GASTRIC TUBE PLACEMENT IN DIFFICULT CASES: AN EXTENSIVE REVIEW OF THE ALTERNATIVE METHODS

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Abstract
Gastric tube placement for enteral feeding and gastric drainage is very commonly performed procedure in the ICU. The placement may sometimes be difficult or impossible in intubated and paralyzed patients due to impaction and/or coiling in the mouth. The recognition of the site/s of impaction and methods to overcome them have been described variously in literature with different degrees of success. Knowledge and practice of these alternative methods can be sometimes of great help particularly while facing difficulty.

Key-words
Gastric tube placement, Alternative methods

Key Messages
While facing difficulty, gastric tube placement by alternative methods can be of immense help in intubated and paralysed patients who cannot co-operate by swallowing on instruction. The chances of coiling and impaction in mouth can be reduced drastically by knowledge and understanding the underlying cause.

Introduction
Gastric intubation via the nasal passage and oral passage is a common procedure that provides access to the stomach for diagnostic and therapeutic purposes. Nutrition supplied through enteral route is of greater benefit to patients than that supplied through parenteral administration.[1,2] Enteral feeding by a nasogastric tube is the standard method of maintaining nutrition in short term. In some patients this method (Gastric tube, GT both Nasogastric tube, NGT or Orogastric tube, OGT) of feeding is impossible because of repeated failures of placement, necessitating either other methods for enteral access or total parenteral nutrition.[3] In certain situations in the ICUs particularly when the patient has already been intubated it is very difficult to pass the GT even by using the alternative methods described in the literature. Normal swallowing efforts and cooperation, in awake patients, helps to successfully place the GT, an option not applicable in intubated and sedated ICU patients. Alternative methods can be exercised to negotiate the GT into the oesophagus.[4]

Coiling in the Mouth: The Underlying Cause

Because the nasogastric tube is flexible and must undergo a significant bend in the oropharynx, it is impossible to precisely control the position of the end of the tube, and there is considerable risk that the tube will coil in the mouth or enter the trachea and eventually the lung, instead of the esophagus. When the gastric tubes are placed orally or nasally they enter the hypopharynx invariably and impact the structures thereby coiling in the mouth. Ozer et al (1999) identified that first attempt successes of orally and nasally placed gastric tubes were 85% and 68% respectively. In 92% of the first pass successes, the gastric tube entered, the hypopharynx just lateral to the arytenoids cartilages (Figure 1) and in rest, 8% entered the hypopharynx in the posterior midline.

The common sites of impaction are pyriform sinuses (46%), arytenoids cartilages (25%), trachea (21%) and nasopharynx (7%). Endotracheal tubes cuff cannot hinder the passage of gastric tubes if inflated normally upto 25 cm of water pressure and the base of the tongue does not cause any impaction, unlike commonly believed. It was obvious that the entry of the gastric tube into the hypopharynx was lateral to the arytenoid cartilages (92%) and midline posteriorly. The better success of some of the alternative methods in difficult cases is based on this fact.[4]

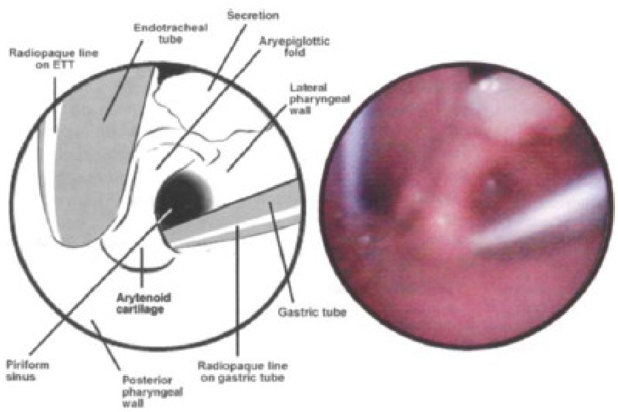

Fig: 1 Gastric tube passing into the oesophagus lateral to arytenoid cartilage

The Coiling of a Hollow Tube

The Young's modulus: The correct transmission of applied force can also explain the possibly greater success rate achieved by alternative methods. In standard method, the advancing end (the tip of NGT) near its common sites of impaction is nearly 25 cm away. In nasopharynx, the tube being curved and the applied force is directed tangentially and is only partly transmitted which depends also on the rigidity of the tube. Tube that is more rigid can transmit more force but will also increase the discomfort caused to the patient. Similarly, a larger diameter tube would increase the success rate because of the larger cross sectional area (πr^2) to transmit the applied force. Again, a larger bore tube will produce more discomfort, higher rate of sinusitis to the patient and cause complications due to pressure on the anatomical structures.[5]

