Feeding intolerance

Marialena Mouzaki, MD MSc – Cincinnati Children's Hospital

Laura Vresk, RD MSc – Hospital for Sick Children

Lucile Packard Foundation for Children's Health

Funded by the Lucile Packard Foundation for Children's Health

Northwestern Medicine® Feinberg School of Medicine

C6 Seminar Series

Presenter Disclosure

- **Presenter:** Marialena Mouzaki
- **Relationships with commercial interests:**

  Nothing to disclose

This activity has received funding from the Lucile Packard Foundation for Children's Health.

Presenter Disclosure

- **Presenter:** Laura Vresk
- **Relationships with commercial interests:**

  Nothing to disclose

This activity has received funding from the Lucile Packard Foundation for Children's Health.

Accreditation

Accreditation Statement

This activity has been planned and implemented in accordance with the accreditation requirements and policies of the Accreditation Council for Continuing Medical Education (ACCME) through the joint providership of Northwestern University Feinberg School of Medicine and University of Toronto/Sick Kids Hospital. The Northwestern University Feinberg School of Medicine is accredited by the ACCME to provide continuing medical education for physicians.

Credit Designation Statement

The Northwestern University Feinberg School of Medicine designates this live activity for a maximum of 1.0 *AMA PRA Category 1 Credit(s)* ^{TM}. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

Learning objectives

- Recognize the causes of feeding intolerance in children with medical complexity
- Breakdown the treatment options currently available for feeding intolerance
- Discuss the knowledge gaps in the field of nutrition support of children with neurologic impairment

Case

- 4yo male, history of premature birth at 26 weeks
- History of IVH with hydrocephalus s/p VP shunt, cerebral palsy, seizure disorder, chronic lung disease
- Unsafe to feed orally → G-tube
  - Boluses given via gravity x4 per day
- Symptoms: discomfort, arching, vomiting (NBNB), sometimes distended abdomen, hard and infrequent stools, leaking around tube
- 10% weight loss – feeds are held often because of the symptoms

The issue of feeding intolerance

- Research priorities per parents and clinicians caring for children with medical complexities

Clinician prioritization				Caregiver prioritization			
Rank	Clinical topic	Frequency[a]	Median (IQR)	Rank	Clinical topic	Frequency score	Median (IQR)
1	Irritability and pain	28	6 (6–6.5)	1	Behavior	40	7 (7–7)
2	Child mental health	20	6 (4–6)	2	Acute LRTI	37	6.5 (6–7)
2	Disorders of tone	20	6 (5–7)	3	Enteral feeding tubes	36	6 (5.25–6.75)
2	Polypharmacy	20	5 (5–6)	4	Sleep	35	5.5 (5–6.75)
2	Sleep	20	5 (5–6)	5	Aspiration	34	6 (6–6)
3	Aspiration	19	6 (5–6.5)	5	Infection control	34	6.5 (5.25–7)
4	Behavior	18	5 (4–6.5)	5	Irritability and pain	34	6.5 (5.25–7)
4	Dysautonomia	18	5 (4–6)	6	Nutrition and growth	33	5 (5–6.5)
4	Feeding tolerance	18	5 (4–6.5)	6	Feeding tolerance	33	6 (5.35–

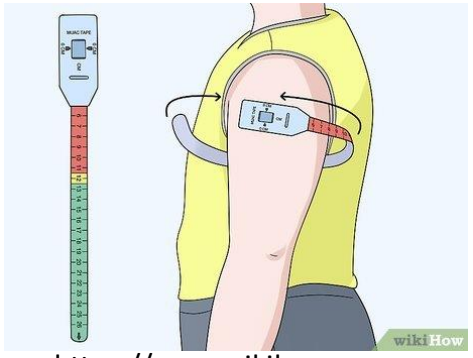
Diskin et al. Dev Med Child Neurol 2021

C6 Seminar Series

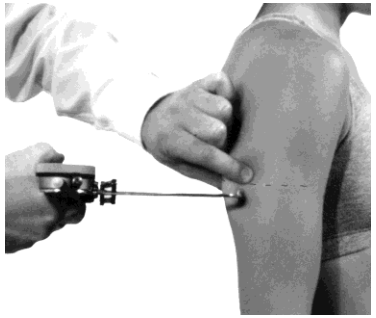
Nutritional assessment guides recommendations

Weight and height

- Challenging to obtain
- Not body composition



https://www.wikihow.com



Norton et al. Standards for anthropometry assessment

MUAC and TSF

- Goal MUAC~25%

Labs

- Often not done
- Abnormalities can be attributed to other causes (e.g., antiepileptics)

Mazzeo & Mascarenhas Curr Probl Ped Adol Health Care 2021

Challenging to estimate needs

- Children with medical complexity have a wide range of caloric needs
  - Premature infants who need to catch up: ↑ ↑ needs
  - Neurologically impaired children: ↓ ↓ needs
- Traditional reference ranges used as starting points
- Indirect calorimetry may be needed in certain cases

TABLE 1. Estimating Resting Energy Expenditure from Body Weight.

Age (years)	Males	Females
0-3	60.9 x w* – 54	61.0 x w* - 51
3-10	22.7 x w* + 495	22.5 x w* + 499
10-18	17.5 x w* + 651	12.2 x w* + 746
18-30	15.3 x w* + 679	14.7 x w* + 496

***w = weight in kilograms.**

Adapted from: Subcommittee on the Tenth Edition of the RDAs. (1989). Recommended Dietary Allowances: 10th Edition.[1,50]

TABLE 2. Activity/stress adjustment factors (multiply by estimated resting energy expenditure).

