Program

WORLD CONGRESS OF PEDIATRIC GASTROENTEROLOGY, HEPATOLOGY AND NUTRITION

OCTOBER 5-8, 2016 • MONTRÉAL • CANADA

Dedicated to the memory of

Dr. Claude Roy

Friday, October 7 - Saturday, October 8, 2016

Association of Pediatric Gastroenterology and Nutrition Nurses (APGNN)

Place d'Armes | Credit : © Tourisme Montréal, Stéphan Poulin

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Letter from the President

Dear APGNN Meeting Participant:

Welcome to the 25th APGNN Annual Meeting, taking place during the World Congress of Pediatric Gastroenterology, Hepatology and Nutrition in Montreal, Quebec. Maureen Egan, our current Program Chair, and her committee members have planned a dynamic and informative conference. We hope you find the program invaluable to your ongoing education. Upon completion of the conference, please take time to complete the course evaluation. Your feedback is an integral part of ensuring that our meetings are always of high quality and meeting the unique needs of our members. We also appreciate your topic suggestions or any other ideas you may have to help our organization evolve and flourish.

In lieu of a keynote speaker this year, you will hear brief updates from the current presidents/chairs of our physician partner's organization, NASPGHAN (North American Society of Pediatric Gastroenterology, Hepatology, and Nutrition); CPNP (Certified Pediatric Nutrition Professionals); and the newly formed PCG (Psychology Collaborative Group). We hope you find the multidisciplinary module format engaging will allow you to tailor your experience to your personal and professional interests. All meeting participants can also attend any of the NASPGHAN and CPNP lectures that are of interest to you.

The Annual Business Meeting will be held at 8:00 on Saturday October 8th. Please make every effort to attend as the Annual Report will be presented at that time and we will be introducing you to your new board members. We hope to see many of you stick around for committee meetings on Saturday evening from 5:15pm-5:45pm. We are always looking to learn from our members and to collaborate on projects of interest that will ultimately enhance the membership experience. We are sure you will find at least one APGNN committee that interests you. All levels of knowledge and expertise are welcome. This is a great way to become involved in APGNN. Our annual APGNN Social Event will be Friday evening.

If you are not an APGNN member, please consider joining. Information about our organization as well as membership applications can be found at the APGNN Membership booth in the exhibit hall and on our website www.apgnn.org.

Lastly, a special thank you to the NASPGHAN staff: Margaret Stallings, Kim Rose, Donna Murphy. We acknowledge the gift of your time and energy, and publicly want to recognize our gratitude for their assistance.

Best wishes,

Ryan Shonce, FNP-C

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APGNN
The Association of Pediatric Gastroenterology and Nutrition Nurses

The Mission of APGNN

The formation and ongoing mission of the *Association of Pediatric Gastroenterology and Nutrition Nurses* is to:

Promote the professional development and recognition of pediatric nurses as experts in their field

Promote excellence in the care of families with children with gastroenterology and nutritional illnesses

Our Goals

The APGNN was founded upon and recognizes the following organizational goals:

Promote nursing research and publication of findings

Promote education for patients, families, nurses, allied health professionals, and physicians

Establish standards of practice

Create a Pediatric Gastroenterology/Nutrition Network

Support role development through attendance and participation in conferences and development of teaching materials

The APGNN web site is:
www.apgnn.org
A membership application is also available through this web site.
Please be patient as this site continues to evolve.
For changes in your membership database go through the
North American Society for Pediatric Gastroenterology, Hepatology and Nutrition
NASPGHAN web site:
www.naspghan.org
Helpful practice guidelines and patient and family brochures are also accessible through this website

APGNN

The Association of Pediatric Gastroenterology and Nutrition Nurses

2016 APGNN Educational Conference

Supported in part through restricted educational grants from:

Mead Johnson Nutrition

NUTRICIA

Abbott Nutrition

APGNN Annual Meeting
October 7 – 8, 2016

Friday, October 7, 2016

7:30-8:00 **Registration**

8:00-8:45 **Welcome**
James Heubi, MD President Elect, NASPGHAN
Ryan Shonce, APN, MSN President, The Association of Pediatric Gastroenterology and Nutrition Nurses
Jennifer Crouse, RD, President, Council of Pediatric Nutrition Professionals
Amanda Deacy, Psychology Collaborative Group

8:45-10:15 **Liver Transplant: A Multi-Disciplinary Approach**

8:45-9:15 Pediatric Liver Transplant: An Overview
Jerome Menendez DNP, MSN Carolinas HealthCare System
Learning Objectives:
- Identify indication for pediatric liver transplant
- Recognize potential complication following liver transplant
- Discuss the need for post-transplant immune suppression therapy

9:15-9:45 Assessment and Management of Barriers to Adherence in Liver Transplant Recipients
Jamie Ryan PhD, Children's Mercy, Kansas City
Learning Objectives:
- List 3 or more barriers to effective self-management in pediatric transplant recipients
- Describe at least 2 benefits of screening for adherence barriers
- Identify 2 or more strategies for addressing adherence barriers in clinical practice.

9:45-10:15 Nutrition in Liver Transplant: A Balancing Act
Kathryn Chambers RD, The Hospital for SickKids Toronto
Learning Objectives:
- Discuss main nutritional concern in patient pre-liver transplant. Explain a few of the nutritional strategies to optimize nutritional status in liver patient pre transplant. Demonstrate the importance of weekly anthropometric collection pre transplant.
- Emphasize the importance of balanced healthy nutritional post transplant

10:15-10:30 **Break**

10:30-12:30 **Cystic Fibrosis: A Team Approach**

10: 30-11:00 Manifestations of Gastrointestinal Issues in Cystic Fibrosis
Veronique Morinville MD, Montreal Children's Hospital

11:00-11:30 GI Nursing Considerations for the Cystic Fibrosis Patient
Sophie Vallee-Smejda RN, Montreal Children's Hospital

11:30-12:00 CF Nutritional Management: Nuts and Bolts
Donna Drury RD, Montreal Children's Hospital
Learning Objectives:

- Recognize the various manifestations of cystic fibrosis involving the gastrointestinal system
- Appreciate how a team approach can help optimize digestive and overall health in a cystic fibrosis child

12:00-12:30 Psychosocial support for GI symptoms in Patients with CF
Brandi Whitaker, PhD Arkansas Children's Hospital
Learning Objectives:

- Overview of common GI issues in patients with CF
- Behavioral/parenting strategies to meet daily calorie needs
- Adherence for taking enzymes
- Non-pharmacological pain management techniques

12:30-1:30 **Lunch and Poster session**

1:30-3:00 **Functional GI disorders: A Multi-Disciplinary Approach**

1:30-2:00 Advances in the Evaluation and Treatment of Functional Abdominal Pain
Samuel Nurko MD, MPH and Elizabeth Burch MSN, CPNP Boston Children's Hospital
Learning Objectives:

- Understand the pathophysiology of functional abdominal pain
- Understand the multi-disciplinary treatment of functional abdominal pain
- Understand the different treatment modalities to be used

2:00-2:30 Nutritional Concerns when Managing Pediatric Patients with Functional Abdominal Pain
Janet Iurilli RD, Phoenix Children's Hospital
Learning Objectives:

- Understand the current nutritional approaches in managing functional abdominal pain in pediatric patients
- Recognize the potential nutritional deficiencies that can be a result of a restricted or elimination diet in pediatric patients (specifically a low FODMAP diet)
- Appreciate the essential role of the dietitian to ensure nutritional adequacy for growth in pediatric patients

2:30-3:00 Promoting Resilience in Youth with Functional Gastrointestinal Disorders
Kari Baber PhD, Children's Hospital of Philadelphia
Learning Objectives:

- Identify factor associated with resilience in youths with functional GI disorders.
- Describe the utility of psychological intervention in promoting adaptive functioning and resilience in youth with functional GI disorders.

3:00-3:15 **Break**

3:15-5:15 **Intestinal Rehabilitation a Team Approach**

3:15-3:45 Building an Intestinal Failure Program: NIFYTy Lessons
Abigail Martin MD, AI DuPont Hospital for Children
Learning Objectives:

- List intestinal failure team members and discuss their role in caring for these patients.
- Describe at least 2 examples of difficulties that may be encountered when trying to build an intestinal failure program

3:45-4: 15 Nutritional Assessment in Children with Intestinal Failure
Nicole Fragale RD, AI DuPont Hospital for Children
Learning Objectives:

- To demonstrate the ability to conduct a nutrition assessment in a child with intestinal failure
- To discuss best practices for feeding patient with intestinal failure
- To identify common nutrient deficiencies in patient with intestinal failure

4:15-4:45 Management of Pediatric Intestinal Failure
Margy Miccolis APN, AI DuPont Hospital for Children
Learning Objectives:

- Describe the definition and etiology of pediatric intestinal failure
- Explain the pathophysiology of pediatric intestinal failure
- Describe techniques for management for pediatric intestinal failure that improve outcomes

4:45-5:15 Psychosocial Risk and Patient/Caregiver Quality of Life within the Context of Pediatric Intestinal Failure Rehab
Rebecca Johnson PhD ABPP, Children's Mercy, Kansas City
Learning Objectives:

- Describe child- and family-related stressors common to pediatric intestinal failure
- Describe how pediatric intestinal failure impacts child/caregiver/family quality of life
- Identify how psychosocial risk factors are related to treatment outcomes and how a team approach can ameliorate risk

5:15 **Wrap up**

5:15-5:45 **Committee Meetings**

6:00 **APGNN Social Event**

Saturday October 8, 2016

07:30-8:00 **Registration/Breakfast**

8:00-8:30 **APGNN Business Meeting**

8:30-9:30 **Update on GI Pharmacology**
Kathleen M. Gura, PharmD, BCNSP, FASHP, FPPAG, FASPEN, Boston Children's Hospital
Learning Objectives:
- Discuss what agents can be used to treat functional abdominal pain
- Compare and contrast strategies to manage functional bowel disorders, including irritable bowel syndrome and chronic constipation
- Describe emerging strategies in the management of pediatric IBD

9:30 – 11:00 **IBD A Multi-Disciplinary Approach**

9:30-10:00 IBD, Sexuality and Pregnancy
Nancy McGreal MD, Duke University Medical Center
Learning Objectives:
- Understand physical and psychosocial influences on sexuality in IBD
- Understand the impact of IBD on reproductive health of men and women

10:00-10:30 Comprehensive Care Considerations in Pediatric Inflammatory Bowel Disease
Amy Donegan MS, APN, Nationwide Children's Hospital
Learning Objectives:
- Describe at least 2 health maintenance topics that should be reviewed annually with all Pediatric IBD patients
- Discuss 2 additional topics related to a comprehensive IBD evaluation

10:30-11:00 Sex, Drugs and Rock 'n' Roll: Health-Risk Behavior Screening for Adolescent IBD Patients
Rose Schroedl PhD, Nationwide Children's Hospital
Learning Objectives:
- Identify developmental factors which impact adolescent engagement in health-risk behaviors
- Identify impact of health-risk behaviors have on adolescent psychosocial functioning
- Identify impact of health-risk behaviors have on IBD
- Identify strategies to screen adolescents with IBD for health-risk behaviors

11:00-11:15 **Break**

11:15-11:45 **Awards**

11:45-12:15 **Research Session – Implementing Nursing Research: Lessons Learned**

Heather Elser PhD, RN, NNP-BC, QOL Medical
Goldie Markowitz MSN, CRNP, Children's Hospital of Philadelphia
Learning Objectives:
- Identify questions to ask in supporting GI nursing practice and research
- Describe the challenges and solutions in implementing nursing research
- Discuss lessons learned by the Susan Moyer Research Grant applicants

12:15-1:30 **Lunch and Posters**

1: 30-3:00 **Potpourri**

1:30-2:00 Tube Wars: A Long Time Ago in a Galaxy Far Away There Was One

Millie Boettcher APN, Children's Hospital of Philadelphia

Learning Objectives:

- Identify appropriate type of access device, enteral.
- Manage complications of multiple types of access device.
- Skin care management: caustic burn, leakage and granulation tissue

2:00-2:30 Intractable Constipation:

John T. Boyle MD, Children's Hospital of Philadelphia

Learning Objectives:

- Understand the "phenotypes" of constipation
- Know the tools to assist in diagnosis and management of constipation
- Understand specialized treatment options based on phenotype

2:30-3:00 Gastroparesis

Jose Garza MD, Children's Center for Digestive Healthcare, Children's Healthcare of Atlanta

Learning Objectives:

- Describe the signs and symptoms of patients with gastroparesis
- Understand differential diagnosis and work up
- Familiarize with treatment options in patients with gastroparesis

3:15-3:30 **Break**

3:30-5:00 **Feeding Problems a Team Approach**

3:30-4:00 The Role of the APN in an Interdisciplinary Feeding Team

Robyn Robinson APN, CHOC Children's Specialists

Learning Objectives:

- Describe at least three skills which uniquely qualify a GI NP for participation in an interdisciplinary feeding team.
- List two common conditions a GI APN diagnoses and treats which significantly impact disordered feedings.
- Identify 2-3 areas of nutritional intervention a GI NP would be likely to recommend to children with feeding problems.

4:00-4:30 Behavioral aspects of feeding problems

Maria Ramsay PhD, Montreal Children's Hospital

Learning Objectives:

- Recognize the physiological causes of feeding problems in infants and young children
- Demonstrate how feeding problems trigger behavioral and interactional problems at mealtimes
- Understand treatment modalities

4:30-5:00 Beyond Vitamins: Managing Nutritional Risk in the Low Appetite Child

Abigail Brodovitch P.Dt. Montreal Children's Hospital

Learning Objectives:

- Identify the multifactorial aspects of food refusal
- Become familiar with the collaborative approach to treatment used by the Montreal Children's Hospital's Pediatric Feeding Program's multi-disciplinary team
- Understand the Feeding Program's treatment philosophies and protocols (ex. Degavage) and the dietitian's role within the protocols

5:00 Conference Wrap up

Carolinas HealthCare System

PEDIATRIC LIVER TRANSPLANT: AN OVERVIEW

Jerome Menendez, DNP, FNP-C
Assistant Vice President, Transplant Center
Carolinas Medical Center

Financial Disclosures

- I once stole a roll of Certs from a Mini Mart in NYC at the age of 7 ($0.25).
- Otherwise, none.

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Objectives

- Review anatomy and essential functions of the liver
- Identify indications for pediatric liver transplant
- Recognize potential complications following liver transplant
- Understand the need for post-transplant immune-suppression pharmacotherapy

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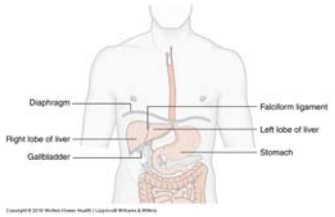
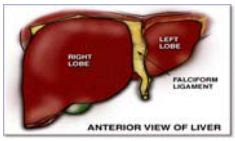
Location of the Liver

- Located in upper right quadrant, beneath diaphragm
- Largest internal organ
- Comprises ~4% of body weight at birth

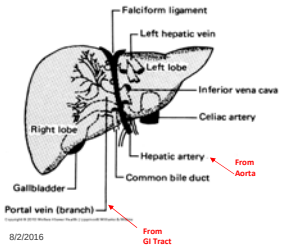


Anatomy of the Liver

- Consists of 2 lobes divided by falciform ligament
- There is no known difference between the lobes



Anatomy of the Liver



- Vascular organ
  - Hepatic artery
    - Supplies oxygen rich blood from heart to liver
    - Provides 20-30% of blood supply to liver
  - Portal vein
    - Supplies nutrient rich blood from the digestive tract
    - Provides 70-80% of blood to liver

Physiology of the Liver

Biomechanical Functions:

- Excretion/Secretion
  - excretion of bile acids, cholesterol, bilirubin
- Synthesis
  - Carbohydrates, lipids, proteins
- Detoxification
  - Serves as gatekeeper between circulation and absorbed substances (drugs, alcohol, ammonia, poisons)

Physiology of the Liver

- Storage
  - Glycogen, vitamins, iron, blood
- Immunologic
  - Phagocytosis of bacteria, IgA secretion

And……

The hidden meaning of that iconic line in 'The Silence of the Lambs'

Etiology of Liver Disease in Children

- Causes vary with age
- Some diseases are associate with certain age groups
  - Biliary atresia; idiopathic neonatal hepatitis are observed only at birth
  - Alcohol/drug toxicity; Wilson disease are typical of older children
- Although list of etiologies is lengthy, about 10 diseases constitute ~95% of all cases of cholestasis in children

History of Pediatric Liver Transplant

- 1963: Dr. Thomas Starzl
- 1967-1979: 84 pediatric cases (pre-cyclosporine)
  - 2-year patient survival = 30%
- 1980s: Introduction of cyclosporine
  - >1-year patient survival rate = 57-83%
  - 7 new pediatric transplant centers
- 1990s: Introduction of tacrolimus
  - Better tolerated
    - No hirsutism or gingival hyperplasia
  - Allows for steroid withdrawal
    - Preserves growth potential of children

History of Pediatric Liver Transplant

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- 1990s: Introduction of tacrolimus
  - Better tolerated
  - Allows for steroid withdrawal
    - Preserves growth potential of children through steroid reduction/withdrawal

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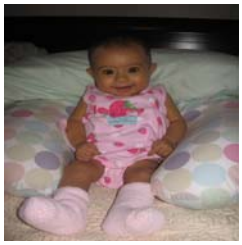
- Today: Almost exclusively use tacrolimus
- 1-year survival rates ~90%
- Advances in surgical techniques
  - Living donors
  - Segmental transplants
- Multidisciplinary approach
- Goals are to improve quality of life, nutrition, bone metabolism, and psychosocial development



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Indications for Liver Transplant

- Cholestatic disorders
- Idiopathic neonatal hepatitis and mimickers
- Viral hepatitis and other infections
- Toxic pharmacologic injury
- Tumors
- Metabolic diseases

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Most Frequent Causes of Liver Disease in Pediatric Patients by Age

Neonates and Infants

- Cholestatic disorders
  - Biliary atresia
  - Choledochal cyst
  - Paucity of intrahepatic bile ducts (eg, Alagille syndrome)
  - Progressive familial intrahepatic cholestasis syndromes
  - Benign recurrent intrahepatic cholestasis
  - Caroli disease and syndrome
  - Inspissated bile
  - Cholelithiasis
- Idiopathic neonatal hepatitis and mimickers
  - Cystic fibrosis
  - Alpha 1-antitrypsin deficiency
  - Hypopituitarism/hypothyroidism
  - Neonatal iron storage disease

Most Frequent Causes of Liver Disease in Pediatric Patients by Age

- Viral hepatitis or other infectious disease
  - Cytomegalovirus
  - Herpes simplex/herpes zoster/human herpesvirus 6
  - Epstein-Barr virus
  - Parvovirus B19
  - Rubella
  - Adenovirus
  - Enterovirus
  - Bacterial sepsis/urinary tract infection
  - Syphilis
  - Tuberculosis
  - Toxoplasmosis
- Toxic pharmacology injury
  - Acetaminophen, TPN, hypervitaminosis
- Tumors
  - Hepatoblastoma
  - Extrahepatic tumors

Most Frequent Causes of Liver Disease in Pediatric Patients by Age

- Metabolic disease
  - Disorders of peroxisomal function
  - Disorders of bile acid metabolism
  - Disorders of urea cycle
  - Disorders of amino acid metabolism
  - Disorders of lipid metabolism
  - Disorders of carbohydrate metabolism

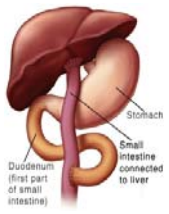
Most Frequent Causes of Liver Disease in Pediatric Patients by Age

Older children:

- Hepatitis
  - Viral hepatitis (HBV, HCV)
  - Autoimmune hepatitis
  - Toxic
  - Pharmacologic
- Liver disease associated with chronic inflammatory bowel disease; sclerosing cholangitis
- Parasitic infections
- Wilson disease
- Fatty liver of pregnancy; HELLP syndrome
- Fatty liver of obesity (NAFLD/NASH)
- Toxins

Biliary Atresia

- Characterized by obliteration of the extrahepatic biliary tract
- Typical presentation includes jaundice, scleral icterus, acholic stools, hepatosplenomegaly
- Requires surgical intervention by 12 weeks of age
- Kasai portoenterostomy



Transplant Candidate Evaluation

- Goals: Identify which patients would benefit from liver transplant and when therapy should occur
- Contraindications
  - Uncontrolled infection
  - Irreversible neuro-catastrophy
  - Tumor outside the liver that cannot be removed or has spread to the liver

Transplant Candidate Evaluation

Medical work-up includes

- Blood work
  - Hematology, chemistry, serologies
- Imaging studies
  - CT scan, US, CXR, cardiac echo, EKG
- Consultations
  - Hepatology, transplant surgery, MSW, transplant coordinator, nutrition, finance, child life
- Formal presentation to Transplant Selection Committee

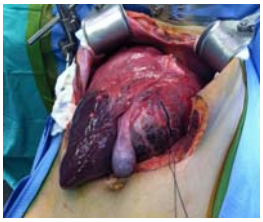
Transplant Candidate Evaluation

- Placed on UNOS waiting list after approved by Selection Committee
- MELD/PELD score
  - Complex mathematical equation involving pt. age, bilirubin, INR, albumin, growth
  - Score reflects 3-month mortality risk
  - Continue to manage liver disease while waiting for organ
    - Focus is no nutrition

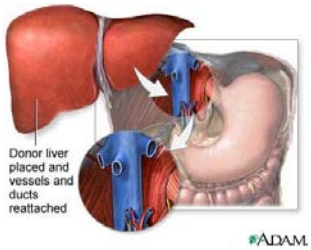
The Transplant

Three types of transplants:

- Deceased donor whole organ
- Deceased donor split organ
- Living donor segment



Intraoperative



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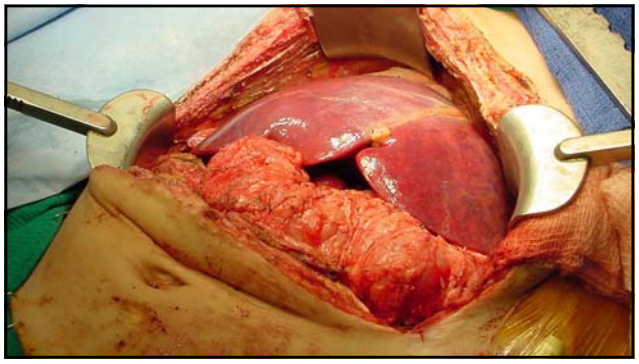

Post-Operative

- Return from OR to PICU
- Intubated/sedated
- Central line
- Multiple peripheral lines
- Arterial line
- Urinary catheter
- Surgical incision +/- JP drain(s)
- Immunosuppressed (tacrolimus, basiliximab, steroid)

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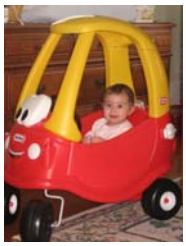

- Hemodynamics
  - Vasodilation
  - Hypovolemia
  - Hypo/Hypertension
- Respiratory status
  - Extubation-associated issues
- GI & Nutrition
  - Malnutrition
  - Ileus
  - Peptic ulceration
  - Acute abdomen

Nursing Considerations

- Renal status
- Neuro
- Integumentary
- Transfer from PICU
  - Extubated and stable hemodynamics
  - Improving LFTs
- Hospital discharge 7-10 days

Outpatient Follow-up

- Seen in Transplant Clinic at scheduled intervals
- Office visit, labs, medication review
  - Immunosuppression medication is life-long
- Imaging and biopsies as indicated
- Multidisciplinary
- Structured transition program

Complications Post-Transplant

Immediate
- Primary non-function
- Bleeding
- Thrombosis (HAT or PVT)
- Wound dehiscence
- Bile duct leak
- Infection
- Rejection

Long-term
- Infection
- Rejection
- HTN
- Diabetes
- Renal insufficiency
- Increased risk for cancers (PTLD)
- Recurrent of disease

Outcomes

Graft survival
- 89.75% at 1 year
- 86.36% at 3 years

Patient survival
- 95.72% at 1 year
- 93.35% at 3 years

Factors that influence outcomes
- Age/size
- Medical condition at time of transplant

Life after Transplant

- Plan for normal growth and development
- Go to school
- Play sports
- Full time employment
- Normal sexual maturing
  - Able to mother/father children
- "Happily ever after"

Thank you!

Assessment and Management of Barriers to Adherence in Liver Transplant Recipients

Jamie L. Ryan, PhD
Division of Developmental and Behavioral Sciences,
Division of Pediatric Gastroenterology

October 7, 2016

Disclosure Statement

- No financial relationships or potential conflicts of interest to report

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Objectives

- Summarize common barriers to treatment adherence in liver transplantation
- Describe the benefits of assessing for adherence barriers
- Discuss practical, evidence-based strategies to identify barriers and promote adherence

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Managing Liver Transplantation

Children's Mercy Kansas City

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Treatment Adherence in Pediatric Transplantation

- Adherence - "*the extent to which a person's behavior coincides with medical/health advice*"[1]
- Rates of nonadherence
  - Immunosuppression 10-71%[2-5]
  - Clinic/lab visits 11-50%[6-8]

Children's Mercy Kansas City

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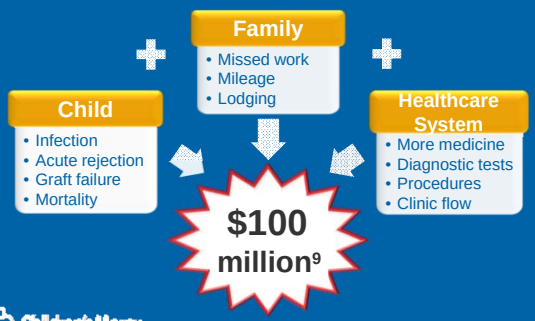
Impact of Nonadherence



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Barriers to Treatment Adherence

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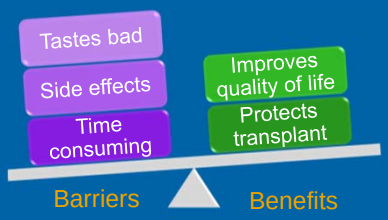
Adherence Barriers

- Health Belief Model - "*perceived constraints or costs associated with a health behavior*"[10]



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Barriers in Transplantation[11-13]

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Assessing Barriers to Adherence

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World Health Organization

… more health benefits worldwide would result from improving adherence to existing treatments than from developing new medical treatments.[14]

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Benefits of Routine Assessment

- Informs adherence interventions
- May help prevent nonadherence
- Promotes better treatment outcomes
- Feasible in standard clinical care

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Initiating Dialogue

- Normalize difficulties with adherence

- *Taking medication consistently can be difficult…*
- *Everyone forgets to take their meds sometimes…*

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Engaging Patients

- Ask open-ended questions

What strategies does your family use to make it easier to take your meds?

…medication?

How many times in the last week was your Prograf missed/ taken late?

What are some things that get in the way or make it hard to take your meds?

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Screening Tools

- Illness Management Survey[15] (self-report only)
- Parent/Adolescent Medication Barriers Scale[12]
  - Brief (<5 minutes)
  - Multidimensional - 4 subscales
  - Predicts adherence and clinical outcomes at 18 months[16]
  - Clinical cutoff[17] – PMBS ≥ 2 barriers, AMBS ≥ 3

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Promoting Adherence in Clinical Practice

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Key Points

- Education alone is not enough[18,19]
- Multicomponent interventions are most effective
  - Education – disease/treatment knowledge
  - Organization – health care delivery
  - Behavioral – health behavior change
- Team effort
  - Psychology or social work – illness adjustment, coping
  - Pharmacy – medication instruction, support services

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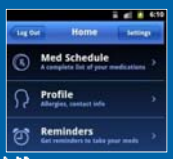
Forgetting to Take/Refill

- Forgetful
  - Set reminders (alarm, post-it note, mobile app)
  - Use organizational tools (pillbox, medication log)
  - Keep in plain sight (kitchen/bathroom counter)
  - Pair with daily tasks (breakfast, brushing teeth)



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Forgetting to Take/Refill

- Runs out of medication
  - Set refill reminders (calendar, phone, mobile app)
  - Enroll in mail service pharmacy
  - Cluster refills together

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Tips: Refilling Prescriptions

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Planning/Scheduling Problems

- Away from home
  - Parents carry extra dose
  - Keep a medication travel bag
  - Set an alarm to take once home
- Disrupts activities
  - Schedule around dosing times
  - Change times to fit routine (summer)
  - Use more cues when routine is disrupted

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Ingestion Issues

- Hard to swallow
  - Alternative medication/form (liquid, smaller pill)
  - Behavioral treatment (pill swallowing)
- Tastes bad
  - Liquid flavoring options
  - Take with thick/strongly flavored drink (smoothie)
  - Coat pill with syrup or Magic Shell

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Tips: Pill Size/Taste

23

Ingestion Issues

- Side effects
  - Ways to alleviate
  - Consider alternative medicine
  - Anticipatory guidance (what to expect, how to resolve)
- Complex regimen
  - Simplify (e.g., 3x/day → 1-2x/day)
  - Written instructions (bullet points, pictures)
  - Teach back – *"What would you tell a friend who asked why and/or how you take this medicine?"*

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Tips: Transplant Medications

Medication Name	Pill	Liquid	Special Instructions: Can split or crush	Special Instructions: Take with food/drink	Special Instructions: Other	Common Side Effects
Immunosuppressant/Anti-Rejection						
Sirolimus (Rapamune®)	✓	✓	✗	✓ Be consistent	• Keep out of light	Anemia, Constipation, Diarrhea, Decreased wound healing, Headache, Heartburn, High cholesterol, High blood pressure, Mouth ulcers, Stomachache
Tacrolimus (Prograf®)	✓	✓	✗	✓ Be consistent	• Do not take with antacids, calcium, or magnesium • Avoid grapefruit	Decreased kidney function, Diarrhea, Decreased electrolytes, Hand tremors, Hair loss, High blood pressure, Hyperglycemia, Sleep difficulties
Mycophenolic acid (CellCept®, Myfortic®)	✓	✓	✗	✓ Be consistent	• Keep out of light • Do not take with antacids, calcium, or magnesium	Anemia, Constipation, Diarrhea, Heartburn, High blood pressure, Stomachache **Contact the Transplant Team if you may be pregnant
Azathioprine (Imuran®)	✓	✓	✓ *With	✓ Be		Feeling tired/weak, Mild rash, Nausea, Vomiting

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Final Thoughts

- Medication adherence is critical for graft survival
- The number and weight of perceived barriers increases the risk for nonadherence
- Routine screening to identify barriers is a necessary first step to improving adherence
- It takes a village to support patients in achieving (and maintaining) optimal treatment adherence!

