

CHILD HEALTH PATIENT SAFETY ORGANIZATION

Patient Safety Action Alert

August 2012



ACTION NEEDED

- 1. Immediately Discontinue**
 - Insertion of an air bolus with auscultation over the abdomen to assess/verify NG tube placement
- 2. Consider Discontinuing**
 - Nose-ear-xiphoid (NEX) as a predictor of NG tube insertion-length
- 3. Consider x-ray verification when indicated (e.g. high-risk situations, difficult placement, when other non-radiologic methods are not confirmatory)**
- 4. Review the attached ECRI Hotline Response: Nasogastric Tube Misplacement and Complications in Pediatrics**
 - Evaluate your NG Tube Placement practices against industry standards
- 5. Participate in national initiatives to develop and implement reliable, best practices to prevent NG tube related complications (2013 ASPEN Summit in process)**
- 6. Participate in collaborative opportunities with vendors for adoption of new verification technologies**

Contact Us

psosupport@childpso.org

A Patient Experienced a SERIOUS SAFETY EVENT

Take Action to Reduce Risk of Similar Harm

Event: Blind Pediatric NG Tube Placements – Continue to Cause Harm

Child Health PSO identified an immediate need for pediatric providers to consider the risks associated with blind NG Tube placement and recommendations to prevent harm as this is the most common method of insertion of nasogastric (NG) tubes is blind passage. In 2011, the United Kingdom's National Patient Safety Agency (NPSA) issued a Patient Safety Alert, *Reducing the harm caused by misplaced nasogastric feeding tubes*, as a result of patient deaths and patient harm due to misplaced feeding tubes. The NPSA also issued an alert specific to neonates providing recommendations and guidance for this vulnerable population. Other organizations, such as the American Association of Critical Care Nurses (AACN) and the American Society for Parenteral and Enteral Nutrition (ASPEN), have recognized the complications resulting from NG tube misplacement and have implemented practice alerts and best practices based on evidence.

Incidence: The Journal of Parenteral and Enteral Nutrition (January, 2011) reported more than 1 million enteral intubations occur annually. In studying over 2,000 feeding tube insertions, Sorokin et al. (2006) determined 1.3 to 2.4 percent of NG tubes were malpositioned and 28 percent of those resulted in respiratory complications (pneumonia, pneumothorax). Malpositioned was defined in the study as placement external to the gastrointestinal tract. NG tube misplacements in children have been reported to be between 20.9 percent and 43.5 percent (Ellett et al. 2005). Farrington et al. (2009) reported the prevalence of NG tube placement errors in children is difficult to verify because of differing definitions across studies. Additionally, poor reporting of tube misplacement has prevented the adoption of protocols to prevent such errors (Metheny 2007).

Known Complications: NG tube placement can lead to complications such as esophageal perforation, bronchopulmonary intubation, pneumothorax, hydrothorax, empyema, and pneumonia. In addition, intracranial placement may occur in patients with facial fracture or facial trauma.

Problem: Evidence and clinical practice with pediatric NG Tube placement is inconsistent (see summary, page 2, e.g., radiographic methods) and misplacement is under reported. Pediatric patients at highest risk for incorrect tube placement include neonates, any children with neurologic impairment, or who are obtunded, sedated, unconscious, and/or critically ill, and those with reduced gag reflex or static encephalopathy.

Who should be concerned: Pediatric clinicians, nutritionists, nurses, nursing leaders, quality and safety leaders, home health clinicians, and hospital leaders.

Has a patient experienced an event at your organization that could happen in another hospital?

- Child Health PSO members submit event details into the [Child Health PSO portal](#).
- Contact Child Health PSO Staff to share risks, issues to assess, and mitigation strategies with member hospitals.
- Forty children's hospitals are actively engaged with Child Health PSO. We currently are enrolling new members.

This Alert is approved for general distribution to improve pediatric safety and reduce patient harm. This Alert meets the standards of non-identification in accordance with 3.212 of the Patient Safety Quality Improvement Act (PSQIA) and is a permissible disclosure by Child Health PSO.

CHILD HEALTH PATIENT SAFETY ORGANIZATION

Patient Safety Action Alert

August 2012



Event: Blind Pediatric NG Tube Placements – Continue to Cause Harm

SUPPORTING LITERATURE OF METHODS STUDIED

Literature Recommendations	References
RADIOGRAPHIC METHODS	
X-ray verification is recommended to confirm placement prior to initiation of feedings/medication administration.	Pediatric Nursing, Farrington et al. (2009) American Journal of Critical Care, Bourgault (2009) American Association of Critical-Care Nurses Practice Alert (2009) Ellett et al. (2011)
Radiologic verification in pediatric patients at high risk for aspiration or when non-radiologic methods are not feasible, or results are unclear.	Cincinnati Children's Hospital Medical Center Best Evidence Statement (2011)
MEASURING FEEDING TUBE INSERTION LENGTH METHODS	
Measuring Feeding Tube Length: Use of age-related height-based (ARHB) (calculated using prediction equation tables) and nose-ear-mid-umbilicus (NEMU). <ul style="list-style-type: none"> For neonates, patients with short stature, or if unable to obtain an accurate height, use of prediction equation tables is recommended (There is new data that suggests NEX should not be used). For children >2 weeks, age-related height-based (ARHB) methods and NEMU are more accurate than NEX. 	Cincinnati Children's Hospital Medical Center Best Evidence Statement (2011) Ellett et al. (2011)
Measuring Feeding Tube Length: Use of nose-ear-xiphoid (NEX) in neonates should no longer be used to estimate the distance to insert NG/OG tubes.	Ellett et al. (2011)
Measuring Feeding Tube Length*: Mark tube exit.	Pediatric Nursing, Farrington et al. (2009) Cincinnati Children's Hospital Medical Center Best Evidence Statement (2011) American Association of Critical-Care Nurses Practice Alert (2009)
OTHER METHODS	
Gastric pH testing* Gastric pH >5 validate NG placement using another method. Gastric pH varies by pediatric population and situation.	Farrington et al. (2009) Cincinnati Children's Hospital Medical Center Best Evidence Statement (2011) Gilbertson et al. (2011) Stock et al. (2008) Longo et al. Journal of Pediatric Nursing (2011) American Association of Critical-Care Nurses Practice Alert (2009)
Observe visual characteristics of aspirate*.	Pediatric Nursing, Farrington et al. (2009) American Association of Critical-Care Nurses Practice Alert (2009)
Auscultation of air insufflated through the feeding tube.	The reliability of this method was not supported by the literature

* Some studies recommended several methods of verification be performed to predict tube location.

HOTLINE RESPONSE

Nasogastric Tube Misplacement and Complications in Pediatrics



Health Technology Assessment
Information Service™

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The Discipline of Science. The Integrity of Independence.