1.3	Well-nourished child at bedrest with mild-moderate stress
1.5	Normally active child with mild to moderate stress, or an inactive child with severe stress (trauma, sepsis, cancer) or a child with minimal activity and malnutrition requiring catch-up growth
1.7	Active child requiring catch-up growth or an active child with severe stress
1.7-2.0	Severe malnutrition
2.5-3.5	Anorexia nervosa requiring growth restoration and weight gain

Adapted from: Subcommittee on the Tenth Edition of the RDAs. (1989). Recommended Dietary Allowances: 10th Edition.[1]

Marchand et al. J Pediatr Gastroenterol Nutr 2006;
Mazzeo & Mascarenhas Curr Probl Ped Adol Health Care 2021

No uniform definition of undernutrition

ESPGHAN recommends

- Using anthropometrics to determine undernutrition
- Not using CP specific growth charts (not reflective of healthy growth)*

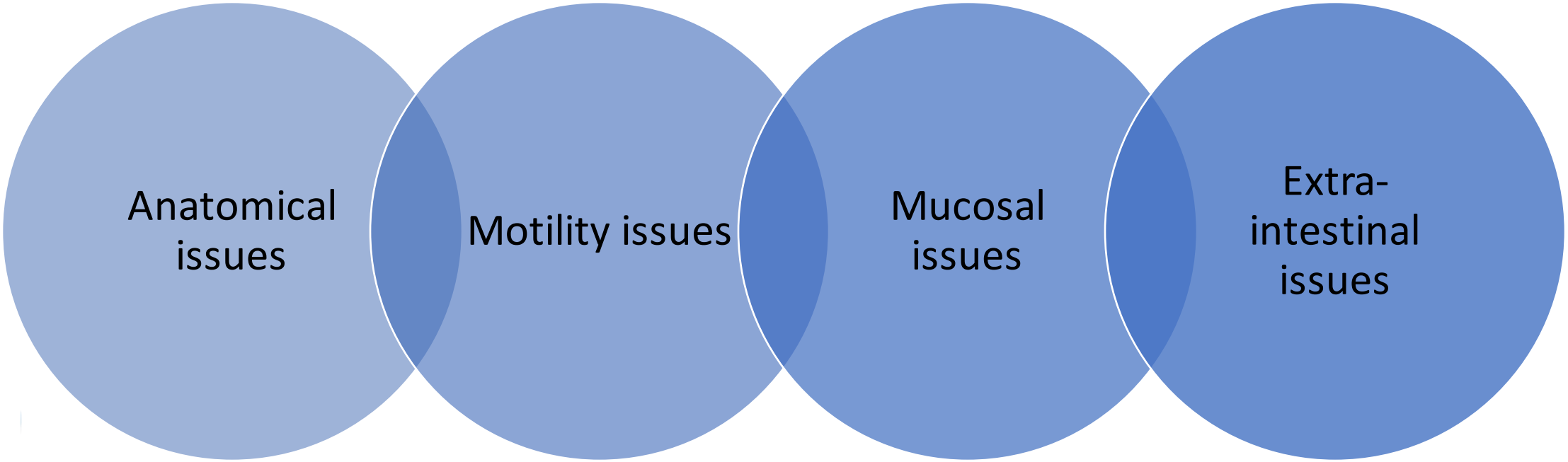
Romano et al. J Pediatr Gastroenterol Nutr 2017
Dietitians of Canada/CPS Public Policy Statement 2010

Back to the case

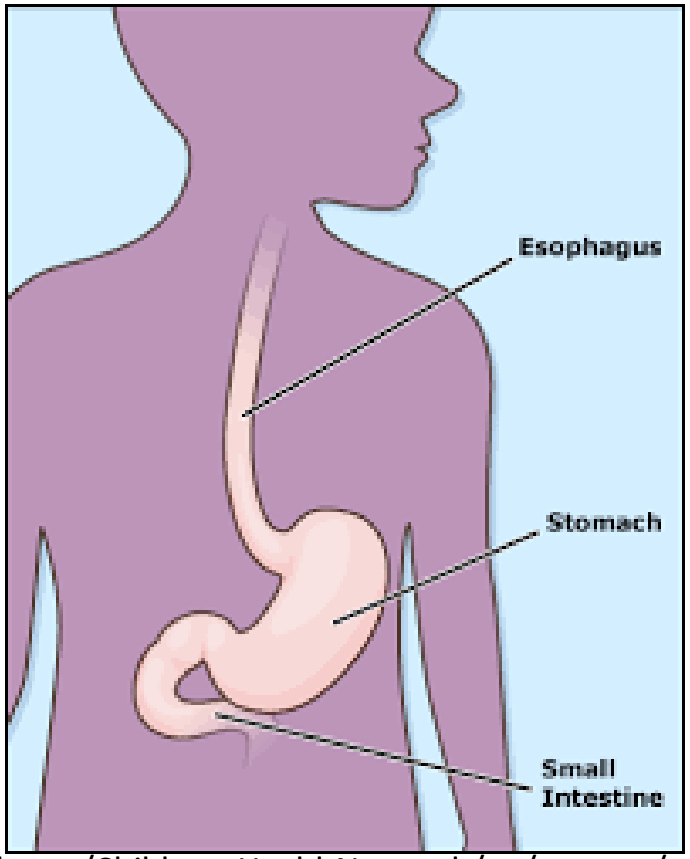
- The patient meets criteria for moderate malnutrition
- They have feeding intolerance

- How does one approach this?

