Nasogastric Tube Knotted Around a Nasal Endotracheal Tube in the Nasopharynx: Possible Cause

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A nasogastric tube is often used along with a nasal endotracheal tube during oral surgery or dental treatment under general anesthesia. Although the insertion of a nasogastric tube is a simple procedure, it can be associated with complications that lead to potentially serious consequences. The knotting of a nasogastric tube around an endotracheal tube is rare. Here, we report a case in which the nasogastric tube became knotted around the nasal endotracheal tube in the nasopharynx. We compare this case with 4 previous similar cases and provide a theory of how the nasogastric tube might have become knotted.

Key Words: Nasogastric tube; Nasal endotracheal tube; Knotted; Nasopharynx.

Concomitant use of a nasogastric tube (NGT) and a nasal endotracheal tube (NETT) is common during oral surgery and dental treatment under general anesthesia; however, numerous complications associated with NGTs have been reported, ranging from minor to life-threatening.[1] One of these complications, knotting of the NGT, can occur during its insertion or removal. This can occur as an isolated event or the NGT can become entangled with another object, such as the NETT. Furthermore, the knotting can cause kinking or breakage of the NGT,[2] perforation of the trachea,[3] and/or difficult removal due to the looped, knotted NGT.[4] In a reported case with severe complications, the NETT was removed on the second postoperative day in the intensive care unit, but the indwelling NGT then became knotted over the epiglottis, resulting in obstruction of the airway.[5] In other cases, the NGT became tied around the NETT, leading to constriction of the NETT itself and impairing ventilation in anesthetized patients.[6,7]

Here, we report a relatively rare occurrence in which the NGT became knotted around an NETT within the nasopharynx. We compare this case with previous similar cases and provide a plausible theory as to how the tube might have become knotted.

CASE PRESENTATION

A 25-year-old man (height 173 cm, weight 62 kg, body mass index 20.7 kg/m^2) underwent the removal of 4 third molars under general anesthesia. Other than nasal obstruction and mild tonsillar hypertrophy, the patient had no significant medical history and reported no medications nor any allergies, and he was deemed American Society of Anesthesiologists physical status I.

The patient was transported to the operating room, standard anesthetic monitors were applied, and peripheral venous access obtained. Rapid intravenous (IV) induction was then accomplished after preoxygenating (6 L/min) the patient using a continuous intravenous infusion of remifentanil (0.3 μg/kg/min) and boluses of propofol (150 mg) and rocuronium bromide (50 mg). Mask ventilation was easily performed after induction of general anesthesia. Subsequently, a preformed 7.5-mm NETT (Parker Flex-Tip; Parker Medical, Highlands Ranch, Colo) was inserted into the left nostril without difficulty or any apparent complications while using a Macintosh laryngoscope. The view obtained during direct laryngoscopy was a Cormack-Lehane class 2 view. Following confirmation of successful intubation and securing of the NETT, general anesthesia was maintained using desflurane (5%) with oxygen (1 L/min) and air (2 L/min), in addition to continuous

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Figure 1. Radiographic image of head and neck. Loop of nasogastric tube shown in hypopharynx (white arrow) and knot shown in nasopharynx (black arrow).

infusion of remifentanil (0.15 μg/kg/min). As part of routine patient management at our institution, a 14-Fr NGT (gastric catheter; TOP Corporation, Tokyo, Japan) was advanced blindly via the right nostril, whereupon the tip of the NGT was visualized emerging from the oral cavity. The anesthesiologist then attempted to redirect and reinsert the NGT under direct vision with a Macintosh-type laryngoscope and the use of Magill forceps. However, the NGT could not be advanced forward although the tip of the NGT passed the upper esophageal sphincter. Subsequent review of the case suggested that the tip of the NGT turned toward the oropharynx or nasopharynx and formed a loop around the NETT before appearing in the oral cavity. When the anesthesiologist held the tip of the NGT and reinserted it into the esophagus, the tip was inadvertently passed through the loop, creating a knot. As the reinserted NGT was unable to pass beyond the upper esophageal sphincter, an attending anesthesiologist also attempted insertion but was unsuccessful and decided that the entire NGT should be removed because its tip could no longer be observed. It was presumed that there was an obstruction present along the path of insertion. However, after approximately 10 cm of the NGT tube had been removed by hand, substantial resistance was encountered, and it could not be removed any further. Notably, the NETT did not move concomitantly when the NGT was pulled out.