Hotline Response

Policy Statement

Hotline Responses provide a guide to the published clinical literature and other information about specific healthcare technologies or services. Hotline Responses are generated directly from clients' custom requests and are therefore customized to address the specific information needs of the requestor. The information contained in the Hotline Response is derived primarily from the currently available, published, peer-reviewed scientific literature and websites. Publications referenced are generally limited to the English language. Often, a relative paucity of published clinical data exists on new and emerging technologies; therefore, information from health technology resources on the Internet and elsewhere may be included. The information presented in each Hotline Response is highly perishable and reflects the state of the technology or service at the time at which the report was compiled. Hotline Responses are developed by a multidisciplinary staff of scientists, clinicians, medical librarian information specialists, medical writers, and other health professionals. For quality assurance, all reports are subject to review by experts within ECRI Institute. Neither ECRI Institute nor its employees accept gifts, grants, or contributions from, or consult for medical device or pharmaceutical manufacturers.

The Hotline Response is based on review of abstracts of published articles and, therefore, no firm conclusions are offered. Abstracts do not always accurately reflect the methods and findings of the full-length article or the limits on interpreting the published data. As such, ECRI Institute has not evaluated the quality of these study designs, nor have we determined whether the authors used appropriate statistical methods to analyze their data. We are reluctant to comment on the reliability of these results in the absence of such evaluations. The purpose of this Hotline Response is to provide you with a summary of the literature based on our searches, and to give you information about what this technology is purported to accomplish. This Response is not intended to provide specific guidance for the care of individual patients. ECRI Institute implies no warranty and assumes no liability for the information contained in the Hotline Response.

The Health Technology Assessment Information Service (HTAIS) and SELECT™ Group provide Hotline Responses and many other forms of information support to help governments, hospitals, health systems, managed care organizations, health insurers, health professionals, and the public meet the challenge of evaluating healthcare technology objectively and rationally.

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General Comments

Enteral Nutrition and Nasogastric Feeding

Tube feeding, also known as enteral nutrition, is a method of providing nutrients to individuals who have difficulty swallowing, have had surgery that interferes with eating, or are unable to eat any or enough food due to illness. Although treatment is typically administered for short periods, individuals can receive treatment for extended periods since nutritive compounds used for enteral nutrition contain adequate amounts of protein, carbohydrates, fats, vitamins, and minerals. Nasogastric feeding tubes administer enteral nutrition by a tube placed through the nose into the stomach or bowel. In addition to providing nutrition, nasogastric tubes may be used to remove gastric secretions, prevent abdominal bloating and vomiting, and provide a means to administer medication. For more information on enteral nutrition, see the links to the American Society of Enteral and Parenteral Nutrition and the article by Cresci in section 8 of the *Search Summary*.

Nasogastric tubes (NGTs) are commonly placed at a patient’s bedside by a nurse, doctor, or other healthcare provider. The correct tube size for pediatric patients is based on the patient’s age (see the article by Shlamovitz in section 8 of the *Search Summary*). Pediatric patients at risk for incorrect tube placement include those who have neurologic impairment, are obtunded, sedated, unconscious, or critically ill and those with reduced gag reflex or static encephalopathy (see the article on nasogastric/orogastric tube placement in section 3 of the *Search Summary*).

Nasogastric tubing may be used immediately after placement is confirmed by one of several methods. In 2011, the following verification methods were recommended by the Cincinnati Children’s Hospital Medical Center for pediatric patients who require NGT or orogastric tube (OGT) placement for feeding or gastric decompression (see article on nasogastric/orogastric tube placement in section 3 of the *Search Summary*):

- Radiologic verification in pediatric patients who are at high risk of aspiration or when non-radiologic methods are not feasible, or results are unclear.
- Aspirate pH testing for pediatric patients who are not considered at high risk for aspiration. Use aspirate pH <5 to confirm gastric placement.
- For predicting NGT/OGT tube length: for children >2 weeks, age- related height-based (ARHB) methods are more accurate than other morphological measures such as nose-ear-xiphoid (NEX) or nose-ear-mid-xiphoid-umbilicus (NEMU). Use of prediction equation tables is recommended.

In March 2011, the National Patient Safety Agency (NPSA)(United Kingdom) issued a Patient Safety Alert, *Reducing the harm caused by misplaced nasogastric feeding tubes in adults, children and infants*. Since 2005, the NPSA’s National Reporting and Learning System had received reports of 21 deaths and 79 cases of harm due to feeding into the lungs through misplaced nasogastric tubes. Misinterpretation of x-rays alone led to 45 incidents; 12 resulting in patient death. The agency indicates that local investigations typically uncover that no written record was made of pH obtained or x-ray interpretation before feeding was initiated. pH testing and x-ray verification were recommended as first and second-line tests respectively in an earlier Patient Safety Alert. (see link to NPSA alert in section 8 of the *Search Summary*)

Clinical Literature on Nasogastric Tube Misplacement and Complications in Pediatrics

We searched PubMed, the Cochrane Library, and selected web-based resources for documents relevant to this topic. Our selected search results are listed in Table 1. The reported results of the clinical studies are summarized in Table 2. The information in these tables is based on a review of abstracts and not full articles.

Table 1. Overview of the Clinical Literature (January 1, 2007, through May 30, 2012)

Publication Type	Number of Publications	References
Systematic reviews/Technology assessments	0	---
Cost-effectiveness analyses	0	---

Publication Type	Number of Publications	References
Randomized controlled trials	2	
age-related, height-based (ARHB) vs. nose-ear-xiphoid (NEX) vs. nose-ear-mid-umbilicus (NEMU) to determine insertion length	1	1
Nonrandomized controlled/Comparison studies	2	
pH testing of nasogastric (NG) vs. endotracheal suctioning	1	3
preoperative NG placement vs. no placement	1	4
Case series	2	
carbon dioxide monitoring	1	5
pH testing	1	6
Radiograph review	2	7,8
Case reports	1	9
Narrative reviews	5	10-14

Table 2: Clinical Trials

Reference	Number of Patients	Treatment	Results	Conclusions Presented in the Abstract
Randomized Controlled Trials				
Cirgin et al. 2012 (2)	Neonates younger than 1 month	Age-related, height-based (ARHB) vs. Nose-ear-xiphoid (NEX) vs. Nose-ear-mid-umbilicus (NEMU)	For the primary analysis, tubes placed with the tube tip in the esophagus or at the gastroesophageal junction were considered to be misplaced. The EMU and ARHB methods were significantly more accurate than NEX to correctly place tubes. For the secondary analysis, tubes placed with the tube tip in low placements (pylorus or duodenum) were also considered to be misplaced. ARHB was not significantly different from NEX when using stricter criteria.	“Direct distance [NEX] should no longer be used as an nasogastric/rogastric (NG/OG) tube insertion-length predictor in neonates. Either NEMU or NG/OG tubes or the new ARHB equation for NG [nasogastric] tubes should be used.”
Ellett et al. 2012 (1)	Children aged 1 month to 17 years (Population size not reported)	ARHB vs. NEX vs. NEMU	The authors reported that ARHB and NEMU were more accurate than NEX. No specific data reported.	“NEX should no longer be used as a gastric tube insertion-length predictor. Either ARHB or NEMU should be used.”