Causes of feeding intolerance



Anatomical issues



https://kidshealth.org/ChildrensHealthNetwork/en/parents/xray-upper-gi.html

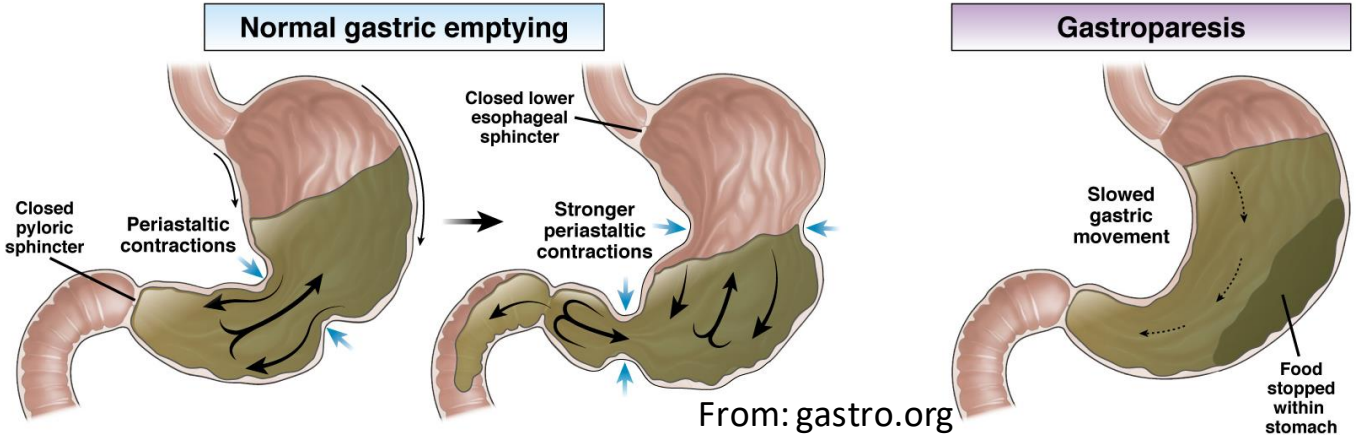
- Esophagus:
  - Stenosis, achalasia, stricture
- Stomach:
  - Pyloric stenosis, developing outlet obstruction, iatrogenic (balloon obstructing)
- Duodenum:
  - SMA, malrotation/volvulus

Anatomical issues

- Characterized by more consistent symptomatology
  - Can also be intermittent if surgical complication (e.g., volvulus)

- Increased suspicion if:
  - Abdominal surgery (e.g., adhesions)
  - Other anatomical abnormalities
  - Weight loss, scoliosis (e.g., SMA)
  - Young child with feeding intolerance of unclear etiology (e.g., esophageal stenosis)

Motility issues

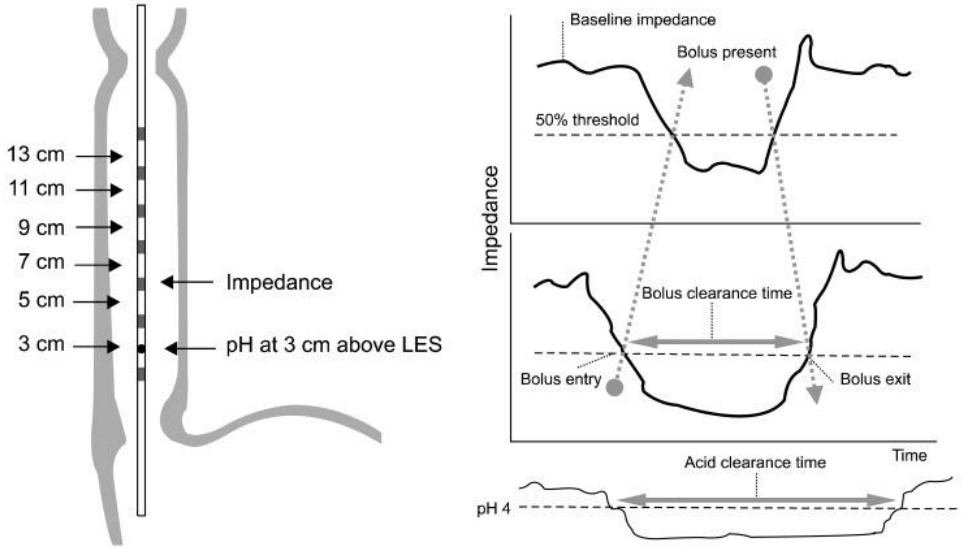


From: gastro.org

- GI dysmotility is a manifestation of CNS dysfunction
- Can be predominantly gastric/duodenal, predominantly colonic or generalized gastrointestinal
  - Delayed gastric emptying → emesis
  - Poor colonic motility → constipation
- Deteriorate with infections/clinical decompensation, changes to certain medications or surgical interventions (e.g., scoliosis surgery)

Gastrointestinal reflux disease

- Often diagnosed clinically
  - Vomiting with feeds, arching of back, drooling, coughing
  - Increased spasticity, seizures, ENT manifestations can also be 2^{o} to GERD
- Work up includes
  - pH probe with/without impedance
  - Scintigraphy (milk scan) to assess for aspiration
  - EGD with biopsies
    - Assess for ulcers, EoE, Barrett's esophagus
  - Contrast studies to rule out anatomical abnormalities