Capnography revealed a normal waveform at this time. Peak airway pressure was 15 cmH_2O, and the patient's SpO_2 was 99%. The chief anesthesiologist checked the NGT by endoscopy, and the NGT tube was confirmed to be properly placed within the right nasal meatus. However, the endoscope could not be advanced via the left nostril because of a noted lack of space due

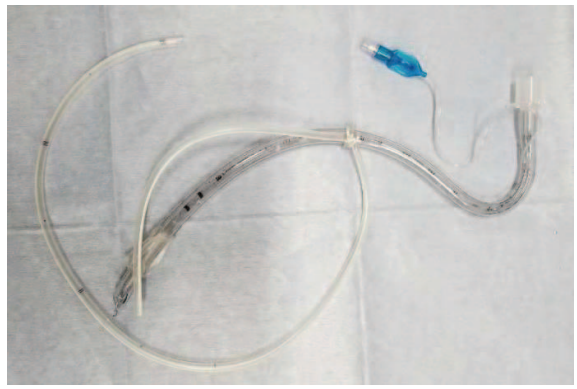

Figure 2. Nasogastric tube (NGT) tightly knotted to the withdrawn nasal tracheal tube (NETT).

to the NETT. Therefore, radiographic imaging of the head and neck (ie, anteroposterior and lateral films) was obtained during general anesthesia. The radiographs of the head and neck revealed that the NGT had apparently formed a loop in the neck (Figure 1, white arrow). At that point, another abnormal finding (Figure 1, black arrow) was missed, which would have revealed knotting of the NGT around the NETT in the nasopharynx.

An otorhinolaryngologist was consulted for inspection of both nasal cavities by endoscopy. The field of view was poor in the left nasal cavity because of nasal hemorrhage. Thus, the cause of NGT immobility could not be determined but was presumed to be related to compression of the nasal septum by the indwelling NETT on the patient's left side. Accordingly, removal of the NETT was attempted. Upon removal of approximately 8 cm of the NETT, the NGT was observed to have formed a knot around the NETT. The proximal portion of the NGT was then cut, which allowed the proximal part of NGT to descend through the right nostril and ascend and be removed through the left nostril. Both the NGT and the NETT were successfully extracted en bloc from the left nostril. Figure 2 shows the NGT tightly knotted to the withdrawn NETT. The attending anesthesiologist immediately inserted an oral endotracheal tube, and the operation was safely completed. The patient had no severe complications, although he experienced slight pharyngeal pain and some nasal obstruction but was discharged the next day.

DISCUSSION

Knotting of an NGT around an endotracheal tube is rare, and there have been few reports of such events occurring within the nasopharynx. In a recent literature search, we found only 4 similar reports[6–9] with which to

Table. Summary of Published Cases in Which a Gastric Tube Became Knotted Around a Tracheal Tube*

Reference	*Patient Age/Sex*	*Tracheal Tube*	*Gastric Tube*	*First Attempt (Blinded)*	*Concomitant Movement*	*Impaired Ventilation*	*Knot Location*
Pousman and Koch[6] (1997)	46 y/F	Oral	NA/oral	Failed	+	+	Hypopharynx
Au-Truong et al[8] (1999)	72 y/F	Nasal	16-Fr/nasal	Failed	+	–	Palpated in oropharynx, visible under direct-vision laryngoscopy
Melki et al[7] (2010)	3 mo/M	Nasal	6-Fr/nasal	Successful	–	+	Nasopharynx
Abe et al[9] (2018)	57 y/F	Nasal	16-Fr/nasal	Failed	+	–	Visible in oropharynx (direct-vision laryngoscopy)
Present report (2020)	25 y/M	Nasal	14-Fr/nasal	Failed	–	–	Nasopharynx

* M indicates male; F, female; NA, not available (gastric tube size was not described); first attempt, first attempt to insert a gastric tube; concomitant movement, simultaneous movement of gastric and tracheal tubes.

compare this case (Table). Among the 4 previously reported cases, the first attempt to insert a gastric tube was commonly performed blindly, with successful results occurring in only 1 case.[7] In the third of the 4 cases (Table), the NGT was inserted successfully but could not be easily removed.[7] Resistance to NGT movement was also common after repeated manipulations of the NGT, including both withdrawal and advancement. These blinded maneuvers might have caused the 2 tubes to become entangled. A characteristic motion of 2 knotted tubes is concomitant movement, whereby movement of either tube results in simultaneous movement of the other. Notably, concomitant movement was observed in 3 of the 5 cases, which include this case report. In our case, attempts to remove the NGT did not cause NETT movement, but attempts to remove the NETT caused NGT movement. In the 2 previously reported cases without concomitant movement, the knot was located in the nasopharynx. Presumably, attempts to remove the NGT would not strongly affect the indwelling NETT in the opposite nostril. Ventilation was impaired in 2 of the 5 cases due to constriction of the tracheal tube. Therefore, anesthesiologists should not forcefully manipulate an NGT when unusual resistance is encountered.

