Assessing the Risk Factors of Tube Misplacement and Displacement in Young Children

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Abstract

The purpose of this preliminary study is to identify the risk factors for nasogastric (NG) tube misplacement in children < 100 months and the risks for displacement of NI tubes over time in children < 19 years of age. The risk factors for misplacement of NG tubes have been extensively reviewed in adults; however, only one study has been conducted to review the risk factors for tube misplacement in children. Thus, there is a need for more research on children. Also, the risks of displacement of nasointestinal (NI) tubes after initial correct placement have not been studied in children. It is necessary to assess these risk factors for misplacement and displacement of NG and NI tubes in children to avoid serious complications. When tubes are out of place, children can be seriously harmed causing increased morbidity and occasionally death. Data will be collected in Riley Children’s Hospital by my mentor’s research team that includes Dr. Marsha Ellett, who is the principal investigator of the studies entitled Gastric Tube Placement in Younger Children (funded by the National Institute of Nursing Research) and Nasointestinal Tube Placement in Children.

Keywords: Nasogastric tube, misplacement, risk factors

1. Introduction

Enteral nutrition is becoming widely preferred over parenteral nutrition in children with a functioning gastrointestinal tract because of decreased cost and complications as well as maintenance of gastrointestinal (GI) mucosa when the need for tube feeding is expected to be six weeks or less. Small bore feeding tubes are often chosen because of their soft, flexible nature and small size. When this type of tube is passed through the nose or mouth, it is usually well tolerated by adults and children, rarely contributing to sinus infections or obstruction of breathing. However, it is too common to have these tubes misplaced during insertion. The risk factors for misplacement of nasogastric (NG) or orogastric (OG) tubes in adults have been extensively reviewed in the literature. Conversely, there has been minimal review of the risk factors of tube misplacement in children. In reviewing literature, I have found that many factors can contribute to malpositioning of NG tubes in adults that can lead to complications. NG/OG tubes can be misplaced into the respiratory tract, esophagus, or small intestine rather than the stomach. Therefore, there is an urgent need to study the risk factors of tube misplacement in children to avoid potential serious problems after insertion.

Displacement of both small and large bore tubes can occur over time, however, small bore tubes displace more easily migrating back up into the respiratory tract without any outward signs of movement. Small bore tubes are also prone to occlusion and coiling.

There are also risks factors for displacement of (NI) tubes (which are placed into the small intestine) over time. NI tubes run the risk of migrating back up into the stomach or the esophagus after initial correct insertion.
1.1. literature review

Nasopulmonary intubation is an uncommon misplacement site for NG/OG tubes. The risk factors for misplacement in adults are far more studied than the risk factors for children. A summary of these risks in adults includes: coughing, upper airway intubation, failure to tip the head forward during passage of the tube, decreased level of consciousness, and upper airway reflexes depressed by sedation. It is also not uncommon for small bore tubes to coil up in the oropharynx or esophagus.

The risk factors for NG/OG tube placement errors in children have been reviewed in only one study. The risk factors were found to be: younger age, level of consciousness (either alert or comatose versus semi comatose), male gender, abdominal distention, increased activity, and vomiting.

The risk factors of displacement of NI tubes for adults and children alike have not been extensively studied; therefore, there is a need to further study the risk factors found in my literature review including: coughing, retching or vomiting, nasotracheal or tracheal suctioning, failure to maintain elevation of the head of the bed at all times, and restlessness. The only risk factors that have been associated with displacement of NI tubes in children were increased activity and vomiting.

Of the few studies that have been done on children with enteral tubes, there have been variable rates of placement errors. In a retrospective chart review study over a three-year period of 201 children, 88.3% of which had NG tubes, 10.0% had OG tubes, and 1.7% had NI tubes, on the first day of radiograph, 15.9% of the children had tube placement errors; 81.2% of these tubes were incorrectly placed high (esophagus if NG/OG tube or esophagus or stomach if NI tube), and 18.8% were incorrectly placed low (intestine if NG/OG tube). Of the 201 children, 20.9% had a tube placement error occur at some time during the review period. Over the time period reviewed, 13.8% of the radiographs showed tube placement errors: 81.1% of these 43 errors were incorrectly placed high and 18.9% low. No respiratory placements were found. On three radiographs the tubes were coiled in the esophagus, and six placements showed the tube was looped in the stomach.