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Thank You

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Nutrition in Liver Transplant

Kathryn Chambers, RD
October 2016

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Objectives

PreTx

- Nutritional concerns
- Nutritional strategies to optimize nutritional status
- Monitoring

Post TX

- Discuss Post Tx Weight Issues
- Frailty?

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PreTx Nutritional Concerns

- Poor intake
- Poor absorption +/-
- Poor utilization/ ↑ energy needs

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PreTx Nutritional Concerns – Poor Intake

- Appetite ↓
  Kalaitzakis E. World J Gastroenterol. 2014 Oct 28;20(40)
- Dysgeusia
  Garrett-Laster et al. Hum Nutr Clin Nutr. 1984 May;38(3):203-14.
  Rahelic et al. Coll Antropol. 2006 Sep;30(3):523-8.
  Burch et al. Arch Intern Med. 1978 May;138(5):743-6.
  Madden et al. Hepatology. 1997 Jul;26(1):40-8.
  Sturniolo et al. Trace Elem Electrolytes Health Dis. 1992 Mar;6(1):15-9.
- Salt restriction
  John S et al. World J Gastroenterol. 2015 Mar 21;21(11):3197-205
  Sinha VK et al. Adv Chronic Kidney Dis. 2015 Sep;22(5):361-7
- Delayed gastric emptying +/-
  Kalaitzakis E et al. Clin Gastroenterol Hepatol. 2009 Mar;7(3):346-52.

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PreTx Nutritional Concerns – Absorption

- Cholestasis
- Pancreatic insufficiency

Ros E. et al. Gastro. 1984 Jul;87(1):180-7.
Aranda-Michel J. Curr Gastroenterol Rep. Aug;3(4):362-70.

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PreTx Nutritional Concerns – Utilization/ ↑ Energy Needs

- ↑ Protein needs
  - ↑ BCAA
    Holecek M. Nutrition. 2015 Jan;31(1):14-20
    Kawaguchi T et al. Nutr Clin Pract. 2013 Oct;28(5):580-8.
- CHO
  - Insulin resistance
  - ↓ glycogen stores
    Taguchi K. J Med Invest. 2014;61(1-2):180-9.
- Fat
  - Children; fast → burn CHO
  - Adults; fast → burn fat
  - Insulin resistance → lypolysis
  - EFAD risk → hard to absorb LCT

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PreTx Nutritional Concerns – Utilization/ ↑ Energy Needs

↑ Energy Needs

- Uncoupled FFAs
- Futile metabolic cycles

Orman MA et al. J Theor Biol. 2012 Jan 21;293:101-10.
Samartsev VN et al. Biochemistry (Mosc). 2011 Feb;76(2):217-24.

Optimize Nutritional Status

- Case Study
- Approach to Nutrition

Optimize Nutritional Status – Case Study DL

Initial tx assessment April 2015 - Re assess June 2015 d/t admission
9 mon BA, kasai @ 2mon 10 days
Wt: 9.57kg dry wt ? 8.5kg 50th%ile (same wt as April) (new ascites)
Ht: Following the 50th%ile
TSF: 9mm (higher than April) **MAC:** 135mm (↓ than April) **MAMC:** 107 (↓ than April)

Current Feeds: GS 0.9kcal/ml 30ml/hr x 12 hrs on 120ml x 4 with 3ml Mct oil/bottle
Purees/solids tried
Provides: 848 kcal/d= 100 kcal/kg based on dry wt
Calorimetry: MREE x 1.5 = 1054 kcal/d (124 kcal/kg) ++ kcal

Supplements: MVW 2ml, Vit D 5000IU, 40000IU Vit A
Labs: sTR 1.9 (high) Vit D 79, Vit A 0.4 (0.6-1.8) Vit E high

Optimize Nutritional Status – Case Study DL cont'd…

Nutrition Diagnosis (PES):

Suboptimal growth rate (no wt gain for 1mon) related to liver failure with increased energy and nutrient needs (>124kcal/kg) and malabsorption as evidenced by lack of wt gain, suboptimal vitamin status on BW leading to increased need for vitamin dosing,

Plan:

1) Increase volume and caloric density of feeds:140ml x 4 per day, 1.0kcal/ml
2) Work on solids feeds 6 tsp BID
3) This will provide 920kcal from formula + 92kcal from MCT + 45 kcal solids = 1057 kcal (may still need more)
4) Follow wt, ht, TSF, MAC, MAMC q 2 weeks.
5) Change Vitamins to Trivisol 3ml + Vit D Drops 2000IU/d
6) Start iron 4mg/kg
7) Follow fat soluble vitamins q month.

PreTx Monitoring

- Frailty
- Height

Monitoring – Frailty

Definition Frailty

Xue QL. Clin Geriatr Med. 2011 Feb;27(1):1-15
Chen X, et al. Clin Interv Aging. 2014 Mar 19;9:433-41
Buch A, et al. Exp Gerontol. 2016 Apr;76:25-32

Frailty in Pediatrics

Binita Kamath et al. Poster presentation, The International Liver Congress April 2015

Adapted frailty assessment in Children

17 North American paediatric LT centres
&
71 once children with chronic liver disease underwent a complete frailty assessment

- 6-MWT
- PAC-T
- PEDSQL
- TRICEPS SKIN FOLD
- GRIP STRENGTH

SD>-1 = 0 / SD -1 - (-2) = 1 / SD <-2 = 2

MAX SCORE = 10

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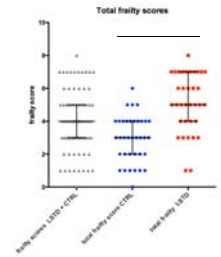
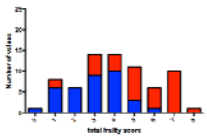
Frailty scores are higher in listed children



blue=control, median 3.000 IQR (2.000 - 4.000); (n=36)
red=listed, median 5.000 IQR (4.000 - 7.000); (n=35)
(two tailed MannWhitney U test, ****p<0.0001)
(OR 8.35 (CI 2.78,25.07))



Frequency distribution of frailty scores per subgroup.
blue=control (n=36) and red=listed children (n=35)

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Monitoring - Height

Linear Growth Predicts Acute Post-Transplant Outcomes in Paediatric Liver Transplant Patients

Jillian S Owens1,2, Michele Strom1,2, Farsad Farassati1,2, Krista Van Roestel1,2,3, Kathryn Chambers1,2,3, Penni Kean1,2,3, Megan Carricato1,2,3, Vicky L Ng1,2,3,4, Yaron Avitzur1,2,3,4 and Glenda Courtney Martin1,2,3,5*

Owens et al. Int J Pediatr Res 2016, 2:020 Volume 2 | Issue 2

Results: Data were analyzed for a total of 128 children; average age at transplant was 6 years. Children with a **height z-score ≤-2.5 had a longer length of stay and greater number of infections** than those who had a height z-score of > -2.5 (54.7 vs. 34.8 d). In addition, those with a height z-score of ≤-1.5 had a longer length of stay and a trend towards more infections than those with a height z-score of > -1.5 (45 vs. 35 d)

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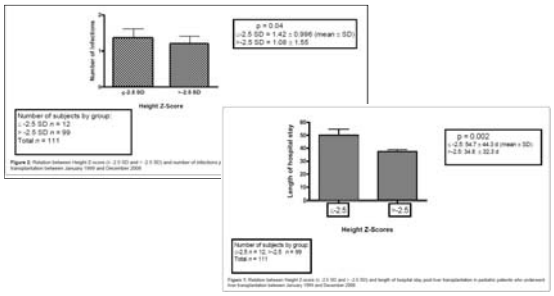
Monitoring - Height



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Post Tx Monitoring

- Healthy Eating
- Frailty/Sarcopenia/Fatigue

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Post Tx – Healthy Eating

- Overweight/Obese/Poor Eating Habits/Education
- Meaningful Healthy Eating Education - A Feasible Task?
- Obesity & Frailty

Leo F et al. Exp Clin Endocrinol Diabetes. 2016 May 11.

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Questions?

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2016 World Congress of Pediatric Gastroenterology, Hepatology and Nutrition
APGNN Course: Friday October 7, 2016

CYSTIC FIBROSIS: A TEAM APPROACH

The Montreal Children's Hospital

Véronique Morinville, MDCM, FRCPC
Sophie Vallée-Smejda, RN
Donna Drury, PDt, MSc

McGill

Objectives of Presentation

- Recognize the various manifestations of cystic fibrosis (CF) involving the gastrointestinal system
- Appreciate how a multidisciplinary team approach can help optimize digestive and overall health in a CF child

Case Scenarios

- 1. A 10-month old girl recently diagnosed with CF with symptoms of FTT.
-
- 2. A 3-year old girl with CF is complaining of abdominal pain, and cries when she stools.
- 3. A 12-year old boy with CF has lost 2kg (5lbs) over 3 months with poor appetite.

→ **Q. What to consider? How to approach?**

The CF Team: Montreal Children's Hospital

- Respirology
- Pediatrics
- Physiotherapy / Respiratory Therapis
- Social Work
- Nursing
- Dietitian / Nutritionist
- Gastroenterology
- Psychology
- Child Life
- Adolescent Medicine, Rheumatology, others
- Clinic secretary

We have no financial relationships with a commercial entity to disclose

Manifestations of Gastrointestinal Issues in Cystic Fibrosis (CF) at Different Ages

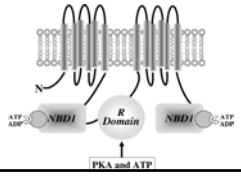
The Gastroenterologist's Viewpoint

Véronique Morinville MDCM, FRCPC
Associate Professor of Pediatrics
Division of Pediatric Gastroenterology and Nutrition
Montreal Children's Hospital
McGill University Health Centre

Cystic Fibrosis Basics

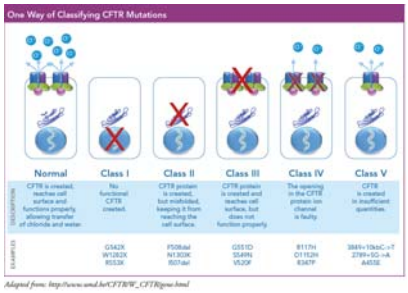
- Autosomal recessively inherited disorder caused by mutations in the CFTR gene (Cystic Fibrosis Transmembrane conductance Regulator)
- Diagnosis based on elevated sweat chloride levels (x 2) and disease-causing CFTR gene mutations

CFTR Protein



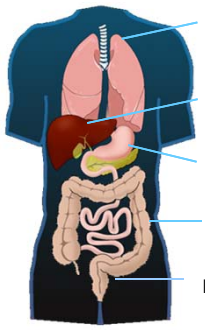
CFTR in cystic fibrosis and cholera: from membrane transport to clinical practice B. E. Goodman, W. H. Percy Advances in Physiology Education Published 1 June 2005 Vol. 29 no. 2, 75-82

CFTR Mutation Classes



- Reduced transport of chloride (and HCO_3) across cell membranes → thick viscous secretions
- Mutation severity implicated in clinical symptoms seen

Clinical Manifestations of CF



Lung

Hepatobiliary*

Pancreas*

Intestines*

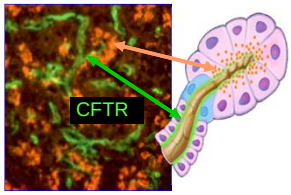
Focus of presentation

Reproductive

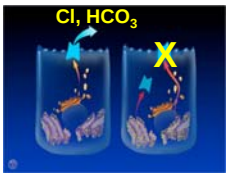
Modified from AGA GastroSlides

CFTR Protein in Pancreas

Failure of excretion Cl, HCO3 → ↓water / ↑viscous pancreatic juice → enzymes activated *within* pancreas → autodigestion → "**cystic pancreas**"



CFTR present in ducts and ductules



Normal

CFTR mutation

C. Marino et al, JCI 1999; 88:712; AGA GastroSlides

The Pancreas in CF

- **Exocrine Pancreatic Insufficiency (EPI) in 85-90%**
  - **"Severe" mutations typically involved**
  - Exocrine function/ Acini destroyed years before Endocrine/ Islets
  - Pancreatic enzymes do not reach duodenum
  - Little/ No neutralization of stomach acid

  → **Maldigestion/ Malabsorption**

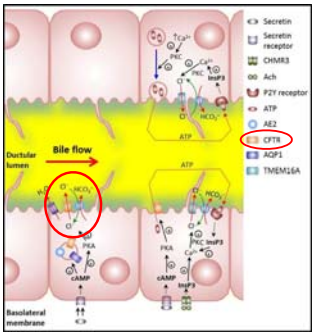
  - **Clinically**: Steatorrhea, diarrhea, malnutrition, bloating, fat-soluble vitamin deficiencies, FTT
  - Require pancreatic enzymes to digest/ grow (PERT)

The Pancreas in CF

- **Exocrine Pancreas Sufficiency (PS): 10-15% CF**
  - **"Milder" mutations (often one mutation class IV-V)**
  - Secretions less thick → not fully obstruct and autodigest pancreas but +/- intermittent blockages/ inflammation
  - **Clinically:**
    - Do not require pancreatic enzyme supplementation
    - Recurrent attacks of "Acute Pancreatitis" in 10% PS
      - **can be initial presentation of CF**
    - Pancreas can "burn out" and develop EPI over time

De Boeck 2005; Ooi 2011

The Liver in CF: Pathophysiology of CFLD



* **CFTR in apical membrane of cholangiocytes**
→ Altered regulation of H2O + electrolytes
→ Abnormally thick viscous bile
→ Plugging of ducts

http://journal.frontiersin.org/Journal/10.3389/fphys.2013.00413/full

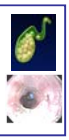
CF Hepatobiliary Manifestations: CFTR in apical membrane of cholangiocytes

Table 1
Hepatobiliary manifestations in CF (modified from Kelly [8])

Type of lesion	Clinical manifestation	Frequency (%)
Specific alterations ascribable to the underlying CFTR defect	Focal biliary cirrhosis	20-30
	Multilobular biliary cirrhosis	10
	Portal hypertension	2-5
	Neonatal cholestasis	<10
	Sclerosing cholangitis	often silent
	Microgallbladder	30
	Cholelithiasis	15
Lesions of iatrogenic origin	Hepatic steatosis	25-60
	Drug hepatotoxicity	undefined
Lesions reflecting the effects of a disease process that occurs outside the liver	Hepatic congestion	rare
	Common bile duct stenosis*	rare

*Might be part of sclerosing cholangitis disease.

Gallstones: xs loss bile acids stool → lithogenic bile
Sclerosing cholangitis: Abnormal gut flora ascends?
Hepatic steatosis: malnutrition, nutrient def., insulin resistance
Neonatal cholestasis
Portal hypertension/ cirrhosis (only late synthetic dysfunction)
Asymptomatic biochemistry or U/S abN



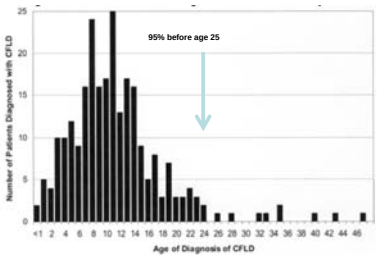
Debray et al 2011

CF-Related Liver Disease (CFLD)

- **Not rare**: up to 70% postmortem livers
- Diagnostic peak in 8-16 yo
- Clinically significant cirrhosis in 1-2% (peak 18-24 yo)
- **3rd most common cause CF death**

- **Associations?**
  - Meconium ileus, male, EPI- severe mutations, younger age dx, CFRD, low BMI/ growth failure; A1AT heterozygote deficiency; steatosis/NAFLD
- DDx other hepatic disorders

CFLD Begins in Pediatrics



***Majority Dx 1st 10y**

***Virtually no incident cases > 18yo**

*But as freq. asympt. → **late presentation** (+ screening correlate poorly with severity)

*Biopsy: patchy; fibrosis score correlates with progression to portal HTN

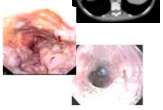
*Hepatic elastography may help follow fibrosis

From Genetic Modifier Study Update 2007/ Molleston JP NASPGHAN 2011 conference

The Liver in CF: Portal Hypertension/ Cirrhosis/Transplant

- Transaminases typically remain only mildly elevated
- Path: Heterogeneous parenchymal involvement with regenerative macronodules
- Can follow APRI score (AST to platelet ratio)

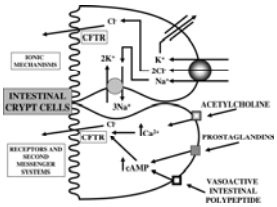
- Portal hypertension complications:
  - Splenomegaly, Thrombocytopenia
  - Esophageal Varices, Bleeding



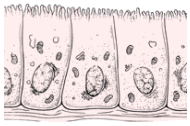
- Synthetic function preserved until late
- Transplant: liver alone or liver-lung

CFTR in the Intestines

Small intestine



CFTR in cystic fibrosis and cholera: from membrane transport to clinical practice
Barbara E. Goodman, William H. Percy
Advances in Physiology Education Published 1 June 2005 **Vol.** 29 **no.** 2, 75-82;
http://medical-dictionary.thefreedictionary.com/brush+border



•Failure of crypt cells to secrete Cl- → ↑ viscosity of luminal contents, thick mucus, ↓HCO_3 near cell surface

•↓ HCO_3 affects intestinal pH → ↑ acidic envir → ↓ mixed micelle formation and solubility

→ **Different bacteria in mucus**
→ **Poorer digestion, absorption**

Gastroesophageal Reflux in CF

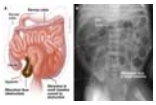
- **More common in CF than general pop** (30-40% CF symptomatic)
- **Mechanism:**
  - Transient relaxation lower esophageal sphincter
    +/- Increased intra-abdominal pressure
    +/- Gastroparesis
- **Symptoms similar to those w/o CF**
- **Unclear if GERD worsens lung disease**

- Management:
  - Pros/ cons of acid-suppressing therapy
  - No significant role for dietary changes
  - PPI trial → follow response

AGA GastroSlides

CF and Meconium Ileus (MI)

- **Obstruction of small bowel/ terminal ileum due to inspissated meconium**
  - 10% CF present with MI (severe genotypes)
  - ≤ 80-90% of children with MI have CF
  - "Complex" MI: ~ 40% total; if with perforation, meconium peritonitis, intestinal atresias, volvulus
- **Symptoms**:
  - 1st 3 dol, abdo distention, failure to pass meconium, vomiting
- **Workup**:
  - AXR (+/- calcifications), water-soluble hyperosmotic contrast enema
- **Management**:
  - NG, NPO, fluid/ lytes; +/- operation; test for CF



Fakhoury 1992; Gorter 2010; www.hopkinscf.org

CF and Distal Intestinal Obstruction Syndrome (DIOS) - 1

- **Acute obstruction of ileocecal region (RLQ) by inspissated luminal contents; partial or complete block**
- "MI equivalent"
- 10-50% CF patients- even young children
- ≠ **Constipation** (more gradual, starting in LLQ)

- Risk Factors?
  - Severe genotype, EPI; malabsorbed fat; inadequate dose enzymes; prior hx; dehydration; dysmotility, MI; narcotics
- **Symptoms:**
  - **Crampy RLQ pain,** acute or intermittent; **abdo distention**; flatulence, weight loss, poor PO; vomiting; **Do not need to stop stooling**

Dray 2004; Lin 2012; Andersen 1990; Blackman 2006

CF and DIOS - 2

- **P/E:** +/- **palpable mass RLQ**
- **Imaging:**
  - AXR: stool RLQ; +/- granular/ bubbly, A/F levels, SB dilatation
  - Water-soluble hyperosmolar contrast enema: can be Dx and Tx
- **Management:**
  - Fluid and electrolyte correction/ replacement
  - Osmotic laxatives PO/ NG
  - +/- NG to decompress (if complete obstruction)
  - Hyperosmolar contrast enemas
  - +/- Surgery

- **To ↓ Recurrence**: ↑ laxatives, ↑ enzymes, ↑hydration

Colombo 2011

CF and Constipation

- **Common**: ~ 25-50% CF
- **Pathophysiology?**
  - Abnormal mucus/ fluid, dysmotility, EPI
  - Even despite regular bowel movements
  - Even in PS (*still relatively dehydrated luminal contents*)
- **Symptoms:**
  - Abdominal pain, distention, flatulence; can → rectal prolapse
- **P/E**: may feel mass LLQ/ distally; can be more diffuse
- **Management:**
  - Good PERT dosing
  - **Osmotic laxatives** (PEG 3350)
  - +/- stimulant laxative such as bisacodyl PRN
  - **Toilet habits**

Van der Doef 2010

CF and Rectal Prolapse

- **Frequency**: ~ 3% CF kids present with prolapse
  ~ 3% kids with prolapse will be dx with CF
- Especially toddlers (post toilet-training)

- **Associations:**
  - Constipation, diarrhea, malnutrition
  - Poor enzyme dosing/ compliance
- **Management:**
  - **Laxatives such as PEG-3350 (+/- very large doses)**
  - ↑ Adherence to enzymes
  - RARE to require surgery

El-Chammas 2015

CF and Intestinal Inflammation?

- Theory: Thick mucus → different microbiota within lumen and in mucus layer near cell surface enterocytes
- Research: Increased immune activation in gut of CF

- **Clinical Findings:**
  - Videocapsule: small bowel edema, mucosal breaks, ulcerations
  - Fecal calprotectin CF > healthy controls
  - "Ill-defined" intestinal complaints >> general population
  - Probiotics ↓ fecal calprotectin levels, ↓ GI discomfort (esp: *Lactobacillus reuteri*) → Q. via ↓ intestinal inflammation ?

Bruzzese 2004; Fallahi 2013; Di Nardo 2014; www.sometruethings.com

CF and Small Bowel Bacterial Ovegrowth (SBBO)

- **Not rare: ~** In up to 30-50% ?
- **Risk Factors/ Mechanism**:
  - Stasis/ slow motility/ dysmotility; prior intestinal surgery, gastric acid suppression; thick intestinal mucus- dysbiosis (spectrum?)
  - Excess bacteria/ metabolites damage enterocytes, deconjugate bile salts → malabsorption
- **Symptoms:**
  - Abdominal pain, bloating, nausea, flatulence, diarrhea, anemia
- **Diagnosis:** Difficult!
  - Poor (oral glucose) breath test reliability; pH pill
  - **+/- Empiric treatment: Antibiotics, Probiotics**

Fridge JGPN 2007, Lewindon 1998

The Intestines in CF: Miscellaneous

- **Celiac Disease**: Higher risk? tTG, duodenal biopsies
- **IBD/ Crohn's Disease**: Higher risk? biopsies (Lloyd-Still 1994)
- **Intussusception**:
  - 1% CF; lead point inspissated luminal contents
  - Sx: colicky abdom pain, V, palpable mass, +/- LGI bleed

- **Bowel obstruction**/ volvulus post surgery
- **Appendicitis**: often atypical presentation
- **Fibrosing colonopathy**: historically related to higher-dose PERT

CF: Long-Term GI Concerns

- **Elevated risk of digestive track cancers***
  - Data from 41, 188 CF patients over 20 years
  - SIR 3.5 overall versus general population
  - May be related to chronic inflammation
  - **Especially at risk:**
    - **Esophago-gastric junction**
    - **Biliary tract**
    - **Small bowel**
    - **Colon**

- Q. Selective screening for those with GERD, sclerosing cholangitis or IBD ?

*Maisonneuve 2013



What to Worry About When?

Although many problems can happen at any age, certain CF problems are more likely at certain ages

GI Issues in the CF Infant (0-1y)

- Meconium Ileus
- Exocrine Pancreatic Insufficiency
  - Malabsorption; Diarrhea; Failure to Thrive
- Reflux Disease
- Hepatobiliary
  - Neonatal Cholestasis, fatty liver, microgallbladder, gallstones

GI Issues in CF Toddler

- Pancreas:
  - Exocrine Pancreatic Insufficiency (for life)
  - Acute Pancreatitis (if PS)
- Feeding:
  - Nutrition, feeding difficulties, stress on parents
- Hepatobiliary: rarer clinical problems
- Intestinal:
  - Reflux, Constipation, DIOS, prolapse; Diarrhea; SBBO/ Dysbiosis

GI Issues in School Age CF Child

- Pancreas: EPI >> AP (PS)
- Nutrition:
  - Enzyme compliance at school; appetite; FTT
- Hepatobiliary: typical onset < 10y; subtle/ asympt.
- Intestinal:
  - Constipation +++, withholding; DIOS; SBBO
  - Rarer: celiac, IBD → could need endoscopies

GI Issues in the CF Adolescent

- Pancreas:
  - Enzyme compliance, friends, body image issues, "easy dieting"
  - CF-related diabetes mellitus
- Hepatobiliary:
  - Cirrhosis, portal hypertension, esophageal varices, rare liver transplant
- Intestinal:
  - Reflux, Constipation, DIOS, SBBO/ Dysbiosis
  - Rarer: IBD, celiac → endoscopies

GI Issues in CF: Future Hopes?

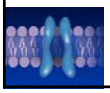
CFTR potentiators/ correctors improve CFTR function

Q. Will they improve / preserve pancreatic function?
Q. Will they preserve cholangiocytes/ hepatocytes and prevent cirrhosis?
Q. Will they improve intestinal health?
Q. Will they reduce risk of long-term GI complications such as cancers?

Considerations of Gastrointestinal Issues in CF at Different Ages

The CF Nurse's Viewpoint

Sophie Vallee-Smejda RN
Montreal Children's Hospital
McGill University Health Centre



CF at the Montreal Children's Hospital

- Patients between ages 0 to 18 years
- Families of all backgrounds
- No neonatal screening in Quebec
- Diagnosis made at different ages, different reasons for testing
  - Intrauterine diagnosis (DNA testing following ultrasound abnormality)
  - Meconium ileus
  - FTT
  - Reccurrent respiratory problems (pneumonias, bronchitis, asthma)
- Grieving process: loss of the idea of a healthy child
- Trust relationship with CF team: highly variable

Burden of care

- Therapies
  - Chest physiotherapy (clapping/PEP)
  - Inhaled therapies (antibiotics, mucolytics, hydrants): 1 to 6 per day
  - Enzymes
  - Vitamins
  - PPI
  - Supplements
  - Exercise
  - Sinus rinses
  - Anti-inflammatories (ibuprofen or azithromycin)
  - Oral antibiotics (PRN)
- Minimum 1 hour/day
- In general, 15 hours/week (2 hours/day)

Role of the CF Nurse

• Helps coordinate and carry out medical care plans.

• Walks [the patient] through [their] daily treatment plan and any changes.

• Helps facilitate communication between [the patient] and the other members on [the] CF care team.

• Alerts [the] CF care team about psychological, social and financial concerns [the patient or their family] may be experiencing.

CFF.org

Role of the CF Nurse (cont'd)

• Provides [the patient] with health information or directs [the patient] to resources to help you manage your disease.

• Helps [the patient] educate family members, friends, the public and other health care professionals like [their] primary care doctor or other non-CF specialists on ways to support [the patient's] health with CF.

• Coordination of hospital admissions

CFF.org

Where is the nurse?

- Phone calls and emails
- " Introduction to CF " visit
- Clinic visits
- Admissions to the hospital
- Home and school visits

Phone calls (…and emails!)