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$$\frac{F/\text{cross sectional area } (\Pi r^2)}{\partial L/L} = Y \text{ (Youngs Modulus, a constant for a given material)}$$

If ∂L is more, bending is more.

$$\partial L = L \times \frac{F/\text{cross sectional area (fixed for a given tube)}}{Y \text{ (Young's Modulus)}}$$

It implies that the larger L as in nasogastric approach increases the chances of bending (∂L). In orogastric approach, the L is small hence bending is less.

Curves in the GT: A fleshly unpackaged tube has curves as shown in the Figure 2. These curves promote coiling in the mouth as observed by Kumar et al (2005). Therefore, a tube, which is unpacked a few hours before (must be kept sterile) and kept straight serves better.

The perforations at the anterior end: Several perforations that are there at the anterior end of the GT which are nonetheless essential for the functioning of the finally placed one make the kinking and coiling likely. The perforations allow the bending on deficient aspect by distributing the transmitted force unevenly. Weighed tip (metallic), which help swallow it in a cooperative patient and detection by roentgenogram can have disadvantage in such patients who are intubated and paralyzed. The stellate used for insertion help stabilizing this portion and tube as a whole.[7]

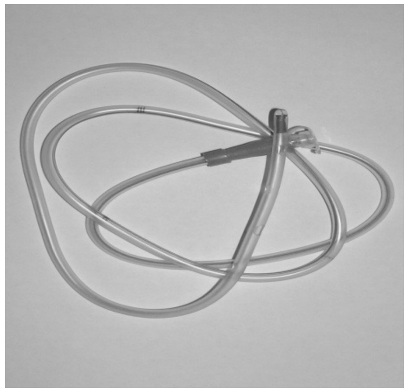

Fig:2 Showing the curves in a freshly unpacked NGT, which may place tip anterior and cause impaction.

The Alternative Methods

1. Lateral neck pressure: Based on fibrescopic view of gastric tube passage (successful) and impaction Ozer et al (1999) devised that lateral neck pressure can turn 85% of the difficult cases into successes. When impacted they withdrew GT 1 cm applied bilateral neck pressure at the level and lateral border of thyrohyoid membrane and the procedure was repeated.

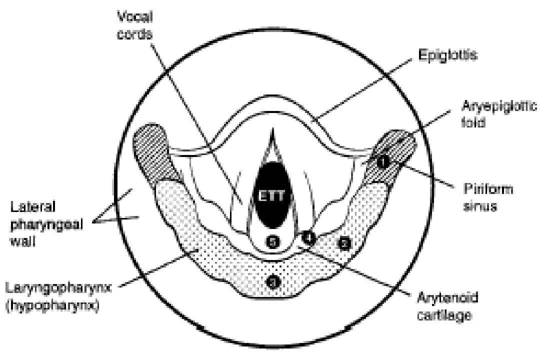

Fig:3 Schematic diagram summarizing the sites of all successes and failures with passage of all gastric tubes. Stippled area = hypopharynx; line hatching = piriform sinus. *Em* = Endotracheal tube. (1) = Piriform sinus; (2) = lateral hypopharynx; (3) = midline hypopharynx, *(4)* = arytenoid cartilage; *(5)* = trachea.

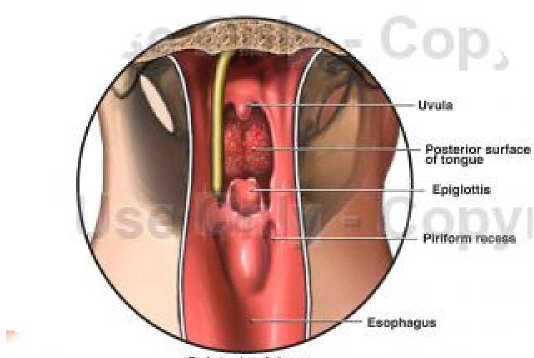

Fig:4 The impaction of GT into pyriform sinus

2. Role of neck flexion: After entry into the nasopharynx (15 cm mark) forward neck flexion is achieved as far as possible. Success rate in the flexion group is higher (80%) than that in the neutral group (50%).[7] Mahajan et al. explained that the reason was that neck flexion along with natural curves in GTs helped to keep the tube posteriorly.