Reference	Number of Patients	Treatment	Results	Conclusions Presented in the Abstract
Nonrandomized Controlled/Comparison Studies				
Gilbertson et al. 2011 (3)	645 pediatric nasogastric tube placement patients and 19 intensive care patients	pH testing of nasogastric vs. endotracheal suctioning	4,330 gastric aspirate samples (96% nasogastric) were collected from 645 patients. The mean (standard deviation (SD)) pH of these samples was 3.6 (1.4) (range, 0-9). 244 radiographs were subsequently taken of 1,339 patients with a pH value of gastric aspirate samples >4. Ten misplaced tubes were identified; 1 with pH of 5.5. Mean (SD) of endotracheal aspirate samples was 8.4 (0.8) (range, 6-9.5).	"Given that the lowest pH value of endotracheal aspirate samples was 6, and a misplaced NG tube was identified with pH 5.5, it is proposed that a gastric aspirate pH \leq 5 is a safer, reliable, and practical cutoff in this population."
Elanahas et al. 2010 (4)	106 infants with pyloric stenosis who underwent pyloromyotomy (NG tube placed in 77 patients)	Preoperative NG placement vs. No placement	Significantly higher episodes of postoperative vomiting, length of stay, and significantly higher bicarbonate levels were reported in patients with NG tube placement. No difference was reported between study groups for duration of symptoms, ultrasound characteristics, or type of operation.	"The data strongly suggest that preoperative [NG] tube placement adversely affects postoperative vomiting and consequently increases length of stay. The lack of consensus about the use of preoperative [NG] tubes coupled with these findings indicates the need to evaluate this practice with a prospective randomized controlled trial."
Case Series				
Stock et al. 2008 (6)	393 pediatric patients in the emergency department	pH testing	<u>341 patients with nasogastric pH \leq 4</u> Correct tube placement confirmed by pH alone: 332 patients (84.5%) Correct tube placement confirmed by radiography: 9 (2.6%) <u>52 patients with nasogastric pH > 4</u> Tube position confirmed by radiography: 18 (34%) Tubes identified by radiography as misplaced: 3 22 patients required more than 1 attempt for NGT insertion. 13 minor but no major adverse events were reported.	"Testing of gastric pH is a reliable way of confirming NGT position when the pH is 4 or lower. When the pH is higher than 4, a radiograph may be necessary."
Ellett et al. 2007 (5)	7 premature infants	Capnography to measure expired carbon dioxide (CO ₂) levels	CO ₂ readings were zero for all 14 correctly placed NG/OG tubes. CO ₂ readings ranged from 32 to 61 mmHg [millimetre of mercury] for all 14 correctly placed endotracheal tubes.	"The results of this pilot study provide evidence that capnography may be useful in differentiating respiratory from gastrointestinal tube placement in premature infants."

Selected References

In preparing the Hotline Response, information specialists research the topic and compile a [Bibliography](#). We exclude individual case reports because they may not represent routine use. Technical articles are also excluded unless they include clinical trial results. In writing the Hotline Response analysts screen the [Bibliography](#) for references relevant to the topic. These references are provided below in the narrower list of Selected References.

1. Ellett, ML, Cohen, MD, Perkins, SM, Croffie, JM, Lane, KA, and Austin, JK. Comparing methods of determining insertion length for placing gastric tubes in children 1 month to 17 years of age. *J Spec Pediatr Nurs*. 2012;17(1):19-32. [PubMed](#) 22188269 [PMID]
2. Cirgin Ellett, ML, Cohen, MD, Perkins, SM, Smith, CE, Lane, KA, and Austin, JK. Predicting the insertion length for gastric tube placement in neonates. *J Obstet Gynecol Neonatal Nurs*. 2011;40(4):412-421. [PubMed](#) 21639864 [PMID]
3. Gilbertson, HR, Rogers, EJ, and Ukoumunne, OC. Determination of a practical pH cutoff level for reliable confirmation of nasogastric tube placement. *JPEN J Parenter Enteral Nutr*. 2011;35(4):540-544. [PubMed](#) 21622643 [PMID]
4. Elanahas, A, Pemberton, J, Yousef, Y, and Flageole, H. Investigating the use of preoperative nasogastric tubes and postoperative outcomes for infants with pyloric stenosis: a retrospective cohort study. *J Pediatr Surg*. 2010;45(5):1020-1023. [PubMed](#) 20438946 [PMID]
5. Ellett, ML, Woodruff, KA, and Stewart, DL. The use of carbon dioxide monitoring to determine orogastric tube placement in premature infants: a pilot study. *Gastroenterol Nurs*. 2007;30(6):414-417. [PubMed](#) 18156957 [PMID]
6. Stock, A, Gilbertson, H, and Babl, FE. Confirming nasogastric tube position in the emergency department: pH testing is reliable. *Pediatr Emerg Care*. 2008;24(12):805-809. [PubMed](#) 19050661 [PMID]
7. de Boer, JC, Smit, BJ, and Mainous, RO. Nasogastric tube position and intragastric air collection in a neonatal intensive care population. *Adv Neonatal Care*. 2009;9(6):293-298. [PubMed](#) 20010147 [PMID]
8. Quandt, D, Schraner, T, Ulrich, BH, and Arlettaz, MR. Malposition of feeding tubes in neonates: is it an issue? *J Pediatr Gastroenterol Nutr*. 2009;48(5):608-611. [PubMed](#) 19367180 [PMID]
9. Gasparella, M, Schiavon, G, Bordignon, L, Buffo, M, Benetton, C, Zanatta, C, Ferro, M, Zoppellaro, F, and Perrino, G. Iatrogenic traumas by nasogastric tube in very premature infants: our cases and literature review. *Pediatr Med Chir*. 2011;33(2):85-88. [PubMed](#) 22111291 [PMID]
10. Longo, MA. Best evidence: nasogastric tube placement verification. *J Pediatr Nurs*. 2011;26(4):373-376. [PubMed](#) 21726788 [PMID]
11. Farrington, M, Lang, S, Cullen, L, and Stewart, S. Nasogastric tube placement verification in pediatric and neonatal patients. *Pediatr Nurs*. 2009;35(1):17-24. [PubMed](#) 19378570 [PMID]
12. Peter, S, Gill, F. Development of a clinical practice guideline for testing nasogastric tube placement. *J Spec Pediatr Nurs*. 2009;14(1):3-11. [PubMed](#) 19161570 [PMID]
13. Clarke, S. Drug administration via nasogastric tube. *Paediatr Nurs*. 2008;20(7):32. [PubMed](#) 18808055 [PMID]

14. Pedroso, AG, de Magalhaes, AM. [Performance analysis of venous puncture, and nasogastric and nasointestinal tube placement in a pediatric ward]. *Rev Gaucha Enferm.* 2008;29(1):18-25. [PubMed](#) 18767356 [PMID]

Search Summary

The following databases were used to identify the literature and related materials. Please note that underlined titles are hyperlinked to the actual documents. For all search results, click on the title to access the document.

