The Ins & Outs of Enteral Feeding:
Gastric Residual Volume & Diarrhea

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Learning Objectives

- Evaluate evidence-based recommendations for determining an acceptable GRV
- Identify risk factors for and interventions to reduce aspiration
- Discuss the etiology and management of diarrhea in tube-fed patients

Factors Contributing to Gastric Dysmotility

- Critical illness
- Opiates
- Catecholamines
- Electrolyte abnormalities
- Diabetes mellitus
- Supine position
- Neurological injury
Residual Volume: A Nebulous Term Impacts Delivery

- EN interrupted with RV of 30-500 mL
  McClave et al. JPEN 2002
- Lack of standardization of protocols
- Inconsistent time periods to check residuals
- Variable responses to increased residuals
- What to do with residuals?
  - Survey: 50% discard; 49% return to patient
    Mateo et al Heart Lung 1996
  - Return residual < 500 mL to patient
    McClave & Snider JPEN 2002

Residual Volume Thresholds

- ≤ 100 mL per 50% of ICU nurses
  Mateo Heart Lung 1996
- PEG ≤ 100 mL; NG ≤ 200 mL
  McClave et al. JPEN 1992
- > 200 mL on 2 consecutive assessment (too high)
  A.S.P.E.N. Guidelines JPEN 200
- 250 mL with routine prokinetics/protocols
  Canadian Guidelines JPEN 2004
- 250 mL on ≥ 2 consecutive assessments
  www.aspenvidencelibrary.org
- < 400-500 mL
  McClave & Snider JPEN 2002

Residual Volumes Monitoring

- No indication for checking residual volumes
  - Communicative patients with functional GI tract
  - Patients whose risk for aspiration is related to inability to handle oral secretions (dementia or sedation)
- Indication for checking residual volumes
  - Uncommunicative patients with potential for impaired gastric emptying (head injury or sepsis)
  McClave & Snider JPEN 2002
Risk Factors for Aspiration  
McClave et al JPPN 2002

- **Major factors**
  - Documented previous aspiration
  - Decreased level of consciousness
  - Neuromuscular disease
  - Structural abnormalities of aerodigestive tract
  - Tracheal intubation
  - Vomiting
  - Persistent high gastric residual volumes
  - Prolonged supine position

- **Additional factors**
  - Nasoenteric tube
  - Intermittent feeding
  - Delayed gastric emptying
  - Large size/diameter FT
  - Malpositioned FT
  - Poor oral care
  - Age
  - Inadequate nursing staff
  - Transport
  - Abdominal/thoracic surgery or trauma

Poor Validity of RV and Aspiration in Critically Ill

- 40 patient with gastric feedings
  - 21 NG vs 19 PEG (regurgitation less with PEG)
- Percent of aspiration
  - RV > 400 mL = 23%
  - RV > 200 mL = 22%
  - RV < 150 mL = 23%
- RV level did not predict aspiration risk
- Monitor for S&S of intolerance regardless of RV

Methods to Reduce Aspiration Risk

- Feed distal to the Ligament of Treitz
- Reassess need, level, and choice of sedatives
- Reevaluate need for opioid analgesia / narcotics
- Elevate head of bed > 30 to 45 degrees
- Consider prokinetic agents
- Change to continuous feeding
- Routinely assess feeding tube position
- Continuous aspiration of subglottic secretions


McClave & Snider JPPN 2002

Metheny et al. Heart Lung 2004
Diarrhea

- Defined by person cleaning it up
- Volume
- Consistency
- Frequency
- Common definitions
  - ≥ 3 stools/d
  - ≥ 500 mL/d x 2 days

Etiology of Diarrhea

- Medications
- Enteric Pathogens
- Disease Processes
  - Enteral Formula
  - Hypoalbuminemia

Osmotic vs Secretory Diarrhea

<table>
<thead>
<tr>
<th>Osmotic</th>
<th>Secretory</th>
</tr>
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<tbody>
<tr>
<td>Lactose</td>
<td>Infections (c.dif)</td>
</tr>
<tr>
<td>Sugar alcohols</td>
<td>↓ GI surface area</td>
</tr>
<tr>
<td>Medications</td>
<td>Inflammation</td>
</tr>
<tr>
<td>Sugars</td>
<td>• Crohn’s</td>
</tr>
<tr>
<td>Pancreatic</td>
<td>• Celiac disease</td>
</tr>
<tr>
<td>insufficiency</td>
<td>• Dysregulation</td>
</tr>
<tr>
<td>Bacterial</td>
<td>• Diabetes</td>
</tr>
<tr>
<td>overgrowth</td>
<td>• Hyperthyroid</td>
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</table>
Enteral Formula Osmolality is a Red Herring

<table>
<thead>
<tr>
<th>Liquid/Medication</th>
<th>mOsm/kg</th>
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<tbody>
<tr>
<td>EN formulas</td>
<td>250-710</td>
</tr>
<tr>
<td>Popsicles</td>
<td>720</td>
</tr>
<tr>
<td>Ice cream/sherbet</td>
<td>1150 / 1225</td>
</tr>
<tr>
<td>KCl elixir</td>
<td>3000</td>
</tr>
<tr>
<td>Tylenol elixir</td>
<td>5400</td>
</tr>
<tr>
<td>Multivit liquid</td>
<td>5700</td>
</tr>
<tr>
<td>Na phosphate</td>
<td>7250</td>
</tr>
<tr>
<td>Reglan</td>
<td>8350</td>
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</tbody>
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Treatment for Diarrhea