- Evaluation of signs and symptoms
  - What is the main complaint?
  - Quantity, quality of BMs (how many, how big, oily/smelly)
  - Nausea/vomitting/abdominal pain
  - Appetite
- Troubleshooting with the family and CF team members
- Teaching opportunity

"Introduction to CF " visit

- Coordination of sessions with CF team members/family
- Nursing assessment
  - Physical - Psychosocial/Emotional
  - Identification of needs
- Initiation of therapies
  - Enzymes
  - Diet
  - Physiotherapy
  - Inhaled medications
- Contact information for families (day to day issues and emergencies)
- Plan for follow-up

Clinic visits

- 1.5 hours to a full day
- Tests may include:
  - Weight and height
  - Throat/sputum culture
  - Chest radiography
  - Pulmonary function test/exercise test
  - Bloodwork
  - OGTT
  - DEXA scan
  - Liver / abdominal ultrasound
- Evaluation by CF team members

Nurse's role: Clinic visits

- Organization of clinic visit
- Pre-clinic and post-clinic meetings
- Nursing assessment
  - Joint team assessment:
    - nurse-nutritionist
    - nurse-GI MD
    - nurse-physio
    - nurse-respirologist
- Teaching opportunity
- Elaboration of care plan
- Making it happen!
  - Follow-up with pharmacist /insurance/family

Hospital admissions

- Main reason: pulmonary exacerbation, I.V. antibiotics
- 10-14 days
- PICC line inserted
- Nutrition: selective menus, oral supplements, cafeteria vouchers
- Multidisciplinary team: ward team+ CF team

Nurse's role: Hospital admission

- Organization of admission
  - PICC insertion, bed management
  - Information to patient/family
  - Education to ward personnel
- Regular nursing assessment and adjustments
  - Time to talk with patients and families
- Team collaboration in care plan
  - Emails, phone calls, texts
- Discharge planning

Home and school visits

- Education to non-health professionals
- Excellent opportunity to get to know the patient and the family
- Calm environment: not as chaotic as the hospital!

CF from infant to adolescent

A nursing perspective

Nursing issues: Infants and toddlers

- Breastfeeding, bottle feeding: enzyme administration
- Introduction of solids
- Teething
- Toilet training

Nursing issues: Daycare

PROS

- Socialization
- Can increase appetite and food intake
- Allows parents to go back to work
- Normalization

CONS

- "Daycaritis " : multiple respiratory infections
  - Loss of appetite, weight loss
  - Dehydration leading to constipation
  - Diarrhea from antibiotics

Nursing: school-age kids

- Working with school: education about CF, identification of resource persons for enzymes
- Limitations for good CF foods (high fat)
  - Microwave available?
  - Enough time to eat?
- Gradual loss of control of parents over food intake
- CF kids and their illness: to tell or not to tell
  - Shy about taking enzymes in public ?
- Busy schedules!
- Learning/concentration issues: ADHD
  - Forgetfulness
  - Medications: loss of appetite

Nursing: adolescence

« Storm and stress » – G. Stanley Hall

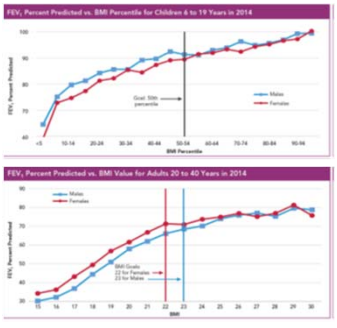
- Establish personal identity
  - where does CF fit in a person's identity?
- Body image, body with CF
  - Purging by not taking enzymes
  - Chronic emphasis on nutrition → disordered eating
- Infection control → Social isolation from CF peers
- Depression, anxiety, FEAR
- Alcohol, smoking, drugs
- Sexuality
- CFRD
- Transition to adult care

Nutritional Considerations in CF at Different Ages

A Nutritionist's Viewpoint

Donna Drury PDt, MSc
Montreal Children's Hospital
McGill University Health Centre

Association of better nutrition with improved lung function in CF



Patient Registry Annual Data Report 2014

746 *Thorax* 2001;56:746–750

Original articles

Wasting as an independent predictor of mortality in patients with cystic fibrosis

R Sharma, V G Florea, A P Bolger, W Doehner, N D Florea, A J S Coats, M F Hodson, S D Anker, M Y Henein

Longitudinal study

584 CF young adults

Sharma 2001

Nutritional status in Cystic Fibrosis: Adults

29.6% of Canadian CF female adults

18.1% of Canadian CF male adults

Are **underweight**

The Canadian Cystic Fibrosis Registry Annual Report 2013

Nutritional status in Cystic Fibrosis: Children

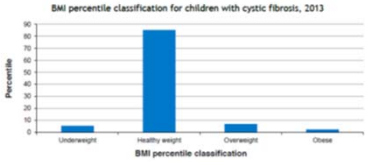


Table 4

BMI percentile classification

Classification	Percentile Range
Underweight	< 5th percentile
Healthy weight	5th percentile - < 85th percentile
Overweight	85th - < 95th percentile
Obese	≥ 95th percentile

2013 Canadian CF Registry

Malnutrition in Cystic Fibrosis

- Higher energy requirements:
  - Increased metabolic rate
  - Infections
  - Work of breathing
- Increased nutrient losses:
  - Malabsorption
  - CFRD
  - Mucus
- Decreased nutrient intakes:
  - Anorexia
  - GERD
  - Abdominal pain / constipation +/- DIOS
  - Medications

New diagnosis/ Infancy

- Work-up for pancreatic status
  - Start enzymes, if Pancreatic Insufficient (PI)
    - Fecal Elastase level
    - Strong genotype-phenotype correlation for pancreatic function (class I-III mutations associated with pancreatic insufficiency)
    - GI/nutritional symptoms history
  - ➢ If Pancreatic Sufficient (PS) – repeat fecal elastase yearly for several years, and later, as symptoms require
- Work-up for nutrition
  - Baseline blood work to including fat soluble vitamin levels, PT/INR, albumin, prealbumin, electrolytes, etc;
  - Start vitamin supplements
  - Breast milk versus infant formula
    - Salt needs – supplement with breast fed infants

New diagnosis/ Infancy

Breast milk versus infant formula?

- Breast feeding should always be favored over infant formula in CF
  - Rich source of very long chain omega-3 fatty acids (DHA and AA) which are deficient in CF
  - Immunoprotective
  - Source of probiotics
- Two cohort studies suggest that human milk provides pulmonary and other medical benefits to CF patients.
- Most infants will need a salt water supplement because of the low sodium content of breast milk (2-4 mEq/kg/day) ≈ ¼ - ⅛ teaspoon of salt

Jadin 2011; Colombo 2007

New diagnosis/ Infancy

Starting enzymes

- If there is a strong clinical suspicion of pancreatic insufficiency, pancreatic enzyme replacement therapy may be started prior to receiving fecal elastase results;
- Starting enzymes are NOT urgent – ensure that experienced CF caregivers are consulted.
  - protect the infant's buttocks and mouth
  - provide teaching & follow-up;

New diagnosis/ Infancy

Dosing enzymes?

More *art* than *science* in enzyme dosing;

Goals are:

- Find the lowest effective dose (symptoms well controlled and normal weight gain on normal dietary intakes for age).
- Start low and work dose up slowly so as to minimize harm (excoriation of the anus or mouth)

Enzyme Dosing

Normal Dose range:

- 500 to 2,500 units lipase per kilogram body weight per meal;
- For infants: 2,000- 5,000 IU lipase/feed

or

- 4,000 units lipase per gram dietary fat per day.

Maximal Dose:

- **10,000 units lipase per kilogram** per day;

Families should contact the CF team if stooling patterns change.

New diagnosis/ Infancy

Work-up for nutritional status

- **Weight** and weight history (carnet de santé or growth curve to be obtained by family physician or pediatrician's office)
- **Height** and height history
- **Head circumference** and HC history
- **BMI** and BMI history
- **Clinical appearance** (fat stores; muscle mass, abdomen) – skinfold measures may be taken
- **Nutritional intakes** and intake history
- **Stool** characteristics and stooling history

New diagnosis/ Infancy

Need for nutritional support?

- Failure-to-thrive, if present at diagnosis, will improve with therapies;
- No invasive nutritional support required unless FTT refractory to standard therapies.
- No dietary supplementation is required until standard therapies are provided and outcomes are observed.

Nutrition in the school-age CF child

Is the child growing normally? If not, why?

– Higher energy requirements: usually minimal at this age
  - Increased metabolic rate
  - Infections "daycaritis" → increase chest physiotherapy
  - Work of breathing → may need antibiotics or admission

– Increased nutrient losses:
  - Malabsorption – difficulties taking enzymes
    – maximal dose of enzymes often reached – multiple snacks and enzyme dose based on weight
  - CFRD – not common in this age group
  - Mucus – minimal impact at this age

Nutrition in the school-age CF child

- Decreased nutrient intakes:
  - Anorexia – common issues: behavioural
  - GERD
  - Abdominal pain / constipation +/- DIOS – common at this age; hydration, salt intake; fibre intake; enzyme issues
  - Medications – ADHD medications

Nutrition in the adolescent with CF

- Higher energy requirements:
  - Increased metabolic rate
  - Infections
  - Work of breathing

  – These issues worsen with age and progression of disease

Nutrition in the adolescent with CF

- Increased nutrient losses:
  - Malabsorption – issues around enzyme adherence
  - CFRD – more prevalent as patients age
  - Mucus – increases with age
- Decreased nutrient intakes:
  - Anorexia – multiple factors including body image
  - GERD
  - Abdominal pain / constipation +/- DIOS
  - Medications – ADHD meds; antibx; etc.

Best treatment for growth failure in CF?

- Treat the **underlying** problem (consider the following)
  - Behavioral interventions
  - High energy / high protein diet
  - Appetite stimulants
  - Motility agents
  - Oral supplements
  - Enzyme adjustments; consider acid suppressors; probiotics
  - Constipation / DIOS therapies (PEG)
  - Pulmonary infection therapies
  - Nocturnal enteral feedings
  - Diabetes treatment
  - Polypectomy
  - Etc, etc, etc……..

Questions to ask:

Decreased nutrient intakes

- Do you feel hunger? Do you become full rapidly?
- Have you been on oral nutritional supplements in the recent past? Are you still taking them? If not, when did you stop? Why?
- Have you started any new medications? If so, has the taste of food or your appetite changed?
- Are you nauseated? Constipated?
- Do you have nasal polyps or congestion? Are they affecting food intake?
- Is anyone at home on a special diet? If so, is this new? Has this affected your food intakes in any way?

Questions to ask:

Increased nutrient losses

- Any increase in abdominal pain? Gas? Urgency? Any nocturnal stooling? Stool incontinence?
- How often in a day/week are enzymes forgotten? Not taken for other reasons? Why?
- What foods/beverages do not require enzymes?
- Are enzymes taken before, during or after meals or snacks?
- How long are mealtimes?
- Are the enzymes swallowed whole or opened?
- Are the enzymes mixed with any foods or drinks? If so, what?

Putting it all Together…

How were the different case scenarios handled as a team with different expertises and viewpoints?

Case 1: 10-month old girl recently diagnosed with CF + symptoms FTT

- HPI
- Making the diagnosis
- Meeting “the team”
- Determining management plan
- Offering support
- Follow up over time

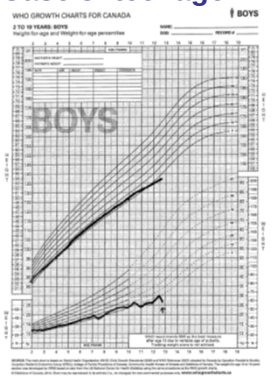
Case 2: 3 yo Girl with Abdominal Pain and Difficult Stooling (1)

- **Multiple phone calls, emails, visits** over months
  - Nurse/ GI/ nutritionist ↔ ↔ ↔ family
- **Exploration of HPI/ Symptoms**
  - Onset during trip to Florida/ change of routine
  - Withholding behaviours; control issues
  - Lower enzymes and PEG3350 use (grandparent…)
- **Review of PMHx**
  - Very significant: rectal prolapse presentation
- **Careful physical examination**: abdo, perianal

Case 2: 3 yo Girl with Abdominal Pain and Difficult Stooling (2)

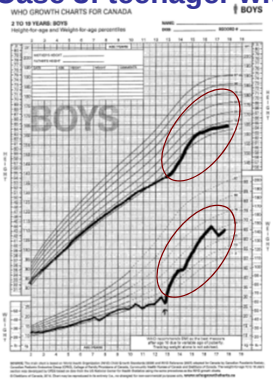
- **Diagnostic considerations**:
  - Combination high fat/ low PERT diet; under-treated constipation, partial DIOS, behavioural/ control issues, "post traumatic"
- **Management tailored to this particular child/ family instituted (included grandparent!)**
  - PERT dosing; compliance to meds; normal child behaviours and supervision at this age; reinforcement
  - "Team Approach" so evident one message
- **Followed over time → Improvement/ Resolution**

Case 3: teenager with growth failure



- 12 1/2 year old male (PJ) with CF and a history of short stature and mild wasting
- Older sister with CF growing very well
- Wasting corresponded with many social, psychological and medical issues
- Family history of psychiatric disease -- father has manic-depression
- Admitted to hospital with 2 kg (5 lb) acute weight loss and poor appetite
- Noted by CF team to be despondent

Case 3: teenager with growth failure



- CF team consulted psychology and psychiatry -- PJ found to be clinically depressed.
- Treatment: Antidepressants and psychotherapy started;
- Outcome: improved mood, and marked improved nutritional status similar to what one would expect with nutritional support – resolution of malnutrition with catch-up growth.

Summary Take Home Points

- **CF includes multiple potential Pancreatic, Hepatobiliary, and Intestinal manifestations that may differ based on age**
- **These "GI" symptoms occur in children with complex medical needs related to CF but also complex psycho-, social- and developmental issues related to having a chronic illness**

Summary Take Home Points

- **Gastroenterology/ Dietetics/ Nursing triad helps best address "GI" issues in CF**
- **A multi-disciplinary team approach allows for optimal combination of interviewing skills and considerations of differential diagnoses, minimizing unnecessary workup, and increasing the probability of families following management plans because they were designed and endorsed by *"The Team"***

Conclusion: The "Worth" of Different Viewpoints?

- When dealing with complex GI issues that can fluctuate over time, a **multi-disciplinary team approach**, with every member contributing their special expertise and viewpoint, optimizes CF patient care and overall health

Thank You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Psychosocial support for GI symptoms in patients with cystic fibrosis

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Disclosures

- I have no conflicts of interests or disclosures.

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Objectives

- Review common GI issues for CF patients
- Discuss behavioral strategies to meet caloric needs
- Examine strategies for adherence to taking enzymes
- Describe steps for pain management techniques

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Eating/Mealtimes

- Individuals with CF require a high-calorie diet
- Common difficulties include managing
  - Mealtime behaviors,
  - Adherence to diet/supplements
  - Gastronomy tube placement

CF Foundation cff.org

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Eating/Mealtimes

- Mealtime for younger children is hard
  - More whining, crying, delaying eating, refusing to eat and leaving the table
- Research shows interventions targeted at teaching parents to shift attention to positive behaviors

Janicke, Mitchell & Stark, 2005
Jelalian, Stark, Reynolds & Seifer, 1998

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Eating/Mealtimes

- Adherence for older children and adolescents
  - Shift to more autonomy
  - Difference is views and increased conflict
- CBT and motivational interviewing can help as well as parents continuing to monitor

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Eating/Mealtimes

- Supplements and enteral feeding
  - Needed to increase BMI
- Attitudes and perceptions about GT placement
  - Prior to placement patients and caregivers feel a GT is a "failure"
  - Post placement report decreased meal conflict
  - On HRQOL, body image is negatively impacted

Pancreatic Enzymes

Study	Age	Adherence issue
Quittner, Barker, Geller, Butt, & Gondor (2007)	Preschool	3 month longitudinal design showed depression in mothers was associated with lower adherence and less weight gain
Quittner, Modi, & Roux (2004)	School-aged	Coordinate with schools and child, study found 25% were not taking as prescribed
Zindani, Streetman, Streetman, & Nasr, (2006)	Adolescents	Adherence drops considerably and is typically primary focus of treatment
Abbott, Havermans, & Hart, (2009)	Adult	Less than 50% are fully compliant with compliance higher for pancreatic enzymes than chest clearance

Pancreatic Enzymes

- Increasing adherence in young children
  - Pill swallowing and time management
    Modi & Quittner, 2006
  - Behavioral management focused on
    •Contingency planning ("if – then"), differential attention, shaping and problem-solving
    Bernard & Cohen, 2004

Pancreatic Enzymes

- Increasing adherence in school aged children
  - Work with school
    - Education to nurses, teachers and students on taking the medication, bathroom privileges
    - Follow-up with the school when there are concerns

      Quittner et al, 2004
  - Assess and address need to fit in

    Quittner et al, 2004

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Pancreatic Enzymes

- Increasing adherence in adolescents
  - Fundamental changes contribute to decrease in adherence
    - More time with friends
    - Need to fit in
    - Greater autonomy

    DiGirolamo, Quittner, Ackerman & Stevens, 1997
    Modi, Marciel, Slater, Drotar & Quittner, 2008
  - Awareness of self and body image

    Shearer & Bryon, 2004

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Pancreatic Enzymes

- Transition to adulthood
  - Shifting responsibilities too soon results in difficulties with organizational skills to manage own illness

    Modi et al, 2008
  - Too restrictive and controlling results in conflicts and decreased adherence and organizational skills

    Smith & Wood, 2007

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Pancreatic Enzymes

- Wait!! There's an app for that!
- Several medicine management apps sponsored by CFF

Abdominal Pain

- Abdominal pain and cramping is common
  - Pain tends to be in the lower abdominal and pelvic region
  - Other common pain areas include joint, head/neck and chest
  - Approximately 60% take NSAIDs

Koh, Harrison, Palermo, Turner & McGraw, 2005

Abdominal Pain

- Implications
  - Patients who report more CF-related pain report lower quality of life and increased psychological distress
  - Decreased tolerance for chest physiotherapy
  - CF-related pain is significantly associated with decreased adherence

Blackwell, & Quittner, 2014
Koh, Harrison, Palermo, Turner & McGraw, 2005
Palermo, Harrison, & Koh, 2006

Abdominal Pain

- Adherence
  - Take enzymes and follow dietary recommendations
  - Discuss vest settings and fit with respiratory therapist

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Abdominal Pain

- Emotional Functioning
  - Anxiety and Depression
    - Known to be associated with more frequent and more intense headache and abdominal pain

      Levy, & Walker, 2005
    - Individuals with CF have been shown to have elevations for anxiety 10% and depression 22%

      The International Depression/Anxiety Epidemiological Study of Cystic Fibrosis; *www.tides-cf.org*

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Abdominal Pain

- Non-pharmacological pain management
  - Need to re-train sympathetic nervous system
  - Deep breathing
    - May have to modify depending on tolerance
    - 5-7 slow deep breaths, 3 cycles daily
  - Progressive Muscle Relaxation
    - Systematically tense and release muscle groups
  - Biofeedback

Schurman, WU, Grayson, & Friesen, 2010

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Abdominal Pain

- Wait!! There's an app for that too!
- Search biofeedback, deep breathing, stress management

Summary

- Abdominal pain is common and has significant negative effects on psychosocial functioning and adherence
  - Address with adherence, emotional functioning and non-pharmacological pain management

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- TIDES

Advances in the Evaluation &Treatment of Functional Abdominal Pain

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Center for Motility and Functional Gastrointestinal Disorders
Boston Children's Hospital

ABDOMINAL PAIN

Abdominal pain and other functional gastrointestinal diseases have a significant impact in clinical practice, accounting for more than 50% of the consultations in pediatric gastroenterology and 2% to 4% of all general pediatric office visits

Table II. FGID prevalence in children and parents

FGID	Child/adolescent prevalence N = 949	Parent prevalence N = 949
Any FGID	219 (23.1%)	324 (34.1%)
Functional constipation	122 (12.9%)	67 (7.1%)
Abdominal migraine	87 (9.2%)	N/A
Aerophagia	41 (4.3%)	N/A
IBS	27 (2.8%)	133 (14.0%)
Nonretentive fecal incontinence	17 (1.8%)	N/A
Cyclic vomiting syndrome	10 (1.1%)	N/A
Functional abdominal pain syndrome	8 (0.8%)	N/A
Functional abdominal pain	3 (0.3%)	N/A
Functional dyspepsia	2 (0.2%)	165 (17.4%)
Rumination	0 (0.0%)	N/A
Functional diarrhea	N/A	45 (4.7%)

N/A, not applicable.

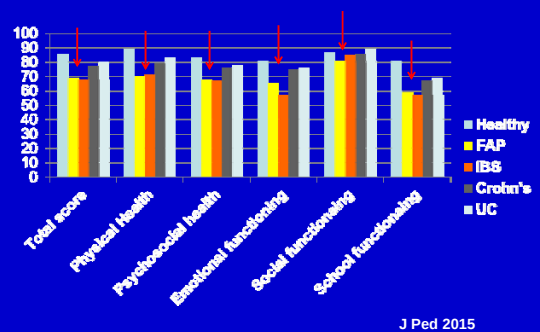
J Peds 2016

PREVALENCE

- Study from schools. Weekly questionnaires
- The weekly prevalence of pain was 38%, and 90% of the children reported at least 1 pain episode.
- Pain persisted for 4 weeks in 52% of the respondents, for 8 weeks in 24%, and for 12 weeks in 18%.
- Abdominal pain was associated with poorer quality of life; increased psychological comorbidities, school absenteeism, and parental work absences; and high cost.

J Peds 2009; 154:322

QOL



J Ped 2015

Table III. PedsQ Family Information Form impact items in pediatric patients with FGIDs, patients with organic GI diseases, and HC

Impact items	FGIDs (n = 368), mean (SD) (a)	Organic GI diseases (n = 317), mean (SD) (b)	HC* (n = 1114), mean (SD) (c)	Difference, a vs c	Difference, b vs c	Difference, a vs b	Effect size, a vs c	Effect size, b vs c	Effect size, a vs b
Days missed from school in past 30 d, mean (SD)†	4.1 (7.2)	3.5 (6.3)	0.8 (2.0)	3.3‡	2.7‡	0.6	0.62	0.58	0.09
Days sick in bed/too ill to play in past 30 d, mean (SD)†	3.8 (6.9)	2.8 (5.9)	0.7 (1.9)	3.1‡	2.1‡	1.0	0.61	0.51	0.16
Days missed rec past 30 d, mean (SD)†	4.1 (8.2)	2.4 (5.9)	0.5 (1.9)	3.6‡	1.9‡	1.7‡	0.60	0.44	0.24
Overnight visit to hospital in past 12 mo, %*	23.7	27.5	5.3	18.4‡	22.2‡	3.8	0.37	0.30	0.04
Emergency/urgent care visits in past 12 mo, %*	46.4	38.6	21.3	25.1‡	18.3‡	6.8	0.24	0.17	0.07
Emergency/urgent care visits in past 12 mo, mean (SD)†	2.5 (2.4)	1.9 (1.8)	1.4 (0.7)	1.1‡	0.5‡	0.6	0.62	0.37	0.28
Parent days missed from work in past 30 d, mean (SD)†	1.9 (5.1)	1.3 (2.8)	0.2 (0.8)	1.7‡	1.1‡	0.6	0.47	0.53	0.15
Parent daily work routine impacted in past 30 d, mean (SD)†‡§	68.1 (29.3)	72.7 (27.9)	97.0 (26.0)	28.9‡	14.3‡	6.6‡	0.75	0.53	0.23
Parent ability to concentrate at work in past 30 d†‡§	63.0 (31.2)	60.7 (29.9)	96.1 (29.0)	23.1‡	17.4‡	5.7	0.76	0.58	0.19

*Healthy sample from Varni et al.[19,20]
†P values based on Games-Howell post hoc tests after Welch 1-way ANOVA. Effect sizes are designated small (0.20), medium (0.50), and large (0.80).
‡P < .001.
§P < .01.

J Ped 2015; 166:85

COST

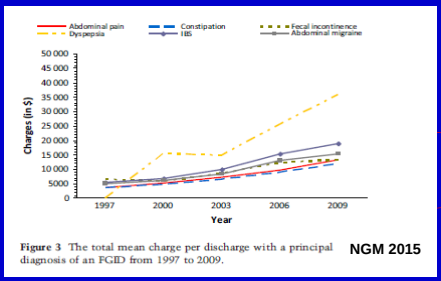


Figure 3 The total mean charge per discharge with a principal diagnosis of an FGID from 1997 to 2009.

NGM 2015

Cost : $6104.30 per patient

JPGN 2010

HOW DO WE DIAGNOSE FUNCTIONAL ABDOMINAL PAIN?

markers
od tests
abnormalities

SED DIAGNOSIS

Rome IV

Table 1. Functional Gastrointestinal Disorders: Children and Adolescents

- H1. Functional nausea and vomiting disorders
  - H1a. Cyclic vomiting syndrome
  - H1b. Functional nausea and functional vomiting
  - H1c. Rumination syndrome
  - H1d. Aerophagia
- H2. Functional abdominal pain disorders
  - H2a. Functional dyspepsia
  - H2b. Irritable bowel syndrome
  - H2c. Abdominal migraine
  - H2d. Functional abdominal pain–not otherwise specified
- H3. Functional defecation disorders
  - H3a. Functional constipation
  - H3b. Nonretentive fecal incontinence

Gastro 2016

ROME IV
IBS

H2b. Diagnostic Criteria[a] for Irritable Bowel Syndrome

Must include all of the following:

1. Abdominal pain at least 4 days per month associated with one or more of the following:
   a. Related to defecation
   b. A change in frequency of stool
   c. A change in form (appearance) of stool
2. In children with constipation, the pain does not resolve with resolution of the constipation (children in whom the pain resolves have functional constipation, not irritable bowel syndrome)
3. After appropriate evaluation, the symptoms cannot be fully explained by another medical condition

[a]Criteria fulfilled for at least 2 months before diagnosis.

Gastro 2016

ROME IV
FAP

H2d. Diagnostic Criteria[a] for Functional Abdominal Pain–NOS

Must be fulfilled at least 4 times per month and include all of the following:

1. Episodic or continuous abdominal pain that does not occur solely during physiologic events (eg, eating, menses)
2. Insufficient criteria for irritable bowel syndrome, functional dyspepsia, or abdominal migraine
3. After appropriate evaluation, the abdominal pain cannot be fully explained by another medical condition

[a]Criteria fulfilled for at least 2 months before diagnosis.

Gastro 2016

Medical model : In the absence of organic pathology

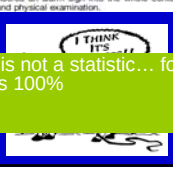
- Peptic, GERD
- Infections, H pylori
- IBD, celiac, food intiolerance
- CHO intolerance
- Gallstones, pancreatitis
- Nephrolithiasis, UPJ
- Endometriosis, ovarian cyst

Table 2. Potential Alarm Features in Children With Chronic Abdominal Pain*

Family history of inflammatory bowel disease, celiac disease, or peptic ulcer disease
Persistent right upper or right lower quadrant pain
Dysphagia
Odynophagia
Persistent vomiting
Gastrointestinal blood loss
Nocturnal diarrhea
Arthritis
Perirectal disease
Involuntary weight loss
Deceleration of linear growth
Delayed puberty
Unexplained fever

*Clinical judgment should be exercised, putting what might be considered an alarm sign into the whole context of the history and physical examination.

- Other…
  - Porphyr… syndror…
  - Great th… cancer



Patient in front of you is not a statistic… for them it is 100%

Initial evaluation

- History and exam can and should direct work up
  - *Exclude disease, find triggers and reassurance*

Indicators of functional cause

- Absence of organic indicators: no “red flags”
- Onset after apparent prior GI infection
- Worse on weekdays and/or during school year
- History of anxiety/depression in child or parent
- Family history of irritable bowel syndrome or other chronic pain disorders
- “Excruciating pain during visit” (looking great)
- MISSING SCHOOL

Initial evaluation

- History and exam can and should direct work up
- Epidemiological considerations
- Initial "screen": CBC, ESR/CRP, Hemoccult, celiac testing, liver tests, amylase/lipase, basic chemistry
- U/A
- Stool for O&P, H pylori

Secondary evaluation

- Breath tests
  - Lactose malabsorption
  - Bacterial overgrowth?
- In
  - WHEN IS ENOUGH ENOUGH?