1. **PubMed [Internet]. Bethesda (MD): National Library of Medicine. [searched 2007 Jan 1 through 2012 May 29]. Available from: <http://www.pubmed.gov>.**

Search Strategy:

S1 "nasogastric tube"[tiab] OR "nasogastric tubes"[tiab] OR "nasogastric intubation"[tiab] OR (nasogastric[tiab] AND (intubat*[tiab] OR tube[tiab] OR tubes[tiab]))

S2 misplace*[tiab] OR placement[tiab] OR complication*[tiab] OR adverse[tiab] OR malposition*[tiab]

S3 "pediatrics"[mesh] OR pediatric*[tiab] OR paediatric*[tiab] OR "infant"[mesh] OR infant*[tiab] OR "child"[mesh] OR child*[tiab] OR "child, preschool"[mesh] OR "adolescent"[mesh] OR adolescent*[tiab] S4 S1 AND S2 AND S3

Results:

We identified 18 records. These records are included in the [Bibliography](#).

2. **Cochrane Library [Internet]. Hoboken (NJ): John Wiley & Sons. [searched 2007 Jan 1 through 2012 May 30]. Available from: <http://www.thecochranelibrary.com>. Subscription required.**

Search Strategy:

S1 "nasogastric tube" OR "nasogastric tubes" OR "nasogastric intubation" OR (nasogastric AND (intubat* OR tube*))

S2 misplace* OR placement OR complication* OR adverse OR malposition*

S3 pediatric* OR paediatric* OR infant* OR child* OR adolescent*

S4 S1 AND S2 AND S3

Results:

We did not identify any unique records.

3. **National Guideline Clearinghouse (NGC) [Internet]. Rockville (MD): Agency for Healthcare Research and Quality (AHRQ), U.S. Department of Health and Human Services. [searched 2007 Jan 1 through 2012 May 30]. Available from <http://www.guideline.gov>.**

Search Strategy:

nasogastric tube*; nasogastric tubing

Results:

We identified one relevant guideline.

- Cincinnati Children's Hospital Medical Center. [Best evidence statement \(BEST\). Confirmation of nasogastric/ orogastric tube \(NGT/OGT\) placement](#). 2011 Aug 22. [Full text](#) (scroll down to NGT Placement).

4. **Healthcare Standards (HCS) database [Internet]. Plymouth Meeting (PA): ECRI Institute. [searched 2007 Jan 1 through 2012 May 30].**

Search Strategy:

nasogastric tube*; nasogastric tubing

Results:

We did not identify any unique documents.

5. **U.S. Food and Drug Administration (FDA) website [Internet]. Rockville (MD): U.S. Department of Health and Human Services. [searched 2012 May 30]. Available from: <http://www.fda.gov>.**

To locate marketing clearance information for a specific device or manufacturer, search the Center for Devices and Radiological Health (CDRH) [510\(k\) database](#) or the [Premarket Approval \(PMA\) database](#) by product and/or manufacturer name.

Search Strategy:

Product code BSS (tube, nasogastric)

Results:

We identified thirteen 510(k) clearances for the product code BSS. A listing of these clearances is available from the Center for Devices and Radiological Health (CDRH) [510\(k\) Database](#).

6. **Health Devices Alerts (HDA) database [Internet]. Plymouth Meeting (PA): ECRI Institute. [searched 2007 Jan 1 through 2012 May 30]. Available from: <http://members2.ecri.org/Components/Alerts/Pages/login.aspx?Page=ALERTSEARCH>. Subscription required.**

Search Strategy:

"nasogastric tube" OR "nasogastric tubing" OR "14221" OR "14-221"

Universal Medical Device Nomenclature System (UMDNS) Codes:

14221/14-221 (tubes, nasogastric)

Results:

We identified three relevant records. Click link to view records: [ECRI Institute](#).

7. **Medicare Coverage Database [Internet]. Baltimore (MD): Centers for Medicare & Medicaid Services (CMS). [searched 2012 May 30]. Available from: <http://www.cms.gov/medicare-coverage-database/search/advanced-search.aspx>.**

Search Strategy:

nasogastric tube; nasogastric tubing

Results:

We identified one relevant document.

- Centers for Medicare & Medicaid Services (CMS). [NCD for enteral and parenteral nutritional therapy \(180.2\)](#). [effective date of this version 1984 Jul 11].

8. **Selected Web Resources [Internet]. [searched 2012 May 30].**

- American Society of Enteral and Parenteral Nutrition. What is enteral nutrition? [cited 2012 May 30].
- Cresci G. [Enteral access](#). In: Charney P, Malone A. ADA pocket guide to enteral nutrition. American Dietetic Association. 2006.
- MedlinePlus. [Nasogastric feeding tube](#). [updated 2012 Apr 19].
- Medscape. Shlamovitz GZ. [Nasogastric tube](#). [updated 2011 May 12]. Note: requires free registration.

- National Patient Safety Agency (NPSA) (UK). [Reducing the harm caused by misplaced nasogastric feeding tubes in adults, children and infants](#). 2011 Mar 10

1. {6}

PUBMED: 05/29/2012

Cirgin Ellett, ML, Cohen, MD, Perkins, SM, Smith, CE, Lane, KA, Austin, JK. Predicting the insertion length for gastric tube placement in neonates. J Obstet Gynecol Neonatal Nurs 2011;40(4):412-421.

