NASOGASTRIC TUBE PLACEMENT- A SIMPLE YET DIFFICULT PROCEDURE- A REVIEW

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ABSTRACT

BACKGROUND

Summary- Despite several novel techniques reported in the literature regarding nasogastric tube placement, no technique has emerged as the most efficient method, especially for unconscious patients. A few of them appears to be achieving higher success rate and considered to be better than the rest. Varied complications have been reported in the literature. We searched for relevant medical literature in English using Google Search Engine. The following Medical Subject Headings (MeSH) terms were used: Decompression, Intubation, Gastrointestinal; Intubation, Intratracheal, Parenteral Nutrition, Stomach. The search was further extended using related keywords such as 'nasogastric intubation,' 'nasogastric tube insertion,' 'nasogastric tube intubation,' 'nasogastric tube placement.' The full text articles published in 2000 onwards were mainly considered with the exception for some old seminal articles. Primarily, original investigations, editorials, letter to Editor and brief communications were consulted. A few review articles were also taken into consideration. A brief outline about nasogastric tubes, its application, confirmatory tests, their current status with loopholes, different method to increase the objectivity of successful placement of nasogastric tube, etc. have been described. Mostly, a general view regarding this has been presented with a mention about the gray zones.

KEYWORDS

Gastric Tube, Nasogastric Tube, Nasogastric Tube Placement, Orogastric Tube, Intubation.

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BACKGROUND

Successful placement of Nasogastric Tube (NGT) in anaesthetised or unconscious individuals in operating room and intensive care unit appears to be challenging one compared with its insertion in conscious patients. It is introduced through the nose into the stomach, mainly for providing short-term or medium-term supplementary nutrition for giving gastric lavage or for decompressing the stomach- the last purpose being most important in anaesthetised patients during surgery. It is frequently needed in patients undergoing thoracic and abdominal surgeries. Its insertion in the unconscious and paralysed patients is often not so easy. Convention method of placement of NGT bears a failure rate of around 50%.[1,2] In this narrative review, an endeavour has been made to depict the general outline about NGT, different novel techniques, their success rates and comparative status and various complications during its placement. Methods for confirmation of successful placement of NGT and techniques to increase the objectivity and safety of blind insertion of NGT have been described.

Types of Nasogastric Tubes

The Nasogastric Tube (NGT) is a narrow tube, made of Polyvinyl Chloride (PVC) or Polyurethane (PUC). The latter is more flexible and less prone to cause trauma.[3,4]

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The weighted nasogastric tubes have tungsten ball instead of mercury ones, reducing the risk of inadvertent absorption and toxicity. The tip of the weighted tube points preferentially towards the posterior oropharynx and as such has a greater chance to enter the oesophagus.[3,4] Many NGTs used today are flexible and need guidewires or stilettes for their insertion. They may be large bore (14F) or small bore (8-12F). The larger ones are made of the tougher PVC and have lesser chance of malposition or kinking and have greater reliability for aspiration of gastric contents and confirmation of position. They can be introduced at the bedside by a trained nurse.[4] Again NGTs may be classified as 'passive' or 'active' depending upon how it functions. The passive could be 'open' or 'closed.' The NGT is left open or connected to a collecting system (closed) without the application of suction machine. NGT is termed as 'active' when it is connected to a suction machine to produce a slow but consistent evacuation of the gastric material. Intermittent connection to suction machine achieves better result than a continuous one.[5]

Feeding by Nasogastric Tubes[6]

- Bolus feed is simple, requiring minimal equipment, executed with the help of gravity. However, it might increase the risk of gastrointestinal (GI) symptoms.
- Intermittent feed using the help of gravity or pump. It allows some feeding-free interval, but increases the propensity of GI symptoms.
- Continuous feed using a pump system: this reduces the incidence of GI symptoms, but the patient remains connected to the system most of the time and hence limit mobility.
- Semi-recumbent positioning reduces the propensity of airway aspiration.

- Contamination of feeds can be curtailed by minimal and careful handling and the use of closed systems rather than open one.