Directed by history, examination, genetic background, epidemiology and environment

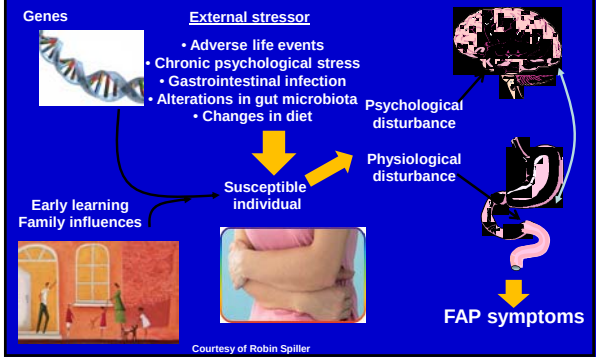
Use in the context of bio-psychosocial model

Consider cost effectiveness/ impact on child

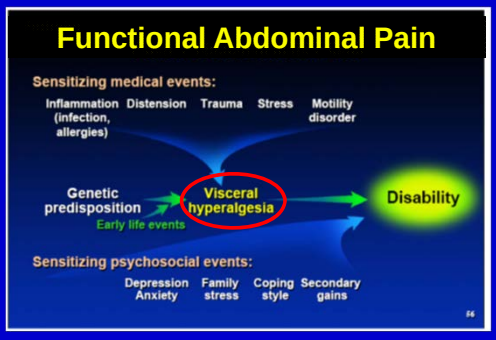
Biopsychosocial model

Biological, psychological, and social factors play significant roles in global function in the context of disease or illness

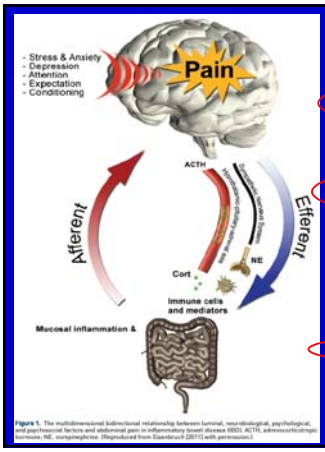
What Causes FAP? bio-psycho-social model



Functional Abdominal Pain



Rome Foundation



Pathophysiological mechanisms

a) visceral afferent hypersensitivity caused different stimuli (inflammation etc)

b) abnormal neuronal responses causing hyperalgesia and allodynia, together with abnormal local reflexes, resulting in altered motility and secretion

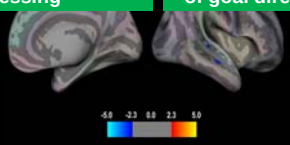
c) central sensitization

d) arousal state (anxiety , depression)

Structural Brain Changes in Pediatric IBS

Attention, directed cognition, awarnes of body and pain porcessing

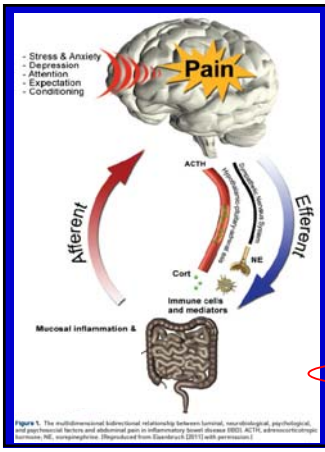
Cognitive control functions, decision making , regulation of goal directed behaviors



Group Differences in Cortical Thickness

Ineffciency in the ability of IBS patients to disengage their attention away for ongoing abdominal/visceral pain

PlosOne 2016



Pathophysiological mechanisms
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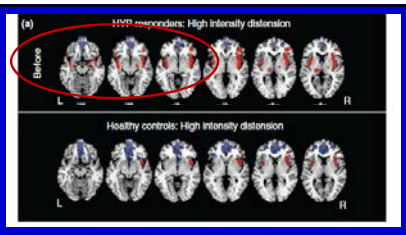
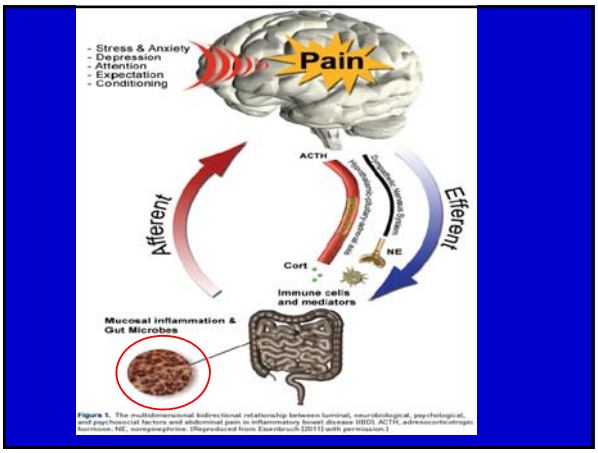
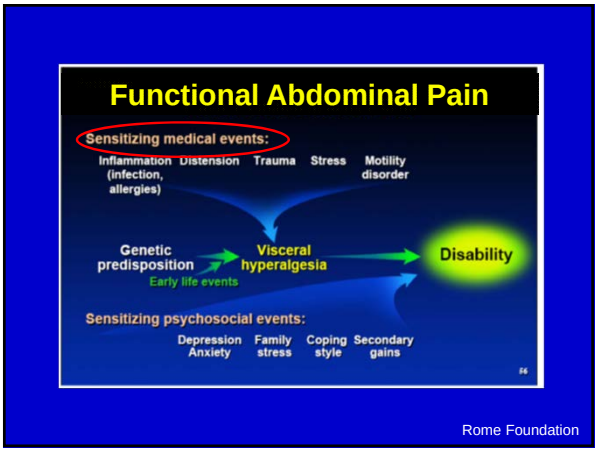
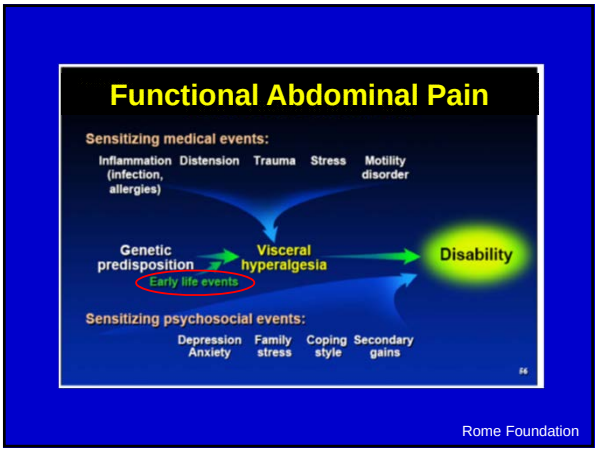


APT 2013


- Stress & Anxiety
- Depression
- Attention
- Expectation
- Conditioning
Pain
ACTH
Afferent
Efferent
NE
Cort
Immune cells and mediators
Mucosal inflammation & Gut Microbes


Functional Abdominal Pain
Sensitizing medical events:
Inflammation (infection, allergies)
Distension
Trauma
Stress
Motility disorder
Genetic predisposition
Visceral hyperalgesia
Disability
Early life events
Sensitizing psychosocial events:
Depression Anxiety
Family stress
Coping style
Secondary gains
Rome Foundation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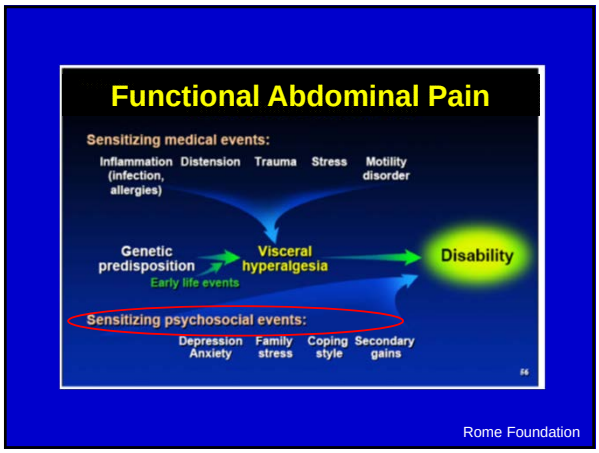
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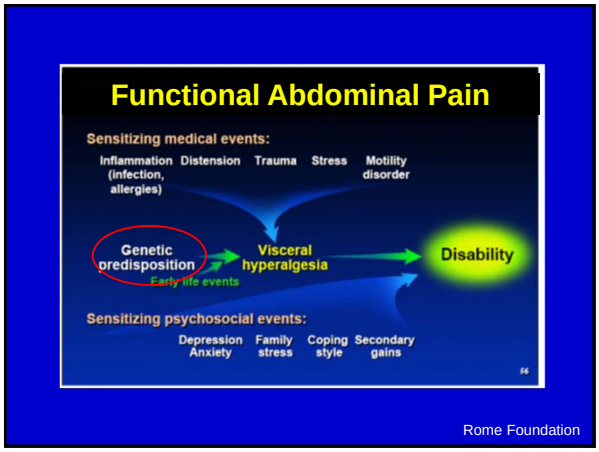
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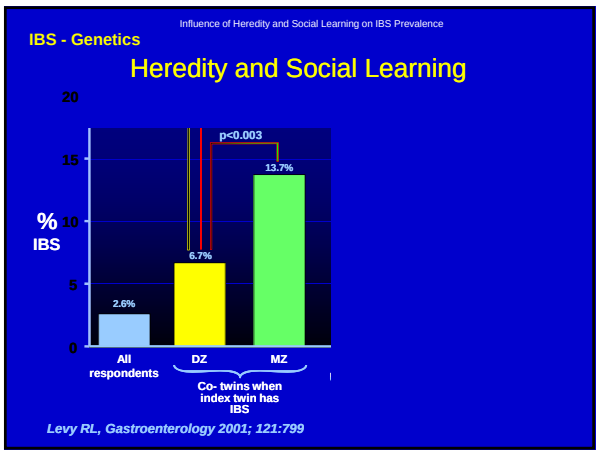
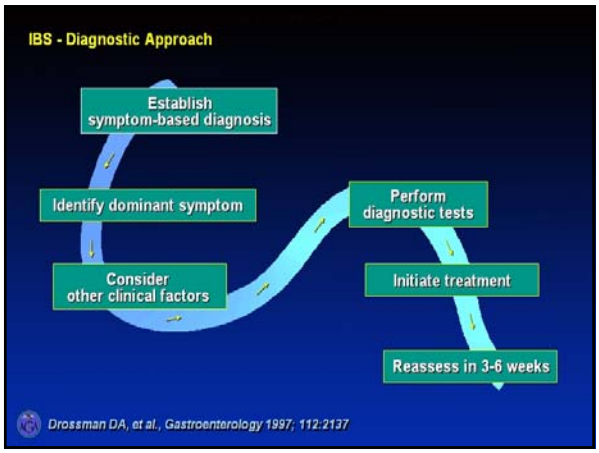
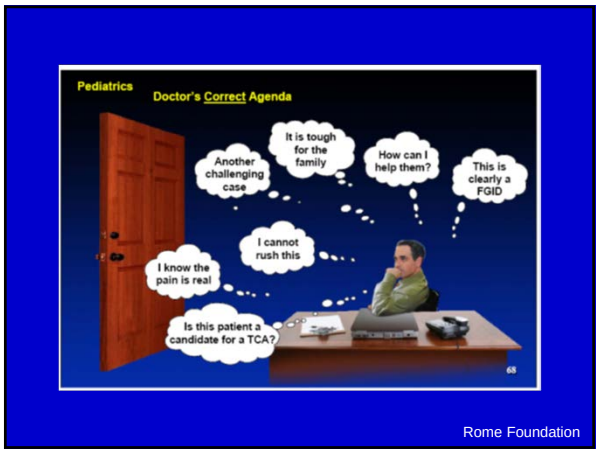

Influence of Heredity and Social Learning on IBS Prevalence
IBS - Genetics
Heredity and Social Learning
20
15
10
5
0
% IBS
p<0.003
13.7%
6.7%
2.6%
All respondents
DZ
MZ
Co- twins when index twin has IBS
Levy RL, Gastroenterology 2001; 121:799


IBS - Diagnostic Approach
Establish symptom-based diagnosis
Identify dominant symptom
Consider other clinical factors
Perform diagnostic tests
Initiate treatment
Reassess in 3-6 weeks
Drossman DA, et al., Gastroenterology 1997; 112:2137


Pediatrics
Mother / Child's Agenda
I hope he finds something
I hope it is not cancer
She loves school and has many friends
I want some tests!
It is not in her head!
I hope he does not find anything
No tests please !
I do not know why I'm here
66
Rome Foundation


Pediatrics
Doctor's Incorrect Agenda
These people are crazy!
Not another one, please
How can I get rid of them?
Could it be porphyria?
This is going to take too long
It does not look like she is in pain
Should I treat her for H pylori?
67
Rome Foundation



IBS - Physician Patient Relationship

Treatment Guidelines

- Identify concerns
- Explain basis for symptoms
- Reassure
- Cost effective evaluation
- Involve patient
- Provide continuity
- Set realistic limits

Drossman DA, Thompson WG Ann Intern Med. 1992; 116:1009

Explanations

- Acknowledge pain is real
- GIVE POSITIVE DIAGNOSIS (do not need tests)
- Discuss bio-psycho-social model
  - Don't say or imply pain is in child's head
- Testing is done to look for triggers (not a diagnosis)
  - Hardware vs software problem
- Don't say or imply that their child is a mystery
  - Parental and child fear of unknown will over ride all else
- Analogies to more familiar conditions (Asthma, headache, atopy)
  - Chronic, recurrent, external triggers
- Compare to rehabilitation from other illness or injury (fracture)
  - Obtainable incremental expectations

TREATMENT

- Comprehensive multi-system approach based on dominant symptoms
- Dietary modifications
- Cognitive – Behavioral interventions
- Family interventions
- Psychotherapy
- Mechanical interventions (Massage, TEN's, Acupuncture, Hypnosis, Imaging)
- Medical interventions (TCAS, SSRI's, Anxiolytics, other)

ALWAYS AIM TO IMPROVE FUNCTIONING

DIETARY

- Fiber
- Lactose free
- Elimination of other foods
  - Gluten
  - FODMAP
- Probiotics

Psychosocial interventions

- Six randomized trials (including a total of 167 participants) of cognitive behavioral interventions were identified
- Five studies reported statistically significant improvements in pain, measured in a variety of ways, in children randomized to receive interventions based on cognitive behavioral therapy compared to children on wait lists or receiving standard medical care (Duarte 2006; Humphreys 1998; Robins 2005; Sanders 1989; Sanders 1994).
- The remaining trial (Hicks 2003) included a wider group of children with recurrent pain and too few with only RAP to provide interpretable data.

Cochrane database Syst Rev 2008

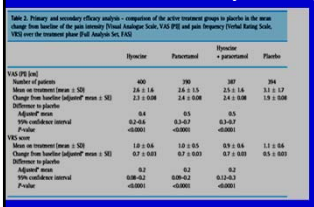
FAMOTIDINE

- Study of 25 children
- Based on the global evaluation, there was a clear benefit of famotidine over placebo (68% vs 12%).
- Using the quantitative assessment, however, the mean improvement of the score using famotidine versus placebo was not statistically significant (3.37 6 3.53 vs 1.66 6 2.7).
- A subset of patients with peptic symptoms demonstrated a significant drug effect that outweighed the period effect (drug effect: *P* 5 0.01; period effect: *P* 5 0.02).
- Famotidine subjectively improves the symptoms of children with recurrent abdominal pain but not objectively using the derived score.
- However, famotidine is significantly more effective than placebo among children with peptic symptoms.

Dig Dis Sci 2001; 46:985

Hyosciamine and Paracetamol

1637 adults randomized to Hyosciamine, paracetamol, H+P or placebo



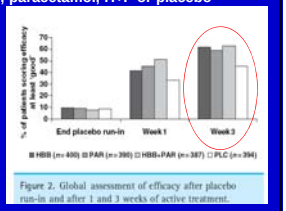


Figure 2. Global assessment of efficacy after placebo run-in and after 1 and 3 weeks of active treatment.

Significant benefit in the groups on medications. No difference between medications groups

Alim Pharmacol ther 2006; 23:1741

ANTIBIOTICS

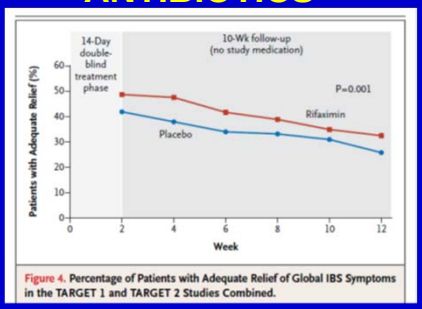
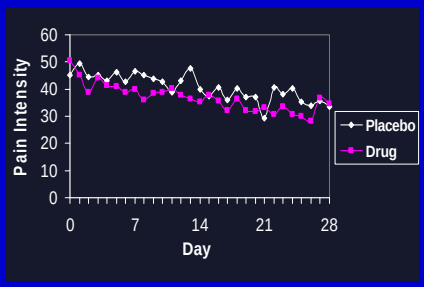


Figure 4. Percentage of Patients with Adequate Relief of Global IBS Symptoms in the TARGET 1 and TARGET 2 Studies Combined.

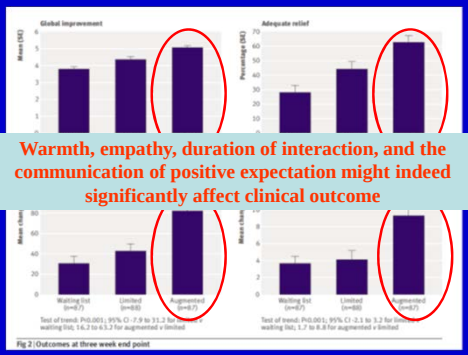
NEJM 2011

Tricyclics Daily Pain



- Significant decrease in pain (p<0.0001).
- No difference between groups

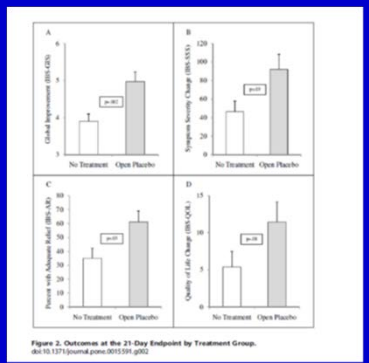
Gastroenterology



Warmth, empathy, duration of interaction, and the communication of positive expectation might indeed significantly affect clinical outcome

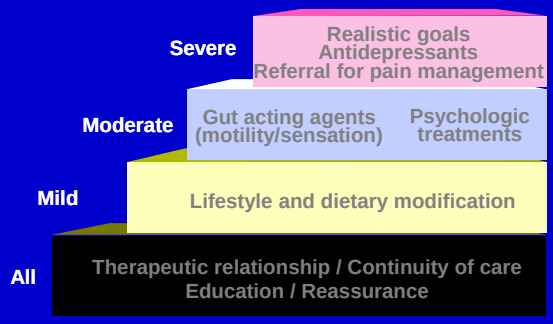
BMJ 2009

OPEN PLACEBO



Plos one 2011

Treatment Summary



BCH Multidisciplinary Functional Abdominal Pain Program

- Gastroenterologist
- Pain Specialist
- Psychologist
- Nurse Practitioner
- Nurse
- Nutritionist
- Social Worker
- Psychiatrist
- Physical Therapist
- Administrative staff

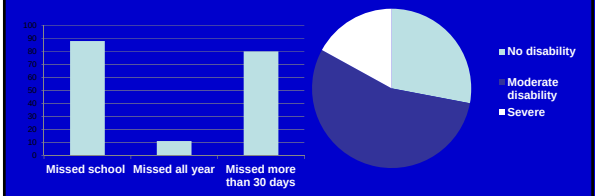
The Nursing Impact

- Confidence in diagnosis and knowledge of pathophysiology , and treatments
- Understanding triggers of pain
- Clear plan of treatment
- Patient and family education
- Reassurance and belief in the model
- Recognizing the biopsychosocial model and alerting the care team to issues not being addressed (TLC)
- Advocating for your patients and coordinating care
- Clinical Judgement

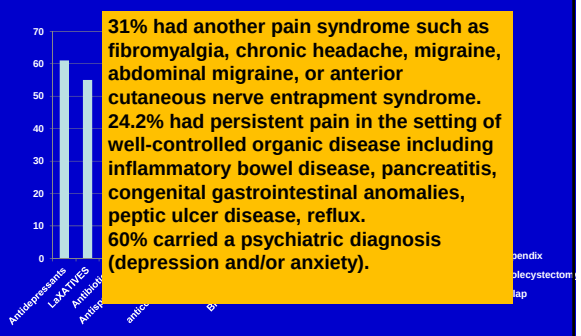
68 patients: 75% female, 25% male with a mean age of 15.4 ± 3.1 years (10 to 21 years

Mean pain duration: 2.5 years Intensity 6.28 ± 2.07

100% previously been seen by a pediatric gastroenterologist; 74% had seen more than one physician, with a mean of 2.34 ± 0.6 physicians prior to their first visit. 16 % seen by previous pain teams



BCH



31% had another pain syndrome such as fibromyalgia, chronic headache, migraine, abdominal migraine, or anterior cutaneous nerve entrapment syndrome.

24.2% had persistent pain in the setting of well-controlled organic disease including inflammatory bowel disease, pancreatitis, congenital gastrointestinal anomalies, peptic ulcer disease, reflux.

60% carried a psychiatric diagnosis (depression and/or anxiety).

TREATMENT

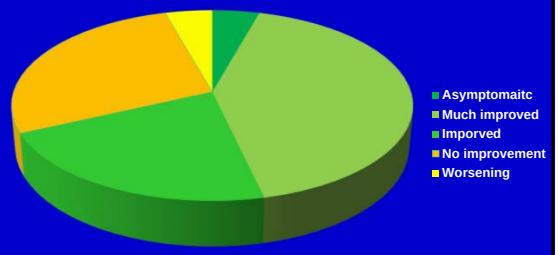
93.7% were treated on an outpatient basis with a combination of CBT and medications, 4.1% in a partial day program, 2% inpatient.

At the fist visit, 72.1% were prescribed additional medications, most frequently an antidepressant (32.3%), gabapentin (17.6%), PPI (26.5%), antibiotics (17.6%), laxatives (10.3%) or antispasmodics (8.8%).

76.5% were prescribed individual psychological therapy, 76.5% CBT, 53% biofeedback.

For 36.8% of patients a school reintegration plan was put in place.

OUTCOME



68% reported subjective improvement

Summary

- Make a positive diagnosis- reassure you have seen this before
- Provide explanations in lay terms- use concrete examples
- Set proper expectations- no quick fix for chronic problem
- Multi-disciplinary approach- NP/MD “coach”, rehabilitation model

Nutritional Considerations When Managing Pediatric Patients With Functional Abdominal Pain

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I have no financial relationships to disclose.

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Objectives

- Understand the importance of nutritional approaches in managing pediatric functional abdominal pain
- Recognize the potential nutritional deficiencies that can be a result of restricted or elimination diet, specifically a low FODMAP diet
- Appreciate the essential role of the pediatric dietitian, as part of the multi-disciplinary team, to ensure nutritional adequacy for growth

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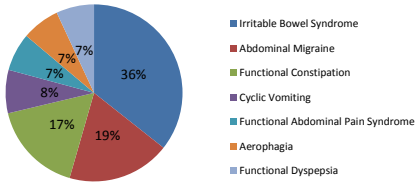
Multidisciplinary Specialist Team

Diagnosis
Management
Shared Team Philosophy

FGIDs Dominate Pediatric GI Practice

976 new patients referred to a pediatric GI clinic
644 (66%) subjects ≥ 4-18yrs; 75% met diagnostic criteria for ≥ 1 FGID

Common FGIDs in Sample



Rouster AS et al. JPGN (2016)62:847-851

Diet & Functional Abdominal Pain

- Concept of diet as a therapeutic management approach - gaining momentum & enthusiasm
- Growing evidence base which validates relationship of certain foods with provocation of GI symptoms
- Largest body of literature exists on the restriction of FODMAPs
  - Fermentable oligo-, di-, monosaccharides & polyols
  - Evidence supports low FODMAP diet as a key treatment strategy

Food sits at the intersection between GI physiology and symptoms.

Mounting evidence links food to changes in GI motility and visceral hypersensitivity.

Pathogenesis of IBS

- **FOOD** - **most common trigger**
  - Patients associate food intake with abdominal symptoms
  - Many implement self dietary changes
- Stress
- Infections
- Antibiotics
- Non-steroidal anti-inflammatory medications
- Surgery

Camilleri M et al. Am J Physiol Gastrointest Liver Physiol (2012); 303(7):G775-G785.
Monsbackken KW wt al. Eur J Clin Nutr (2006);60:667-672

Symptom Expression in Pediatric IBS

- Motility disturbance
- Visceral hyperalgesia
- Intestinal permeability
- Gut microbiome composition
- Psychological distress
- Food intolerance
- Colonic bacterial fermentation
- Genetics
- Gut inflammation

→ Biopsychosocial Model

Chumpatazi BP & Shulman RJ. Molecular & Cellular Pediatrics (2016) 3:11
Drossman DA.Gastroenterol (2016) Vol 150, Issue 6, 1262-1279
Korterink J et al. Nat. Rev.Gastroenterol.Hepatol (2015)12.159-171

Integrative Management Approaches

- Support & reassurance
- Psychological interventions
- Diet
- Pharmacologic agents

Therapies must be individualized.

Gibson PR et al. Gastroenterology (2015); 148:1158-1174

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Goals of Nutritional Intervention

- Promote adequate nutrition for growth
- Identify offending trigger food(s)
- Identify, prevent & correct nutritional deficiencies
- Expand diet as able to avoid potential adverse effects
- Improve quality of life through symptom relief

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Nutritional Approaches

- **Low FODMAP**
- Lactose restriction
- Fructose restriction
- Gluten-free diet
- Conceptual diet
- Patient-initiated dietary change

Gibson PR et al. Gastroenterology (2015); 148:1158-1174

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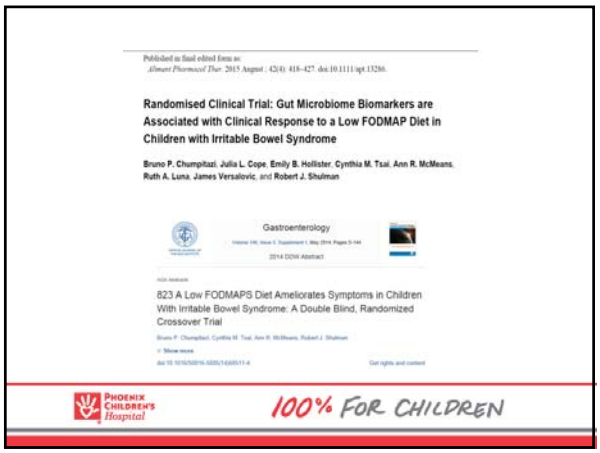

Published in final edited form as:
Aliment Pharmacol Ther. 2015 August ; 42(4): 418–427. doi:10.1111/apt.13286.