LA - eng

PT - Comparative Study

PT - Journal Article

PT - Multicenter Study

PT - Randomized Controlled Trial

PT - Research Support, N.I.H., Extramural

Author affiliation: School of Nursing, Indiana University, 1111 Middle Drive, Rm. 439, Indianapolis, IN 46202-5107, USA. mlellett@iupui.edu

Abstract: OBJECTIVE: To compare error rates of three existing methods of predicting the gastric tube insertion length in a group of neonates <1 month corrected age: age-related, height-based (ARHB); direct distance nose-ear-xiphoid (NEX); and direct distance nose-ear-mid-umbilicus (NEMU). DESIGN: Randomized controlled trial. SETTING: Five neonatal care units in a large midwestern city. PARTICIPANTS: One hundred and seventy-three hospitalized neonates. METHODS: Neonates were randomly assigned to one of three groups: ARHB, NEX, or NEMU. For primary analysis, only tubes placed too high with the tube tip in the esophagus or at the gastroesophageal junction were considered to be misplaced. For secondary analysis, a stricter definition was used, and low placements (pylorus or duodenum) were also considered to be misplaced. All radiographs were blinded and read by a pediatric radiologist. RESULTS: For the primary analysis, the differences in percentages of correctly placed tubes among the three methods was statistically significant ($\chi^2=34.45$; $p<.0001$), with NEMU and ARHB more accurate than NEX (NEMU $\chi^2=18.59$, $p<.0001$; ARHB $\chi^2=21.34$, $p<.0001$). Using the stricter definition for placement, ARHB was not significantly different from NEX ($p=.0615$). A new ARHB equation was developed specific for neonates <1 month corrected age. CONCLUSIONS: Direct distance nose-ear-xiphoid should no longer be used as a nasogastric/orogastric (NG/OG) tube insertion-length predictor in neonates. Either NEMU for NG/OG tubes or the new ARHB equation for NG tubes should be used

Descriptors: analysis/Article/Enteral Nutrition/instrumentation/*methods/Esophagogastric Junction/anatomy & histology/radiography/Esophagus/Evidence-Based

Practice/Female/Humans/Infant,Newborn/Intubation,Gastrointestinal/instrumentation/*methods/Male/Medical Errors/*statistics & numerical data/methods/Randomized Controlled Trial/Single-Blind Method

2. {14}

PUBMED: 05/29/2012

Clarke, S. Drug administration via nasogastric tube. Paediatr Nurs 2008;20(7):32.

LA - eng

PT - Journal Article

PT - Review

Author affiliation: School of Nursing and Midwifery, Queen's University, Belfast

Abstract: In 2005, the National Patient Safety Agency (NPSA) highlighted concerns about the management of nasogastric tubes following reports of unnecessary deaths because of misplaced feeding tubes in infants, children and adults. During 2006, I investigated the management of nasogastric tubes (NGTs) in children (Clarke and Richardson 2007a, 2007b). This systematic review divided primary papers into three principal themes: enteral feeding via the NGT; confirmation of NGT position and associated incidence of tube placement error; and hydration via the NGT for acute gastroenteritis in children. Findings of the review are summarised here in relation to using the nasogastric tube to administer medication to children with the aim of informing practice and improving safety

Descriptors: *Drug Administration Routes/*Intubation,Gastrointestinal/Adult/Anticonvulsants/administration & dosage/Article/Carbamazepine/administration & dosage/Child/Humans/Infant/Review

3. {9}

PUBMED: 05/29/2012

de Boer, JC, Smit, BJ, Mainous, RO. Nasogastric tube position and intragastric air collection in a neonatal intensive care population. Adv Neonatal Care 2009;9(6):293-298.

LA - eng

PT - Journal Article

Author affiliation: Division of Neonatology, Erasmus MC, Sophia Children's Hospital, Department of Pediatrics, Division of Neonatology, Rotterdam, The Netherlands. j.boer@erasmusmc.nl

Abstract: PURPOSE: For neonates receiving intensive care, nasogastric tube feeding is essential. Since nasogastric tube placement techniques are not well standardized and common verification methods can be unreliable, placement errors may lead to unsafe situations. In mechanically ventilated neonates and neonates on continuous positive airway pressure, malpositioning of the nasogastric tube may prevent excess air within the stomach to escape. In this study, we aimed to relate tube position to amount of air. The hypothesis was: the better the position of the tube, the smaller the amount of air in the stomach. SUBJECTS: A 1-year cohort of neonates in a level IIIc neonatal intensive care unit with a nasogastric tube. DESIGN AND METHODS: We retrospectively reviewed 326 radiographs and classified nasogastric tube position and gastric air. Descriptive statistics were used to describe demographic data. Kendal's tau statistic was applied to explore the relationship between nasogastric tube position and amount of gastric air. A Mann-Whitney U test was performed to confirm the differences in gastric air in neonates with Ch5 and Ch6 gastric tubes and neonates with Ch8 gastric tubes. RESULTS: One or both orifices of nasogastric tubes were in the esophagus in 7.1% of cases, tubes were curled up in the stomach in 35.3% of cases, and tube tips were beyond the pyloric sphincter in 5.5% of cases. Substantial or excessive air was found in 37.7% of cases. Kendal's tau value indicated that there was no significant correlation between nasogastric tube position and gastric air. The Mann-Whitney U value indicated that children with Ch5 and Ch6 gastric tubes had significantly more gastric air than children with Ch8 gastric tubes. CONCLUSION: Nasogastric tubes were malpositioned in nearly half of cases, and substantial or excessive air was found in more than one-third of cases. The hypothesis-the better the position of the tube, the smaller the amount of gastric air-was not confirmed by the data. However, a significant relationship was found between tube size and gastric air

Descriptors: Air/Article/Cohort Studies/Enteral Nutrition/adverse effects/instrumentation/*statistics & numerical data/Equipment Failure/*statistics & numerical data/Esophagus/Esophagus/radiography/Female/Humans/Infant,Newborn/Intensive Care Units,Neonatal/Intensive Care,Neonatal/methods/*statistics & numerical data/Intubation,Gastrointestinal/adverse effects/instrumentation/*statistics & numerical data/Male/Medical Errors/*statistics & numerical data/methods/Neonatal Nursing/methods/Netherlands/epidemiology/Pediatrics/Retrospective Studies/Statistics,Nonparametric/Stomach/*radiography

4. {1}

ECRI Institute 05/30/2012

ECRI Institute. [Electromagnetic Tube Placement for Nasogastric Feeding \[Hotline Response\]](#). 2011;

5. {8}

PUBMED: 05/29/2012

Elanahas, A, Pemberton, J, Yousef, Y, Flageole, H. [Investigating the use of preoperative nasogastric tubes and postoperative outcomes for infants with pyloric stenosis: a retrospective cohort study](#). J Pediatr Surg 2010;45(5):1020-1023.

