja/aeg203
PMid:14504169

9. Piepho T, Thierbach A, Werner C. Nasotracheal intubation: look before you leap. Br J Anaesthesia 2003; 94:859–860.
https://doi.org/10.1093/bja/aeg203
PMid:15833776

10. Enk D, Palmes AM, Van Aken H, Westphal M. Nasotracheal intubation: a simple and effective technique to reduce nasopharyngeal trauma and tube contamination. Anesth Analg 2002;95:1432–1436.
https://doi.org/10.1097/00000539-200211000-00061
PMid:12401639

11. Goranovic T, Milic M, Knezevic P. Naso-endotracheal tube obstruction by a nasal polyp in emergency oral surgery; a case report. World J EmergSurg 2007;2:31–32.
https://doi.org/10.1186/1749-7922-2-31
PMid:18034893 PMcid:PMC21692218

12. Bandy DP, Theberg DM, Richardson DD. Obstruction of naso endotracheal tube by inferior turbinate. Anesth Prog 1991; 38:27–28.
PMid:1809051 PMcid:PMC2162367

13. Morimoto Y, Sugimura M, Hirose Y, et.al. Nasotracheal intubation under curve-tipped suction catheter guidance reduces epistaxis. Can J Anesth 2006; 53: 295-8.
https://doi.org/10.1007/BF03022218
PMid:16527796

14. Watt S, Pickhardt D, Lerman J, et al. Telescoping tracheal tubes into catheters minimizes epistaxis during nasotracheal intubation in children. Anesthesiology 2007; 106: 238-42.
https://doi.org/10.1097/00000542-200702000-00010
PMid:17264716

15. Seo KS, Kim JH, Yang SM, et al. A new technique to reduce epistaxis and enhance navigability during nasotracheal intubation. Anesth Analg 2007; 105: 1420-4.
https://doi.org/10.1213/01.ane.0000281156.64133.