Objectives

• Describe several serious adverse events associated with enteral feedings
• Review specific practice recommendations for
  – Enteral nutrition delivery
  – Enteral access
  – Enteral nutrition monitoring

A Bit Of History

• Rectal feeding – 1500 BC to 1950 AD
• Upper GI tract feeding used in the 16th C
• Oroduodenal and orojejunal feeding – 1910
• Enteral tube feeding techniques – 1939
• Chemically defined nutrient formulation - 1949
• Disease/disorder specific formulations - 1970
A.S.P.E.N. Enteral Nutrition Practice Recommendations - 2009

- Multidisciplinary task force established
- Charged by A.S.P.E.N. leadership to examine the literature related to:
  - Ordering enteral nutrition
  - Preparation of enteral nutrition
  - Delivery of enteral nutrition
  - Monitoring of the provision of enteral nutrition
- Establish evidence-based practice guidelines

A.S.P.E.N. Enteral Nutrition Practice Recommendations

- Limited research to support practice of many aspects of enteral nutrition support
- Consensus of expert opinion based on current knowledge and best practice
- Strength of each practice recommendation systematically graded
- Grading system based on the Agency for Healthcare Research and Quality (AHRQ), US Department of Health & Human Services criteria

A.S.P.E.N. Enteral Nutrition Practice Recommendations

- Evidence supporting each statement classified as:
  - A: There is good research-based evidence to support the guideline (Prospective, randomized trials)
  - B: There is fair research-based evidence to support the guideline (Well-designed studies without randomization)
  - C: The guideline is based on expert opinion and editorial consensus
Introduction

• Enteral nutrition (EN) is the delivery of enteral products through an enteral access device into a functioning gastrointestinal tract
  – Includes all practice settings
• Recognition by the health care practitioner is essential
  – areas for potential human error
  – administrative and organizational conditions that are conducive to error
  – the patient’s own tolerance to EN

Adverse Events Related To Enteral Nutrition

• Enteral misconnections
• Enteral access device misplacements/displacements
• Metabolic abnormalities
• Mechanical tube complications
• Bronchopulmonary aspiration
• GI intolerance related to formula contamination
• Drug-nutrient interactions.

Question:
What safety issues are important to consider when administering enteral nutrition?

• Formula contamination
• Handling of formula during administration
• Hang times for various enteral formulas
• Formula stability
Contamination Points in Enteral Nutrition

Sterile, liquid EN formulas should be used in preference to powdered, reconstituted formulas (A)
- Powdered formulas are not sterile
- Use of disposable gloves recommended when administering EN (A)
- Setting up and manipulating EN feedings primary source of contamination
- Use a purified water or sterile water for irrigation supply for formula reconstitution and medication dilution (B)
  - Consider purified water for enteral access device flushes in at-risk patients

Formula Contamination/Handling

Feeding pumps with drip chambers prevents retrograde contamination (A)
- A recessed spike on a closed system container is preferable (B)
- Change administration sets every 24-48 hours (A)
  - Closed system feeding sets have been demonstrated to be safe within this time period
**Formula Hand Time**

8-hour hang time for decanted formula with adults (B)
- Powdered, reconstituted formulas and formulas with additives should have a 4-hour hang time (C)
- Closed system EN formulas may hang for 24-48 hours according to manufacturer recommendations (A)

**Formula Hang Time/Stability**

- 8-hour hang time for decanted formula with adults (B)
- Powdered, reconstituted formulas and formulas with additives should have a 4-hour hang time (C)
- Closed system EN formulas may hang for 24-48 hours according to manufacturer recommendations (A)

**Broncho-pulmonary Aspiration**

- Patient positioning
  - Sustained supine position increases GE reflux and probability for aspiration
  - Pneumonia greater in those with frequent aspiration
  - Strategies for improving HOB elevation
    - Included in medical order sets
    - Staff education

Patient Positioning

- Elevate the backrest to a minimum of 30º, and preferably to 45º (A)
- Use the reverse Trendelenberg position to elevate the HOB (C)
- If necessary to lower the HOB for a procedure position as soon as feasible (C)

Aspiration Risk Factors

- Sedation
- Supine patient positioning
- Presence and size of nasogastric tube
- Malpositioned feeding tube
- Mechanical ventilation
- Vomiting
- Bolus feeding delivery
- High-risk disease or injury
- Poor oral health
- Nursing staffing level
- Advanced patient age

“No adequately powered studies have, to date, demonstrated a relationship between aspiration pneumonia and GRV”

McClave S. Crit Care Med. 2005;33:324-330
Gastric Residual Volumes (GRV)

• Monitoring of gastric residual volumes
  – Practice is based on opinion and ritual
  – Frequency and method of measurement is undefined
  – Identified as the most significant contributor to underfeeding

Williams & Leslie, Int Crit Care Nurse, 2004

Physical Exam and Abdominal Film Distinguish Normal vs Abnormal Gastric Emptying (ileus)
Better than GRVs

Physical Exam Abdominal Radiograph

• Physical exam findings correlate to radiographic findings (p=0.016)
• GRV failed to correlate with PE or Xray findings

McClave (JPEN 1992;16:99)

Research: Aspiration & GRVs

<table>
<thead>
<tr>
<th>STUDY</th>
<th>OUTCOME</th>
<th>GRVs</th>
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<tr>
<td>Elpem, AJCC, 2004 Flaccarduri, Kid Int, 2004</td>
<td>Visible formula or glucose in secretions to detect aspiration</td>
<td>&gt; 150 ml</td>
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<tr>
<td>McClave, CCM, 2005 Metheny, 2007</td>
<td>Laboratory methods to detect aspiration</td>
<td>0 to &gt; 400 ml</td>
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<tr>
<td>Petriolo-Albarano, Prof Crit Care Med, 2006</td>
<td>Aspiration (not defined)</td>
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Prospective study of 206 critically ill patients receiving gastric feeds over 3 consecutive days. Residual volumes quantified as at least 150 ml, 200 ml, or 250 ml.