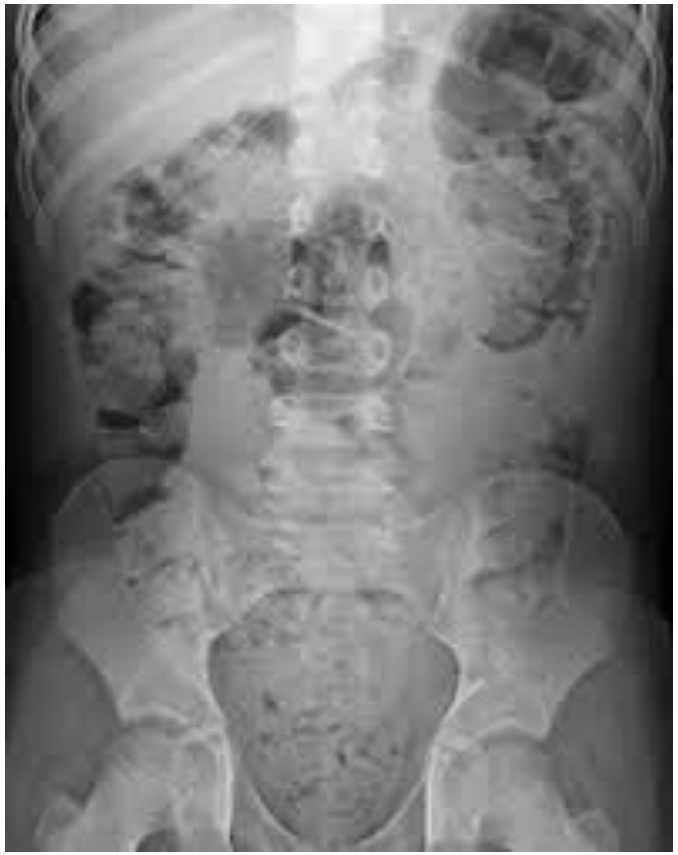
Shin. Ped Gastro Hep Nutr 2014

Romano et al. J Pediatr Gastroenterol Nutr 2017;
Mazzeo & Mascarenhas Curr Probl Ped Adol Health Care 2021

Constipation

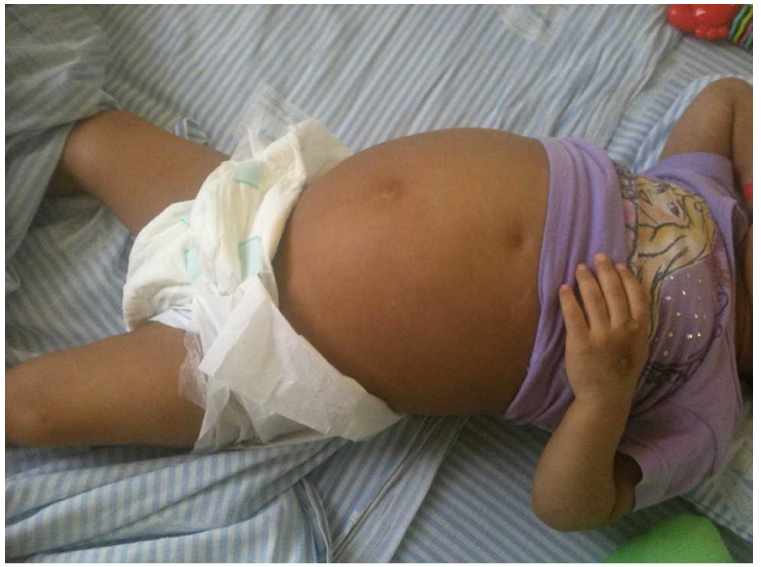
- Typically diagnosed clinically

- Multifactorial
  - Underlying colonic dysmotility
    - Further worsened by electrolyte abnormalities
  - Dysbiotic microbiome
  - Iatrogenic (medication side effects)
  - Secondary: hypothyroidism, spinal cord pathology, HD



Abdominal distention

- Causes
  - SIBO: Small Intestinal Bacterial Overgrowth
  - Aerophagia
  - Gas-bloat syndrome



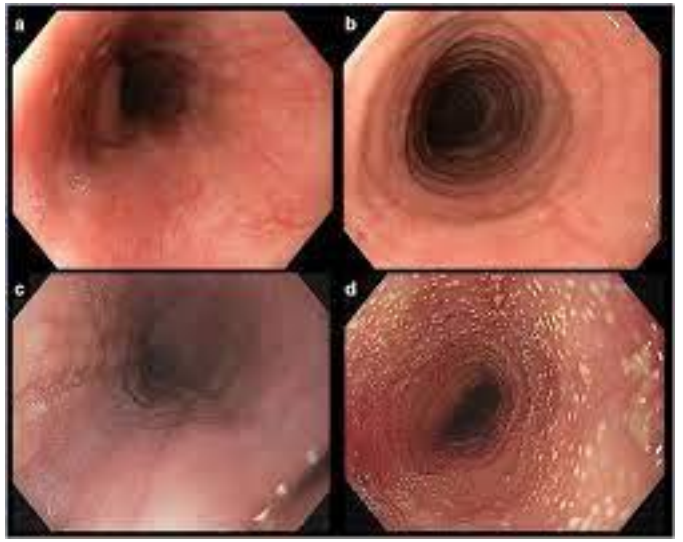
Rev Paul Ped. 2015;33:371–5

- Can cause significant discomfort, feeding intolerance
- Respiratory compromise in those with tenuous respiratory status

Mucosal issues

- Medications, allergies, underlying illnesses (e.g., autoimmune disorders or infections) can affect the intestinal mucosa

- Symptoms can vary:
  - Emesis, bloody or not: if PUD, esophagitis
  - Abdominal pain: if irritation of esophageal, gastric mucosa
  - Diarrhea, high volume: if irritation of small intestinal mucosa
  - Diarrhea, bloody: if irritation of colonic mucosa