Contraindications of NGT Insertion

Feeding through NGT is not suitable in some clinical scenario, such as substantial maxillofacial trauma, recent history of ingestion of caustic materials, oesophageal strictures and diverticula, severe nasal injuries, base of skull fractures, etc. In patients with altered mental status or impaired airway defenses, NGT insertion should not be tried before securing airway with endotracheal intubation as the former may precipitate vomiting and aspiration.[6]

Preparing the Patients for Nasogastric Tube Placement

Frequently, a lubricating jelly (2% lignocaine, K-Y jelly or any non-anaesthetic lubricant jelly) and a nasal decongestant is used to aid the insertion of the NGT. Current recommendations include 2% lignocaine jelly, nebulisation with 4% lignocaine, atomised 4% lignocaine nasal spray, 4% lignocaine and oxymetazoline atomised nasal spray and oxymetazoline nasal spray.[7,8] In the anaesthetised patient, K-Y jelly can be easily used. K-Y jelly is a simple lubricating jelly which contains glycerine and hydroxymethyl cellulose as lubricating material. Chlorhexidine gluconate and glucono-delta-lactone act as antiseptics. It also contains methylparaben and sodium hydroxide as preservative agents.

Confirmation of Position

Clinical

The confirmation of position of a nasogastric tube can be done clinically by- i) Examining the length of the tube introduced beyond the nostril, ii) Ausculting over the epigastrium while deflating an air-filled syringe attached to the proximal end of the tube, iii) Aspirating the gastric contents through the NGT. Combination of all three yields the best result. Of these, auscultation is the commonest and most popular. But, loopholes exist. A gurgling sound can be heard over the epigastrium even if the NGT is in the trachea-bronchial tree, pleural space or oesophagus.[9]

Testing pH of Aspirate

Gastric placement is indicated by a pH of less than 4, but may increase in the range of 4 - 6 in case of acid-inhibiting drug therapy. The use of blue litmus paper to check the acidity of aspirate material lacks sensitivity to distinguish between levels of acidity.[10,11] Magnetic guidance can rule out lung or oesophageal placement– the two most hazardous potential tube sites, whereas a pH test with cut-offs at 5.5 or lower can rule out lung misplacements. There is potential of magnetic guidance testing to be the safest option followed by the pH test with a cut-off of 4.0 or 5.5. However, the pH test remains the safest test when using a cut-off of 4.0.[12]

X-Rays

This will confirm position at only the time the x-ray is carried out. The tube may get displaced by the time when patient returns to ward. In the absence of pH testing facility, an x-ray must be repeated to confirm the initial position of the NGT.[13] X-ray also ensures that the ports of an NGT are in the stomach and therefore it is properly positioned in the gastrointestinal tract. Even nasogastric tubes that ended in the distal oesophagus can result in aspiration. Many experts and professional bodies agree that the cost of an x-ray to confirm correct placement of a blindly inserted tube prior to its use to administer feeds or medications should be regarded as justified.[14]

An NGT is considered 'malpositioned' if it is not within the oesophageal lumen or if the distal end of the tube is not below the gastro-oesophageal junction. To place an NGT, it is assumed that the median distance from the anterior nasal spine to the tracheo-oesophageal junction to be about 20 cm, the oesophagus to be 25 cm long and to aim for the tip of the NGT to lie 10 cm below the gastro-oesophageal junction. Therefore, ideally the NGT should be secured at the 50 to 60 cm mark at the nasal vestibule. Alternatively, the length of insertion is determined by adding the distances from nose to pinna and the distance from pinna to the xiphoid process plus extra 5 cm allowance. This will place the tip of the NGT in the fundus of the stomach.[14]

When and how many times should the tube position be checked?

The Position of NGT should be checked in the following Manners-

- It should be checked after initial placement and thereafter at least once daily during continuous feeds. It is essential to check tube position before the start of feed following a break.
- It should be checked in case of reflux of feed and after episodes of coughing, retching or vomiting after oropharyngeal suction or if there is any discomfort or respiratory distress.
- Before administration of any drug if NGT is not being used for any other purpose.
- Its position should be checked and noted during transport of patient or if any change in length of the visible part of tube is noticed.