In a prospective cross-sectional study of 39 children, 61.7% male and age range from 1 week to 13 years were followed from 1 to 59 days each for a total of 329 observation days. Approximately 75% of these children were chronically ill and being fed through enteral tubes. Seven had more than one type of tube during the study period; therefore, there were a total of 46 tubes – 35 NG, 3 OG, and 8 NI. All but 3 of the 35 NG tubes and all 3 of the OG tubes were in children < 100 months of age, the age range for the proposed study. Over all study days, 21.8% of the 101 radiographs obtained showed incorrectly placed enteral tubes; 50% of these were too high, and 50% too low. This compares with the 13.8% error rate in the retrospective chart review. Importantly, either on the first or subsequent radiograph days, 43.5% of the 46 tubes were incorrectly placed at least once. Incorrect placement occurred in 42.9% of the NG tubes, 66.7% of the OG tubes, and 37.5% of the NI tubes. The 43.5% error rate was twice as high as the 20.9% found in the retrospective chart review which suggests a major problem.

In a study of 90 adults admitted for dysphagia, patients with nasoenteric tubes had a 10% complication incidence (aspiration or endotracheal placement of the tube) resulting in a 30% mortality rate.

In a study of 64 adults carried out in an Internal Medicine Unit, the error rates for tube dislodgement after correct initial placement was 48.5%.

2. Methodology

A chart audit was conducted on the children who were involved in the study entitled, “Gastric Tube Placement in Younger Children.” A list of risk factors identified in the literature review as causing the highest incidence of tube misplacements included endotracheal tube or tracheostomy, coughing, decreased level of consciousness, sedation, decreased airway protective reflexes, concurrent respiratory illness, anatomic abnormality, N/G tube with stylet, positioning of head, failure to maintain elevation of the head of the bed, and diagnoses were recorded for each child.

2.1. specific aims

The purpose of this preliminary study is to identify the risk factors for nasogastric/orogastric (NG/OG) tube misplacement in children < 100 months, and risk factors for displacement of nasointestinal (NI) tubes over time in children < 19 years of age. The most important outcome will be increased awareness of the risk factors leading to safer tube feeding in children.
2.11. Research question

What risk factors are associated with NG/OG tube misplacement? What risk factors are associated with NI tube displacement over time after initial correct placement?

3. Data

The average number of risk factors occurring in the 36 patients was 2.33, with 7 (19.4%) having 0 risk factors, 9 (25%) having 1 risk factor, 5 (13.9%) having 2 risk factors, 6 (16.7%) having 3 risk factors, 3 (8.3%) having 4 risk factors, 5 (13.9%) having 5 risk factors, and 1 (2.8%) having 6 risk factors. The most common of these risk factors were: aspiration pneumonia, respiratory distress, asthma, respiratory insufficiency, tracheomalacia, and feeding intolerance.

Of the 36 patients studied, 4 (11.1%) experienced tube misplacement of too short of a distance into the esophagus and one coiling back up within the esophagus upon initial insertion.

The first patient with placement too high had no endotracheal tube, no cough upon insertion, alert level of consciousness, no sedation, no decreased airway protective reflexes, no NG tube with a stylet, no anatomic abnormality, with her head positioned at midline, diagnosed with a chronic respiratory illness of feeding intolerance totaling 1 risk factor.

The second patient with tube misplacement too high also had no endotracheal tube; however he did experience coughing upon tube insertion, was alert, had no sedation, no decreased airway protective reflexes, no NG tube with a stylet, no anatomic abnormality, with his head positioned at midline, a diagnosis of asthma and a chronic respiratory illness of laryngomalacia totaling 3 risk factors.