- Frequent aspirators (≥ 40% tracheal secretions + pepsin)
- Infrequent aspirators (< 40% + for pepsin)
- GRV compared within the 2 aspiration groups

**Gastric Residual Monitoring Recommendations**

- If the GRV is ≥ 250 mL after a second gastric residual check, a promotility agent should be considered in adult patients (A)
- A GRV >500 mL should result in holding EN and reassessing patient tolerance by use of an established algorithm (B)
- Consideration of a feeding tube placed below the ligament of Treitz when GRVs are consistently measured at > 500 mL (B)
Optimizing Enteral Feeding

• Aspiration Risk Reduction Protocol - ICU
  – Metheny, Nurs Research, 2010;59:18-25
• Advanced practice RN driven protocol
• Combined HOB, small bowel tube and GRV assessment
  – HOB $\geq 30$
  – GRV $\geq 200$ ml $\times 1$, prokinetic $\times 1$
• If GRV remains $\geq 200$ ml, place small bowel tube

Optimizing Enteral Feeding

• Aspiration Risk Reduction Protocol - ICU
  • Protocol initiated in 2008, compared to 2006 data
  • HOB elevation increased 38 – 82% (p<0.001)
  • SB tube placement increased 39% - 68% (p<0.001)
  • Aspiration decreased 88% - 39% (p<0.001)
  • Pneumonia decreased 48% - 19% (p<0.001)

Are Pump Assisted Feedings Better Than Gravity Feedings?

• Base enteral delivery method and initiation and advancement of EN regimens on patient condition, age, enteral route (gastric vs small bowel), nutrition requirements, and GI status. (C)
• Shang E, et al, 2004; JPEN;28:180
• Prospective, randomized crossover trial (n=100)
• Compared pump assisted to gravity feedings
  – Pump: maximum 12 hr cycle feeding – 200-300 ml/hr
  – Gravity: 300 ml/hr over 5 hours
• Side effects measured included
  – Regurgitation, vomiting, pneumonia, diarrhea
Long Term Enteral Access Devices

- Successful long term EN requires careful selection of access device and proper maintenance
  - GI anatomy and motility
  - Prior GI surgery
  - Patency of the upper GI tract
  - Intended use
  - Intended length of therapy
- Long-term feeding devices should be considered when the need for enteral feeding is at least 4 weeks in adults, children, and infants after term age (C)

Long Term Enteral Feeding Devices

- Problem areas
  - Inappropriate use of urinary drainage catheters and other tubes not designed or intended for enteral feeding
  - Premature removal
  - Accidental catheter tip malposition
  - Excessive traction of the feeding device
- External and internal retention device ideal
  - To prevent migration
- Complications
  - Buried bumper syndrome
  - Peritonitis
Long Term Enteral Feeding Devices

- Document tube type, tip location, and external markings in the medical record and in follow-up examinations (C)
- Avoid placement of catheters or tubes not intended for use as enteral feeding devices (B)
- Evaluation by a multidisciplinary team is indicated prior to insertion of a long-term feeding device to establish whether:
  - benefit outweighs the risk of access placement
  - insertion of feeding tubes near end of life is warranted

Enteral Misconnections

- An inadvertent connection between an enteral feeding system and a non-enteral system

Enteral Misconnections

- First report in 1972 with IV infusion of breast milk
- April 2006 - The Joint Commission issued a Sentinel Event Alert on tubing misconnections
- Review in 2007 reported up to 60 published reports of enteral misconnections
- Reports to the FDA cite key factors
  - confusion about a new patient’s medical history
  - confusion during patient transfer to another department
  - treatment situations that require nurses to perform multiple tasks simultaneously and quickly
  - devices with different functions that appear similar

Simmons D, Graves K. Small bore medical connectors reference list. 2007; http://www.jointcommission.org/assets/1/18/SEA_36.PDF
Enteral Misconnections

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<tr>
<th>Issue of Feeding</th>
<th>Number of Cases</th>
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Enteral Connections Practice Recommendations – All Grade C

- Do not modify or adapt IV or feeding devices
- Practitioners should routinely trace lines back to their origins
- When arriving at a new setting or as part of a hand-off process, staff should recheck connections and trace all tubes
- Identify and confirm the EN label, because a 3-in-1 PN admixture can appear similar to an EN formulation bag
- Purchase pre-filled enteral feeding containers with design technology labeled non-IV compatible.

To Summarize

- Enteral nutrition is not without adverse events/complications
- Recognition of ordering, administration, and monitoring steps of EN delivery which may increase risk of complications is essential
- Specific practice recommendations provided to optimally provide EN
- Further research is needed