Why is it difficult to Introduce NGT in Anaesthetised Patient?

The piriform sinuses and arytenoids cartilages have been incriminated as the most common sites of impaction.[15] The distal portion of the NGT has multiple apertures and thus is the weakest part. This makes the NGT susceptible to kinking, coiling and knotting when it encounters some resistance in its journey through nasopharynx and laryngopharynx. After a failure, subsequent attempts using the same NGT and applying the same technique leads to the same outcome (kinking at the same place) resulting in low success rate owing to the 'memory effect.'[16] Flegar and Ball[17] described one technique utilising refrigeration of nasogastric tube, while in-situ within package to make it rigid with a 'memory' for its coiled shape. The nasogastric tube should be inserted through nose with the concave side 'hugging the floor' of the nasal cavity. After reaching the oropharynx, the tube is rotated 180 degrees to bring its tip up against the posterior pharyngeal wall. This will allow the tip to stay over the posterior pharyngeal wall, facilitating its entrance into oesophagus. At this time point it is important to lift the chin and observe the neck, whilst slowly feeding the nasogastric tube. Any bulging noticed at the neck can be rectified by slight rotation of the tube. The authors opined this technique as a 'simple, but very useful technique' which may prove

invaluable both in operating room and in intensive care unit.[17]

Techniques of NGT Placement: A Flood in the Literature

To overcome the difficulties mentioned above, many people have adopted different techniques, e.g. 'head flexion' (80% success rate encountered in the 'flexion group' compared to 50% in the 'neutral group')[1], 'reverse Sellick's manoeuvre' or anterior lifting of the cricoid's cartilage with a success rate 75% to 80%,[18] and the 'slit-tracheal tube'-guided insertion[19] where the nasogastric tube is put inside a longitudinally slit endotracheal tube, which is then inserted blindly into the oral cavity up to a length of 18 cm and then withdrawn leaving the NGT inside. In the last study, Appukutty et al[19] found a success rate of 94%, 92% and 92% within two attempts using the 'neck flexion with lateral pressure,' 'ureteral guidewire-assisted technique' and 'slit-tracheal tube-guided methods', respectively.

While using a 'Rusch' intubation stylet and attaching a slipknot to tie the NGT to its tip ('slipknot to intubation stylet'), the success rate was found to be around 98%.[20] Frozen NGT technique[21] by filling a silicone NGT with distilled water and freezing it, has been reported a success rate of around 88%; and the use of oesophageal guidewire[22] has been claimed to have a higher success rate of around 99%. Kumar P et al[23] used gloved fingers to guide the NGT along the posterior pharyngeal wall, whereas Kayo R et al[24] used a 5 cm pillow beneath the patient's head.

Sometimes, the NGT has been introduced under direct endoscopic visions. Use of the Glide Scope had a first-attempt insertion rate of NGT of around 85%.[25-27] The nasolaryngoscope was used by Boston AG et al[28] for inserting the NGT under direct visualisation with minimal trauma with the distal tip of the NGT being manipulated through a suture connecting the distal ends of NGT and the endoscope; however, this process needed active swallowing by the patient and is questionable in anaesthetised ones. The King Vision video-laryngoscope was used orally for guiding the NGT introduced through the nose through the piriform sinus or the oesophagus.[29] This has been reported to have 100% efficacy and minimal complications, but is not always available at hand. A Seldinger technique of gliding NGT over nasoendoscope has also been mentioned in the recent past.[30]

A combination of four steps one after another, viz. sniffing position, nasogastric tube orientation, contralateral rotation and twisting movement (SORT) achieved a high success rate.[31]