Randomised Clinical Trial: Gut Microbiome Biomarkers are Associated with Clinical Response to a Low FODMAP Diet in Children with Irritable Bowel Syndrome

Bruno P. Chumpitazi, Julia L. Cope, Emily B. Hollister, Cynthia M. Tsai, Ann R. McMeans, Ruth A. Luna, James Versalovic, and Robert J. Shulman

Gastroenterology

2014 DDW Abstract

823 A Low FODMAPS Diet Ameliorates Symptoms in Children With Irritable Bowel Syndrome: A Double Blind, Randomized Crossover Trial

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FODMAPs

Fermentable
Oligosaccharides
Disaccharides
Monosaccharides
And
Polyols

Gibson PR, Shepherd SJ. Aliment Pharmacol Ther. (2005);21:1399-1409

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FODMAPs

- Diverse group of short-chain carbohydrates
- Poor absorption in small intestine
- Rapid fermentation in intraluminal space by intestinal bacteria
- Increased osmotic effects
- Physiologic changes believed to exacerbate GI symptoms
- Commonly found in Western diet
- Span 4 food groups

Mansueto P et al. Nutrition In Clin Pract (2015);30(5);665-682

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Benefits of Low FODMAP Diet

- Moderates intake of poorly absorbed carbohydrates
- Reduces osmotic effects, intraluminal fermentation & associated gas production
- Minimizes GI symptom severity, especially in hypersensitive gut
- Integrates understanding of GI physiology with known interactions between luminal contents, microbial gut colonization & function

Gibson PR & Shepherd SJ. J Gastroenterol Hepatol (2010): 25:252-258
Murray K et al . Am J Gastroenterol (2014); 109:110-119

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FODMAP Carbohydrates

FRUCTOSE (Monosaccharides)
- Honey, apples, pears, watermelon, mango, high fructose corn syrup, agave

LACTOSE (Disaccharides)
- Milk (cow, sheep, goat), dairy containing foods

FRUCTANS (Fructo-oligosaccharides)
- Wheat, rye, onions, garlic, artichokes

SORBITOL
- Apples, pears, peaches, nectarines, apricots, plums, mints/gum (sugar free)

MANNITOL
- Watermelon, cauliflower, mushrooms, snow peas, mints/gum (sugar free)

GALACTANS (Galacto-oligosaccharides)
- Legumes, lentils

Gibson PR & Shepherd SJ. J Gastroenterol Hepatol (2010); 25(2):252-258
Mullin GE et al. J Paren Ent Nutr (2014); 38 (7)781-799

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FODMAP - Oligosaccharides

Fructans and Galactans

Dairy	Grains	Fruits	Vegetables	Proteins	Other/ Sweetener
	Wheat bread	Watermelon	Artichoke	Garbanzo/	Oligofructose
	Couscous	Apple	Asparagus	Chickpeas	Inulin
	Muesli	Pear	Beetroot	Red kidney bean	
	Rye	Nectarine	Brussel sprout	Baked beans	
	Barley	Peach	Broccoli	Soy beans	
	Pasta	Persimmon	Cabbage	Edamame	
	Couscous	Grapefruit	Fennel	Split peas	
	Breakfast cereal	Dried fruit	Garlic	Lentil	
	Biscuits		Leeks	Pistachios	
	Cookies		Okra	Cashews	
	Crackers		Onion/Shallot		
			Pea		
			Sweet potato		

FODMAP - Disaccharides Monosaccharides

Lactose and Fructose

Dairy	Grains	Fruits	Vegetables	Proteins	Other/ Sweetener
Cow's milk Goat's milk Sheep's milk Condensed milk Evaporated milk Ice cream Custard Yogurt Soft cheeses Milk powder		Apples Pears Peaches Mango Fruit juices Watermelon Cherries Canned fruit Dried fruit	Asparagus Artichoke Sugar snap peas		Honey Agave Fructose HFCS

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FODMAP – And Polyols

Dairy	Grains	Fruits	Vegetables	Proteins	Other/ Sweetener
		Apples Apricots Cherries Lychee Avocado Nectarines Pears Peaches Plums Watermelon Blackberries Prunes Fruit juices	Cauliflower Mushroom Snow pea Celery Sweet potato Corn		Sorbitol Mannitol Xylitol Maltitol Isomalt Polydextrose

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Western Diet

https://schoollunchboston.wordpress.com/menu/

http://www.usd320.com/Programs/FoodService/images/Stuffed%20Crust%20Pizza.JPG

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Implementation

- Growth & nutritional assessment
  - Detailed diet history with symptom history
  - Frequency & volume of FODMAP foods consumed
  - Identify/correct/prevent potential nutritional deficiencies
- Education
  - Scientific basis of FODMAP malabsorption
  - Reduction of most problematic FODMAP containing foods
- Initiation of individualized dietary approach
- Continue diet for 6-8 weeks

Low FODMAP Foods

Dairy	Grains	Fruits	Vegetables	Proteins	Other/ Sweetener
Lactose-free milk	Rice	Grapes	Potato	Beef	Herbs
Lactose-free dairy products	Corn	Pineapple	Lettuce	Lamb	Cane sugar
Ripened cheeses	Polenta	Cantaloupe	Broccoli	Pork	Glucose
Butter	Tapioca	Honeydew	Tomato	Poultry	Maple syrup
Cream	Quinoa	Strawberry	Carrot	Fish	Golden syrup
Coconut milk	Buckwheat	Blueberry	Zucchini	Shellfish	Aspartame
Rice milk	Oats	Orange	Parsnip	Eggs	Stevia
	GF grains	Grapefruit	Squash	Tofu	
	GF pastas	Lemon	Bean sprouts	Seeds	
	GF flours	Banana	Bell peppers	Peanuts	
		Kiwi	Celery		
		Rhubarb	Eggplant		
		Passionfruit	Cucumber		
		Kumquat	Pumpkin		
			Bok choy		

Follow Up

- Work with family, monitoring
- Re-evaluate
  - Growth/nutritional assessment
  - Diet recall
  - Symptom history
  - Compliance
- Begin re-introduction/challenge - to avoid unnecesary restriction
- Balance nutritional status, symptom tolerability & willingness to restrict diet
- Monitor nutritional labs

Mansueto P et al. Nutrition In Clin Pract (2015) 30 (5):665-682

Limitations

- Nutritionally restrictive
  - Decreased fiber & prebiotic intake
  - Moderation of staple foods can impact energy & nutritional intake
- Cultural/Personal considerations:
  - Vegan, vegetarian, Mexican, Indian cuisines
- Breakthrough symptoms possible
- No long term safety data

De Giorgio R et al. Gut (2016) 65:169-178

Risks

1. **Nutrition and Growth**
2. Psychosocial
   a. Feeding disturbances/difficulties/behaviors
   b. Eating disorders; orthorexia nervosa, anorexia nervosa
   c. Anxiety
   d. Difficulties socializing
3. Change of Gut Microbiota
   a. Alters relative abundance of Bifidobacteria (butyrate producing clostridia gps positively associated with health)

De Giorgio R, et al. Gut (2016) 65:169-178
Halmos E, et al. Gut (2015) 64:93-100

Nutritional Risks

↑ foods restricted = ↑ risk for nutrient def ciencies

Considerations:

- Child's nutritional status at diagnosis
  - Malnutrition
- Presence of additional risk factors
  - Other clinical diagnoses, deeding disturbance
- Removal of wheat & milk pose greatest impact
- Is an educational handout sufficient?

Proportion of Daily Requirements of Nutrients Provided by 500ml Cow's Milk for 8 Year Old Boy

Energy	20%
Protein	70%
Calcium	57%
Vitamin D	22%
Vitamin B2	155%
Vitamin A	35%
Zinc	38%

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Key Nutrients & Alternative Sources

High FODMAP	Nutrients Provided	Low FODMAP Alternatives
Milk (cow, goat, sheep)	Protein, energy, calcium, Vitamins D, A, B12, B1 (riboflavin), pantothenic acid, zinc	Lactose free fortified milks (Lactaid, rice, almond, coconut), hard cheeses (parmesan, cheddar, mozzarella, Swiss), lactose free yogurt, ice cream, cottage cheese, mushroom, yellow bell pepper, carrots
Wheat, Rye, Barley	Energy, iron, protein, Vitamins B1, B2 (thiamin, riboflavin), niacin, folate, fiber	Rice, corn, polenta, tapioca, quinoa, buckwheat, oats, oat bran, gluten/wheat free grains, flours & foods (pasta, breakfast cereals, crackers), potatoes, seeds (pumpkin, sesame, flax, sunflower)
Fruits	Vitamins C, B1, B2, B6 (thiamin, riboflavin, pyridoxine), folate, fiber	Grapes, banana, pineapple, strawberry, blueberry, orange, grapefruit, kiwi, passion fruit, rhubarb, cantaloupe & honey dew melon, kumquat, meats, grains (gluten/wheat free), seeds (pumpkin, sesame, flax, sunflower)
Vegetables	Vitamins C, B12, pantothenic acid, biotin, selenium, fiber, prebiotics	Potato, broccoli, tomato, carrot, zucchini, parsnip, squash, bell peppers, celery, eggplant, lettuce, celery, cucumber, pumpkin
Legumes/Lentils	Protein, iron, fiber, zinc, folate, vitamins A, E, B6, pantothenic acid, niacin, phosphorus, copper, selenium	Tofu, meats, poultry, gluten/wheat free grains, flours & foods (pasta, breakfast cereals, crackers), seeds (pumpkin, sesame, flax, sunflower)

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Team Philosophy

Validation
Education
Support
Reassurance
Empowerment
Expectation
Coping strategies

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Conclusions

- A multidisciplinary team approach with established team philosophy in the nutritional management of pediatric FGIDs is ideal
- The low FODMAP diet decreases abdominal pain frequency in IBS
- In order to reach full potential of symptom minimization & meet nutritional requirements, involvement of a pediatric RD is essential
- The RD provides expert knowledge on the complexity required for safe & effective implementation of diet, specifically the low FODMAP diet

Promoting Resilience in Youth With Functional GI Disorders

Kari Baber PhD

Objectives

- Identify at least 2 forms of resilience in the context of functional GI disorders (FGIDs)
- Explain the utility of psychological intervention in promoting resilience in youth with FGIDs

Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.

Preamble to the Constitution of the World Health Organization as adopted by the International Health Conference, New York, 19-22 June, 1946; signed on 22 July 1946 by the representatives of 61 States (Official Records of the World Health Organization, no. 2, p. 100) and entered into force on 7 April 1948.

Resilience Defined

- "Resilience is the process of adapting well in the face of adversity, trauma, tragedy, threats or significant sources of stress…It means "bouncing back" from difficult experiences".[1]
- "In the context of pediatric/health psychology, resilience is the demonstration of emotional, behavioral, or health outcomes that match or surpass normative developmental milestones, behavioral functioning, or emotional well-being, despite exposure to the substantial challenges of living with and managing a medical or developmental condition".[2]

Risk and Resilience

- Risk factors/resilience resources
- Risk mechanisms/resilience mechanisms

Capacities and processes demonstrated by *individuals* and *families* result in recovery and growth.[3]

Cousins, L.A., Kalapurakkel, S., Cohen, L.L. & Simons, L.E. (2015). Topical review: resilience resources and mechanisms in pediatric chronic pain. *Journal of Pediatric Psychology*, 40(9), 840-845.

Risk Factors and Mechanisms in Pediatric FGIDs

- Anxiety
- Depression
- Functional Disability
- Family Impact
- School Absenteeism

Anxiety as Risk Factor/Mechanism

- Anxiety promotes avoidance
- Avoidance reduces engagement in effective coping strategies
- Ineffective coping strategies promote attention to pain
- Parent/caregiver anxiety inadvertently reinforces attention to pain
- Pain perception is heightened
- Pain is perceived as having catastrophic results

Cognitive Behavioral Therapy for FGIDs

- Children with FAP/IBS participating in CBT interventions demonstrate
  - Symptom improvement [4, 5, 6, 7, 8, 9]
  - More adaptive coping [7,8]
  - Decreased functional disability [11,12]
  - Less emotional distress [12]
  - Improved school attendance [6,9]
  - Decreased health care utilization [5,6]

CBT Goals for Youth with FGIDs

- Pain/symptom management
- Promote treatment adherence
- Learn adaptive coping strategies
- Decrease distress associated with FGID symptoms
- Decrease negative thinking patterns/catastrophizing
- Maintain desirable activities
- Promote positive emotion and emotion regulation
- Increase mastery/self-efficacy in coping

Promoting Adaptive Coping

- No inherently "good" or "bad" strategies[13]
- Some strategies predict pain, anxiety, depression, disability [14, 15, 16, 17, 18]
  - Passive strategies (disengagement, catastrophizing) associated with > pain, depressive symptoms, disability
  - Accommodative strategies (acceptance, encouragement) associated with < pain and depressive symptoms

Resilience Described

"Sadie" is an 8 year old, previously healthy African American female who presented to GI service with several month history of abdominal pain, headache, back pain and leg pain. She had been seen 5 times in the Emergency Department and admitted to the hospital 4 times for further evaluation that was ultimately reassuring. Sadie was diagnosed with Functional Abdominal Pain Syndrome. The family received education about the diagnosis and was referred for outpatient behavioral health services to promote coping with pain.

Risk Factors/Mechanisms	**Resilience Resources/Mechanisms**
<u>Sadie</u> - Mild anxiety - Recent bullying and difficulties with teacher - Limited adaptive coping skills	<u>Sadie</u> - Optimism - Social connection: friends, community - Self efficacy (social, academic)
<u>Family</u> - Maternal depression - Catastrophizing about Sadie's pain/symptoms - Parent conflict/tension - Recent parent job change	<u>Family</u> - Social connection: friends, faith community, extended family

Intervention

- Psychoeducation (Parent and child)
- Skills training (Sadie)
  - Emotion identification and regulation
  - Active coping with pain and negative emotions
  - Cognitive restructuring

Outcomes

- No additional ED/urgent care visits
- Regular school attendance
- Increased efficacy to cope with physical symptoms and stress

Of course, this isn't the end of the story….

Partnering to Promote Resilience

- Patient/family
- Physician, nurse practitioner, nurse
- Social worker
- Psychologist/behavioral health provider

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Building an Intestinal Failure Program: NIFTy lessons

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Disclosures

- I have no financial relationships to disclose
- Much of what we discuss today is based on personal experience in attempting to develop a comprehensive, multidisciplinary intestinal failure program
- NIFTy refers to the Nemours Intestinal Failure Team

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Objectives

- Objectives
  - List intestinal failure team members and discuss their role in caring for these patients.
  - Describe at least 2 examples of difficulties that may be encountered when trying to build an intestinal failure program.

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Short Bowel Syndrome ≠ Intestinal Failure

- Anatomic loss of greater than half of the length of small intestine
- Reduced intestinal absorption so that macronutrient and/or water and electrolyte supplements are needed to maintain health

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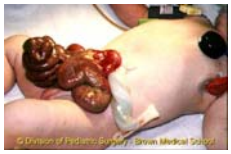
4

Causes of Intestinal Failure

- Causes of SBS during the Neonatal Period
  - Gastroschisis
  - Midgut Volvulus
  - Necrotizing Enterocolitis
  - Multiple Intestinal Atresias
  - Long-segment Hirschsprung's Disease



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Causes of Intestinal Failure, cont.

- Causes of SBS Outside of the Neonatal Period
  - Crohn's disease
  - Trauma
  - Hypercoagulable states/Ischemia
  - Desmoid tumors/Gardner's syndrome
- Non- SBS Causes of Intestinal Failure
  - Intestinal length is preserved
  - Failure of absorption of nutrients
  - Not as easily identified in the nenonatal period
  - Examples
    - Pseudo-obstruction
    - Microvillus Inclusion Disease
    - Tufting Enteropathy (Intestinal Epithelial Dysplasia)

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Common Medical Needs for IF patients

- Need to provide adequate nutrition
  - Maintain growth and normal development
- Issues related to long term central venous access
  - CLABSIs and Venous thrombosis
- Need for surgical feeding tubes and ostomies
  - Access for feeds and need to decompress stomach
  - Anatomic issues
- Logistical issues to care for patient outside of hospital
  - Family capabilities versus long term care facilities
- Availability of advanced expertise close to home
- Financial burden to families and society

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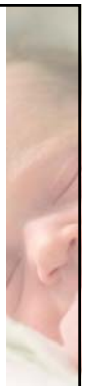
How much intestine is enough?

- Normal length
  - 600-800 cm in adult
  - 250-300 cm in term neonate
  - 100-150 cm before 30 WBD gestation
- Predicting irreversible intestinal failure
  - Intestinal length <30-40 cm in neonates
  - Absence of ileocecal valve
  - Resection of some colon
  - Minimal tolerance of enteral nutrition in first few months after resection



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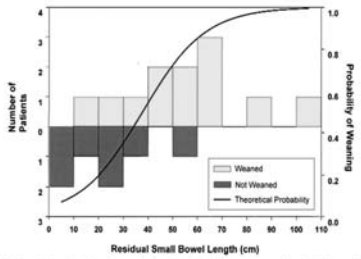

Fig. 1. Relationship of residual bowel length and ability to wean from PN in a cohort of IF patients. The solid line demonstrates the theoretical possibility of completely weaning from PN based on residual bowel length. (*Reproduced from* Andorsky DJ, Lund DP, Lillehei CW, et al. Nutritional and other postoperative management of neonates with SBS correlates with clinical outcomes. J Pediatr 2001;139(1):27–3; with permission.)

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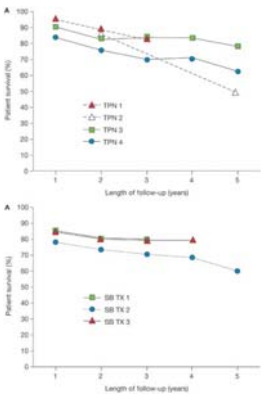
Survival on long term TPN versus Intestinal Transplantation



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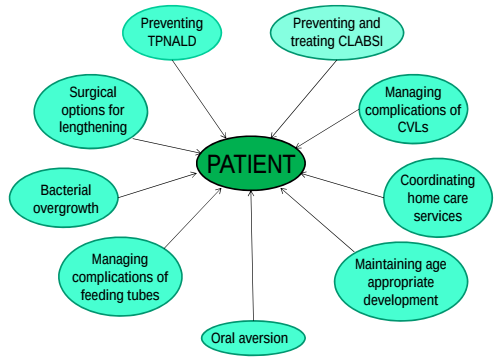

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What is an intestinal failure team?

- A multidisciplinary group of medical providers whose goal is to provide comprehensive care in both the inpatient and outpatient setting to patients with intestinal failure, including:
  - Adequate nutrition to maintain growth and development
  - Treatment aimed at increasing the amount of nutrition that can be provided enterally
    - Medical management
    - Surgical management
  - Strategies to prevent complications associated with intestinal failure
    - TPNALD
    - CVL complications
    - Oral aversion
  - Options for intestinal transplantation if necessary

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Goals of an intestinal failure team

The ultimate goal for a patient with intestinal failure is to eat enough food by mouth to maintain growth and development

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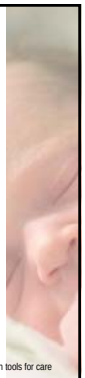
13

Building Multidisciplinary Teams

- Multidisciplinary teams have been developed for various diseases
- Often includes coordination of inpatient and outpatient care
- Examples
  - Obesity management
  - Oncology
  - Disorders of sex development
  - Intestinal failure



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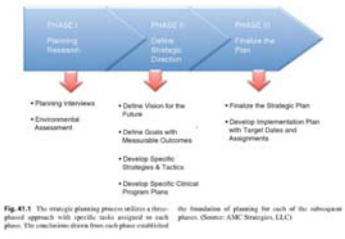

Fig. 41.1 The strategic planning process utilizes a three-phased approach with specific tasks assigned to each phase. The conclusions drawn from each phase established the foundation of planning for each of the subsequent phases. (Source: AMC Strategies, LLC)

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Steps	Brief summary
1. Develop a business plan	– Vision of program – Market share analysis and anticipated growth
2. Obtain physician/administrative buy-in	– Establish communication from participating physicians and hospital administration
3. Obtain hospital support	– Secure hospital resources (conference room, ancillary staff, clinic space)
4. Hire the multidisciplinary clinic coordinator	– Full-time dedicated coordinator (experienced Advanced Practice Provider [APP] or specialty trained registered nurse [RN])
5. Coordinate scheduling logistics	– Mutually agree on day of clinic and time of conference – Dedicated "slots" for diagnostic tests or procedures
6. Provider schedule	– Develop a rotating schedule from all participating specialists to decrease individual burden
7. Support services	– Dedication from support services (nutrition/social work) for day of clinic consultation
8. Patient flow template	– Useful in structuring whole-day clinic appointment that flows smoothly
9. Weekly handout	– Brief summary of diagnosis and treatment to date
10. Meeting the patient and welcome folders	– Greet each patient and provide welcome folder with letter describing all appointments for that day
11. Mock day	– Minimize obstacles/delays
12. Tracking patients	– Flag patients to capture clinic volumes in the EMR
13. Marketing	– Website, brochures, easy access phone number
14. Community outreach	– Provides immediate feedback to referring physicians – Presentations to potential referring practices – Participation in local/national support group events
15. Data collection	– Data collection for future research projects

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Meguid C, et al. Establishing a framework for building multidisciplinary programs. J Multidiscipl Heathcare 2015:8 519-526.

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The importance of a program coordinator

- Examples in other disciplines
  - Solid Organ Transplant coordinators
- Who should fill the role?
  - Advanced Practice Provider
  - Specialty-trained RNs
  - Medical Assistant
- Benefits
  - Significantly decreases physician time per visit
  - Expertise in systems management
  - Dedication to a single program allows for development of expertise
  - APPs can bill independently
- Disadvantages
  - Cost to support salary

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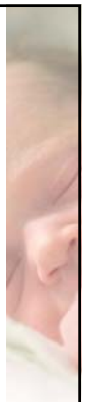
What does the program coordinator do on an Intestinal Failure Team?

- Primary contact point for the family
  - The "PCP" or "gatekeeper" of the multidisciplinary team
- Liaison between the various disciplines
- "Jack of all Trades"
  - The coordinator's role will likely overlap with other team members' roles
  - Should be able to problem-shoot most questions, then go to the specialist for more complicated issues
- Helps to coordinate home health care
  - Ordering outpatient supplies, prescriptions, etc.
  - Works with home health care or long-term care facility
  - Scheduling various tests, visits, referrals, etc.
- Large role in directly teaching family or coordinating teaching



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Who should be on the Intestinal Failure Team?

- Patient and Family
- Program Coordinator
- Pediatric Gastroenterologist
- Pediatric General/Transplant Surgeon
- Neonatologist
- Primary Care Physician
- Registered Dietician
- Speech Therapist
- Advanced Practice Nurse
- Social Worker
- Other specialists based can be consulted based on other cormorbities and individual needs of the patient

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Care Coordination – Programmatic Issues

- Identify the "home" division or department
  - "one phone number, one fax" concept
  - The multidisciplinary coordinator should probably be a member of this division or department
- Clearly define the roles of each practitioner
  - Who is the final decision maker or "tie-breaker"?
- Regularly schedule meetings
  - Routine patient care conference
  - Administrative meetings
- Importance of educational materials
  - Web based, paper based, etc.
- Respect different opinions, experiences, etc.

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Care Coordination – Outpatient Setting

- Setting up the clinic
  - Identify practitioners who need to see patients in clinic setting
    - Does every practitioner need to see patient at every visit?
  - Coordinate schedules
  - Respect team members competing responsibilities
- Weekly planning meeting
- Importance of educations materials
  - Web based, paper based, etc.
- Billing issues
  - Individual billing versus team visit

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Care Coordination – Inpatient Setting

- Decide which service will admit patients
  - May change from admission to admission, patient to patient
  - Admitting service likely "tie breaker" for that admission
- Define which teams will be consulted
  - Automatic consultations versus need-based consultations
- Call schedule for nights/weekends
- Educating hospital personnel about who to call
  - Hospital operators or switchboard operators
  - ER physicians, housestaff, hospitalists, PCP, etc.
- Standardization of care
  - Pre-filled order sets
  - Protocols for common problems

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Care Coordination – Moving from Inpatient to Outpatient

- Identify all available resources
  - Care givers
  - Insurance and other financial support
- Define expectations of parents
- Importance of training care givers in the necessary skills
  - Skills list
  - Rooming in session
- Timeline
  - Start early!

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NIFTy model for new IF diagnosis in the NICU

- Series of family meetings
  - First meeting after diagnosis
    - "big picture"
    - Estimated time line
    - Introduce idea of teaching
  - Second meeting
    - Review big picture, answer questions
    - Begin setting up timeline for teaching
  - Subsequent meetings
    - Review caregiver progress in mastering skills
    - Review home health needs and make plans to fill deficiencies
  - Final meeting before discharge
    - Confirm that all teaching is complete
    - Confirm that all home health needs are met
    - Establish definitive follow up plan

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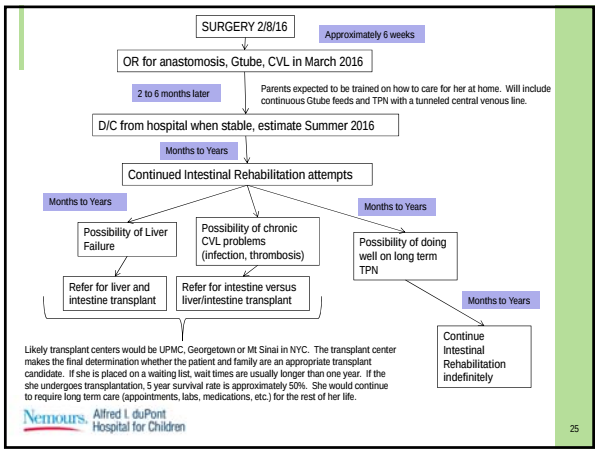

NIFTy model for teaching caregivers with new IF diagnosis

- Identify two caregivers
  - Usually parents, but can be other family members
  - Should live in the house with the patient
- List of skills that need to be mastered
  - Based on individual needs of patient
- Bedside nurses and specialty APNs perform majority of teaching
- Social worker coordinates home health care needs
- Each skill must be performed satisfactorily two times by each caregiver – i.e. four times total
- 24 hour rooming in session prior to discharge home
- *We hold discharge until caregivers have satisfactorily completed all skills and the rooming in session*

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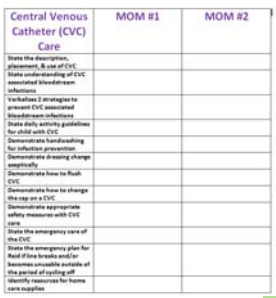
G-Tube Care	MOM #1	MOM #2
Verbalize Reid's feeding plan		
Administer feeds x2		
Identifies preferred pharmacy by 2 weeks prior to discharge		
Administer medications x2		
Identify, what to do if there is leakage around the tube		
State what to do if the tube is blocked		
Demonstrate what to do if there is redness/drainage at the site		
State actions to take if diarrhea/vomiting occurs		
Verbalize actions to take if the tube falls out at home		
Demonstrate stoma site care		



Central Venous Catheter (CVC) Care	MOM #1	MOM #2
State the description, placement, & use of CVC		
State understanding of CVC associated bloodstream infections		
Verbalizes 2 strategies to prevent CVC associated bloodstream infections		
State daily activity guidelines for child with CVC		
Demonstrate handwashing for infection prevention		
Demonstrate dressing change aseptically		
Demonstrate how to flush CVC		
Demonstrate how to change the cap on a CVC		
Demonstrate appropriate safety measures with CVC care		
State the emergency care of the CVC		
State the emergency plan for Reid if line breaks and/or becomes unusable outside of the period of cycling off		
Identify resources for home care supplies		

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Benefits of a Multidisciplinary Intestinal Failure Team

- Benefits for the patient and family
  - Decreases number of visits to multiple specialists
  - Reduces travel time and time off work/school
  - Avoids the problems of multiple, possibly contradictory plans
  - Limits costs of copays in some situations
  - Prevents redundant diagnostic testing
  - Program coordinator helps families navigate complex system
  - Consistent, evidence based approach and larger patient volume likely leads to better patient outcomes
- Patient satisfier
  - Better understanding of diagnosis
  - Better understanding of available resources
  - More convenient

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Tartaglia N, et al. The eXtraordinarY Kids Clinic: an interdisciplinary model of care for children and adolescents with sex chromosome aneuploidy. J Multidiscipl Healthcare 2015:8 323-334.

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Benefits of a Multidisciplinary Intestinal Failure Team

- Benefits for the providers
  - Program coordinator helps efficiency of physicians in clinic
  - Better communication between providers
  - Possibility of CME/CEU credit for planning conferences
  - Easier for referring providers to make only one referral
  - Research opportunities
- Benefits for the institution
  - Potentially attracts new patients
  - Possible increase in ancillary income from pathology, radiology, laboratory studies
  - Research opportunities
  - Enhance institutional reputation

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Thanks to all of the patients, families, nurses, therapists, students, residents, and physicians who have contributed to my ongoing education!

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Nutritional Assessment and Intervention in Children with Intestinal Failure

Nicole Fragale, MPH, RD, CSP, LDN

Objectives

- Demonstrate the ability to conduct a nutrition assessment in a child with IF
- Discuss best practices for feeding the patient with intestinal failure
- To identify common nutrient deficiencies in patients with intestinal failure

Nutrition Assessment in The Child with Intestinal Failure

- Anatomy
- Growth parameters
- Estimated calorie requirements
- Enteral nutrition
- Output history
- Food intake
- Supplements
- Parenteral nutrition
- Labs

Anatomy–What's left?

Growth Assessment

- Anthropometrics
  - Weight
    - Daily, naked weights on same scale
      - With ostomy bag off
    - Calculate average daily weight gain and compare to standards
  - Length/height
    - Length board for children 24 months and younger
    - Standing height for children greater than 2 years old
  - **Monitor weight-for-length or BMI**
    - Goal is ~25th percentile
    - Stunting is common in children with SBS

Growth Assessment

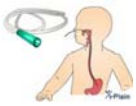
- Mid-upper arm circumference
  - Measures fat stores
  - Monitor serial measurements and compare to CDC established percentiles
- Nutrition-focused visual assessment
  - Prominent clavicles?
  - Edema?
  - Well hydrated?
  - Micronutrient deficiencies?
    - Angular cheilitis
    - Thinning hair
    - Dry skin
    - Paleness

Estimating Energy Requirements

- Calories
  - Enteral: REE in infants is similar to healthy children but enteral energy intake can be 30-70% higher due to malabsoprtion
  - Parenteral: Prescribed at 10% less than enteral needs
    - Do not need to factor in malabsorption
  - **Estimate needs based on RDA's/WHO equation and adjust on patient-by-patient basis**
- Protein
  - 3-4 g/kg in neonates
  - 2-3 g/kg in older children
- Fat
  - Enteral: 40% of total calories minimum (due to malabsorption)
    - Prescribe combination of MCT and LCT
  - Parenteral: limit to no more than 30-40% of total calories

Enteral Nutrition

- Crucial for intestinal rehabilitation
  - Exposes the GI tract to nutrient and hormonal stimuli
  - Enhances intestinal epithelial cell growth, brush border enzyme activity and enhances motility
  - Protects against IFALD
- Important to feed to the most proximal location



What type of formula?

- Breast is best →
  - Associated with shorter duration of PN when compared to cow's milk or protein hydrolysates
  - Supplies epithelial growth factors
- Standard formulas →
  - Complex nutrients stimulate bowel adaptation
- Hydrolyzed formulas →
  - High in MCT Oil
  - Lower osmolality than elemental formula
- ***Elemental*** →
  - Hypoallergenic
  - Contain MCT
  - Typically tolerated well

Pureed/Blenderized Feeds

- Pureed bolus feeds
  - Stage 1 and 2 baby foods via g-tube
  - Start small and increase gradually
- Blenderized feeds
  - Special recipes used in older children with feeding aversions

How is the patient fed?