Approaches to successfully manage this type of complication included knot removal by excision under direct vision during laryngoscopy in 2 cases.[8,9] In 2 other cases, both tubes were removed en bloc. In the fifth case, the gastric tube was severed. The options selected were highly dependent on the location of the knot. Notably, when there is a risk of airway obstruction, prompt removal of the impaired tracheal tube and reinsertion should be considered, with attention directed toward maintaining and securing the airway.

To evaluate why the NGT formed a knot around the NETT in the nasopharynx, we constructed a model of the oral cavity, pharynx, and larynx (Figure 3). During insertion in this case, the tip of the NGT progressed toward the piriform sinuses, underneath the NETT. The cuffed tracheal tube itself might have also interfered with successful advancement of the NGT. The NGT then folded, turned backward toward the oropharynx, and reappeared in the oral cavity after the first blinded insertion attempt (Figure 3A). Subsequently, the NGT was reinserted under direct vision with a laryngoscope and the use of Magill forceps. The 2 tubes became entwined and formed a loose knot (Figure 3B and C). Motion during NGT removal caused the knot to move upward toward the nasal cavity. This caused the knot with the NETT to become tighter, as observed in our case (Figures 2 and 3D). Generally, the use of Magill forceps under direct vision is a secondary choice for inserting a NGT, although it is associated with fewer

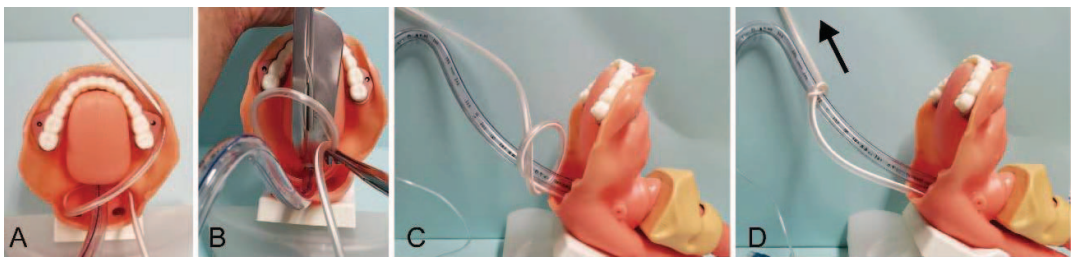

Figure 3. Model used to theorize how the nasogastric tube (NGT) might have become knotted around the nasal tracheal tube (NETT). (A) The NGT folded and turned backward toward the oropharynx, leading to its appearance in the oral cavity after the first (blinded) intubation attempt. (B, C) The NGT and NETT became entwined and formed a loose knot, although this maneuver was performed under direct vision with forceps. (D) The motion of pulling the NGT (arrow) to move the knot upward toward the nasopharynx led to tight knotting of the NGT to the NETT.

complications.[10] However, our model showed that the use of Magill forceps can also cause complications. There are some underlying factors that contribute to significant knotting. Blind insertion can lead to NGT misplacement, at an estimated rate of 1.2% to 2.3%.[11] Moreover, NGT malpositioning tends to recur in 13% to 32% of subsequent repositioning attempts.[12] These unfavorable conditions collectively increase the risk of NGT complications.

Routine use of an NGT has been suggested as a means of preventing postoperative nausea and vomiting, as well as risk of aspiration. In our institution, we have routinely employed intraoperative NGT insertion and gastric decompression/emptying. However, the evidence for prevention of postoperative nausea and vomiting, as well as risk of aspiration, is lacking or questionable in many investigations.[13] Therefore, anesthesia providers should ideally use an NGT only when necessary. Of note, we now refrain from placing an NGT for minor oral surgery or dental treatment in healthy adults, unless otherwise indicated.

CONCLUSION

Although commonly employed, the blind approach for inserting an NGT can induce complications. Following an unsuccessful attempt at inserting an NGT, it is advisable to completely withdraw the NGT from the nasopharynx before the next attempt. If removal is not possible, the anesthesiologist should suspect complications involving placement of the NGT. It is important to recognize the possibility that an NGT can become knotted around an NETT in the nasopharynx and to consider alternatives to the use of an NGT.

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