Myriad of other techniques have been employed to help in NGT insertion. Prior inflation of pharynx with a facemask and self-inflating bag via two positive pressure breaths of 500 - 600 mL was claimed to open up the collapsed oesophagus in the anaesthetised patient, owing to which the NGT could be introduced with much ease (success rate 96%).[32] Dobson et al[33] used an innovative 'peel-away tube technique' by using a perforated endotracheal tube split near the distal end, which could be easily peeled off after the NGT had been introduced into the oesophagus wrapped in the ET tube. Application of lateral neck pressure[2] was claimed to have a success rate of 80% at the first attempt. There is report of NGT insertion with an angiography catheter placed inside the NGT to strengthen it, the ET tube cuff having been inflated so as to have an audible leak and the cricoid cartilage lifted outwards and rightward (Samanta and Ghatak's technique).[34] The technique of 'neck flexion and lateral pressure' also has been claimed to achieve a high success rate within two attempts; 88%[16] and 94%[19] in two different studies, respectively. The frozen NGT technique[20] was found to achieve 88% success rate regarding proper placement of NGT. The reverse Sellick's manoeuvre have been reported to achieve success rates of 75% - 80%[18] and 96%[35] within two attempts in two different studies, respectively.

Techniques tried to Increase the Objectivity and Safety of Blind Insertion of NGT

In 1989, Roubenoff and Ravich[36] proposed a 'two-step protocol' for the NGT insertion. Here, the tube is initially advanced blindly to 30 cm and the position is verified by an x-ray. This initial check is crucial to prevent a pulmonary malposition by keeping an already misdirected tube away from the more distal smaller bronchi or the lung, where a perforation is most likely. At the same time, the 30 cm length allows it to reach only the proximal main stem bronchi, so that the abnormal curve of deviation away from the midline will be detected on the x-ray and the procedure is halted. If the x-ray shows a midline tube, this confirms position of NGT to be in the oesophagus and the NGT then can be further advanced to the optimum length of 50 cm and confirmed with a second x-ray. The 2-step insertion procedure eliminates the potential for complications at the cost of two radiologic exposures and more time; hence, is not routinely practised.[3] Marderstein EL et al[37] modified the Roubenoff and Ravich's 'two-step protocol' with application of a pause when the NGT reached 35 cm. Marderstein and co-researchers[37] reported that with this two-step approach, no tube placed in the oesophagus has caused pulmonary damage.

Thomas BW et al (1998)[38] used a colorimetric end-tidal CO_2 indicator device, which uses a sulphapthalein-impregnated pH-sensitive filter paper that changes from purple to yellow in the presence of CO_2. The authors suggested that it was 100% sensitive and specific in discriminating between the tubes passed into the airways and those passed into the alimentary tract.

Haddad N et al (1993)[39] used an external transmitter with an electromagnetic pulse sensor system at the bedside to observe the location of the tip of the tube, as it is manually inserted. Prima facie, the reports suggest about its high success rates and decreased insertion time. Bercik P et al[40] monitored the tip of NGT using a magnet-tipped computer tracking system during its insertion and compared it with simultaneous monitoring with fluoroscopy and manometry. An excellent correlation was found between the three techniques. Sorokin R and Gottlieb JE[41] applied three changes to reduce the possibility of pneumothorax from NGT insertion in intubated patients. First, the NGT were either not advanced beyond 35 cm until an x-ray was obtained or were advanced under direct laryngoscopic view, fluoroscopic guidance or capnometric monitoring guidance. Second, they monitored the NGT malposition and reported to the clinical staff regularly. Third, training (orientation) program on NGT insertion among residents was started.

