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Gastric Tube Use and Care in the NICU

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ABSTRACT

Orogastric and nasogastric tubes are used for both decompression and feeding in the NICU. The placement and use of these tubes are one of the most frequent nursing procedures in the NICU. These tubes are essential to the wellbeing and growth of critically ill infants and yet there is little empiric evidence to guide practice in the newborn. This paper will review the science available to guide practice, discuss controversies and examine interventions to improve safety.

The placement and use of gastric tubes are one of the most common nursing procedures performed in the newborn intensive care unit (NICU). These tubes are used for gastric decompression, enteral nutrition and medication administration. Few patients in the NICU will avoid having a gastric tube placed at some point during their hospitalization. Placing a gastric tube in a term or preterm infant is a multiple step process involving a series of decisions. The initial decision-making involves determining the type and size of tube to use, measuring for depth of placement of the tube, accurate assessment of successful placement, and planning for ongoing care of the tube.

Despite the regularity with which this procedure is performed, there is a surprising lack of empirically derived evidence to guide the performance of gastric tube placement and care in neonates. Much of current practice has been borrowed or modified from practice in older children and adults. This is unacceptable given the importance of these tubes to the safety and feeding of these vulnerable infants. Good nutrition and growth are essential for good outcomes. The insertion and use of gastric tubes pose a risk of injury to the infant. Safety issues include misplacement of the tube into the lung or small intestine, migration of the tube outside of the stomach, perforation of the trachea, esophagus, or stomach, and aspiration of the feeding into the lungs.[1] Because of these potential adverse events, it is critical that protocols developed for this procedure in neonates be based on the best available evidence for neonates. This paper will review the current evidence available and attempt to make some initial recommendations for evidence-based practice.

Sick neonates exhibit at least three risk factors that make them uniquely susceptible to the complications of tube placement and gavage feeding. These risk factors include their immature anatomy and physiology, the lack of evidence to guide care, and the rapidly changing equipment and technology in the NICU. The first risk factor is not easily modified, but empirical studies of the practice of gavage feeding and the associated technology used to provide these feedings may offer insight into the prevention of complications. These studies need to be specific to the neonate and include infants of all sizes and gestations.

Choosing the Type of Feeding Tubes to Place

Gastric tubes are available in a variety of materials, sizes and configurations. The composition of a medical device should be determined by the environment in which it is meant to reside and the properties that are required to perform its function. Materials used for neonatal feeding tubes need to be resilient across wide ranges of pH, gentle to fragile tissues, and have the tensile strength to allow for the largest possible interior lumen in a tube that will have a very small exterior size. A search of currently commercially available products reveals tubes that are labeled as *neonatal* that are generally made from one of three materials: polyvinylchloride (PVC), polyurethane, or silicone. A few feeding tubes are made of other polymers or mixtures of these products. Tubes found labeled *neonatal use* range in size from 3.5 fr to 10 fr with an equally wide range of lengths.

Why is it important that the bedside nurse be aware of the composition of tubes? Each material has advantages and disadvantages. The materials vary in stiffness, strength, ease of placement and cost. Each nursing unit must balance the qualities and costs of tubes in identifying the correct tube for their population.

For many years, feeding tubes were frequently made of PVC. PVC is relatively inexpensive, but stiff. Feeding tubes made of PVC become stiffer over time when exposed to the acid environment of the stomach.[2] While these tubes are still available commercially, they have fallen out of favor in the last several years due to the stiffness of the product and concerns about exposure to the plasticizer Di (2-ethylhexyl) phthalate (DEHP).[3]

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Polyurethane is slightly more expensive and has some unique features. Polyurethane becomes softer at body temperature. It is the strongest of the materials currently used; this allows polyurethane tubes to be made with a relatively thin wall that does not easily collapse when suction is applied.[2] The use of polyurethane with its greater strength allows for the largest interior diameter with the smallest exterior diameter. Most commercially available sumped or double lumen gastric tubes are made of polyurethane for this reason.

The last material is silicone; it is the most expensive material of the group, but is the softest and least likely to cause trauma.[2] The silicone tubes require thicker walls in order to maintain strength and stability of the tube, due to the softness of the material.[4] There is at least one documented case of a feeding tube curling during insertion in the literature[5]; the composition of this tube was not noted. There is also a case report of a Silastic™ (a silicone elastomer) tube becoming knotted inside the patient.[6] There are no data to document the frequency with which these types of complications occur, but there is some discussion among experts that softer tubes may be more likely to coil or turn during placement.