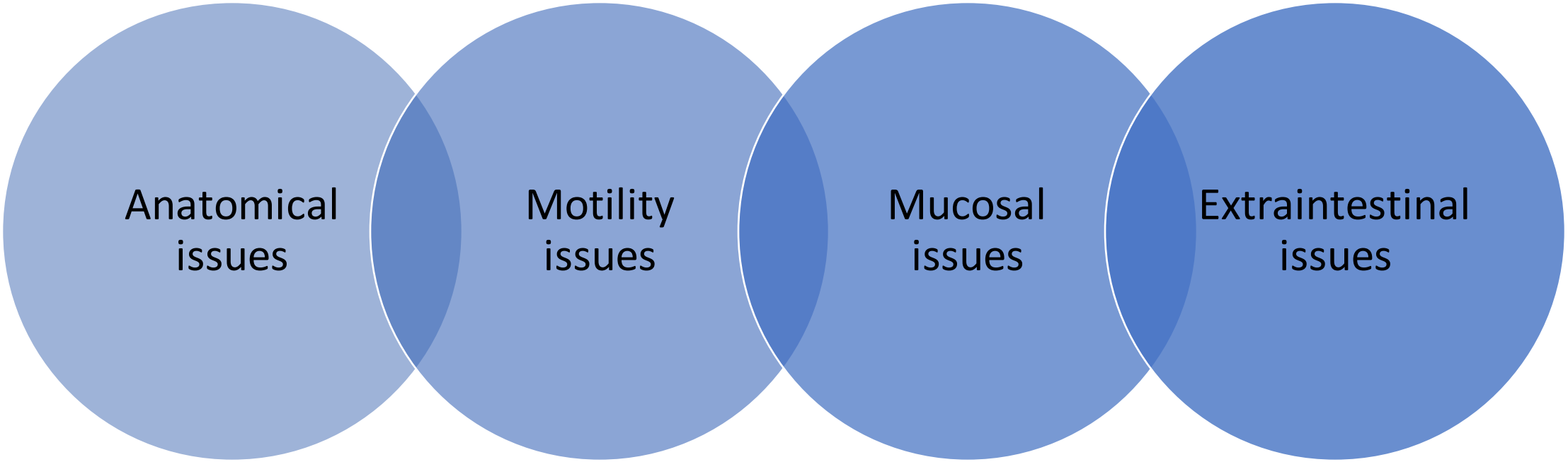


Biedermann et al. Sem Immunopath 2021

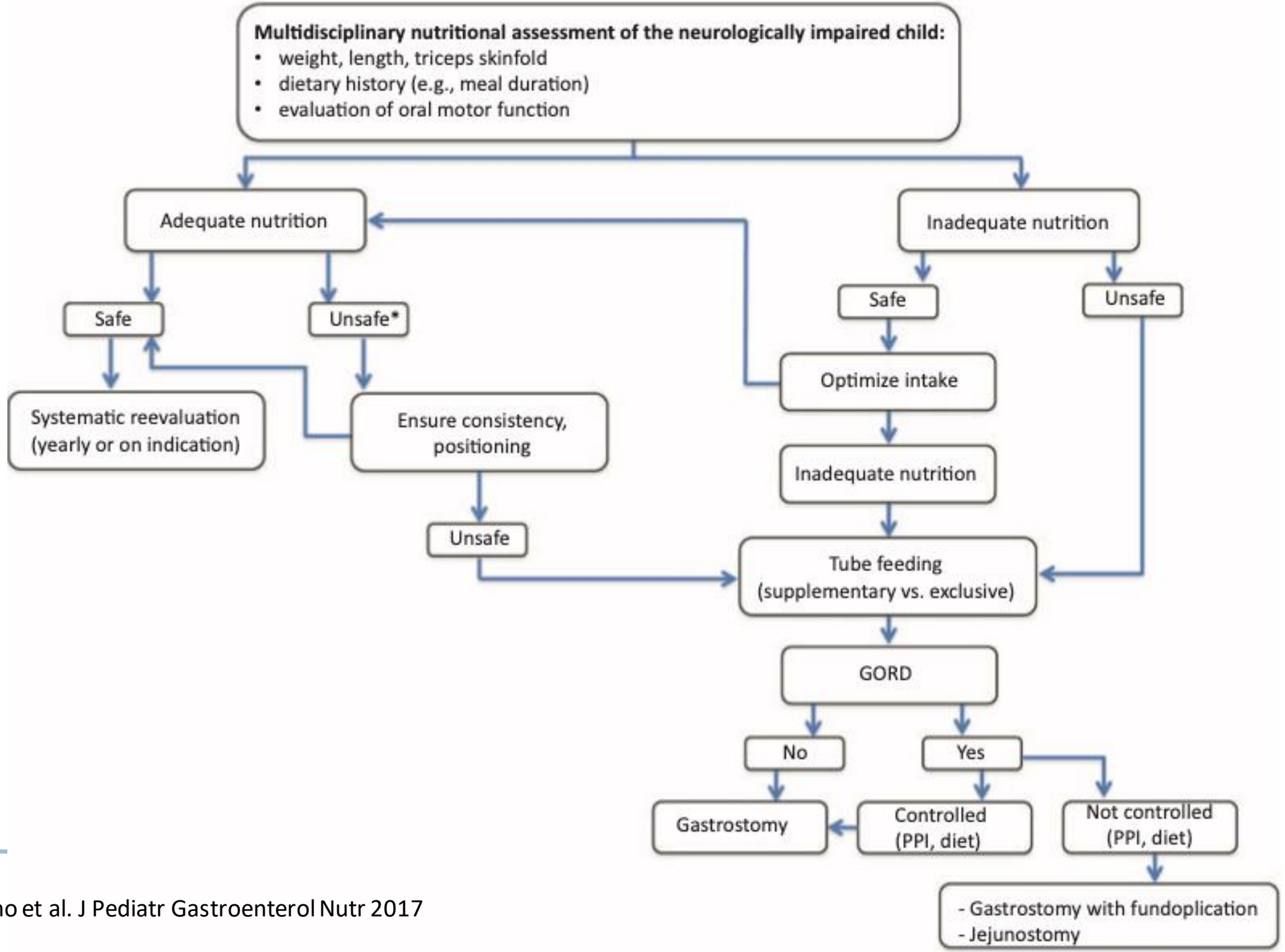
Extraintestinal issues

Dental	Hepatobiliary: e.g., cholecystitis, cholelithiasis	Pancreatic: e.g., pancreatitis	Renal: e.g., nephrolithiasis
CNS: e.g., increased ICP, autonomic dysfunction	CV: e.g., heart failure	Resp: e.g., pneumonia	ID: e.g., sepsis, UTI

Investigating feeding intolerance



Recommended approach



Romano et al. J Pediatr Gastroenterol Nutr 2017

Seminar Series

Treatment options - GERD

"Lifestyle changes"

- Change in formula, e.g., casein→ whey based
- Addition of pectin, removal of excess fat; change in kcal/ml or rate

PPIs often given empirically

- Often, higher doses are needed
- Gastric pH

Fried et al. J Pediatr 1992; Khoshoo et al. J Pediatr Gastroenterol Nutr 1996;
Miyazawa et al. BMC Gastroenterol 2008; Kawai et al. J Pediatr Gastroenterol Nutr 2004

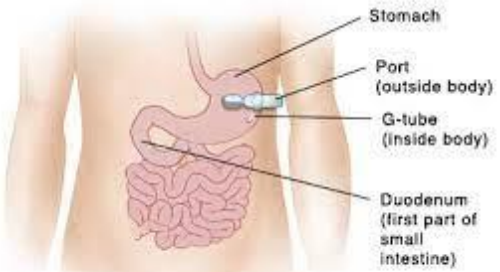
Treatment options – GERD: blenderized diets

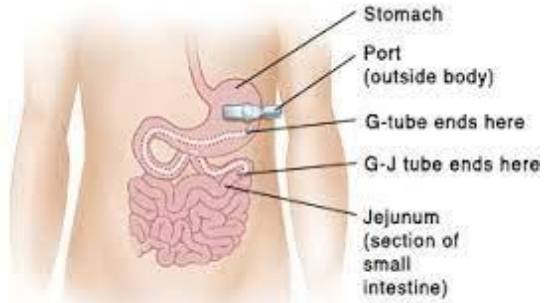
Benefits	Concerns/ Considerations