The third patient with placement too high also had no endotracheal tube, no cough upon insertion, an alert level of consciousness, no sedation, no decreased airway protective reflexes, no NG tube with stylet, no anatomic abnormality, with her head positioned at midline, a diagnosis of Russell Silver Syndrome, with no chronic respiratory illness, totaling 1 risk factor.

The fourth patient with tube misplacement coiled up in the esophagus had an endotracheal tube, experienced cough upon insertion, an alert level of consciousness, sedation, decreased airway protective reflexes, no NG tube with stylet, an anatomic abnormality of tracheomalacia, with her head positioned at midline, and respiratory insufficiency, totaling 6 risk factors.

Of the 32 patients without tube misplacement 2 (6.3%) had an endotracheal tube, 11 (34.4%) experienced coughing upon insertion, an alert level of consciousness, sedation, decreased airway protective reflexes, no NG tube with stylet, an anatomic abnormality of tracheomalacia, genetic large head, and laryngomalacia, 1 (3.1%) had a neck extension, and 14 (43.8%) had a concurrent respiratory illness which included acid reflex, aspiration pneumonia, asthma, chronic lung disease, vomiting, respiratory insufficiency, respiratory distress, feeding intolerance, laryngomalacia, glutaric audemia, sinusitis, congestion, and obstructive sleep apnea.

Table 1. Number of children having each risk factor

<table>
<thead>
<tr>
<th>Risk Factors</th>
<th>Frequency</th>
<th>How many misplaced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endotracheal Tube</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Concurrent Respiratory Illness</td>
<td>17</td>
<td>3</td>
</tr>
<tr>
<td>Head of Bed Not Elevated</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Sedated</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Coughing</td>
<td>13</td>
<td>2</td>
</tr>
<tr>
<td>Decreased Level of Consciousness</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Neck Extension</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Anatomic Abnormality</td>
<td>20</td>
<td>2</td>
</tr>
</tbody>
</table>
4. Conclusion

Concurrent respiratory illness (whether having the diagnosis of asthma or not) was present in three of the four children (75%) with misplaced NG/OG tubes, coughing upon insertion was present in two of the four children (50%). An endotracheal tube, decreased airway protective reflexes, sedation, and an anatomic abnormality were present in at least one of the four children (25%). An anatomic abnormality that was present in one of the patients with tube misplacement was tracheomalacia - a collapsed trachea that has to be kept open by medical intervention. Another anatomic abnormality that was present in one of the patients with tube misplacement was Russell Silver Syndrome, a disorder present at birth which is characterized by poor growth demonstrated by low birth weight and short stature and frequently, asymmetry in the size of the two halves or other parts of the body.

We suspect prematurity as well as anatomic abnormalities to be risk factors of tube misplacement that have not yet been identified in previous studies. Seven of the 36 patients had a history of prematurity and one of the 4 patients with tube misplacement was diagnosed premature.

Of the 32 patients without tube misplacement, 12 had anatomic abnormalities that put them at the most risk for misplacement including hydrocephaly, causing the child to be small for their age, therefore affecting the accuracy of the methods used to measure insertion length. A genetic large head may also affect the measured distance for insertion of the tube. Laryngomalacia, collapsing of the larynx, could lead the tube into the away from its intended destination. Myelomeningocele, the protrusion of the spinal cord and the membranes covering it through a defect in the vertebral column, may lead to incorrect placement.

Of the 4 tube misplacements, 1 had an anatomic abnormality of tracheomalacia which we suspect is the reason for the tube coiling back up into the esophagus.

In summary, the most common risk factors in children for tube misplacement included airway problems, such as laryngomalacia and tracheomalacia, pneumonia, respiratory insufficiency and distress, chronic lung disease, asthma, vomiting, feeding intolerance, congestion, and obstructive sleep apnea.

We also present prematurity and anatomic abnormalities such as short gut, hydrocephaly, subglottic stenosis, myelomeningocele, dystonia, Russell Silver Syndrome, genetic large head, laryngomalacia, and tracheomalacia, leading to decreased airway protective reflexes, as well as coughing upon insertion of the tube as potential risk factors that have not been studied previously.

5. Acknowledgements

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6. References