- Trophic feeds
  - Maximize saturation of carrier proteins
  - Reduce risk of osmotic diarrhea
- Daytime bolus/ overnight continuous feeds
  - Bolus feeds are more physiologic (may be given orally)
  - Have been shown to enhance organ growth in animal models

How are the feeds advanced?

- In infants, increase by 1 ml/hr every 1-2 weeks
- Tolerance is determined by:
  - Emesis >3 times or >20% intake
  - >50% increase in stool output
  - If stool output exceeds greater than 50 mL/kg of body weight
  - Comfort of the patient

Output History

- Stooling
- Emesis
- Ostomy output
- Other drains?
  - Pancreatic
  - Fistula
  - Biliary drains

Dietary methods to slow gastric emptying

- Soluble Fiber
  - Fermentation to SCFA helps colonic sodium and water resorption and contributes calories
  - Thickens/bulks stool
  - Contraindicated for infants without IC valve and/or colon

Product	Type of Fiber	Benefit	Suggested dose
Nutrisource fiber (guar gum)	Soluble	Obtained via script	0.5 g fiber/kg
Pectin	Soluble	Bought OTC	1–3% total formula solution
Green beans	Soluble and insoluble	Can be taken orally	~po ad lib or 1 jar of stage 2 baby food to every 8 oz 30 cal/oz formula (makes 22 cal/oz)

Oral Intake?

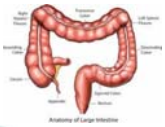
- Formula feeding via bottle at gestational age of >32–34 weeks
  - If neurologically stable and alert
- Initiate solids at 4–6 months
  - Or as developmentally appropriate
- OT and SLP therapy
- Small feeding volumes → avoid dumping and associated oral aversions
- Liquids should be consumed separately from meals

Dietary Guidelines for the Patient with IF

Good Choices	Avoid
Starches/Breads Breads, bagels, plain waffles/pancakes, plain muffins, banana/zucchini bread, tortillas, pasta, macaroni, noodles, brown rice, crackers, pretzels	Donuts, pastries, pop-tarts
Cereals Unsweetened cereals such as Cheerios, Cornflakes, Rice Crispies, Rice Chex, Kix, Cream of Wheat, Oatmeal	Sugary cereals
Vegetables Canned, cooked, or frozen. **Green beans are a good source of soluble and insoluble fiber	None
Fruits Fresh, frozen, or unsweetened canned fruits. **Bananas are a good source of pectin.	Avoid fruits that have been canned in syrup. Also avoid Fruit Juice and "High Fructose Corn Syrup"
Protein Meats, fish, shellfish, poultry, tuna fish, ham, eggs, nut butters without added sugar	Avoid heavily fried meats and poultry. Avoid Nutella, and peanut butter with jam/jelly mixed in.
Dairy/Soy Cheese, cottage, cheese, plain yogurt or artificially sweetened yogurt, cream cheese, plain soy milk, lactaid milk	Avoid highly sweetened yogurts, chocolate or other flavored milks, Go-Gurts, and flavored soy milks
Other	Avoid added sugars and "sugar alcohols," especially Sorbitol. Anything ending in "-ol" is most likely a sugar alcohol. Also avoid maple and chocolate syrups, jams, honey and molasses.

Special Considerations

- Patients with a colon
  - "Lower"-fat diet with higher intake of carbohydrates (and fiber)
- Patients with ileostomy or jejunostomy
  - Higher fat diet with "lower" intake of carbohydrates
  - Avoid high fiber foods or supplements
  - Encourage salty meals and snacks



Special Considerations

- Oxalate stones
  - Pts with retained colon and <100 cm ileum at risk
  - Malabsorbed fat binds with calcium which frees oxalate to be absorbed in colon→kidney stones!!
    - **Foods high in oxalates to be limited:** blackberries, cherries, tangerines, lemons, limes, baked beans, sweet potatoes, green beans, tomatoes, peanuts, chocolate, whole wheat bread, french fries, whole wheat bread
    - **Reduce fat intake (microlipids?)**
    - **Consider calcium supplementation**

Enteral Supplements

- Microlipids
  - Long chain fats that are used to prevent **essential fatty acid deficiency**
  - Aids intestinal adaptation
- MCT oil
  - Better absorbed if bile acid losses or pancreatic insufficiency
  - Also aids intestinal adaptation

- Omega-3 fatty acids
  - Reduces inflammation and may help to prevent PNALD
- Vitamins and minerals
  - Iron (tablet form)
  - AquaDEKS's
    - Fat soluble vitamins in water miscible form
  - Selenium
  - Zinc
  - B vitamins

Parenteral Nutrition

- IV Nutrition is comprised of
  - Carbohydrates (dextrose)
  - Protein (amino acids)
  - Fats (lipids)
- Risk of PNALD with overfeeding of PN

Parenteral Nutrition

- Dextrose
  - Main source of calories/energy
  - Monitored via Glucose Infiltration Rate (GIR)
    - Measure of the milligrams of dextrose per kilogram infused per minute (mg/kg/min)
    - Should be monitored to prevent hepatic steatosis
    - GIR typically should not go above 14 mg/kg/min for those <3 years of age

Parenteral Nutrition

- Amino Acids
  - Can start at goal
    - 3-4 g/kg/day for preemies
    - Max of 2 g/kg/day for older children
  - May need to be minimized if there is kidney damage
  - Monitor via BUN, prealbumin and CRP

Parenteral Lipids

- Soy based emulsions **Used in the US currently**
  - Linoleic acid (ω6-PUFA)
    - Pro-inflammatory
  - Lipid Minimization/Reduction is key to preventing PNALD
    - Providing 0.5 to 1 gm/kg/day
    - Must monitor for EFA deficiency if lipids make up less than 3-5% total kcal
- Omegaven (study drug, not FDA approved)
  - Linolenic acid (ω3-PUFA)
    - DHA & EPA
    - Anti-inflammatory
  - Used for prevention of PNALD
  - Must monitor for EFA deficiency

Cycling of PN

- Prevents PNALD
- Provides a break from the line
- Reduces the incidence of hyperinsulinemia

- **Recommend gradually increasing infusion rate over 1-2 hrs at the beginning of infusion and gradually decrease over final hour of infusion**

Weaning of PN

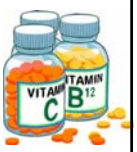
- Increase feeds, assure tolerance and weight gain→then wean PN
  - Calories vs. fluids
  - Wean fats first
  - Then dextrose
    - May Reduce hours on PN as dextrose is reduced (as GIR allows)
  - Protein and fluids weaned last

Lab Monitoring

- Electrolytes
  - Weekly until stable, then monthly
- Trace minerals and fat solubles
  - Every 3-6 months
- Essential Fatty Acids
  - Only as indicated
    - If recently transitioned off PN
    - If PN fat calories comprise less than 3-5% total calories
    - If on Omegaven

Most Common Nutrient Deficiencies

- **Those who are at highest risk of deficiency are**
  - **<10 years of age**
  - **Wt/ht < 5th percentile**
  - **Recently transitioned off of PN to full enteral or oral feeds**
- Selenium
  - May result in cardiomyopathy
  - Begin at 6 mcg/kg/day in PN and adjust prn
- Copper
  - Can cause anemia that is unresponsive to iron therapy
- Zinc
  - From increased stool losses
    - Especially in those with jejunal resection
  - Can cause growth retardation, loss of appetite, & impaired immune function



Most Common Nutrient Deficiencies

- Iron
  - Common in those with duodenal resection
  - Can result in poor growth and impact brain development
  - Iron solutions vs. iron infusions
- Vitamin B12
  - Absorbed in the distal ileum
- Fat soluble vitamins A, D, E, and K
  - Especially in those with ileal resection
  - ADEKS or individual supplementation may be indicated
- Essential Fatty Acid deficiency **(triene:tetraene ratio > 0.2:1)**
  - Impairs brain development
  - Signs/symptoms = dry skin, scaly rash, decreased growth, increased susceptibility to infection, poor wound healing

IF Nutrition Goals

- Promote adequate growth/development
- Encourage oral intake at an early age to avoid aversions
- Wean PN within first 2 years of life
- Prevent/treat micronutrient and essential fatty acid deficiencies

Conclusion

- Patients with intestinal failure require close monitoring and follow-up in the inpatient and outpatient setting
- Multidisciplinary teams have been shown to provide the best outcomes for SBS patients
- Nutrition plays a key role in the management and outcomes of these patients.

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3) Drenckpohl. Et al. Adding Dietary Green Beans to Formula Resolves the Diarrhea Assoicated with a Bowel Resection in Neonates. ICAN. 2012; Vol.5;1: 8-13.
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5) Jeejeebhoy KN. Management of short bowel syndrome: avoidance of total parenteral nutrition. Gastroenterology 2006;130:S60–66.
6) Nightingale, J., Woodward, J. M., & Small Bowel and Nutrition Committee of the British Society of Gastroenterology. Guidelines for management of patients with a short bowel. Gut. 2006; 55 Suppl 4:iv1–iv12.
7) Olieman JF, Penning C, Spoel M, et al. Long-term Impact of infantile short bowel syndrome on nutritional status and growth. Br J Nutr 2012; 107:1489.
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Pediatric Intestinal Failure

October 7, 2016

Margy Miccolis, PNP-BC, CNSC

Outline

- Definition & Etiology
- Factors Contributing to Outcome
- Management
  - Nursing
  - Medication
  - Surgical
    - Bowel lengthening
    - Transplant

Definition

Critical reduction of functional gut mass below the minimal amount necessary for adequate digestion and absorption to satisfy body nutrient and fluid requirements in adults or growth in children.

Thompson, JS. Gastroenterology 2006;130:S3-S4

Incidence IF

- Not well known
- 1% of hospitalized neonates
- Population based: 25/100,00 live births

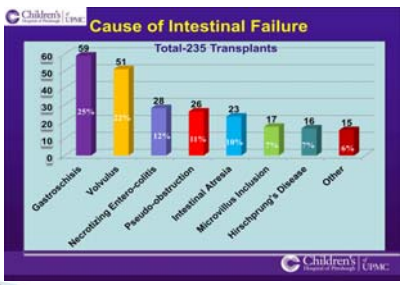
- Pediatrics 2008:122(3), 573-582
- J Pediatr Surg 2004,, 690-69539 (5)

Etiology of Intestinal Failure in Infants

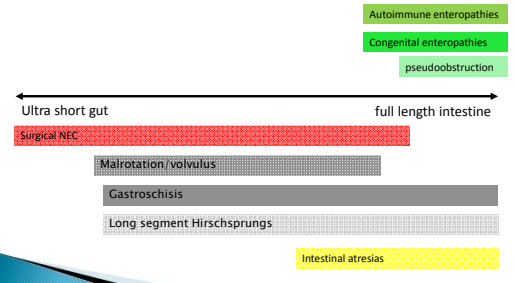
Diagnoses associated with intestinal failure and short bowel syndrome in infants (N=272)	
Diagnosis	**N (%)**
Necrotizing enterocolitis	71 (26)
Gastroschisis	44 (16)
Intestinal atresia (large/small)	27 (10)
Volvulus	24 (9)
Long segment Hirschsprung's disease	11 (4)
Tufting or microvillus inclusion	3(1)
Other single diagnoses	14 (5)
Unknown	1
Multiple single diagnoses	77 (28)

Squires RH et al, for the Pediatric Intestinal Failure Consortium. J Pediatr 2012; 161:723-8.

Etiology Intestinal Failure

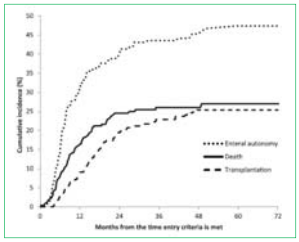


Etiology of Intestinal Failure in Pediatrics: Anatomical vs. Functional Perspectives



Adapted from: Rudolph JA, Children's Hospital of Pittsburgh of UPMC, 2011

Morbidity



- 47% of patients with IF reach enteral autonomy (no PN for >3 months)
- Highest probably of reaching enteral autonomy is during the first 2 years of life

Squires RH et al, for the Pediatric Intestinal Failure Consortium. J Pediatr 2012; 161:723-8.

Factors Contributing to Outcome

- Age at time of injury
- Amount and site of remaining bowel
- Function and motility of residual intestine
- Adaptation
- Other complicating factors
  - Small Bowel Bacterial Overgrowth
  - Central Line Associate Blood stream Infection (CLABSI)

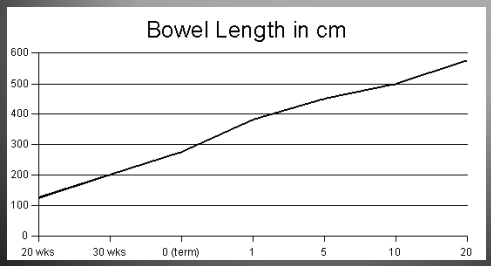
Age at Time of Injury

- Intestine will grow as the infant grows
- Potential for growth is greatest in premature infant
  - 19 to 27 weeks gestation: 115 ± 21 cm
  - 27 to 35 weeks gestation: 172 ± 29 cm
  - over 35 weeks gestation: 248 ± 40 cm

  (length of normal jejunum and ileum at autopsy)
- Peak length velocity in third trimester
  - Small intestine doubles in length between 27 and 40 weeks gestation

Touloukian. J Ped Surg 1983

Bowel Length



Factors Contributing to Outcome

- Age at time of injury
- Amount and site of remaining bowel
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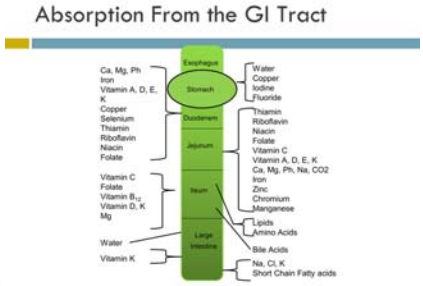
  - Small Bowel Bacterial Overgrowth
  - Central Line Associate Blood stream Infection (CLABSI)

Factors Affecting Outcome IF



Loss of Any Bowel

- Decreased surface area for absorption
- Shorter transit time
- Hypergastrinemia
  - decreased pancreatic enzyme activity
  - precipitation of bile acids
  - damage to epithelium of proximal small bowel
  - stimulates intestinal motility

Loss of Jejunum

- The primary digestive and absorptive site for most nutrients
- Marked temporary reduction in most nutrient absorption
- Generally better tolerated because of adaptive capacity of ileum

Loss of Ileum

- Large fluid and electrolyte losses
- Sodium loss can contribute to poor growth
- Diarrhea can contribute to Zinc depletion
- Malabsorption of bile acids impairing fat and fat soluble vitamin absorption
- Lack of absorption of Vitamin B_{12}

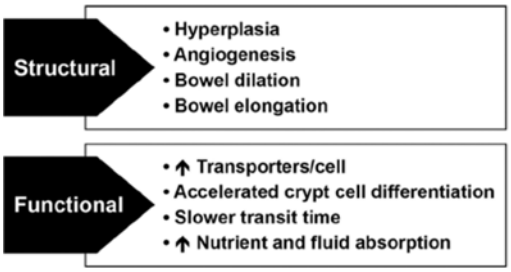
Loss of Ileocecal Valve

- Causes small bowel bacterial overgrowth
- Malabsorption, cholestatic liver injury and infection

Loss of Colon

- Important role in absorption of water, electrolytes, and short-chain fatty acids
- Slows down the transit time and stimulates intestinal adaptation

Adaptation

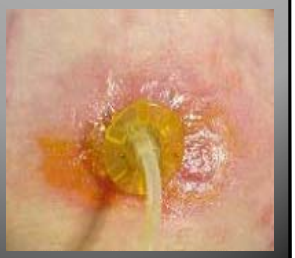


Kelly A. Tappenden JPEN J Parenter Enteral Nutr 2014;38:23S-31S

Gastric Acid Hypersecretion

- 50% of patients with SBS
- Omeprazole is effective in reducing esophageal acid exposure in premature infants

Omari et al, JPGN, 2007

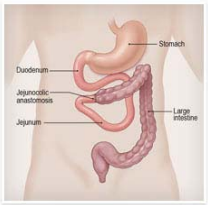


Small Intestinal Bacterial Overgrowth (SIBO/SBBO

- Symptoms:
  - Foul smelling flatus
  - Abdominal cramping
  - Diarrhea
  - Lack of weight gain
  - Difficulty weaning parenteral nutrition

Small Intestinal Bacterial Overgrowth (SIBO/SBBO)

- Due to dysmotility, lack of ileocecal valve in the presence of colon
- Translocation of bacteria or bacterial products like lipopolysaccharides (LPS)
- Increase risk of :
  - Central line infections
  - Liver disease

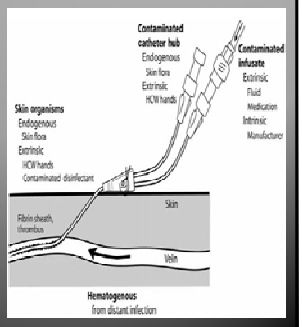


Small Intestinal Bacterial Overgrowth (SIBO/SBBO

- Diagnosis: hydrogen breath test, culture of small bowel fluid and biopsies of small bowel.
- Treatment: best to treat both aerobic and anaerobic organisms for 10 to 14 days
- Medications:
  - Trimethoprim/sulfamethoxazole,Metronidazole, Amoxicilin-clavulanic acid, Rifaximin, ciprofloxacin, gentamicin, neomycin.

CLABSI (Central Line Associated Blood Stream Infection)

- Most common cause of hospital admission
- Cause:
  - Contamination
  - Translocation
- Outcomes:
  - Septic shock and death
  - IFALD (each episode can cause 30% rise in bilirubin)

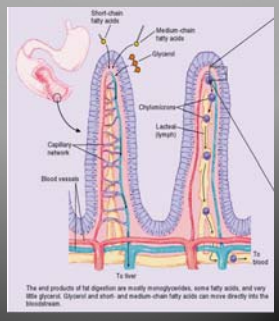


Prevention–CLABSI

- Aseptic precautions
- Lock therapy (ethanol and antibiotic)
- Early recognition and Rx of SBBO

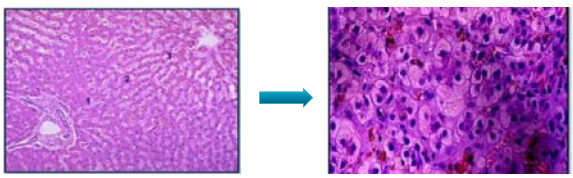
Intestinal Failure Associated Liver Disease (IFALD)

- Fat supplied IV is carried by liposomes rather than chylomicrons
- PN nutrition delivers lipids through hepatic artery rather than portal vein



Squires, J Pediatr 2012

Intestinal Failure Associated Liver Disease (IFALD)



Management IF

- Nursing Management
- Medication Management
- Surgical/Transplant

Nursing Management

- Start at admission and continue until discharge:
  - Expect parents to participate in as much of care as possible
  - When patient leaves the hospital parents must be competent G-tube, CVC, skin, assessing stool output and hydration status
  - Binder given to patients to collect data from multiple care givers regarding stool output, vomiting, feeding tolerance

Nursing Management

- GI Assessment
  - Stools – frequency, color, consistency (ie: watery, pasty), volume (can it stay in diaper or blow out).
  - Vomitting- spit up, whole feed, bilious
  - PO and G-tube tolerance
- Hydration status – accurate intake and output
  - Signs of dehydration- dark urine, decreased volume urine, oral saliva or cotton mouth

Nursing Management

- Skin
  - Diaper area
    - No skin breakdown – need barrier- triple paste/desitin with zinc
    - Skin breakdown – depends on cause. Know what treatment (ie: fungal, cavalon spray and stomahesive powder-crusting)
  - G-tube site
    - Need assess each shift
    - Granulation tissue- sometimes requires silver nitrate application done by surgical or GI APN

Nursing Management

- CVC site
  - CVC is lifeline for child with IF
  - Meticulous care of site
  - Weekly changes of CVC dressings
  - Must have biopatch or chlorhexidine gel on CVC site
  - Some IF children have specialized protocol
    - Ie: no chlorhexidine/alcohol based- use betadine
- Education of families-all of the above

Medication Management

- Cholestyramine (Questran):
  - Action: binds to bile acids, making them insoluble and inactive
  - Important because Ileum location where bile acids reabsorbed
  - Ileum resected- bile acids pass into large bowel and cause diarrhea due to stimulation of chloride/fluid secretion by colonocytes resulting in secretory diarrhea

Medication Management

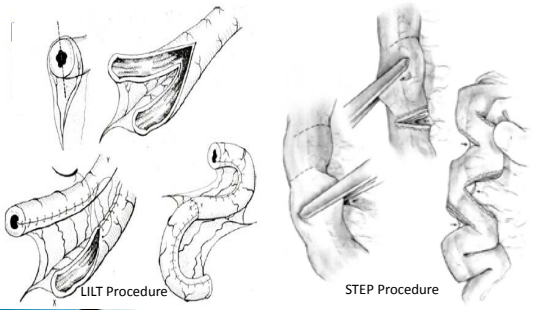
- Antimotility
  - Loperamide (imodium)
    - Acts as opiod receptor large intestine by increasing length of time substances stay in intestine. Improves absorption of nutritients.
  - Diphenoxylate (lomotil)
    - Decreases speed and amplitude of peristalsis in intestines and improves absorption fluid and nutrients. Used mainly with adults

Medication Management

- Actigall (ursodiol):
  - Mechanism of action-Protects hepatocytes from cytotoxic effects bile acids by inhibiting their absorption in intestine. Facilitate bile excretion and used in treatment of cholestasis secondary to TPN
- Probiotics- not recommended when CVC present due to risk fungal translocation

- Surgical Management/Transplant

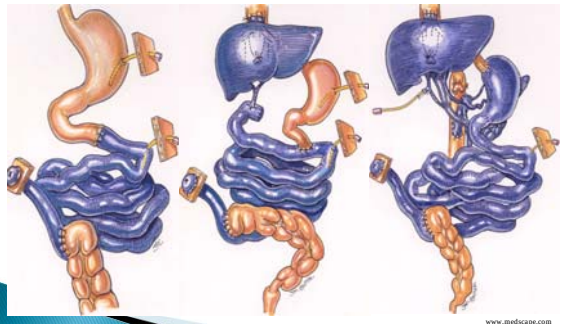
Surgical Management



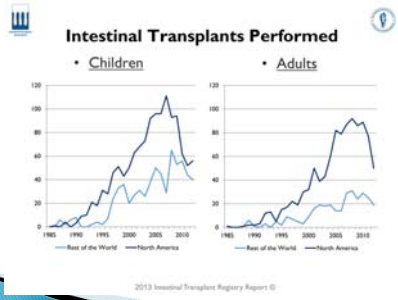
LILT Procedure

STEP Procedure

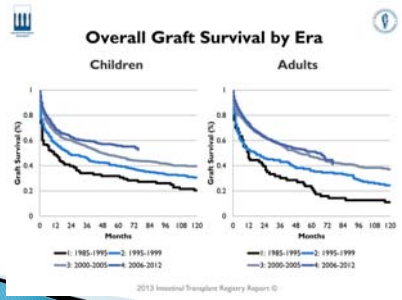
Transplant



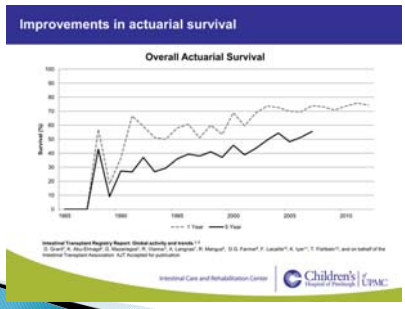
Incidence of Intestinal Transplants



Outcome Intestinal Transplants



Outcome Intestinal Transplants



Summary

- Pediatric intestinal failure patients are complex and best outcomes with interdisciplinary team
- Patients with intestinal failure require close monitoring and follow-up in the inpatient and outpatient setting
- Need to remember there are short and long term goals for these patient (ie: short- prevent CLABSI/ long- Central IV access for length of time needed during patient's life)


THANK YOU
FOR
LISTENING

Update on Pediatric GI Pharmacology

Kathleen M. Gura PharmD, BCNSP, FASHP, FPPG, FASPEN
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Center for Advanced Intestinal Rehabilitation (CAIR)
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Boston Children's Hospital
Until every child is well

Disclosures*

- Sancillio & Company – scientific advisory board, research support
- B Braun – pharmaceutical advisory board
- Fresenius Kabi – consultant, research support
- Pronova/BASF- consultant, research support

*not related to the content of this lecture

I will be speaking on unapproved and off label medications.

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"Off label" does not necessarily mean "experimental

The FD&C Act does not, however, limit the manner in which a physician may use an approved drug. Once a product has been approved for marketing, a physician may prescribe it for uses or in treatment regimens or patient populations that are not included in approved labeling. Such "unapproved" or, more precisely, "unlabeled" uses may be appropriate and rational in certain circumstances, and may, in fact, reflect approaches to drug therapy that have been extensively reported in medical literature.

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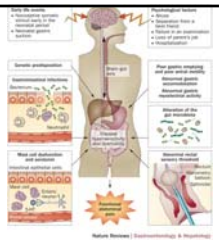
Learning Objectives

1. Discuss what agents can be used to treat functional abdominal pain.
2. Compare and contrast strategies to manage functional bowel disorders, including irritable bowel syndrome and chronic constipation.
3. Describe emerging strategies in the management of pediatric IBD.



FUNCTIONAL GI DISORDERS (FGIDS)

Functional GI Disorders (FGIDs)

- Due *abnormal functioning* of GI tract
- Not caused by structural or biochemical abnormalities
  - Makes diagnosis difficult
- More than 20 FGIDs identified
- Impact any part of the GI tract
- 3 primary features
  - Dysmotility
  - Altered sensation
  - Brain-gut dysfunction

Highly Prevalent

- ~2 out 5 people are affected by a FGID
- Impacts all ages, genders, race, ethnicity and socioeconomic status

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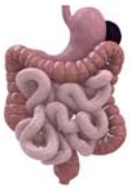
FGIDs: Motility

- Normal
  - orderly sequence of muscular contractions from the top to the bottom(e.g., peristalsis)
- FGIDs
  - motility abnormal
    - muscular spasms that can cause pain
    - contractions altered
      - very rapid (fast motility=diarrhea)
      - very slow (slow motility = constipation).