3. Intraoral manipulation: Kumar et al (2005)[6] described a method where the placement of the NGT was similarly achieved until the tip reached the oropharynx. Control of advancing the NGT was taken in the left hand (for right-handed person). Index and middle finger of the right hand was lubricated with Xylocaine jelly and introduced (Step 1) straight into the mouth so that the tip of the finger reached unto the posterior pharyngeal wall. The NGT was held in the space between the two fingers (Figure 5a,b) so that the tendency to coil in the mouth could be reduced and also the tube could be pushed slightly backwards. Very light pressure was applied to the NGT so that the tip finds the posterior most path i.e. esophagus. Left hand is used to slowly advance the NGT. If resistance or coiling is evident, the guiding right hand is manipulated to achieve the path of least resistance (and successful placement). Excessive force for pushing was avoided. Application of right pressure was learnt through experience. If the tip of NGT gets impacted and coiling is unavoidable the NGT is withdrawn completely through the mouth (Step 2, Figure 6 a, b), so that approximately 70 cm was out of the oral cavity available for manipulation. The gastric end was introduced as if putting an orogastric tube by standard technique. 25 cm was introduced into the esophagus. Nasal end was pulled to undo the coiling that was there in the mouth, thereby converting it to the usual nasogastric placement. Kumar et al observed that this manoeuvre was successful in all difficult cases (18%) where the conventional method had failed.

Fig: 5a Close view. Procedure (Step 1) being conducted and fingers are to be withdrawn.

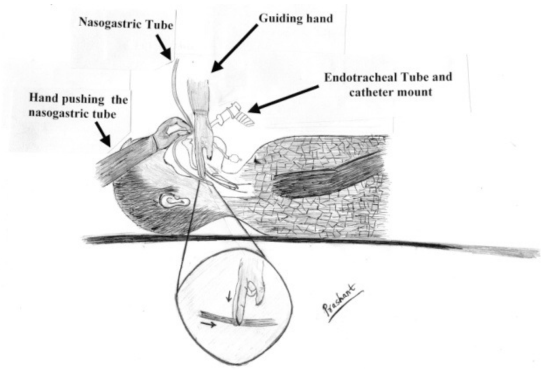

Fig: 5b Schematic, showing the intraoral and intapharyngeal relations mainly of the NGT, fingers and others structures while performing Step 1 of Kumar's maneuver.

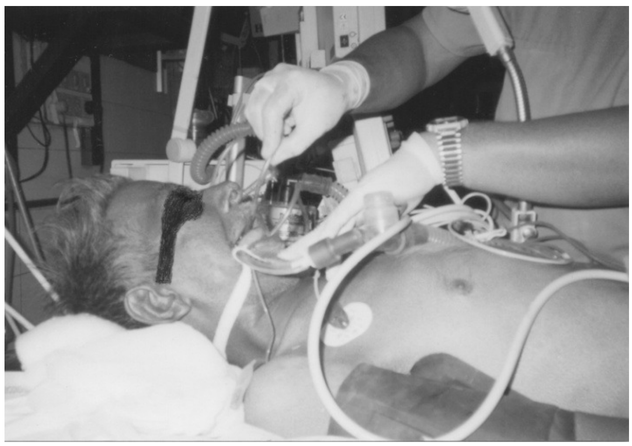

Fig: 6a If coiled the end in mouth is withdrawn completely and put as if putting an orogastric tube (Step 2).

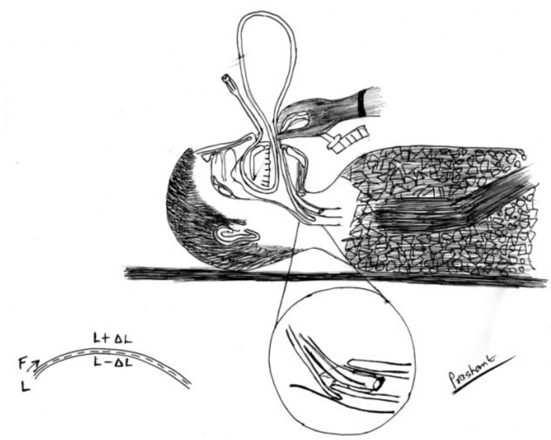

Fig: 6b Schematic show the events of Step 2.