- Provide adequate hydration
  - Replace loses
  - May need to stop EN
- Maintain electrolyte balance
  - Stool losses include bicarb, K, Phos, Na
- Identify etiology
- Rule-out C dif or other pathogen before initiating anti-peristaltic agents or narcotics

Clostridium difficile-associated Disease (CDAD)

- Found in stool of 15-25% of pts with antibiotic associated diarrhea
- Found in 95% of pts with pseudo-membranous colitis
- CDC: increase from 31 per 100,000 (1996) to 61 per 100,000 (2003)
- Transmission primarily via fecal-oral route
- Recently identified strain more toxic
Clostridium difficile-associated Disease (CDAD)

Uncomplicated diarrhea → sepsis → death
- Risk factors for CDAD
  - Antibiotic therapy (all antimicrobials except aminoglycosides associated with CDAD)
  - > 65 years of age
  - Severe underlying illness
  - NG intubation
  - Anti-ulcer medication
  - Longer hospitalization

Symptoms may start immediately after starting antibiotics or several weeks later
- Mild disease: mild to moderate nonbloody diarrhea, low abdominal cramping
- Severe disease: colitis – profuse watery diarrhea, abdominal pain, distention. Risk of developing paralytic ileus and toxic megacolon
- Reinfection or relapse?

Diagnosis
- Test only watery or loose stools to identify infection versus colonization
- 30% of hospital pts with diarrhea have CDAD

Treatment
- Stop the inciting antibiotic
- 10 days with oral vancomycin or metronidazole for mild to moderate CDAD
  - Treat severe disease with oral vancomycin as initial therapy
  - Probiotics with vanc/metronidazole may reduce recurrence
- Do not treat asymptomatic colonization
**Clostridium difficile-associated Disease (CDAD)**

- Prevention
  - Infection control
    - Hand hygiene with soap and water
    - Isolation precautions with private rooms, gloves & gowns
    - Single-use items for patient rooms
    - Environmental cleaning with hypochlorite-based germicides
  - Reduce patient risk of disease after exposure
    - Probiotics have not demonstrated improved outcome

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**A.S.P.E.N. Practice Guidelines (JPEN 2002)**

- Check GRV frequently when feedings are initiated (A)
- Hold EN when GRV >200 mL on 2 successive assessments (A)
- Use standardized protocols for ordering, administering, and monitoring EN (B)
- Consider post-pyloric FT placement with high risk for aspiration (C)

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**ESPEN Guidelines on EN*, 2006**

- No data showing improved outcome with early EN, but recommend feeding hemodynamically stable pts within 24h
- Consider metoclopramide or erythromycin with EN intolerance
- No difference in efficacy between jejunal and gastric feeds
- Use supplemental PN if EN cannot meet goals

*all the above are Grade C recommendations
ADA’s Evidence Analysis Library
www.adaevidencelibrary.org

- Accept isolated RV of 250mL. Evaluate ≥ 2, 250 mL consecutive volumes before interrupting (III)
- No evidence for significant relationship between RV and aspiration pneumonia (V)
- Research indicates that the risk of using blue dye outweighs the benefit and that the blue dye method should be abandoned in EN (III)
- Elevating the HOB 45 degrees reduces reflux of gastric contents (I) and aspiration pneumonia (II)

Canadian Clinical Practice Guidelines 2007 Recommendations

- Initiate SB feeding within 24-48 hours of ICU admission
- Obtain SB access when feasible
- Elevate HOB 45 degrees
- Do not start PN at same time as EN

Canadian Clinical Practice Guidelines 2007 Considerations

- Optimize nutrient delivery in head injured patients
  - Initiate at target rate, allow higher GRV, use SB feeds
  - Feeding protocol for prokinetics and 250 mL RV
  - Metoclopramide with high GRV/EMesis
  - SB feeds with increased risk of EN intolerance, regurgitation, aspiration
  - Elevate HOB as much as possible if 45° not feasible
Canadian Clinical Practice Guidelines
2007 Insufficient Data

- Achieving EN target improves outcomes
- Feeding protocol
- Probiotics, prebiotics, synbiotics
- Continuous vs other administration methods
- Gastrostomy vs nasogastric feeding

Defensive Strategies for Reducing EN Complications

- Elevate HOB 45° or as high as possible
- Assess all patients for risk of aspiration
- Allow residual volume of 250 mL
  - Provide prokinetic with persistent high GRV
- Evaluate potential sources of diarrhea
  - Medications are primary etiology
  - Rule out enteric pathogen before anti-diarrheals
- Implement protocols for EN management

Conclusion

Enteral nutrition is not as easy as it looks to provide to patients.

Monitor closely and manage effectively for optimal outcomes.
Published Evidence ≠ Practice

- 30-40% of clinicians do not provide care according to scientific evidence
- 20-25% of care provided is not needed or potentially harmful
- Challenge: translation of evidence into practice
- “Blind leading the deaf?”

Vakil. Am J Gastroenterol 2004