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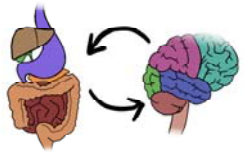
FGIDs: Brain-Gut Dysfunction

- The regulatory conduit between the brain and gut function may be impaired
- Can lead to increased pain & worsening bowel difficulties



THE GUT-BRAIN CONNECTION

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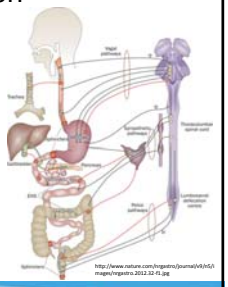
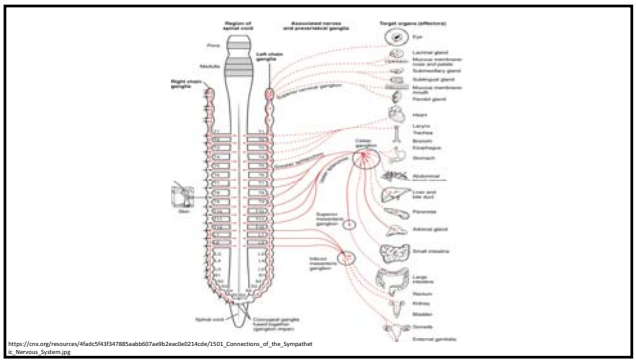
FGIDs: Sensation

- Sensation: how the nerves of the GI tract respond to stimuli (i.e., digesting a meal)
- FGIDs: the nerves are hypersensitive
  - normal contractions can result in pain or discomfort



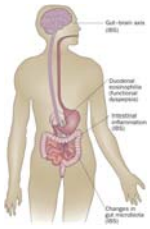
http://www.nature.com/nrgastro/journal/v9/n5/images/nrgastro.2012.32-f1.jpg



https://cnx.org/resources/4fadc5f43f347885eabbb607ae9b2eac0e0214cde/1501_Connections_of_the_Sympathetic_Nervous_System.jpg

Examples of FGIDs

- Irritable bowel syndrome (IBS)
- Functional dyspepsia (FD)
- Functional vomiting
- Functional diarrhea /constipation
- Functional abdominal pain (FAP)



TREATMENT OF FGIDS

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Goals of Treatment

- Not complete resolution of symptoms
  - Not initially
  - Long term goal
- Initial goal: to return to "normal" without interferences

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VISCERAL SENSATION
FUNCTIONAL ABDOMINAL PAIN

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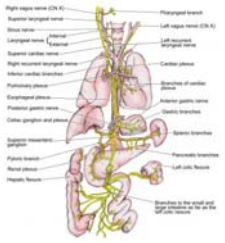
Location of Abdominal Pain

- T_5-T_9 Foregut
  - Distal esophagus
  - Stomach
  - Duodenum
  - Liver, biliary tree, pancreas
- T_8-L_1 Midgut
  - Small intestine
  - Appendix
  - Cecum (ascending)
  - Proximal 2/3rd of transverse colon
- T_{11}-L_1 Hindgut
  - Distal 1/3d of transverse colon
  - Descending
  - rectosigmoid



http://emedicine.medscape.com/article/1875811-overview

Goals of Therapy

- Decrease stress for child, promote normal activities
- Pain is REAL and not imagined
  - Use headache analogy
- Abnormal GI motility and autonomic activity related to stress

Disclaimer

- Limited evidence-based recommendations for most of the meds used in the treatment of PP-FGIDs in children
- Most drug therapies are based on anecdotal experience or adult data

Current Therapies

- Antispasmodics
  - Muscarinic receptor antagonists
  - Smooth muscle relaxants
  - Ameliorate chronic abdominal pain via inhibition of smooth muscle contraction
- Gunylate cyclase-C agonists
- Psychoactive agents
  - antidepressants

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Antispasmodics

- Hyoscyamine (e.g.,Levsin)
- Dicyclomine (e.g.,Bentyl)
- Decrease spasms in GI tract
- More effective if taken prior to an event that is expected to trigger symptoms
  - Example- before meals
    - Will blunt exaggerated responses that result in cramping and pain

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Hyoscyamine: Dosing

- Oral, Sublingual:
  - Children 2-12 yrs: 0.0625-0.125 mg every 4 hours as needed; maximum daily dose 0.75 mg **or** timed release 0.375 mg every 12 hours; maximum daily dose 0.75 mg
  - Children >12 yrs to Adults: 0.125-0.25 mg every 4 hours as needed; maximum daily dose 1.5 mg **or** timed release 0.375-0.75 mg every 12 hours; maximum daily dose 1.5 mg
- IV, IM, SubQ:
  - Children >12 yrs to Adults: 0.25-0.5 mg at 4-hour intervals for 1-4 doses

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Dicyclomine: Dosing

- Pediatric:
  - Infants ≥6 months and Children <2 years: Oral: 5 to 10 mg 3 to 4 times daily administered 15 minutes before feeding
  - Children ≥2 years Oral: 10 mg 3 to 4 times daily
  - Adolescents: Oral: 10 to 20 mg 3 to 4 times daily
- Adult:
  - Oral: Initial: 20 mg 4 times daily for 7 days;
    - after 1 week, may increase to 40 mg 4 times daily.
  - If efficacy not achieved in 2 weeks or if adverse effects require a dose <80 mg/day, therapy should be discontinued
  - safety data unavailable for doses >80 mg day for a duration that exceeds 2 weeks
  - IM only: 10 to 20 mg 4 times/day; convert to oral therapy as soon as possible

Antidepressants

- Used to treat chronic GI pain
- MOA: modify messages between gut and grain
  - Act on central and peripheral nervous system through anticholinergic effects
  - Modulates mood, visceral and neuropathic pain
  - Downregulates pain intensity
    - Work directly on GI tract
    - Decreases pain perception
    - Normalize motility
      - Improves diarrhea by slowing transit
      - Lessens constipation by hastening transit time

Tricyclic antidepressants (TCAs)

- Pediatric data mixed; most evidence is adult based
- Amitriptyline
  - Beneficial in adolescents with IBS in improving QOL
  - ***Large RCT showed no difference in pain scores***
    - High placebo effect
- May be better than SSRIs in reducing chronic neuropathic pain

TCAs: Concerns

- Side effects
  - Most seen with tertiary TCAs (amitriptyline, imipramine) than in secondary amines
  - Sedation
  - Constipation
  - Urinary retention
  - Insomnia
  - agitation

Amitriptyline: Dosing

- 30-50 kg: 10mg orally at bedtime
- 50-80 kg: 20mg orally at bedtime
- >80kg: 30mg orally at bedtime

Patients should undergo EKG screening for prolonged QT syndrome.

Serotonin reuptake inhibitors (SSRIs)

- MOA: block reuptake of 5-hydroxytyrptamine (5-HT)
  - Increase 5-HT concentration at presynamptic nerve endings
- Improve overall feeling of well being
  - ↓anxiety of GI related symptoms
  - Useful when anxiety or depression co-exist
  - Augments analgesic properties of TCAs when used together
- *No pediatric placebo controlled trials*
- Thought to be *less effective* in treatment of IBS in adults

Role of SSRIs in IBS

- Propensity to cause diarrhea
  - Useful in constipation related IBS
  - Campo et al
    - Open label prospective non controlled pediatric trial
    - **Citalopram** evaluated for treatment of FAP
      - Dosing:
        - » Week 1:10mg/day
        - » Week 2: 20mg/day
          - If no response, dose increased to 40mg/day
        - » Well tolerated
      - Children showed improvement on a clinical global impression scale

SSRIs: Concerns

- FDA black box warning
  - Increased risk of suicidal thoughts/actions in children & adolescents
- EKG should be performed prior to initiating SSRIs for IBS
  - R/O QT prolongation

OTHER THERAPIES

Propranolol

- Can be used for prophylaxis
- mechanism of action of propranolol not well understood
  - ? related to beta-blockade
  - May inhibit vasospasm of cerebral arteries in the early stages of the attack.
- Do not be withdraw abruptly; but gradually taper to avoid acute tachycardia, hypertension, and/or ischemia

Cyproheptadine

- MOA: serotonin antagonist or a calcium-channel blockade
  - competes with histamine for H1-receptor sites on effector cells in the gastrointestinal tract, blood vessels, and respiratory tract
- Dosing (oral): Infants ≥9 months and Children <12 years: 0.04 to 0.6 mg/kg/day in divided doses 2 to 3 times daily; median effective dose: 0.22 mg/kg/day (Rodriguez 2013)
  - Sadeghian M, et al. (2008)
    - double-blind placebo-controlled trial
    - efficacious for the *treatment* of PP-FGIDs in children
- Side effects: sedation, increased appetite

Sumitriptan

- Selective agonist for serotonin (5-HT1B and 5-HT1D receptors)
- Abdominal migraine
- Administered during acute attack
- Dose:
  - Children 5-12 years: 5 mg, 10 mg, or 20 mg administered in *one nostril as a single dose* (weight based: 20-39 kg: 10 mg/dose; body weight ≥40 kg: 20 mg/dose)
- Intranasal
  - Tastes bitter
  - Each nasal spray unit is preloaded with 1 dose
- Concerns: serotonin syndrome

Pizotifen (Sandomigran)

- Available in Canada (Not approved in the US)
- antimigraine agent: strong serotonin antagonist; weak antihistamine
- Migraine prophylaxis: Adolescents ≥12 years: Oral: Initial: 0.5 mg at bedtime; may increase dose gradually up to maximum of 1.5 mg daily. Doses >1 mg should be administered in divided doses.
- Note: may require several weeks of therapy for response seen
  - Drug holidays recommended periodically to assess the need for ongoing therapy
  - Do not discontinue abruptly (reduce gradually over 2-week period)
- Hepatotoxic effects may occur with prolonged used
- May increase appetite, weight gain
- Can cause significant sedation

Emerging Therapies

- Pregabalin (Lyrica)
  - 3-isobutyl derivative of inhibitory neurotransmitter γ-aminobutyric acid (GABA)
    - binds to the α2δ subunit (A2D)- voltage-gated calcium channels (VGCCs)
    - modulates calcium influx at the nerve terminals
  - Increase distension sensory thresholds
  - Reduce dose in renal dysfunction
  - Do not abruptly discontinue; taper dosage over at least 1 week

Complementary and Alternative Medicine (CAM) for FGIDs

- Supplements and herbs are not regulated by FDA
- Examples of therapies studied in clinical trials for FGID symptoms:
  - Enteric coated peppermint oil
  - Tumeric extract
  - Chios mastic gum
  - Ginger
  - Artichoke leaf extract

Peppermint Oil

- Derived from *Mentha piperita L*.
- Relaxes intestinal smooth muscle by blocking calcium channels
  - Additional analgesic properties through its effect on transient receptor potential channels
- Typically provided as an enteric coated capsule
  - Since not a drug, product quality can vary
  - Premature release of peppermint in stomach can cause heartburn

Pro-motility Agents

- Stimulate propulsive motility within GI tract
- Examples
  - Motilides
    - erythromycin
  - 5-hydroxytryptamine4 (5HT4) receptor agonists
    - Tegaserod
    - Cisapride

Motilides

- Activate motilin receptor on smooth muscle & cholinergic nerves
- Enhance gastric (antral) contractility
  - Improved fundic tone
  - Enhances gastric emptying
- Motilin receptor agonists
  - Erythromycin
  - Azithromycin
  - Clairthromycin

Erythromycin: Dosing

- Available in oral and intravenous forms
- Limited data available: Infants, Children, and Adolescents
- Diagnosis; gastric emptying study (provocative testing): IV: 2.8 mg/kg infused over 20 minutes; maximum dose: 250 mg (Waseem 2012)
- Treatment: Oral: 3 mg/kg/dose 4 times daily; may increase as needed to effect; maximum dose: 10 mg/kg or 250 mg (Rodriguez 2012)

Erythromycin: Cautions

- Tachyphylaxis
- Reduces accommodation (gastric relaxation in response to food)
  - Low doses (1-2mg/kg/dose) enhances GI motility without loss of accommodation
- Altered cardiac conduction
  - Rare QTc prolongation and ventricular arrhythmias, including torsade de pointes.

Tegaserod (e.g., Zelnorm)

- partial type 4 serotonergic (5-HT4) receptor agonist
- Useful when treating chronic constipation
- Available in U.S. under an emergency investigational new drug (IND) process (druginfo@fda.hhs.gov or 301-796-3400)
- may be associated with an increased risk of ischemic cardiovascular events (e.g., unstable angina, myocardial infarction, stroke)
- dosing: Oral: 6 mg twice daily, before meals, for 4-6 weeks; may consider continuing treatment for an additional 4-6 weeks in patients who respond initially

Cisapride (Propulside)

- Enhances the release of acetylcholine at the myenteric plexus
- 5 HT_4 agonist
  - may increases gastrointestinal motility and cardiac rate
  - increases lower esophageal sphincter pressure and lower esophageal peristalsis
  - accelerates gastric emptying of both liquids and solids
- Highly restricted due to QT interval prolongation
  - Check EKG, electrolyte status
- Numerous drug interactions
- Dosing: Infants and Children: 0.15-0.3 mg/kg/dose 3-4 times/day; maximum dose: 10 mg/dose
- In U.S. available via limited-access protocol only. Call 877-795-4247

Emerging Therapies

- Relamorelin
  - Peptapetide synthetic gherlin agonist
- Camicinal
  - Small molecule non-motilde motilin receptor agonist
  - Phase II
- Loxiglumide/dexloxiglumide
  - Cholecystokinine-1 receptor antagonists
- Capsaicin
  - Transient receptor potential cation channel, vannilloid member 1 agonist
  - More effective than placebo in treating functional dyspepsia

Probiotics

- Effects vary with specific strains/doses
  - Cannot extrapolate findings to other products
- Lactobacillus GG
  - 3 pediatric studies
  - Showed greater pain relief vs. placebo
- VSL#3
  - 6 week international, multicenter crossover study
  - Superior improvement in symptom relief, abdominal pain/discomfort, abdominal bloating/gassiness

Fiber

- Decreases whole gut transit time
- Accelerates oral-to-anal transit
- Decreases intra-colonic pressure
- Few RCTs performed in children
- No current consensus on their use
- Soluble fiber preferred
  - Insoluble fiber can cause abdominal bloating/discomfort

Partially Hydrolyzed Guar Gum (PHGG)

- Soluble fiber
  - Metabolized in large bowel
  - Produces short chain fatty acids
  - Selective stimulation /modulation of bacterial growth
- Pediatric dose: 5g/day
- RCT showed significant improvement IBS symptoms, abdominal pain, normalization of bowel habits after 4 weeks

FUNCTIONAL CONSTIPATION/FECAL INCONTINENCE

Pediatric Treatment Considerations

- Comprehensive program
  - Laxatives
  - Behavior modification
  - Dietary changes
- Type and intensity of treatment tailored to severity of constipation and child's developmental stage

Goal of Therapy

- Passage of soft stools
  - Ideally once per day or least every other day
  - May take weeks to months (maybe years) to achieve

ORAL MEDICATIONS

Rationale

- Noninvasive
- Gives child feeling of control
- Useful in children with history of painful defecation, perineal trauma, difficulty tolerating enemas
- Adherence difficult
- May take 2-3 days or 2 weekends of treatment if need to do complete disimpaction

Treatment: Infants

- Reassure mothers who are breast feeding
- Disimpaction
  - Glycerin suppository (intermittent)
- Medication
  - Lactulose (1ml/kg/day or bid)
  - Corn syrup
  - Malt extract

Treatment: Older Child

- Disimpaction
- Medications
- Diet
- Behavior Modification
- Follow up

Polyethylene Glycol 3350

- PEG without electrolytes
- Miralax
- Dose
  - Double strength (34g/8 ounces water)
    - 20-30kg: 1 liter (4 cups)
    - 30-40kg: 1.5 L
    - >40kg: 2 L
  - Consider adding senosides 15mg
  - Repeat next day if not clean

Maintenance Medications: Lubricants

- PEG (Miralax)
  - 1g/kg/day (17g=1cap; mix 4-8 oz water) 1 tsp= 1 gram
  - Rare to exceed 17g bid
- Lactulose
  - 1ml/kg/dose daily or bid
  - Max dose 30ml bid
- Mineral oil
  - 1ml/kg/dose daily or bid (max dose 30ml bid)
  - Avoid in children <4 years, neurologically impaired

Maintenance

- Stimulants
  - Senna 7.5mg sennosides 2-3x/week
    - 1 Ex-lax – 15mg sennosides
    - 1 Senakot = 7.5mg sennosides/5mL
- Osmotic agent
  - Milk of magnesium 1mL/kg/day (up to 30mL)

Emerging Treatments

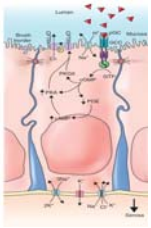
- Often considered rescue medications
  - 5-HT4 receptor antagonists
  - Intestinal secretagogues
  - Bile acid modulators

5-HT4 Receptor Agonists: Next Generation

- High intrinsic activity
- Greater specificity at intestinal 5-HT4 receptors
- Low intrinsic activity in cardiac muscle
- Better cardiovascular safety profile than older 5-HT4 agonists
- Examples
  - Prucalopride
  - Mosapride
  - Velusetrag
  - Naronapride

Intestinal Cl- Secretagogues

- Acts on CF transmembrane regulator or ClC-2 chloride channels on the apical aspect of gastrointestinal epithelial cells
- Produces a chloride-rich fluid secretion
- These secretions soften the stool, increase motility, and promote spontaneous bowel movements (SBM)
- Approved agents:
  - Lubiprostone (Amitiza)
  - Linaclotide (Linzess, Constella)
- Still in development
  - Plecanatide, Tenapanor



Published in: Noel Lee; Arnold Wald; Expert Opinion on Drug Metabolism & Toxicology 2011, 7, 651-658.

Lubiprostone

- Acts on CF transmembrane regulator and ClC-2 chloride channels on the apical aspect of gastrointestinal epithelial cells
- Produces a chloride-rich fluid secretion
- Bicyclic fatty acid
- Given orally
- Approved indication: chronic constipation and IBS-C in adults

Lubiprostone: Pediatric Experience

- Hyman et al (2014)
  - Multicenter, open label trial trial
    - ≥12 kg, ≤ 17 years [mean age 10.2 years (range 3-17 years)]
    - <3 spontaneous BMs /week
  - 4 weeks trial
    - doses: 12 µg once daily, 12 µg twice daily, or 24 µg BID based on age and weight
    - primary endpoint was SBM frequency during week 1 versus baseline
  - SBM frequency was improved significantly from baseline overall ($P<0.0001$)

Linaclotide

- stimulates secretion by a different pathway than lubiprostone
  - Stimulates of guanylate cyclase C receptors to increases concentrations of cGMP
  - Increases intestinal secretion of water and electrolytes
- contraindicated in patients< 6 yrs
- Avoid use in pediatric patients 6 to 17 years of age.
  - deaths due to dehydration were observed in *young juvenile animals* during nonclinical studies
  - deaths were not observed in older juvenile animals

Linaclotide: Pediatric Experience

- Corral et al (2015)
- Case report
- 16yr old female with Prader-Willi syndrome
  - rectal pain and constipation for 2 years despite multiple medications and weekly enemas
  - Improved with combination of biofeedback and once daily doses of linaclotide (dose not specified)
    - Approved adult dosing:
      - Chronic idiopathic constipation (CIC):145 mcg once daily
      - Irritable bowel syndrome with constipation (IBS-C): 290 mcg once daily

Bile Acid Modulation

Rationale:

delivery of bile acids into the colon due to inadequate ileal reabsorption results in secretory diarrhea

25% patients with IBS-D have bile salt malabsorption

Elobixibat (Phase II)

selective inhibition of ileal bile acid transporter (IBAT inhibitor)

↑ bile salts to the colon

improves stool consistency and increases stool frequency

Peripherally Acting μ- Opioid Receptor Antagonists

- N-methylnaltrexone & Naloxegol
  - Designed to reverse peripheral effects of opioids without compromising central opioid analgesia
- Alvimopan
  - improve stool output for children whohave opioid-induced constipation
  - carries the risk of introducing withdrawal

NARCOTIC BOWL SYNDROME (NBS)

Narcotic Bowl Syndrome (NBS)

- Newly recognized condition
- Characterized by abdominal pain that began after starting narcotics for any type of medical problem
- Should not be confused with Opioid Bowel Dysfunction

Diagnostic Criteria for NBS

- Chronic or frequently recurring abdominal pain that is treated with acute high dose or chronic narcotics and **ALL** of the following:
  - Pain worsens with continued or escalating narcotic dosages
  - Marked worsening of pain dose decreases and improves when narcotics re-instituted
  - Progression of frequency, duration, & intensity of pain episodes
  - Nature & intensity of pain not otherwise explained by GI diagnosis

Treatment of NBS

- Narcotic detoxification
  - Add a new medication to manage abdominal pain prior to narcotic withdrawal
    - Most commonly used medications: anti-depressants
      - TCAs (desipramine, amitriptyline, nortriptyline)
      - Serotonin norepinephrine reuptake inhibitor (duloxetine, venlafaxine, milnacipran)
    - Clonidine – blocks withdrawal effects
    - Anxiolytics –lorazepam or quetiapine
      - Improves sleep
      - Reduces anxiety
      - Enhances pain control

CHRONIC DIARRHEA
DIARRHEA-PREDOMINATE IBS

Current Therapies
μ-opioid receptor agonists

Loperamide

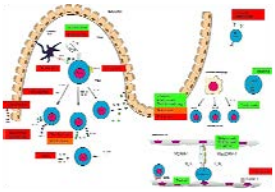
- Limited ability to cross BBB
- Inhibits secretion
- Reduces colonic transit
- Increases resting anal sphincter tone
- Dosing (oral):
  - Infants ≥2 months and Children: 0.08-0.24 mg/kg/day divided 2-3 times/day (Buts, 1975).
  - Initial: 1-1.5 mg/kg/day in 4 divided doses with subsequent dose decreased as stool output and diet tolerance improved and patient weight increased. Reported final dose range of 0.25-0.5 mg/kg/day in 2 divided doses was used long-term until patient achieved target weight and dietary goals; reported duration of therapy: 6 months to ~2 years (Sandhu, 1983); maximum single dose: 2 mg

Bile Acid Binders

- Cholestyramine
  - oral: 240 mg/kg/day in 3 divided doses; maximum daily dose: 8 g/day (Ching 2009)
  - Tastes bad, sticks to teeth
- Colesevelam (Welchol)
  - 625mg 1-3 tablets twice daily
  - Tablets are large, may be difficult to swallow

Novel Therapies

- Rifaximin
  - Minimally absorbed antibiotic
  - Improves global IBS symptoms and bloating
  - No effect on bowel function
- Eulxadoline
  - μ-opioid agonist and δ-opioid antagonist
  - Do not use in patients with history of acute pancreatitis
- Glutamine
  - 1g TID associated with improved abdominal pain, bloating & diarrhea
  - Restored intestinal permeability



EMERGING STRATEGIES IN THE MANAGEMENT OF PEDIATRIC IBD

Overall Goals of Treatment

- Changed dramatically in past 15 years
  - Previously treatment options limited; goals focused on reducing symptoms
- With advent of biologics, new goals have emerged
  - Eliminate symptoms; restore quality of life
  - Restore normal growth
  - Eliminate complications

Classification of IBD Therapies

- Induce remission of active disease
  - Steroids, anti-TNFs
  - Aminosalicylates for UC
- Maintain remission in patients with quiescent disease
  - Anti-TNFs
  - Immunodulators
  - Aminosalicylates for UC

Corticosteroids

- Effective in induction of clinical remission
  - Approximately ½ children will become dependent on steroids or require surgery
- Less than 30% will achieve mucosal healing
- Budesonide
  - Limited bioavailability due to extensive hepatic first pass metabolism
  - Effective in for induction of remission, not effective as maintenance therapy
  - Not as effective as conventional steroids; use in mild-moderate disease

Aminosalicylates

- Exert topical anti-inflammatory effects on intestinal mucosa
- Given orally to release active moiety (5-ASA) in ileum/colon or topically via enema or suppository
- Sulfasalzine – hard to tolerate side effects
- Sulfa-free 5-ASA drugs
  - Mesalamine
  - Balsalazide
  - Osalazine
- Systematic review do not support their use in Crohn's Disease

Balsalazide

- Only 5-ASA agent with a pediatric indication
- Induces clinical response in 8 weeks in 45% children with mild-moderate active UC (12% remission)
- 30% with UC maintain remission with 5-ASA monotherapy
- Rare side effects include:
  - Paradoxical exacerbation of colitis
  - Interstitial nephritis
  - Pericarditis
  - Pneumonitis

Immunomodulators

- Thiopurines
  - Azathioprine Mercaptopurine (6MP)
  - Delayed onset of action – effective only for maintenance therapy
  - If started within 8 weeks of diagnosis – reduces steroid requirements
  - AEs: myelosuppression/pancreatitis/ ↑ transaminases/lymphoma
- Methotrexate
  - Alternative to thiopurines
  - Effective in maintaining remission in 1/3 children with CD
  - AEs: nausea/myelosuppression/hepatotoxicity
  - Take with daily folic acid supplements

THERAPEUTIC MONOCLONAL ANTIBODIES

Anti-TNF therapy

- Revolutionized IBD treatment
- Intravenous infusion
  - Infliximab
- Subcutaneous injection
  - Adalimumab
  - Certolizumab pegol
  - Golinmumab
- Typically used in children with IBD refractory to steroids or who remain steroid dependent despite immunomodulator therapy

ANTI-TNF Benefits

- Superior to thiopurines for inducing complete mucosal healing
- Only class of drugs shown to completely heal perianal fistulas in CD
  - Should be first line therapy for CD in children with deep mucosal ulcerations, perianal fistulas, and/or growth failure
  - Infliximab shown to improve linear growth in children with associated growth failure

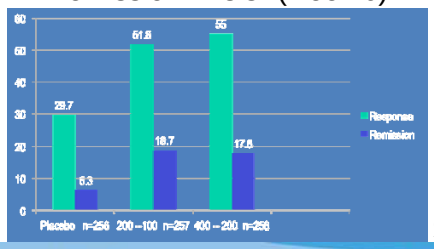
ANTI-TNF Adverse Effects

- Infusion/injection related reactions
- Psoriasis like rash
- Increased risk of infection
  - Screen for latent TB infections prior to starting treatment
- Lymphoma ?
  - Hepatosplenic T-cell lymphoma
  - May be associated with prior exposure to thiopurines
  - Risk higher in males

Golimumab for moderate to severe UC

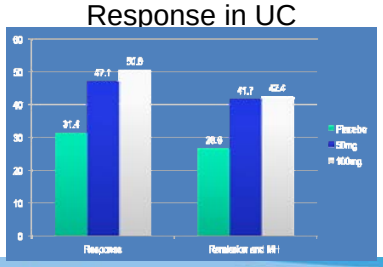
- fully human monoclonal antibody TNF -α
- PURSUIT trial (Sandborn et al Gastroenterology 2014)
  - Failed conventional therapy
  - Immunosuppressants allowed
  - Prior Anti TNF not permitted
  - Followed 6 weeks
    - Placebo
    - Golimumab 200 mg- 100mg
    - Golimumab 400 mg – 200mg at week 0 and 2

Golimumab Clinical Response and Remission in UC (week 6)



Gastroenterology. 2014 Jan;146(1):85-95

Golimumab Maintenance of Treatment Response in UC



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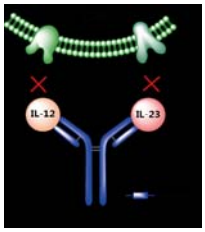
Golimumab Dosing

- US labeling: SQ: Induction: 200 mg at week 0, then 100 mg at week 2, followed by maintenance therapy of 100 mg every 4 weeks
- Canadian labeling: SQ: Induction: 200 mg at week 0, then 100 mg at week 2, followed by maintenance therapy of 50 mg every 4 weeks

Ustekinumab (Stelara)

- Human monoclonal antibody
- Binds to and interferes with the proinflammatory cytokines, interleukin (IL)-12 and IL-23
- Approved for the treatment of psoriasis

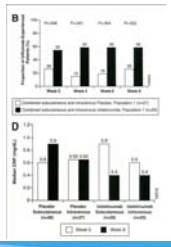


Ustekinumab in UC

- Sandborn et al, Gastro 2008 135:1130
  - Four arm study – 3 different doses and placebo
  - 526 patients from 153 centers
  - Inclusion criteria
    - Crohn's for at least 3 months
    - Active CDAI (220-450)
    - Failed anti-TNF therapy
      - loss of response or serious adverse event
    - Stable doses of ASA, 6MP, MTX, or prednisone allowed

Ustekinumab Response

- Dosing:
  - 3mg/kg
  - 90 mg SQ monthly
- Week 6 response
  - 35% ustekinumab (3mg/kg)
  - 23% placebo
- Week 22 remission
  - 42% ustekinumab
  - 27% placebo
- Limited evaluation of mucosal healing

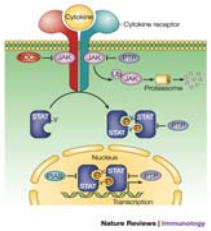


Ustekinumab: Concerns

- Serious infections
  - 7 patients (6 ustekinumab) during induction
  - 11 patients (4 ustekinumab) during maintenance
- Antibodies rare
- 1 basal cell CA in an ustekinumab patient
- Infusion reactions 5% (including in the placebo group)
- Psoriasis trials suggest overall good safety profile
  - no significant increase in infections or cardiovascular events

Tofacitinib (Xeljanz)

- Small molecule
- **Oral** Janus Kinase inhibitor -JAK
  - Affinity for JAK 1 and 3
  - Inhibits cytokine signaling
- Approved for RA that has not responded to MTX
- Metabolized by liver (CYP3A4)
- Phase 2 clinical trial suggests efficacy in UC

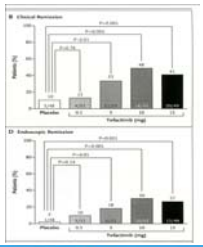


Tofacitinib in Active UC

- Sandborn et al NEJM 2012; 367:616
  - Phase 2 placebo RCT
  - 194 adults active UC assigned to 4 different doses of tofacitinib or placebo [0.5, 3, 10 ,15 mg BID or placebo (8 weeks)]
  - Prior medications
    - 40% immunomodulator failure
    - 30% prior anti-TNF exposure
  - Short term trial – only 2 months

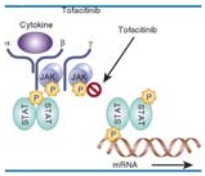
Tofacitinib Results

- Clinical remission at 2 months
  - 48% at tofacitinib, 10 mg bid vs. 10% on placebo
- Endoscopic remission
  - 30% on tofacitinib 10 mg bid vs. 2% on placebo



Tofacitinib: Concerns

- Myelosuppression
- Lipid abnormalities
  - Increase in both LDL and HDL
  - Some patients need statins to control
- Serious infections
  - Pneumonia, cellulitis, zoster, UTI
- Liver function abnormalities
- Malignancies (including lymphoma)



Boston Children's Hospital
Until every child is well

Scott, Drugs 2013; 73: 857

Future Therapies

- Intestinal microbiome manipulation
  - Antibiotics
  - Probiotics
  - Fecal Transplant
- Drugs selective to specific targets in the inflammatory cascade
- Gene Therapies

Boston Children's Hospital
Until every child is well

98

Boston Children's Hospital
Until every child is well

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Sexuality and Reproductive Health in Adolescents and Young Adults with Inflammatory Bowel Disease

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Disclosures

- None

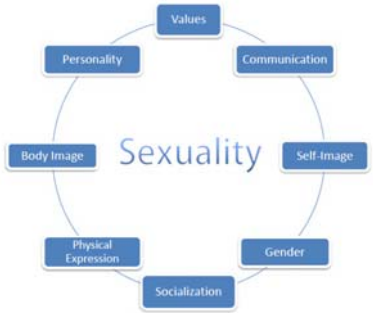
Objectives

- Provide an overview of adolescent sexuality development
- Review factors impacting sexuality and sexual function in inflammatory bowel disease (IBD)
- Review sexual and reproductive health issues for men and women with IBD

Pediatric and Adolescent IBD

- 25% of individuals with IBD diagnosed in childhood or adolescence
- Developmental milestones
  - Physical growth
  - Puberty
  - Psychological development
  - Sexuality

Components of Adolescent Sexual Development



WHO. (2004). Sexual Health – a new focus for WHO, No.67, Department of Reproductive Health and Research, World Health Organization, Geneva, Switzerland.