LA - eng

PT - Comparative Study

PT - Journal Article

Author affiliation: McMaster University-Hamilton, Ontario, Canada L8N 3Z5

Abstract: PURPOSE: Literature is lacking regarding the role of nasogastric tubes in patients with pyloric stenosis. There is also no consensus among surgeons. Some believe that pyloric stenosis is a form of gastric outlet obstruction, and the stomach should be drained until the obstruction is relieved. Others claim that infants can handle their secretions, and draining the stomach may further exacerbate the alkalosis. This chart review examines the use of preoperative nasogastric tubes in a single pediatric institution and its effect on vomiting rates and length of stay. METHODS: After research ethics board approval, a retrospective review was performed on 109 patients admitted between January 1, 2007, and December 31, 2008, with pyloric stenosis who underwent pyloromyotomy. Data were collected on presence of a preoperative nasogastric tube, preoperative electrolyte levels, ultrasound characteristics, episodes of postoperative vomiting, and length of stay. RESULTS: One hundred six patients were used in the final analysis. A nasogastric tube was placed in 77 patients (73%). Patients with a preoperative nasogastric tube had significantly higher episodes of postoperative vomiting ($P = .015$; 95% confidence interval [CI] 0.29-2.63) and length of stay ($P = .017$; 95% CI, 2.49-25.01). Bicarbonate levels were also significantly higher in patients with a nasogastric tube. There was no difference in the duration of symptoms, ultrasound characteristics, or type of operation between the 2 cohorts. CONCLUSION: The data strongly suggest that preoperative nasogastric tube placement adversely affects postoperative vomiting and consequently increases length of stay. The lack of consensus about the use of preoperative nasogastric tubes coupled with these findings indicates the need to evaluate this practice with a prospective randomized controlled trial

Descriptors: *Preoperative Care/analysis/Article/Cohort Studies/Female/Humans/Infant/Infant,Newborn/Intubation,Gastrointestinal/*adverse effects/Length of Stay/Male/methods/Postoperative Nausea and Vomiting/*etiology/Pyloric Stenosis/*surgery/Randomized Controlled Trial/Retrospective Studies/Review/Treatment Outcome

6. {16}

PUBMED: 05/29/2012

Ellett, ML, Woodruff, KA, Stewart, DL. The use of carbon dioxide monitoring to determine orogastric tube placement in premature infants: a pilot study. Gastroenterol Nurs 2007;30(6):414-417.

LA - eng

PT - Clinical Trial

PT - Journal Article

Author affiliation: School of Nursing, Indiana University, Indianapolis 46202-5107, USA. mlellett@iupui.edu

Abstract: Enteral nutrition, frequently given through gastric tubes inserted through the nose or mouth, is an important part of supportive care for children unable to maintain adequate nutrition orally. To provide safe enteral nutrition, however, correct tube position must be achieved. Capnography, a noninvasive monitoring technique designed to measure expired carbon dioxide (CO₂) levels, has been used previously to identify respiratory placement of nasogastric tubes in adults; however, its use in children is understudied. The purpose of this pilot study was to determine the potential of CO₂ monitoring to differentiate respiratory from gastric placement of nasogastric/orogastric (NG/OG) tubes in the youngest, most fragile children-premature infants. Immediately prior to chest radiograph, CO₂ levels in 7 premature infants were measured at the open ends of both the endotracheal and NG/OG tubes by using a bedside capnography monitor. The 14 CO₂ readings from the correctly placed endotracheal tubes ranged from 32 to 61 mmHg (M = 47.6 mmHg, SD = 10.0). CO₂ readings were zero in all 14 correctly placed NG/OG tubes. The results of this pilot study provide evidence that capnography may be useful in differentiating respiratory from gastrointestinal tube placement in premature infants

Descriptors:

*Capnography/*Infant,Premature/Adult/Article/Carbon Dioxide/metabolism/Clinical Trial/Enteral

Nutrition/*instrumentation/nursing/Female/Humans/Infant/Infant,Newborn/Intubation,Gastrointestinal/*methods/Male/Pilo

t Projects/Point-of-Care Systems

7. {2}

PUBMED: 05/29/2012

Ellett, ML, Cohen, MD, Perkins, SM, Croffie, JM, Lane, KA, Austin, JK. Comparing methods of determining insertion length for placing gastric tubes in children 1 month to 17 years of age. J Spec Pediatr Nurs 2012;17(1):19-32.

LA - eng

PT - Comparative Study

PT - Journal Article

PT - Multicenter Study

PT - Randomized Controlled Trial

PT - Research Support, N.I.H., Extramural

Author affiliation: Indiana University School of Nursing, Indianapolis, USA. mlellett@iupui.edu

Abstract: PURPOSE: The purpose was to compare three methods of predicting the gastric tube insertion length in children 1 month to 17 years of age: age-related, height-based (ARHB); nose-ear-xiphoid (NEX); and nose-ear-mid-umbilicus (NEMU). DESIGN AND METHODS: The design was a randomized controlled trial. Children were randomly assigned to the ARHB, NEX, or NEMU groups. Tubes placed high were considered to be misplaced. RESULTS: There were significant differences in percentages of correctly placed tubes, with ARHB and NEMU being more accurate than NEX. PRACTICE IMPLICATIONS: NEX should no longer be used as a gastric tube insertion-length predictor. Either ARHB or NEMU should be used

Descriptors:

Adolescent/Article/Child/Child,Preschool/Female/Humans/Infant/Infant,Newborn/Intubation,Gastrointestinal/*methods/Lo
gistic Models/Male/methods/Randomized Controlled Trial

8. {11}

PUBMED: 05/29/2012

Farrington, M, Lang, S, Cullen, L, Stewart, S. Nasogastric tube placement verification in pediatric and neonatal patients. Pediatr Nurs 2009;35(1):17-24.

LA - eng

PT - Journal Article

Author affiliation: Department of Nursing Sciences and Acute Care, [corrected] University of Iowa Hospitals and Clinics, Iowa City, IA, USA

Abstract: This article reports an evidence-based practice project using the Iowa Model of Evidence-Based Practice to Promote Quality Care for a common nursing procedure, nasogastric tube placement verification in children. Little research exists regarding the care of nasogastric tubes in children, and traditional verification methods prevail. Auscultation of air insufflation over the abdomen is still used to check placement in many settings, despite research dating back to the 1980s questioning this approach. X-ray remains the only certain way to verify placement, but getting an X-ray before each feeding would be costly and impractical. Additional bedside methods are needed. Project results demonstrate a decrease (93.3% to 46.2%) in the use of auscultation and improved use of other, more reliable methods to determine nasogastric tube placement. Changing practice can be challenging. However, with persistence and re-infusion, this project provides an important example of how the evidence-based practice process leads to excellence and improves patient care

Descriptors: *Evidence-Based Practice/Air/Article/Auscultation/Child/Child,Preschool/Education,Continuing/Hospital Administration/Humans/Infant/Infant,Newborn/Intubation,Gastrointestinal/methods/*standards/methods/Organizational Policy/Outcome Assessment (Health Care)/X-Rays

9. {3}

PUBMED: 05/29/2012

Gasparella, M, Schiavon, G, Bordignon, L, Buffo, M, Benetton, C, Zanatta, C, Ferro, M, Zoppellaro, F, Perrino, G. Iatrogenic traumas by nasogastric tube in very premature infants: our cases and literature review. *Pediatr Med Chir* 2011;33(2):85-88.