hormonal response improving motility	• Risk of bacterial contamination • Cost?

More research is needed to determine whether blenderized diets improve outcomes (nutritional, gastrointestinal, social, etc.)

Pentiuk et al J Parent Ent Nutr 2011; Gallagher et al J Parent Ent Nutr 2017; Oparaji et al. Gastroenterol Res 2019; Diskin et al. Dev Med Child Neurol 2021

Tube feeding





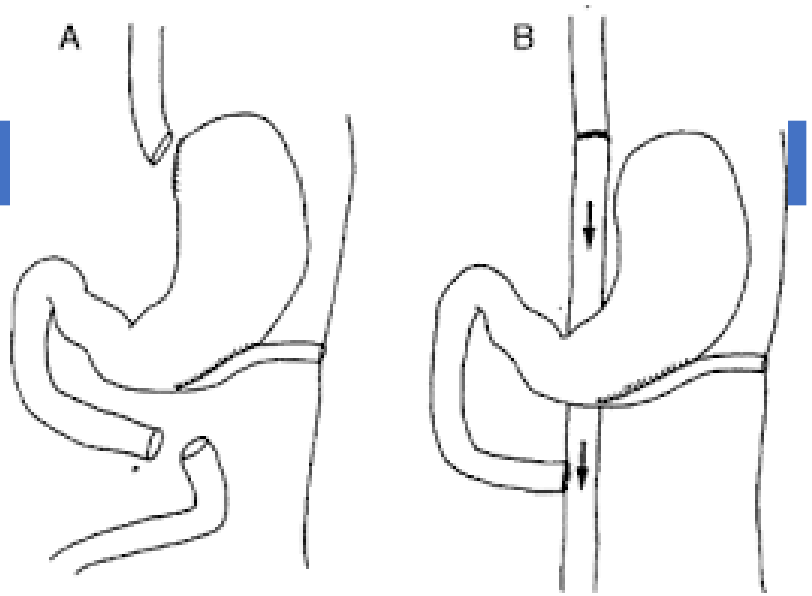
- Indicated in unsafe or inefficient (>3h/day) oral feeding, ideally before undernutrition develops
- NG vs G: not studied in children. In adults: more convenient, less discomfort, interfering less with social activities
- GJ/J: indicated in aspiration from GERD, bloating, refractory vomiting/retching

Gomes et al. Cochrane Database Syst Rev 2015;
Romano et al. J Pediatr Gastroenterol Nutr 2017

Treatment options - GERD

G-tube

- Bolus feeds more physiologic
- Allows for blenderized feeding
- Risk of aspiration



Total esophagogastric dissociation

G-/fundoplication

- Worsened motility initially
- Poor or no evidence of effectiveness in treating nutritional issues
- ~15% risk of recurrence/ persistence of GERD