The available evidence suggests that there may be an important relationship between the material used to manufacture NG/OG tubes and perforation of immature tissues. Case reports in the literature demonstrate that preterm infants are at increased risk for perforation of the oropharynx, esophagus, stomach or duodenum.[7–10] (See Fig. 1.). As described above, NG/OG tubes manufactured from PVC have been implicated in tissue perforation. Yong et al.[10] describe three cases of esophageal perforation in preterm infants following the insertion of a 5 fr NG tube made of PVC. Esophageal perforations have also occurred with the use of silicone tubes. While the rate of tissue perforation is difficult to define, it is imperative that infants are monitored closely for signs of tissue perforation such as pneumothorax, pleural effusion, pneumoperitoneum, and sepsis.[10] In the above mentioned case reports, tube composition cannot be isolated as the single causative agent. In 2005, Filippi et al. published a report suggesting that in a group of infants less than 750 grams the incidence of esophageal perforation might be as high as 1 in 25 when PVC tubes were used and recommended the use of softer materials.[8]

There has been some discussion, but little research about the use of tubes with end holes or side holes. Some manufacturers have suggested that the use of end holes rather that side holes may decrease stagnation of feeding in the tube and eliminate a space for bacterial growth. A search of the literature did not demonstrate a single study to substantiate this claim. This literature search also found no studies to guide the decision whether to place a tube with an end hole or side holes. If a tube with side holes is chosen, these holes should be in the radiopaque strip of the tube so they can be identified on x-ray[11] and the tube needs to be placed deep enough that all of the side holes are in the stomach.[12,13] Quandt et al. have demonstrated that the injection of a small amount of air into a feeding tube prior to x-ray allows the tip to be more easily visualized and improves assessment of placement.[14]

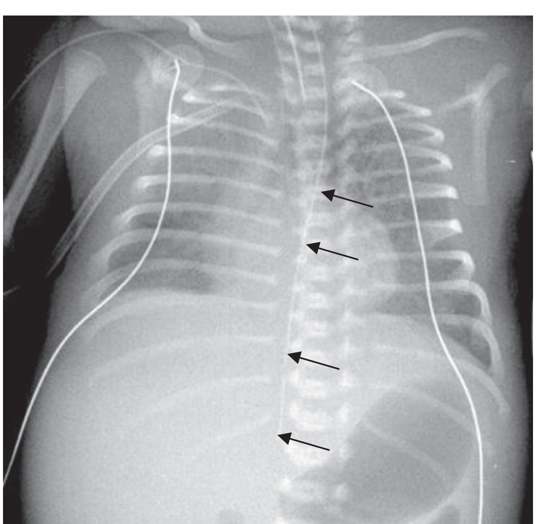

Fig. 1. Esophageal perforation of feeding tube (arrows demonstrate route of feeding tube).

There is a relatively large range of sizes and lengths of feeding tubes available for use in neonates. It is important that the nurse considers the use for the tube when determining the size feeding tube to place. While some authors have attempted to create guidelines, this issue is unstudied and no standard of care exists. The size of the tube affects both the comfort for the infant and how feedings or secretions move through the tube. Poiseuille's Law of Physics notes that resistance to flow through a tube depends on the viscosity of the fluid, the length of the tube, and the internal radius of the tube to the fourth power. This means that small changes in tube size quickly change how easily feedings can flow through a tube, how completely residuals can be aspirated, and how well these tubes can decompress the stomach. Even small changes in tube size can change the functionality of a tube.

Gastric residuals are frequently used as a measure of feeding tolerance in preterm infants. Gastric residuals are measured by aspirating stomach contents through the feeding tube. Of concern is whether the small bore feeding tubes used in these infants are restrictive and prevent the accurate measurement of gastric residuals. A study of tube feeding in adults demonstrated that when these adults had concurrently indwelling tubes of varying sizes, smaller residuals were obtained from smaller bore tubes and larger residuals were obtained from the larger bore tubes.[15] The ability of tube size and tube composition to alter residual volumes obtained was also documented in a laboratory study using neonatal tubes and frequently used neonatal formulas. The researchers attempted to aspirate a known volume of breast milk or formula mixed with hydrochloric acid to simulate the gastric environment. Tubes with a smaller internal diameter consistently allowed less residual volume to be aspirated.[16]

Gastric tubes are also frequently used to provide decompression of the stomach. A study by De Boer, Smit, and Mainous[17] examined 326 x-rays for gastric distention and correlated this with the position of the tube and the size of tube in place. They demonstrated a significant relationship between tube size and gastric air; bigger tubes did a better job of decompressing the stomach. The researchers hypothesized that the smaller sized tubes may provide too much resistance to allow excess air to readily escape.

The features that improve feeding tube function, namely a larger size and a shorter length, are features that are frequently at odds with infant comfort and respiratory effort. As a general rule, caregivers presume smaller tubes are more comfortable and interfere less with work of breathing. The nurse must carefully consider what the tube is being used for, the composition of the tube, and the size of the infant when choosing a tube. The goal should be to choose the smallest tube that will perform the function while minimizing infant discomfort. Unfortunately, little specific data exist to guide these decisions.

Selection of Oral or Nasal Placement of Gastric Tubes

Gastric tubes in neonates can be placed orally or nasally. Infants are obligate nasal breathers, so one of the considerations in choosing where to place a tube needs to be the infant's respiratory status and current respiratory support. Researchers have demonstrated increased work of breathing and decreased minute ventilation with nasal placement of the gavage tubes in preterm infants.[18–20] Unfortunately, none of these studies looked at relative changes in work of breathing based on the size of tube placed. Nasally placed feeding tubes have also resulted in lower oxygen saturations.[21] It has been speculated that orally placed tubes might have more movement and make infants more prone to vagal stimulation and