4. Head in lateral position: Head turned to either side (right or left) has higher success rate of correct placement of a gastric tube. Bong et al (2004)[8] found that by turning the patient's head laterally, the path taken by the tip of the tube follows the lateral border of the pharynx, and the tube glides smoothly through the esophagus into the stomach, without coiling in the laryngopharynx. They opined that this might have same effect as applying lateral neck pressure. Passage of the nasogastric tube

was successful during the first pass in 80% in the lateral group versus 40% patients in the neutral group. 20% patients in the lateral group required three or more attempts versus 40% patients in the neutral group. Insertion of esophageal echocardiography probe was also achieved easily without the need of jaw thrust maneuver.

5. Digital lateralization of gastric tube: Mahajan and Gupta (2005)[7] explained technique of digital assistance to facilitate the insertion of gastric tube in anesthetized and sedated patients. The gloved index finger of the left hand was introduced into the left side of the oral cavity of the patient. Once the gastric tube could be negotiated into the oropharynx, it was pulled towards the lateral pharyngeal wall with the index finger, virtually grasping it between the index finger and the lateral pharyngeal wall. As the tube was pushed to the proximal end by the right hand, the left index finger simultaneously guides the tube along the lateral pharyngeal wall into the esophagus. The fingertip provides the buttress against the holes in the distal part of the gastric tube providing it the requisite sturdiness, preventing its bending and impaction with simultaneous steering into the esophagus. This method was found to be successful in 83% of the attempts.

6. Insertion of gastric tube in prone position: Yamauchi et al[9] compared the ease of insertion in prone cases (93%) scheduled for elective lumber spine surgery versus supine (33%) position. After intubation and final position in prone position a well-lubricated GT was passed. The provider was at liberty to lift the patients tongue, jaw, cricoid cartilage and the thyroid cartilage.

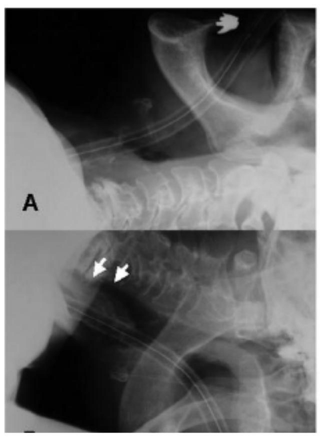

Fig:7 Cervical *x-ray* imaging of a case in which a nasogastric tube (NGT) could not be advanced into the stomach with the patient in the supine position (A), but could be advanced with the patient in the prone position (B). There was obviously a wide space (arrow) to pass an NGT at the hypopharynx and esophageal constrictions in the prone position, but no space in the supine position.

Although the method demonstrated, better success but can be practiced in those patients who are scheduled for surgery in the prone position. In the ICU this technique might be of immense help for cases being mechanically ventilated in prone position and cases of burn on the back kept prone. Turning the patient supine solely for GT placement is not wise because we have so many alternatives even to the alternatives.

7. The use of red rubber tube and fibreoptic bronchoscope to assist placement of GT in patients with a laryngeal mask airway (LMA). In such difficult cases the NGT invariably coils. Dutta (2006)[10] passed a well-lubricated red rubber Endotracheal tube (ETT) of size 6 mm ID through the nostril (while LMA in proper position) and fully inflated the cuff in hypopharynx and introduced the NGT through the ETT. Later red rubber tube could be withdrawn as required. This procedure may need cutting of the proximal adapter portion of some gastric tubes which are wider than the red rubber tube.

In another case with LMA in place initially the NGT was advanced into the naso-pharynx while a fibreoptic bronchoscope is passed through the oral cavity behind the cuff both concurrently (cm by cm). Once the NGT is advanced beyond the hypo pharynx, it can be negotiated alone slowly into the stomach.

8. Use of two gastric tubes: Literature review show that the success of the orogastric tube placement is higher than that of the nasogastric tube. Samantaray and Rao (2003)[11] pushed a small tube nasally so that the distal end coiled and came in the mouth. Next, a larger size tube was passed orogastrically into the stomach. The distal end of nasally passed smaller tube and proximal end of the larger tube is connected one inside another and slowly the nasal end pulled out to final desired position. They suggested that the higher success of orogastric tube placement may be because the orogastric tube takes the natural anatomical course. The technique they found was very helpful in cases with limited neck mobility and patients on cervical traction.

9. Use of ETT to place a NGT: Haung (1983)[12] described an explicitly simple solution for all difficult cases. NGT is introduced into the nose and if coiled taken out of mouth. The tip is threaded through the side hole of the ETT (Size #7 or #7.5) (Figure 8). The tubes should be well lubricated. The provider then placed the left hand index finger into the mouth to guide and the advancing tube is kept in the right hand. Once the tube passed the resistive area, the index finger holds the NGT by pushing it against the posterior pharyngeal wall and ETT alone is advanced. The operator can easily feel the NGT dislocating from the side-hole. Later the NGT alone is advanced to the stomach.

