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A Review of Published Case Reports of Inadvertent Pulmonary Placement of Nasogastric Tubes in Children

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Key words:

Adolescent;
Child;
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intubation;
Intratracheal intubation;
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Diagnostic errors;
Pneumothorax;
Enteral Nutrition;
Charcoal

Problem: Little is known about the incidence of inadvertent pulmonary placement of nasogastric tubes during blind insertions in children. **Purpose:** The purpose of this paper was to conduct a review of published case reports over the past two decades. **Methods:** An OVID Medline search was conducted of articles published from 1993 through 2012. **Results:** Fifteen published case reports were located; four patients died as a result of their malpositioned tubes. The auscultatory bedside method failed to detect the malpositioned tubes in all seven cases in which it was used. **Conclusions:** The incidence of inadvertent pulmonary placement of nasogastric tubes is relatively low but can lead to serious and even lethal results in children. The auscultatory method to predict tube location is unreliable.

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LITTLE IS KNOWN about the incidence of inadvertent pulmonary placement of nasogastric tubes in children; however, it may be similar to that seen in adults, which is estimated to range between 2.4 and 3.2% (De Aguilar-Nascimento & Kudsk, 2007; Sorokin & Gottlieb, 2006). Even if the incidence is low, the frequent use of nasogastric tubes in pediatric settings predisposes a sizable number of children to this potentially catastrophic event. The National Patient Safety Agency (NPSA) in the United Kingdom (UK) issued a safety alert regarding the danger of misplaced nasogastric and orogastric feeding tubes in the neonatal population (National Patient Safety Agency, 2005). The Joint Commission in the United States identified the accidental insertion of feeding tubes into the trachea or bronchus as a sentinel event (Joint Commission, 2000). Similarly, the National Health Service in the UK has added

misplacement of nasogastric and orogastric feeding tubes to a list of “never events” (National Health Service, 2012).

Purpose

The purpose of this paper was to conduct a review of published case reports over the past two decades in which blindly inserted nasogastric tubes were radiologically confirmed to have been inadvertently positioned in the respiratory tract of children.

Methods

An OVID Medline search was conducted of articles published from 1993 through 2012 that describe cases in which blindly inserted nasogastric tubes were inadvertently positioned in the respiratory tract of children. Key words

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used in the search included the following: adolescent, child, infant, newborn, gastrointestinal intubation, intratracheal intubation, medical errors, diagnostic errors, pneumothorax, enteral nutrition, respiratory disorders, and charcoal. The review sought the following information: age, circumstances of nasogastric tube insertion, results of bedside tests used to predict tube location, radiological evidence of tube site, and patient outcomes following the event.

Results

Fifteen published case reports were found in which blindly inserted nasogastric tubes were radiologically confirmed to have been placed in the respiratory tract of children (Creel & Winkler, 2007; el-Gamel & Watson, 1993; Fuentealba & Taylor, 2012; Golej, Boigner, Burda, Hermon, & Trittenwein, 2001; Graff, Stark, Berkenbosch, Holcomb, & Garola, 2002; Jakubczyk et al., 2010; Johnstone, Leung, & Friedman, 2011; Karlowicz & Gowen, 1995; Metheny, Wehrle, Wiersema, & Clark, 1998; Yardley & Donaldson, 2010). Some of the case reports did not include complete information.

Children described in the reports ranged in age from 11 days to 16 years; most were cared for in a critical care or emergency department setting. Five of the cases occurred in a 19-bed pediatric intensive care unit in the United States over a 15-month period (Creel & Winkler, 2007) and four cases involved the administration of activated charcoal into the respiratory tract following toxic ingestions (Godambe et al., 2003; Golej et al., 2001; Graff et al., 2002; Metheny et al., 1998).

As noted in Table 1, radiographic reports indicated that five of the tubes were positioned in the left lung region or bronchus, and six in the right lung region or bronchus; one was in the trachea. In the remaining three cases, the precise location in the respiratory tract was not described.

Bedside testing methods were described for seven of the cases; in all of these, auscultation of the epigastrium for air injected through the tubes was performed and caused the operators to believe the tubes were positioned in the stomach. A litmus test was performed in one case and was presumed to indicate gastric placement because the pH was acidic (<7). Fluid was withdrawn from two of the tubes (one aspirate consisted of bright red blood and the other was not described).

Four of the patients described in Table 1 died following their tube misplacements (Creel & Winkler, 2007; Metheny et al., 1998; Yardley & Donaldson, 2010). One death occurred after the infusion of enteral formula into an 8 year-old child's pleural space (Yardley & Donaldson, 2010); a second death followed the instillation of activated charcoal into the respiratory tract of a 2-year old child (Metheny et al., 1998). A third death occurred following progressive pulmonary hemorrhage following removal of the malpositioned tube

(Creel & Winkler, 2007), and a fourth death occurred when respiratory failure worsened significantly following the event (Creel & Winkler, 2007). Five of the reports described children who developed a pneumothorax (Creel & Winkler, 2007; el-Gamel & Watson, 1993; Johnstone et al., 2011; Karlowicz & Gowen, 1995); and at least four required mechanical ventilation following the faulty tube insertions (Creel & Winkler, 2007; Golej et al., 2001; Graff et al., 2002; Karlowicz & Gowen, 1995).

Not included in Table 1 is a report in which 5% (3 of 60) blindly inserted nasogastric tubes in children were strongly suspected of being inadvertently positioned in the respiratory tract, based on findings from a carbon dioxide detection device (Gilbert & Burns, 2012). Radiographic confirmation of respiratory placement was not obtained since the clinicians removed the nasogastric tubes when the carbon dioxide detection device indicated the tubes were in the trachea rather than the esophagus.

Discussion

Finding only 15 published case reports of radiologically confirmed pulmonary placement of nasogastric tubes in children suggests that the problem is uncommon in this population. However, it is probable that other pulmonary insertions occurred during the dates of the search period and were not reported in the literature.

Our review shows that inadvertent pulmonary placement of nasogastric tubes in children can lead to serious injury and even death. For this reason, it is crucial to verify correct positioning of all blindly inserted tubes prior to their initial use for feedings or medications. Had this been done for the patients described in Table 1, feedings would not have been administered via the malpositioned tubes in two children and charcoal would not have been administered via the malpositioned tubes in four others.

Clearly, radiography is the most accurate method to determine feeding tube placement; however, clinicians prefer to limit its use in children to avoid excessive exposure to radiation. Thus, bedside tests to predict tube location take on added significance in children. As shown in Table 1, the auscultatory method failed in all seven of the cases in which it was used; there are also numerous reports of this method failing in adults (Hensel & Marnitz, 2010; Metheny, Dettenmeier, Hampton, Wiersema, & Williams, 1990; Ng, Wan, Lee, & Yim, 2002). It is noteworthy that multiple sources caution against reliance on the auscultatory method to predict tube location (American Association of Critical-Care Nurses, 2009; Itkin et al., 2011; National Patient Safety Agency, 2005).

In one case, litmus paper was used to measure the pH of fluid withdrawn from the tube; an acidic reading (<7) falsely

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