LA - eng

PT - Case Reports

PT - Journal Article

PT - Review

Author affiliation: Department of Pediatric Surgery, Department of Pediatrics, Treviso, Italy. marco.gasparella@unipd.it

Abstract: OBJECTIVE: The nasogastric tube is the chosen nutritional technique in premature infants. However, it is not without complications. The aim of this study is to compare our experience in iatrogenic complications caused by nasogastric tube (especially in very low birth weight infants) to a review of the most recent literature. METHODS: From January to December of 2008, in the Department of Neonatal Pathology at the Hospital of Treviso, 118 premature patients were treated. 110 of them had a body weight less than 1,500gr: serious complications caused by nasogastric tube occurred in two of these very low birth weight infants. The first case relates an injury of the esophagus, while the second case is about a perforation of the posterior wall of the stomach, left lobe of the liver and the spleen hilus. RESULTS: The surgical treatment was limited to the second case ending in splenectomy and repair of the posterior gastric wall and liver lobe.

DISCUSSION AND CONCLUSIONS: Among all the iatrogenic injuries described in the literature, this last case is the most serious. It is important to verify always the position of the gastric tube and to doubt for a dislocation in any case of deviation of the tube from the normal course. In those cases in which a patient suddenly goes from a full well-being to a critical state without a precise contingent cause it is imperative to check the nasogastric tube place. In addition those cases have guided us to change our habits for managing these critical patients: we are then oriented toward the usage of silastic gastric probes, which are softer, less dangerous for ulcer damages, and long term replaceable, thus reducing the possibility of a iatrogenic injury

Descriptors: *Infant,Premature/Article/complications/Esophagus/Gastrointestinal Tract/injuries/Humans/Iatrogenic Disease/Infant/Infant,Newborn/injuries/Intubation,Gastrointestinal/*adverse effects/Male/methods/pathology/Pediatrics/Review/surgery

10. {7}

PUBMED: 05/29/2012

Gilbertson, HR, Rogers, EJ, Ukoumunne, OC. Determination of a practical pH cutoff level for reliable confirmation of nasogastric tube placement. *JPEN J Parenter Enteral Nutr* 2011;35(4):540-544.

LA - eng

PT - Comparative Study

PT - Journal Article

PT - Research Support, Non-U.S. Gov't

Author affiliation: Department of Nutrition and Food Services, Royal Children's Hospital, Parkville, Victoria, Australia. heather.gilbertson@rch.org.au

Abstract: BACKGROUND: Enteral feeding is a common method of nutrition support when oral intake is inadequate.

Confirmation of correct nasogastric (NG) tube placement is essential. Risks of morbidity/mortality associated with misplacement in the lung are well documented. Studies indicate that pH \leq 4 confirms gastric aspirate, but in pediatrics, a

pH of gastric aspirate is often >4. The goal of this study was to determine a reliable and practical pH value to confirm NG tube placement, without increasing the risk of not identifying a misplaced NG tube. METHODS: Pediatric inpatients older than 4 weeks receiving enteral nutrition (nasogastric or gastrostomy) were recruited over 9 months. Aspirate samples were pH tested at NG tube placement and before feedings. If pH >4, NG tube position was confirmed by chest radiograph or further investigations. In addition, intensive care unit (ICU) patients who required endotracheal suctioning were recruited, and endotracheal aspirate samples were pH tested. RESULTS: A total of 4,330 gastric aspirate samples (96% nasogastric) were collected from 645 patients with a median (interquartile range [IQR]) age of 1.0 years (0.3-5.2 years). The mean (standard deviation [SD]) pH of these gastric samples was 3.6 (1.4) (range, 0-9). pH was >4 in 1,339 (30.9%) gastric aspirate samples, and of these, 244 were radiographed, which identified 10 misplaced tubes (1 with pH 5.5). A total of 65 endotracheal aspirate samples were collected from 19 ICU patients with a median (IQR) age of 0.6 years (0.4-5.2 years). The mean (SD) pH of these samples was 8.4 (0.8) (range, 6-9.5). CONCLUSION: Given that the lowest pH value of endotracheal aspirate sample was 6, and a misplaced NG tube was identified with pH 5.5, it is proposed that a gastric aspirate pH \leq 5 is a safer, reliable, and practical cutoff in this population

Descriptors: Article/Child,Preschool/Enteral Nutrition/instrumentation/*methods/Female/Gastric Acidity Determination/Gastric Juice/Humans/Hydrogen-Ion

Concentration/Infant/Intubation,Gastrointestinal/*methods/Male/methods/Pediatrics/Prospective Studies/Reference Standards/Risk/Suction/Trachea/surgery/Victoria

11. {4}

PUBMED: 05/29/2012

Longo, MA. Best evidence: nasogastric tube placement verification. J Pediatr Nurs 2011;26(4):373-376.

LA - eng

PT - Journal Article

Author affiliation: Cincinnati Children's Hospital Medical Center, USA

Abstract: Further research on cost-effective techniques to verify enteral tube placement is warranted using a variety of pediatric populations with differing conditions that may impact gastric pH. It is imperative that clinical facilities review current policies and procedures to ensure that evidence-based findings are guiding nursing practice. Many nurses continue to rely on auscultation to verify NGT placement. Education and competency validation can assist with current practices for NGT placement being consistently incorporated by all personnel in the health care setting. Continuing to search for evidence related to nursing care will guide the direct care RN in providing best practice

Descriptors: *Evidence-Based Nursing/*Pediatric

Nursing/Article/Auscultation/Child/Humans/Intubation,Gastrointestinal/*methods/nursing/Practice Guidelines as Topic/Review/Societies,Nursing

12. {15}

PUBMED: 05/29/2012

Pedroso, AG, de Magalhaes, AM. Performance analysis of venous puncture, and nasogastric and nasointestinal tube placement in a pediatric ward. Rev Gaucha Enferm 2008;29(1):18-25.