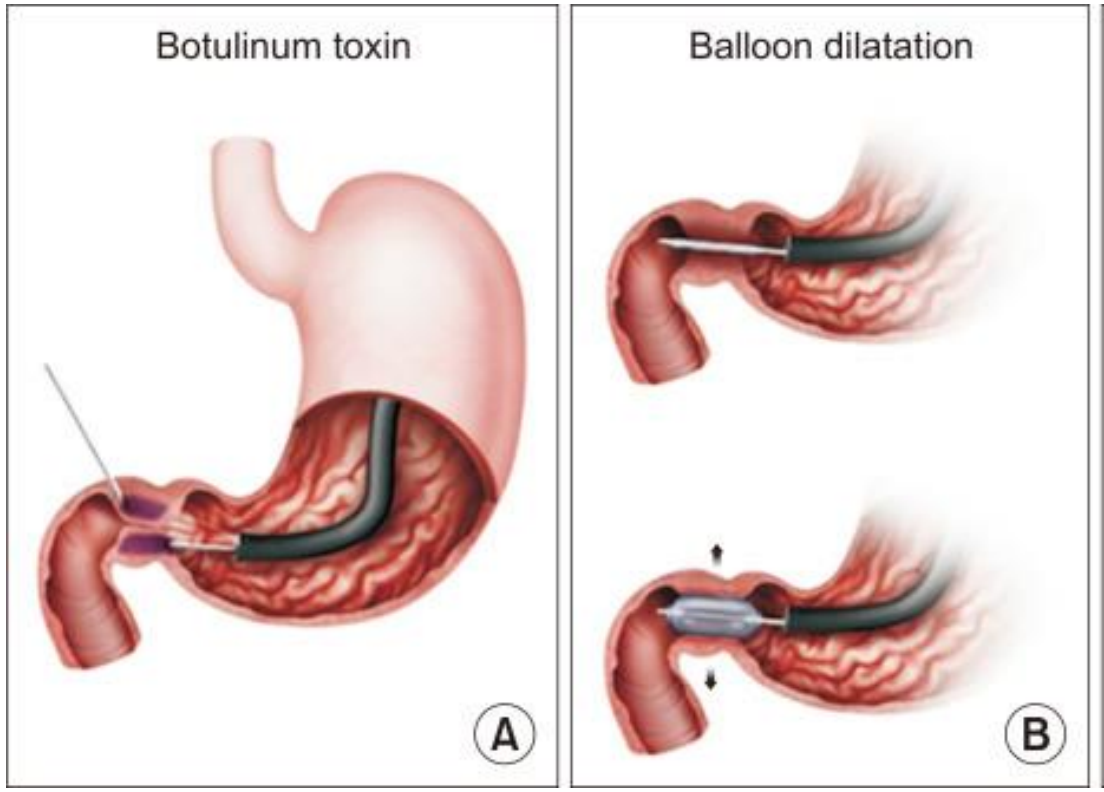
Meta-analysis 2018:

- Symptoms persist after GJ- and fundoplication at similar rates, requiring surgical intervention
- Total esophagogastric dissociation is superior to fundoplication in terms of symptom recurrence
  - More invasive, considered if repeated fundoplications needed or in microgastria

Lauriti et al. Ped Surg International 2018; DeRaddo et al J Pediatr Gastroenterol Nutr 2019

Treatment options – delayed gastric emptying: pyloric botulinum toxin A and dilation

- Rapid response
  - Complete or partial effectiveness in ~75% of patients
- Repeat treatments may be needed in ~50-70%
  - Less successful each time
  - Typically within 3-6 months
- Can be done after fundoplication



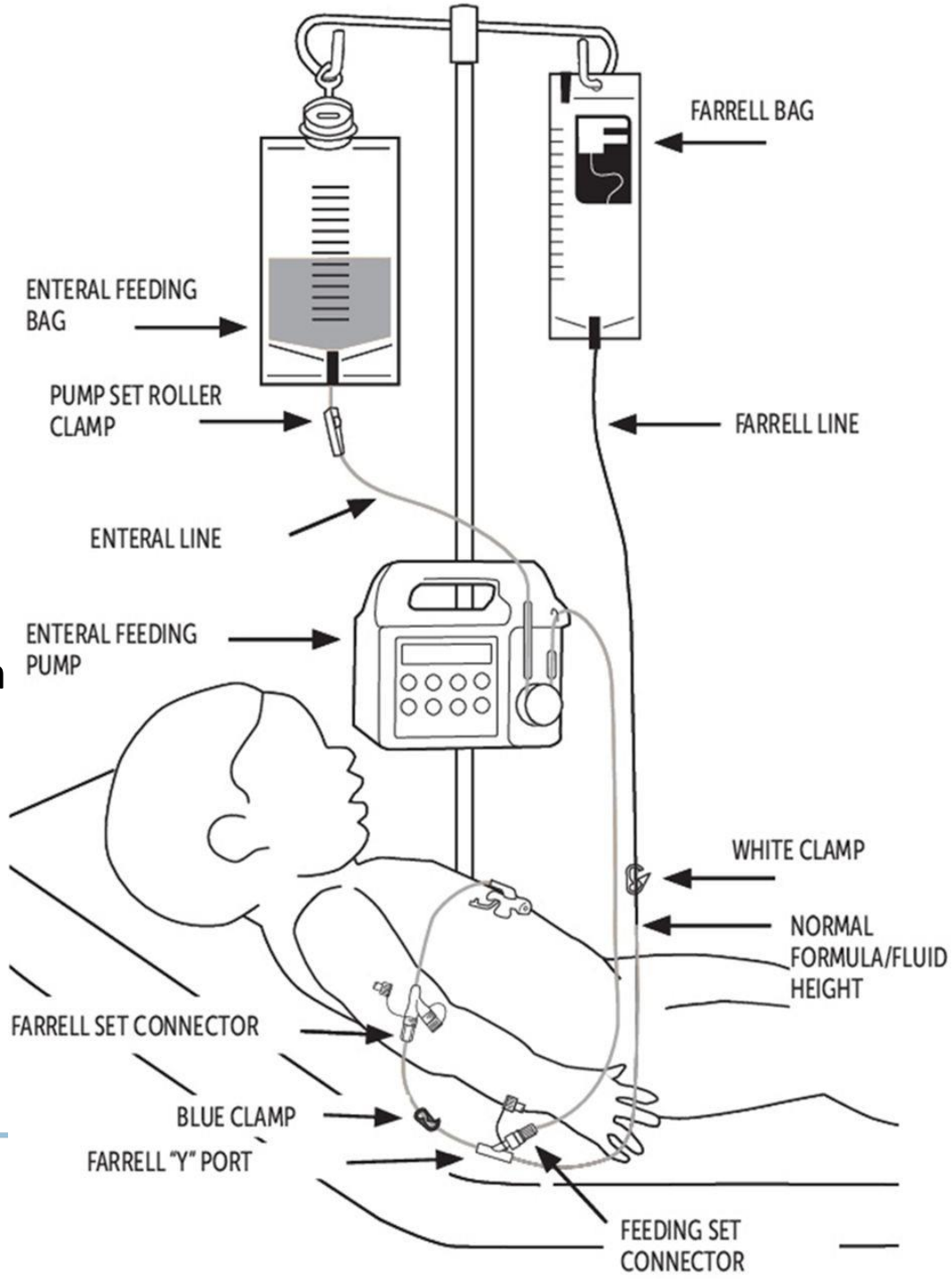
Kim D. Korean J Cardiovasc Thoracic surgery 2020