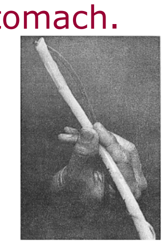

Fig: 8 Use of EET to place a NGT: method of Haung (1983)

10. Use of esophageal stethoscope and a pouch: Ohn (1979)[13] described a method of use of esophageal stethoscope modified to accept 2-3 cm of a NGT tube tip by cementing a thin layer of rubber (cut finger portion of a glove) so the proximal portion has a pouch. The distal portion of the tip of coiled tube taken out of mouth was placed in the pouch. The two tubes were together advanced until the maximal heart sound was heard. The NGT is now held and stethoscope advanced so that the two separate. Later NGT was advanced into the stomach and stethoscope is taken out.

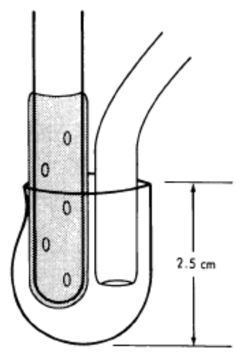

Fig:9 The nasogastric tube tip placed over the
Pouch over the esophageal stethoscope

11. Use of pre-emptive metoclopramide: Intravenous injection of 10 mg of metoclopramide before insertion of a gastric tube is associated with significantly lesser pain nausea and discomfort (Ozucelik et al, 2005[14]) and better success.

12. Laryngopharyngeal Examination blade (LpEx blade): Ashfaque (2006)[15] has designed a new laryngoscope blade. The new design can be routinely used to facilitate tracheal intubation. In addition, once the trachea is intubated, this laryngoscope blade can be inserted on the back of ETT in situ allowing it to stay in the midline without hindering the hypopharyngeal views. This has been achieved by adding a furrow to the tongue part of the blade, which accommodates the ETT and helps to lift it with the floor of the mouth. The gastric tube can be passed under vision with the help of this laryngopharyngoscope.

Fig:10 LpEx Blade and the view

13.FREKA® Nasogastric feeding tube: Are nasogastric feeding tube with hollow flexible guide wire which stabilizes the advancing feeding tube in the hypo pharynx and can be withdrawn later. These are made up of polyurethrane material radio-opaque tissue compatible, which is softer, and are available in 8 Fr (60 cm, 80cm, 120 cm) and 12 Fr sizes (120 cm).

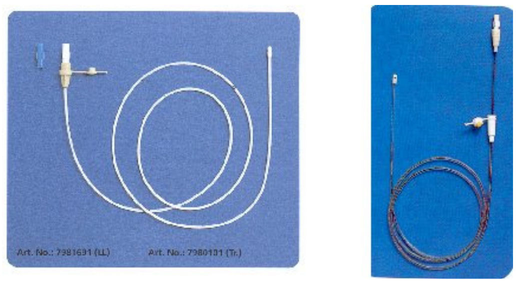

Fig:11 FREKA® Nasogastric feeding tube

14. Use of Capnometry: Capnometry can be used to guide and verify the correct placement of GT. The inner cannula of disposable tracheostomy tube with 15 mm snap-lock connector can be used to connect the GT to the end tidal CO_2 detector. NGT is advanced as usual if no CO_2 is detected. Color change from purple to yellow indicates misplacement. This procedure to facilitate, confirm and save cost on roentgenogram has cent percent sensitivity and specificity (Araujo-Preza et al, 2002)[16]. Takashi[17] supported the same idea of connecting CO_2 sampling tube to the side port of feeding tube thereby continuously measuring the exhaled CO_2. The complication such as pneumothorax can be eliminated since the wrong entry right at the airway can be recognized. Or else as he suggested that a tracheal tube be passed into the alimentary tract, no CO_2 elimination confirmed and then GT passed through the same.