LA - por

PT - English Abstract

PT - Journal Article

Author affiliation: Unidade de Internacao Pediatrica do Hospital Nossa Senhora das Gracas, Rio Grande do Sul, Brasil

Abstract: This article is an observational study that analyzes the performance of venous punctures and nasogastric and nasointestinal tube placement in pediatric patients, performed by nurses in a pediatric ward. This exploratory descriptive study was carried out at a teaching hospital in Porto Alegre, Rio Grande do Sul, Brazil, and its purpose is to identify frequency and time spent in the performance of these procedures, as well as to provide data for the management of nursing human resources. Two nurses were selected intentionally and an observation structured record was used to collect the data. The average time spent in the performance of venous punctures was 17.62 minutes, and tube placement, 10.8 minutes. The outcomes provided an understanding of the processes complexity, whose elements are related to the nurse's work process, as well as to the other professionals involved, the family and the child who underwent the procedures

Descriptors: analysis/Article/Child/Child,Preschool/Hospital

Departments/Human/Humans/Infant/Intubation,Gastrointestinal/*nursing/standards/statistics & numerical data/Pediatrics/Phlebotomy/*nursing/standards/statistics & numerical data/Time Factors

13. {12}

PUBMED: 05/29/2012

Peter, S, Gill, F. Development of a clinical practice guideline for testing nasogastric tube placement. J Spec Pediatr Nurs 2009;14(1):3-11.

LA - eng

PT - Journal Article

Author affiliation: Ambulatory Care, Princess Margaret Hospital for Children, Child & Adolescent Health Service, Subiaco, Perth, WA, Australia. sue.peter@health.wa.gov.au

Abstract: PURPOSE: A Perth metropolitan hospital group standardized changes to nasogastric tube placement, including removal of the "whoosh test" and litmus paper, and introduction of pH testing. DESIGN AND METHODS: Two audits were conducted: bedside data collection at a pediatric hospital and a point-prevalence audit across seven hospitals.

RESULTS: Aspirate was obtained for 97% of all tests and pH was ≤ 5.5 for 84%, validating the practice changes.

However, patients on continuous feeds and/or receiving acid-inhibiting medications had multiple pH testing fails.

PRACTICE IMPLICATIONS: Nasogastric tube placement continues to present a challenge for those high-risk patients on continuous feeds and/or receiving acid-inhibiting medications

Descriptors: *Intubation,Gastrointestinal/methods/nursing/standards/*Practice Guidelines as

Topic/Adolescent/Article/Child/Clinical Nursing Research/Humans/Infant/Medical Audit/methods/Pediatric Nursing/Point-of-Care Systems/Risk Assessment

14. {19}

PUBMED: 05/29/2012

Quandt, D, Schraner, T, Ulrich, BH, Arlettaz, MR. Malposition of feeding tubes in neonates: is it an issue? J Pediatr Gastroenterol Nutr 2009;48(5):608-611.

LA - eng

PT - Journal Article

Author affiliation: Clinic for Neonatology, University Hospital of Zurich, Frauenklinikstrasse 10, 8091 Zurich, Switzerland. daniel.quandt@kispi.uzh.ch

Abstract: OBJECTIVES: Accurate tube placement of orogastric and nasogastric feeding tubes in neonates is important to ensure safe and effective enteral feeding. Errors in placement and position of feeding tubes are described in literature, but there is little evidence of the exact prevalence of improperly placed tubes, especially in neonates. MATERIALS AND METHODS: To evaluate the prevalence of improperly placed feeding tubes, we reviewed 381 consecutive radiographs and defined the position of the feeding tubes. RESULTS: We found that in 41% of the placements, the optimal position of the feeding tubes was achieved, whereas overall 59% of the feeding tubes had been placed incorrectly. CONCLUSIONS:

There is a need for both better rules to measure the distance between nose (lips) and the body of the stomach and improved methods to confirm correct tube position in neonates

Descriptors: *Medical Errors/Article/Enteral

Nutrition/*instrumentation/methods/Esophagus/radiography/Female/Humans/Infant,Newborn/Intubation,Gastrointestinal/*instrumentation/methods/Male/methods/Stomach/radiography

15. {13}

PUBMED: 05/29/2012

Stock, A, Gilbertson, H, Babl, FE. Confirming nasogastric tube position in the emergency department: pH testing is reliable. Pediatr Emerg Care 2008;24(12):805-809.

LA - eng

PT - Journal Article

PT - Validation Studies

Author affiliation: Emergency Department, Royal Children's Hospital, Melbourne, Australia

Abstract: OBJECTIVE: The aim of this study was to determine whether pH testing is an accurate method of confirming nasogastric tube (NGT) position in children with and without gastroenteritis in the emergency department.

METHODOLOGY: A prospective observational study of NGT insertions was conducted at a tertiary pediatric emergency department, during a 9-month period in 2006. We evaluated methods of NGT position confirmation, pH of nasogastric aspirates from patients with and without gastroenteritis, and adverse events. RESULTS: A total of 404 patients were enrolled. For 393 patients (97.3%), NGT aspirates could be obtained to assess pH. Of these patients, 294 (74.8%) had a diagnosis of gastroenteritis and 99 (25.2%) did not. There was no difference in median pH between the patients with gastroenteritis (pH, 2; interquartile range, 2-4) and those without gastroenteritis (pH, 2; interquartile range, 2-4; $P = 0.09$). Overall, 341 patients (86.8%) had a pH of 4 or lower. The patients with gastroenteritis were more likely to have a pH of 4 or lower than the patients without gastroenteritis ($P = 0.018$). Tube position was confirmed by pH alone in 332 patients (84.5%). Nine (2.6%) of the 341 patients with a pH of 4 or lower also had radiography (7 for causes other than confirmation of NGT position) indicating correct placement of all NGTs. Fifty-two patients (13.2%) had a pH higher than

4, and 18 (34%) of these had the tube position confirmed by radiography, of which 3 had tubes misplaced in the distal esophagus. Irrespective of pH level, there were no respiratory placements clinically or by radiography. Overall, 22 patients (5.6% 95% CI 3.5%-8.3%) required more than 1 attempt for NGT insertion. There were 13 minor adverse events (3.3% 95% CI 1.8%-5.6%) and no major adverse events. CONCLUSIONS: Testing of gastric pH is a reliable way of confirming NGT position when the pH is 4 or lower. When the pH is higher than 4, a radiograph may be necessary

Descriptors: *Emergency Service,Hospital/statistics & numerical data/*Gastric Acidity Determination/*Hydrogen-Ion Concentration/*Intubation,Gastrointestinal/methods/nursing/Adolescent/Article/Child/Child,Preschool/Dehydration/etiology/*therapy/Device Removal/diagnosis/Emergencies/Equipment Failure/Esophagus/Female/Fluid Therapy/*instrumentation/Gastroenteritis/*complications/Hospitals,Pediatric/statistics & numerical data/Hospitals,Urban/statistics & numerical data/Humans/Infant/Male/methods/Prospective Studies/radiography/Reproducibility of Results