The pH and Bilirubin Estimation of the Aspirate Position Status

Mean pH levels of inner environment of lungs and intestine are significantly higher than that of the stomach (7.73, 7.35 and 3.90, respectively). However, after acquiring infection, pleural or respiratory secretion can show an acidic pH and a false positive for the gastric position. Misleading alkaline pH in the stomach can be seen in case of achlorhydria and with the use of potent anti-acid drugs. Proper (gastric) placement is indicated by a pH below 4. The pH may increase to 4 - 6 in those receiving acid-inhibiting therapy. The blue litmus paper was found insufficiently sensitive to distinguish between the levels of acidity.[3,10,11] Magnetic-guidance can rule out lung or oesophageal placement, both are potentially hazardous. In contrast, a pH test with cut-off point set at 5.5 or lower can rule out NGT misplacement in lungs. There is potential of magnetic-guidance testing to be the safest option, followed by the pH test with a cut-off set at 4.0 or 5.5. A higher cut-off point of pH should only be used when the clinicians have sufficient experience and the pH is measured accurately. Hence, the pH test may be the safest test when using a cut-off of 4.0.[12]

Mean bilirubin levels in the lung (0.08 mg/dL) and stomach (1.28 mg/dL) were considerably lower than in the intestine (12.73 mg/dL). Measurement of bilirubin is now possible using a colourimetric test-strip with visual scale. Metheny NA[42] combined these 2 markers and proposed a predictive, useful yet simple, bedside test. (i) A pH less than 5 and bilirubin less than 5 mg/dL of NGT aspirate identified 98% of gastric sites. (ii) A pH greater than 5 and a bilirubin less than 5 mg/dL of NGT aspirate identified 100% of the respiratory sites. (iii) A pH greater than 5 and bilirubin greater than 5 mg/dL of the NGT aspirate has identified nearly 88% of the intestinal sites. However, this method only confirms the complication and does not prevent it.

Capnography

The presence of carbon dioxide (CO_2) is a surrogate marker for inadvertent pulmonary placement of NGT. Incorporating capnography into Roubenoff and Ravich's '2-step protocol,'[3,36] could potentially increase its practical utility and can avert one extra radiological exposure compared with its original protocol. Araujo P[43] reported excellent initial results with a compact, disposable colourimetric end-tidal CO_2 detector. It was noted that the capnometer confirms the tube position at the crucial 30 cm position. The capnometer was found to detect CO_2 coming out of the NGT reliably even with the guidewire in-situ. The tube is further inserted to 50 cm with a single radiologic confirmation for the final placement. They reported this colourimetric end-tidal CO_2 detector to have 100% specificity and a 100% sensitivity rate in confirming successful NGT placement.[43]

Complications of NGT Insertion

The most common complication from insertion of NGT is the coiling in the pharynx or oesophagus. If the side holes are positioned within the oesophagus, there is every possibility of aspiration; hence, the tip of NGT should be at least 10 cm caudal to location of the gastro-oesophageal junction. Fine bore nasoenteric tube have been in use for over three decades. Reported overall complication rates vary widely from 0.3 to 8.0%. Several thoracic (bronchial placement and intravascular penetration) and non-thoracic (Enteral and intracranial) complications have been reported.[3,44]

Bronchial placement can lead to various complications such as atelectasis, pneumonia and lung abscess, bronchial perforation, pulmonary laceration, pulmonary haemorrhage, pleural cavity penetration and their consequences such as pneumothorax, empyema, pleural knotted tube, etc. The inadvertent insertion into the trachea or bronchial tree occurs in approximately 0.2% - 0.3% of patients. Rarely, pharyngeal and oesophageal perforations can occur with serious consequences.[3,14,44,45] Intravascular penetration occurred after erosion into retro-oesophageal aberrant right subclavian artery, erosion into right internal jugular vein and then to right atrium, etc. Enteral complications such as tube knotting and impaction in the posterior nasopharynx, tube breakage after being brittle with time, oesophageal perforation leading to mediastinitis and duodenal perforation- all have been reported. Intracranial entry has been observed following repair of choanal atresia and transnasal trans-sphenoidal surgery and in maxillofacial trauma patients.

To summarise, the procedure of nasogastric tube insertion may seem to be an easy one in daily practice. But, when the situation demands that one be inserted during an operation in an anaesthetised patient, it may not be that simple. Many have tried out different methods to ease out the process and many will in the future. Which procedure is the best depends on the expertise of the anaesthesiologist and the situation in hand, and should better not be generalised.

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