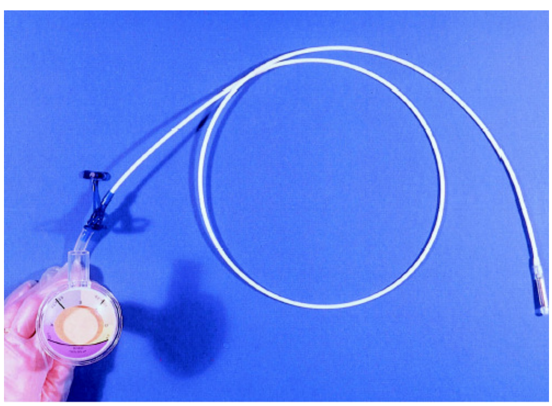

Fig: 12 The CO_2 detector

15. Shetty and Joshef[18,19] suggested the use of 13.5 mm nasopharyngeal airway and opined that it is unlikey to enter the cranial vault in case of suspected fracture of base of the cranium. Chen and Wang[20] used uncuffed red rubber tube. Alexander[21] suggested the use of longitudinally split red rubber tube, which can be withdrawn unhindered and can be used several time after sterilization to save the cost too.

16. Gilbert (2003)[22] avoided inadvertent placement of feeding tubes into the airways. After passing the feeding tube just past the larynx, or 30 cm, a luer-lock syringe is attached to the stylet of the feeding tube. The side port of the feeding tube is capped shut. Then an attempt was made to aspirate air with the attached syringe. If the tube was correctly placed in the esophagus, no air can be aspirated. Suction was felt in the resistance of the plunger and is observed in its spontaneous return toward its original position. If the tube tip was instead incorrectly positioned in the trachea, air could be aspirated and the plunger kept its position when released.

17. Endoscopically guided placement: Shukla et al[23] supported endoscopically guided placement of NGT, in patients of carcinoma esophagus with absolute dysphagia, where blind method had failed. In those cases, there was overall 75% success. Difficulty was more common if the upper third of esophagus was involved.

Lin et al (2006)[24] described the use of specially designed ultra thin endoscope (Olympus GIF-N230, outer diameter 6 mm) for the feeding tube placement in cases of esophageal cancer with absolute dysphagia (99% success). No procedure-related complications, such as bleeding or perforation, occurred.

18. Use of ice water: when facing coiling in the mouth one can try curling the distal end and partially freezing it in a cup of ice in order to temporarily hold its curled shape better. Lubricated tube tip is inserted through the nose with the curled end pointing downwards. Once the distal tip passes into the hypopharynx, the curved tip will be facing anteriorly. The tube is rotated 180 degrees so that the curved end is pointing posteriorly toward the esophagus. Continued to insert in the usual manner by having the patient swallow water.[25]

19. Manipulation of thyroid: Lifting the thyroid cartilage anterior and upward might open the esophagus and allow passage into the proximal esophagus.[25]

20. Knott nasogastric tube: Pushing the hard tip of the nasogastric tube through the nasal passage and sinus often causes pain, bleeding, and significant trauma to the nasal cavity. Knott (U.S. Pat. No. 5,690,620) discloses an anatomically conforming nasogastric tube having a normally-curved or normally-bent leading end and an additional bend near the leading end. The bent portion of the nasogastric tube is intended to conform to the shape of the soft palate, thereby applying a reduced pressure against the posterior nasopharynx. Knott further discloses a method of inserting the nasogastric tube which involves rotating the tube to bias the bent leading end of the tube in various desired directions so as to avoid obstructions, reliably enter the esophagus, or bias the tip in a particular position with respect to the stomach outlet. However, Knott's apparatus and method do not assure that the leading end of the tube will

not encounter, abrade, and irritate tissues during insertion. It also does not resolve the problem that the presence of the tube excites the patient's gag reflex. Moreover, rotating the trailing end of the tube does not ensure that the leading edge of the tube will identically rotate. Therefore, the difficulty of precisely positioning the leading end of the nasogastric tube remains. Thus, the Knott nasogastric tube does not satisfactorily resolve the problems of potentially intubating the trachea and lung, irritating or damaging the nasal cavity, and causing patient discomfort.

21. Seldinger technique: After passing the endoscope into the stomach a stiff guidewire is passed through the hole for suction; endoscope withdrawn, guidewire left in situ over which the GT is passed and finally guidewire removed carefully. This method can be of immense help in such as carcinoma of the esophagus where the initial passage is very narrow. Serious complications such as oesphageal perforation is extremely rare.

This is the era of fiberscopes and video monitor. However, when it comes to a simple manoeuvre like placing a gastric tube, practitioners invariably depend on the use of Magills forceps and not uncommonly find themselves in bloody mess in the oral cavity. The author's efforts would be prized if the readers find some of these manoeuvres useful while they actually practice and the deserving patients benefited.

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