Leal et al. Clin Gastroenterol Hep 2015;
Clemence et al. J Pediatr Gastroenterol Nutr 2021

Treatment options – abdominal distention

- Using G-tube to decompress
  - 60 ml syringe
  - Farrell bag

- Post fundoplication retching
  - Manage all reversible causes of increased intraabdom pressure (e.g., constipation)
  - Whey based formulas (↑ gastric emptying)
  - Slow feeds:
    - boluses <15 ml/kg
    - Continuous <8 ml/kg/h
  - Limit polypharmacy



Mazzeo & Mascarenhas Curr Probl Ped Adol Health Care 2021;
Phippen et al. BMJ Support Palliative Care 2017

Treatment options - constipation

“Lifestyle changes”

- Formula/diet changes
- Addition of fluid if safe

Tabbers et al. J Pediatr Gastroenterol Nutr 2014;
King et al. J Pediatr Surg 2005

Seminar Series

Treatment options - constipation

"Lifestyle changes"

- Formula/diet changes
- Addition of fluid if safe

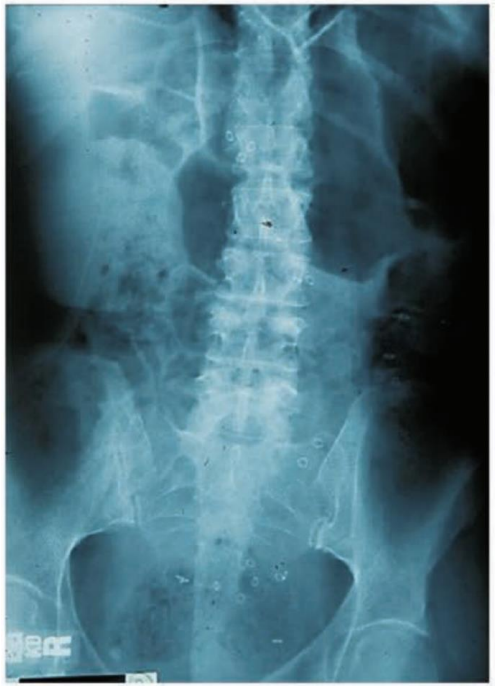
Medications

- Clean out with osmotic laxatives
- Maintenance treatment (PEG3350, lactulose); stimulants can also be helpful (senna etc.)
- Fiber may cause intolerance (distention, flatulence)
- Aspiration is a concern with high volume therapies

Tabbers et al. J Pediatr Gastroenterol Nutr 2014;
King et al. J Pediatr Surg 2005

Treatment options - constipation

- Newer medications
  - Prucalopride: 5-HT4 receptor agonist
    - Used for slow transit constipation – negative RCT*
    - Also effective in feeding intolerance/nausea at 0.03 mg/kg
      - 70% of those who have failed other meds/interventions have symptom improvement
- Anorectal dysmotility
  - Botulinum toxin type A



Mugie et al. Gastroenterol 2014;
Hirsch et al. DDW abstract 2021

Research priorities

Delineate specific phenotypic presentations

- E.g., not lumping all patients with neurologic impairment together
- Assess body composition: use to prescribe and adjust nutrition support → impact on outcomes?

Predictors of response to various treatment approaches

- What is the best feeding approach (feeds/gut location/medications)
- Offer directly the treatment most likely to succeed

Personalized medicine

- E.g., who does blenderized diet work for and how?
- Gene-drug-nutrient interactions

Thank you

Questions?

Lucile Packard Foundation for Children's Health

Funded by the Lucile Packard Foundation for Children's Health

Northwestern Medicine® Feinberg School of Medicine

C6 Seminar Series