Adolescent Sexual Development

Early Adolescence ♀: 9-13 years ♂: 11-14 years	• Puberty as a hallmark • Concern with body changes and privacy • Sexual activities are usually non-physical
Middle Adolescence ♀: 13-16 years ♂: 14-17 years	• Full physical maturation is attained • Experimentation with relationships/sexual behavior • Sexual behaviors may not match sexual identity
Late Adolescence ♀: 16-21 years ♂: 17-21 years	• Body image & gender role definition nearly secure • Greater intimacy skills • Sexual behavior becomes more expressive

Adapted from "Sexual health-CA Version – An Adolescent Provider Toolkit" Adolescent Health Working Group, 2003

Impact of IBD on Sexuality

40-60% of men and women with IBD report sexual dysfunction

80% indicate that symptoms affect sexual satisfaction

↓sexual satisfaction correlates with ↑disease activity

IBD

75% of patients report impairment in body image

Depression is a common comorbid factor with sexual dysfunction

Jedel S et al. Inflamm Bowel Dis 2015; 21(4): 923-938
Sanders J et al. Am J Obstet Gyn 2016; 215(1): 58-62

IBD and Sexuality

Physical Impact

- Perianal disease
- Fistulae
- Skin lesions
- Arthritis
- Pain
- Fatigue
- Surgical Scars
- Stoma
- Med effects
- Diarrhea

Jedel S et al. Inflamm Bowel Dis 2015; 21(4): 923-938

IBD and Sexuality

Psychological Impact

- Body image
- Disclosure
- Sexual drive
- Sensations with sexual activity
- Self-esteem
- Anxiety
- Depression
- Loss of identity

Jedel S et al. Inflamm Bowel Dis 2015 April; 21(4): 923-938

Impact of Surgery on Sexual Function in IBD

- Rates of post-operative sexual functioning variable between both men and women
- Fear of a stoma is a common concern
- Colectomy with ileal pouch anal anastomosis may be associated with sympathetic/parasympathetic nerve damage
  - ♀ - dyspareunia, vaginal dryness 15%
  - ♂ - erectile dysfunction, retrograde ejaculation 3%

Jedel S et al. Inflamm Bowel Dis 2015 April; 21(4): 923-938
O'Toole et al. Aliment Pharmacol Ther 2014; 39; 1085-1094

Sexual Function and Pediatric Colectomy with Ileal Pouch Anal Anastomosis

- Paucity of data regarding impact of colectomy + IPAA in the pediatric population
- Survey of 16 patients who underwent TAPC+IPAA < 18 yrs

Sexual Function	• 6/7 ♀ and 2/4 ♂ reported negative impact on sexual activity • Erectile dysfunction, dyspareunia, ↓ libido
Reproductive Health	• 2 ♂ had one child post-colectomy • 3 ♀ unable to conceive post-colectomy

Dalal D et al. JPGN 2012; 55(4): 425-428

Sexual Health and IBD

- Chronic steroid or antibiotic use may ↑ risk of vaginal or urinary tract infections in women with IBD
- Paucity of information regarding sexually transmitted diseases
  - ↑ *Gardnerella vaginalis* biofilms in women with IBD
- IBD patients on immune suppressive therapy have an ↑ risk of cervical high grade dysplasia and cancer
  - HPV vaccination: ♀ 11-26 yrs and ♂ 11-22 yrs
  - Gardasil, Gardasil 9, Cervarix
  - Not live virus vaccines; safe on immunesuppressants

Sanders J et al. Am J Obstet Gyn 2016; 215(1): 58-62
Feagins L et al. Gastroenterol Clin N Am 2016; 45: 303-315

Contraception and IBD

Category 1 *No Restrictions*	• Levonorgestrel and copper IUDs • Contraceptive implants
Category 2 *Benefits Outweigh Risks*	• Injectable contraceptives • Progestin-only pills
Category 2/3 *Assess Thrombosis Risk**	• Combination estrogen oral therapy • Transdermal patch • Vaginal ring

***In women with increased risk of thrombosis risks outweigh benefits**

Gawron L et al. Inflamm Bowel Dis 2016; 22(2): 459-464

Fertility and Fecundity

Fertility

- Capacity to reproduce
- Infertility = failure to conceive after 1 yr unprotected intercourse

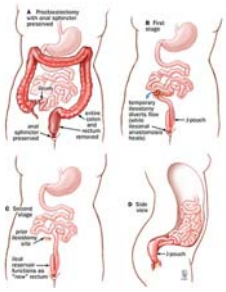
Fecundity

- Ability to achieve a live birth within one menstrual cycle

Female Fertility and IBD

- Women with medically managed IBD do not have reduced fertility compared to the general population

Population	Infertility Rate
General	13-14%
UC without surgery	15%
CD without surgery	14%
UC after colectomy	25-65% (↓ fecundity)
CD after bowel surgery	May ↑ - variable



- Decreased fecundity after colectomy + IPAA due to scarring of fallopian tubes
- Successful pregnancies with IVF

Gawron L et al. Inflamm Bowel Dis 2016; 22(2): 459-464

Male Fertility and IBD

- Overall pregnancy rates for men with IBD lower than controls but no differences in fecundability

Common causes of infertility in men with inflammatory bowel disease

Medications
Active inflammatory bowel disease
Poor nutritional status
Tobacco use
Alcohol use
Postsurgical

Drug	Sexual dysfunction	Infertility	Adverse pregnancy outcomes
Sulfasalazine	Single report of ED	Yes, oligospermia, reversible	Limited data, possible increase in congenital anomalies
Other 5-ASAs	None reported	Case reports of oligospermia	None reported
Steroids	None reported	None reported	None reported
6-MP/azathioprine	None reported	None reported	Conflicting data but no clear link
Methotrexate	ED	Probable altered spermatogenesis	None reported, but limited data
Cyclosporine	None reported	None reported	None reported
Infliximab	None reported	Unclear, but decreased motility noted	None reported
Adalimumab	No data	No data	No data

Feagins L et al. AJG 2009; 104: 768-773

Pregnancy and IBD: Disease Activity

- Remission before conception is key
  - Inactive disease: 70% no flare 30% flare
  - Active disease: 1/3 worsen 1/3 unchanged 1/3 improve
- Flares most common 1st trimester and immediate post-partum
  - 20-50% associated with med discontinuation
- Disease activity may be associated with:
  - Low birth weight, pre-term labor, fetal loss
- IBD surgery during pregnancy – less predictable outcomes

Pregnancy and IBD: Medication Safety During Pregnancy

Safe	Probably safe	Contraindicated
Mesalamine*	Azathioprine	Methotrexate
Sulfasalazine	6-mercaptopurine	Thalidomide
Corticosteroids	Tacrolimus	6- Thioguanine
Metronidazole	Cyclosporine	
Loperamide	Natalizumab	
Infliximab	Vedolizumab	
Adalimumab		
Certolizumab		
Golimumab		

*Except Asacol and Asacol HD which contain dibutyl phthalate – potential teratogen in animal studies

McConnell R et al. Gastroenterol Clin N Am 2016; 45: 285-301
Hendy P et al. Frontline Gastroenterology 2015; 6:38-43

IBD and Delivery

- Women with IBD are 1.5x more likely to have a C-section than women without IBD
- Crohn's disease
  - Avoid vaginal delivery if active perianal disease
  - Vaginal delivery safe if perianal disease is inactive
  - Consider avoiding episiotomy
- J-Pouch
  - Vaginal and C-sections can be safe
  - Discuss with OB and colorectal surgeon

McConnell R et al. Gastroenterol Clin N Am 2016; 45: 285-301

Pregnancy and IBD: Birth Outcomes

- May be increased in IBD
  - Low birth weight
  - Pre-term labor
  - Small for gestational age
  - Spontaneous abortions
- Rate of congenital malformations in IBD – unclear if ↑

McConnell R et al. Gastroenterol Clin N Am 2016; 45: 285-301

Pregnancy and IBD: Medication Safety During Breast Feeding

Safe	Probably Safe	Contraindicated
Mesalamine Sulfasalazine Corticosteroids Infliximab Adalimumab Certolizumab Golimumab Natalizumab	Azathioprine 6-mercaptopurine Tacrolimus Vedolizumab	Methotrexate Metronidazole Cyclosporine

McConnell R et al. Gastroenterol Clin N Am 2016; 45: 285-301
Hendy P et al. Frontline Gastroenterology 2015; 6:38-43

Conclusions

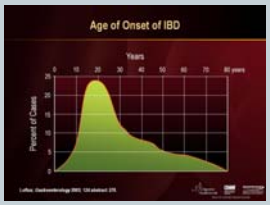
- Development of sexuality is a adolescent milestone and may be impacted by IBD
- Sexual functioning in IBD is influenced by both physical and psychological factors
- Body image impairment and depression are leading causes of sexual dysfunction among patients with IBD
- Female fecundity is reduced after colectomy + IPAA; however successful conception may be achieved with IVF
- Male fertility may be reduced by medications but is reversible
- The majority of IBD medications are compatible with pregnancy and lactation

Comprehensive Care Considerations In Pediatric IBD

AMY DONEGAN MS, APN
NATIONWIDE CHILDREN'S HOSPITAL

Background

- Inflammatory Bowel Disease is a **chronic** inflammatory disease
- Peak incidence of onset is between 15-25 years of age
- Estimated that > 50,000 children in North America have IBD with approximately 4,500 new cases annually



Background

- At Nationwide Children's Hospital we follow >600 patients with IBD
- We diagnose 100-120 new patients/year with IBD
- Can we consistently provide comprehensive care to every patient? What would this look like?

Considerations

- Consistent Health Maintenance Recommendations
- Education and Self-management support
- Financial
- School
- Psychosocial
- Transition preparedness

A Practical Approach

- Diagnosis
- Annually
- Prior to Initiation of Biologics
- Surveillance

Diagnosis

- Health Maintenance:
  - Immunization Status
  - Nutrition Evaluation
  - Bone Health
  - Eye Exam
- Additional Considerations
  - Education
  - School Issues
  - Financial Considerations

Immunization status

- Review immunization record at diagnosis
- Obtain VZV antibody titer at diagnosis, consider MMR titer if unknown immunization status
- Varicella and Mumps (via MMR) confer an 80-85% response after 1 dose of live vaccine and 95-99% after the second.
- Varicella and MMR are generally contraindicated in immunosuppressed patients

Live Vaccines

"Routine" vaccines to be avoided in patients that are immunosuppressed

- Varicella
- MMR
- Oral polio
- Intranasal influenza
- Smallpox

Hepatitis B

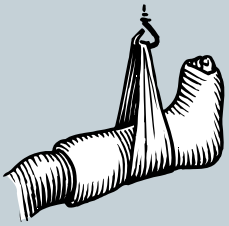
- Hep B vaccines are 80-95% effective in preventing Hep B
- In patients with a protective antibody response, recipients are virtually 100% protected
- Loss of detectable antibody ranged from 13-60% after 9 years
- Need to repeat 3 shot series if low titer

Nutrition

- Assess Ht
  Wt
  BMI
  MPH
- Helpful to have RD involved from the start

Bone health

- Bone health is negatively affected by IBD
- Inflammation decreases the rate of bone formation
- DEXA is the preferred method for measuring BMD



DEXA SCAN

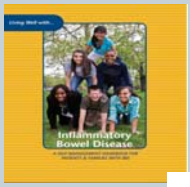
Consider DEXA (total body minus head) in kids with the following risk factors:

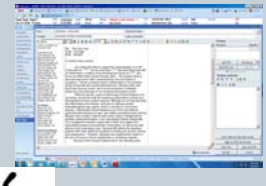
- poor linear growth
- lean muscle mass deficits
- irregular menses
- delayed puberty
- severe inflammatory disease course
- prolonged steroid use

Eye exam

- Inflammation of the eyes occurs in 5%of people with Crohn's
- Episcleritis/scleritis may be asymptomatic
- Refer to Ophtho at diagnosis for baseline screen

Additional Considerations





Annual Recommendations

Health Maintenance

- Immunizations
- Nutrition
- Eye exam
- Bone Health
- Skin screening

Additional considerations

- Psychologic assessment
- Self-management
- Financial
- School
- Adherence

Vaccines in Pediatric IBD: Continue Inactivated Vaccinations

- Inactivated vaccines: Maintain schedule
- Vaccinations:
  - Influenza (injectable only)
  - Tetanus, Diphtheria, Pertussis (DPT)
  - Human Papillomavirus (HPV)
  - Pneumococcal
  - Hepatitis A and Hepatitis B
  - Meningococcal

Melmed GY. 2009. *Inflamm Bowel Dis.*
Wasan SK *et al.*,2010. *Clin Gastroenterol Hepatol*

Annual Nutrition Recommendations

Skin Screening

- Data suggests there is an increased risk of NMSC in patients on immune suppressing meds
- Wear Sunscreen
- Have annual skin assessment

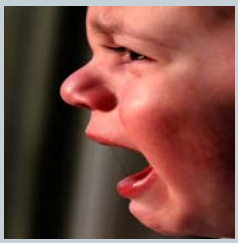
Psychological evaluation

Psych Evaluation

- Children with IBD are at an increased risk for altered psychosocial functioning
- Areas of concern include:
  - Depression
  - Anxiety
  - Self-image
  - Social/Family/School functioning

Symptoms

- < 25 % of patients will display obvious symptoms
- The majority of symptoms go unrecognized unless specifically asked
- Is there a better way to screen?



Children's Depression Inventory

- Parent and Child forms
- Takes about 10-15 minutes
- Easy scoring with validated cut off level for referral to behavioral health

PedsQL form

- Takes about 10-15 minutes to fill out
- Age specific forms
- Parent and child forms
- Established cut off values for referral to Behavioral Health

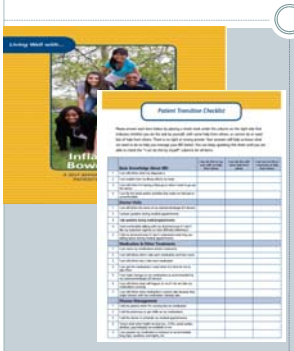
GAD

GAD-7

	Not at all	Several days	More than half the days	Nearly every day
1. Feeling nervous, anxious or on edge	0	1	2	3
2. Not being able to stop or control worrying	0	1	2	3
3. Worrying too much about different things	0	1	2	3
4. Trouble relaxing	0	1	2	3
6. Being so restless that it is hard to sit still	0	1	2	3
6. Becoming easily annoyed or irritable	0	1	2	3
7. Feeling afraid as if something awful might happen	0	1	2	3

(For office coding: Total Score T___ = ___ + ___ + ___ + ___)

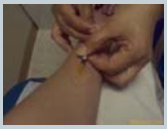
Self-Management and Transition

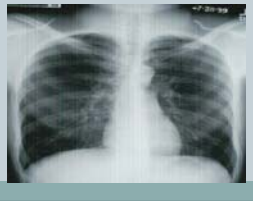


Prior to Biologics

- If you do not confirm varicella vaccination status at diagnosis, this should be done prior to starting therapy
- If you do not confirm anti-HBs antibody at diagnosis, this should be done prior to starting therapy
- Consider screening for Histoplasmosis, Hep C via qualitative PCR and HIV

Tuberculosis Screening

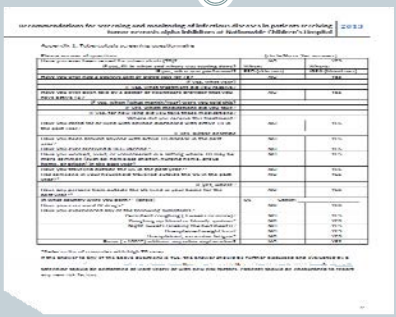




Tuberculosis Screening

- TB screening is recommended on every patient prior to starting Biologic therapy
- PPD
- Chest X-ray: PA/Lateral
- Quanitferon Gold or T-spot (< 5 yrs)
- There are currently no guidelines for yearly monitoring for TB while on biologic therapy

TB Questionnaire



Surveillance Monitoring

- Surveillance colonoscopy after 8-10 years, then every 1-2 years
- Surveillance colonoscopy yearly in patients with PSC

Summary

- IBD is a Chronic Disease that impacts approximately 50,000 children
- There are many opportunities to provide comprehensive care beyond what is routinely covered in scheduled office visits
- Using checklists and specified intervals can increase the success of reliably reviewing health maintenance recommendations with all IBD patients

Sex, Drugs & Rock'n'Roll: Screening for Health-Risk Behavior Among Adolescents & Young Adults with IBD

Rose Lucey Schroedl, PhD
Department of Pediatric Psychology

Objectives

- Overview of Adolescent Development
- Review Prevalence of Health-Risk Behavior Among Adolescents
- Discuss a screening model for health-risk behavior
- Discuss brief interventions for positive screens

The Developmental Context of Adolescence

- Period of rapid change and growth
  - Physiologically
  - Social
- Increased risk for and opportunity to engage in risk-taking behavior
- "Rite of passage"

Health-Risk Behavior Among Adolescents

- Sexual Behavior
  - 42% have ever had sexual intercourse
  - 30% were currently sexually active
  - 12% multiple partners
  - 4% first sexual intercourse before age 13
  - 56% of sexually active youth use condoms
  - 14% did not use any protection

(CDC, 2015)

Health-Risk Behavior Among Adolescents

- Cigarette Use
  - 11% of 12th graders reported use in past 30 days
  - 5.5% reported daily use in past 30 days
- Marijuana
  - 21% 12th graders reported use in last 30 days
  - 6% reported daily use in past 30 days

(Johnson et. al. 2015; Miech et. al, 2015)

Health-Risk Behavior Among Adolescents

- Alcohol
  - 40% alcohol use in the past year
  - 22% alcohol use in the past 30-days
  - 17% of 12th graders reported binge drinking in past two week
  - 6% of 12th graders report extreme binge drinking

(Johnson et. al. 2015; Miech et. al, 2015)

Why Screen for Health-Risk Bx?

- Some adolescents with IBD will engage in health-risk behaviors
- These behaviors have health and psychosocial consequences
- IBD patients may be at greater risk for negative consequences

Clinical Implications

- Regular screening for health-risk behavior is important in an adolescent population
- IBD clinic visits provide an opportunity to reduce risk associated with health-risk behaviors and/or prevent engagement in health risk behavior

Development of a Screening Process

- Universal Screening
  - Who?
  - What?
  - When?
  - How?

Who Should We Screen?

- 11-years and older
  - Early initiation = greater risk for problematic substance use later in life
  - Screening as a preventative intervention

What Should We Screen For?

- Sexual Behavior
  - Sexual Activity
  - Number of partners in past year
  - Condom Use
  - STDs/HIV Screening

What Should We Screen For?

- Alcohol, Tobacco & Marijuana Use
  - Lifetime Use vs. Time-Limited Use
  - Daily vs. Episodic Use
  - Quantity Used

When Should We Screen?

- On-Going Process
  - Time of Diagnosis
  - Annually at follow-up visits

How Do We Screen?

- Standardized Questionnaires
- **ASK!**
  - Assume the patient engages in the behavior
    - "How often do you use marijuana?"
    - Timeline is important as these behaviors are often episodic and infrequent
    - Assessment or Risk
      - Normative risk taking vs. problematic behavior

A Word of Caution

- Have a process/plan for how to respond to a postive screen
- Screening can provide a place for brief intervention for behavior change

What To Do With a Positive Screen?

- Assess motivation to change
  - How bothered are you by this?
  - How important is it for you to change this?
- Provide Education (important but not sufficient)

Harm Reduction

- Focus is on reducing consequences of health-risk behavior, rather than on preventing the behavior
  - Controlled alcohol use
  - Regular STD/HIV Screening

Refer

- Build your referral network
  - Smoking Cessation
  - Drug Treatment Programs
  - Mental Health Providers
  - Sexual Health Services

Conclusion

- Adolescents engage in health-risk behavior, which has health and psychosocial consequences
- IBD clinic visits provide an opportunity to screen for engagement in these behaviors
- Screening can serve as a point of intervention for behavior change

Tube Wars: " A long time ago in a galaxy far away there was one"

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10/2016

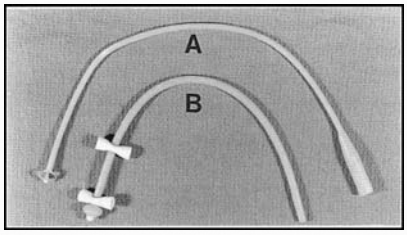
Tube Wars:

I have no financial disclosures

Learning Objectives

- Review the various types of enteral access devices
- Indications
- Acquire knowledge of placement techniques
- Assessment and management of complications

"In the beginning there was one"



What type of feeding tube ??

- Gastric feeding
  - normal gastric emptying
  - Low risk of gastric aspiration
- Small bowel feedings
  - Gastric outlet obstruction
  - Gastroparesis
  - Increased risk of aspiration
- GJ tube feedings
  - Gastric outlet
  - GERD
  - Gastroparesis

Indications for Enteral Access Tubes

- No definitive guidelines for transition to more permanent/durable feeding tube
- Short term <4 weeks in adults
  - NG/ND/NJ
- Long Term >4 to 6 weeks
  - Enterostomies --

Types of Tubes

- Nasogastric tubes
- Nasoduodenal/jejunal tubes
- Gastrostomy tubes
- Gastro-Jejunal tubes
- Jejunostomy tubes
- Cecostomy tubes

Methods of Access

- Nasogastric/enteric tubes –
- Sizes – Adults – 6fr to 12fr
- Non-invasive
- PVC, Polyurethane, Silicone
- Polyurethane – Stylets – provide tube structure, decrease risk of perforation, water activated lubricant internal and external - weighed, Y ports – single ports
- X-ray confirmation

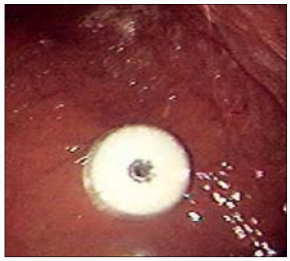
Methods of Access

- Enterstomy
  - Long term access
  - Placed endoscopic, interventional radiology, open surgical or laparoscopic
  - Sizes 12 to 18 French
  - Percutaneous G tube placement has been done at bedside with conscious sedation in adults

Methods of Access

- Gastrostomy tubes
  - PEG – percutaneous endoscopic gastrostomy
  - Endoscopic procedure or Interventional Radiology
  - Stomach is inflated with air – positions gastric wall against abdominal wall
  - IR placed G tube requires barium enema
  - Gastroenterologist/Interventional Radiologist
  - Contraindications – ascites, coagulopathy, gastric varices, obesity, neoplasm, inflammation of esophagus or stomach wall

IR Percutaneous G tube Placement



Changed after 12 weeks in IR

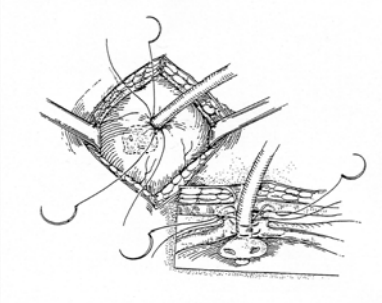
Methods of Access

Laparoscopic Placement

- Advantages
  - Can be performed in conjunction with other operative procedure
  - Stomach sutured to abdominal wall
  - Low profile device initially placed

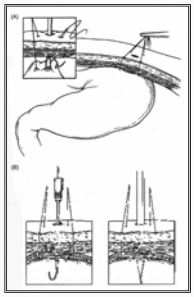
Interventional Radiology

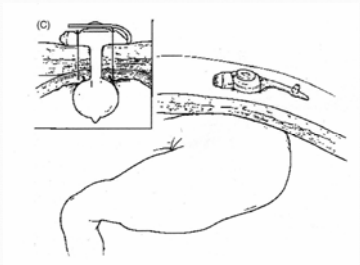
- Advantages
  - No scar
  - No OR
  - No delay in feedings



Non-Balloon low profile

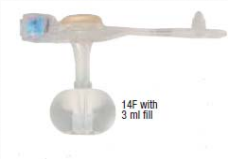
Laparoscopic G – Tube





Laparoscopic placement

- Initial placement of a balloon gastrostomy tube.
- Any surgical tube must be in place for at least 4 to 6 weeks before it can be changed. **The first change is always done by surgery.**

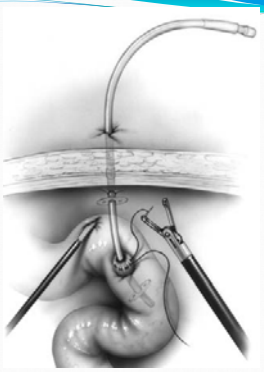


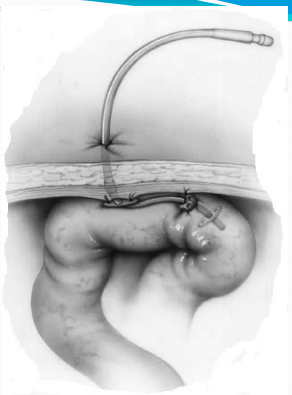
Securement dressings for Lap placed G tubes

Initially placed surgical low profile G Tubes are secured with gauze & tape (Colorado Dressing)

Methods of Access

- Jejunostomy tubes
  - DPEGJ
  - Surgical placement – open Witzel
  - Laparoscopic placement or Direct J





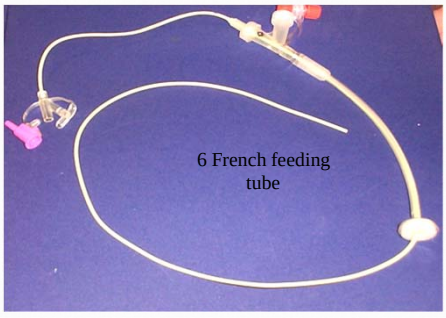
Methods of Access

- GJ tube
- DPEGJ
  - Same method is used for each procedure for placing the gastric tube but and small feeding tube is passed through the gastric tube and passed to the into the small intestine
  - Requires Fluoroscopy
  - Difficult

Methods of Access

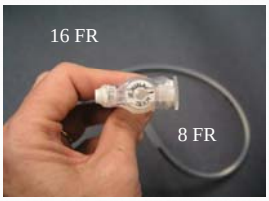
- Gastrojejunal tubes
  - PEGJ – G tube placed then feeding tube passed through the existing G tube
  - PRGJ – Interventional Radiology
  - Surgical – Laparoscopic

PERC GJ tube system – initial tube



Balloon GJ Tubes

Low Profile Balloon GJ tubes



Prevention of Clogging

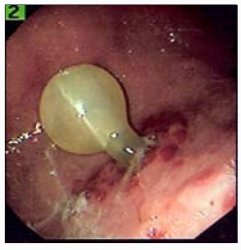
- All types of tubes
  - Causes - inadequate flushing use 10 to 15 mls
  - Medications liquid forms as much as possible
  - Pills crushed or dissolved – flush with water before and after
  - Flush before and after feedings and every 2 to 4 hours on continuous feedings –
  - Fungal degradation – silicone tubes
  - Pancreatic enzymes and Clog Zapper

Basic care of all G and J tubes

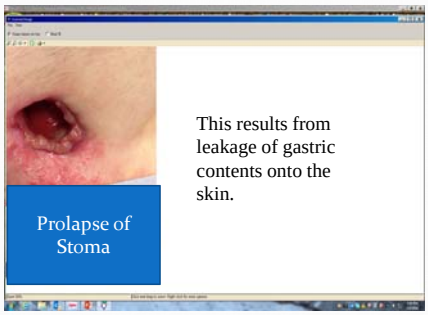
- Cleanse site with soap and water – do not use hydrogen peroxide – exfoliates that skin
- If there is leakage at the site, first check the water in the balloon, to ensure it is inflated properly
- Apply skin barrier if warranted
- Stoma powder can dry out leaky sites and helps to decrease granulation and gastric mucosa
- Replacement of G tube every 3 to 6 months
- Replacement of GJ tube in IR every 3 months

Complications of Enteral Access Devices

- Overall complications up to 70%
- Malfunction
- Leakage
- Migration
- Occlusion
- volvulus
- Granulation tissue
- Gastric mucosa prolapse
- Buried bumper



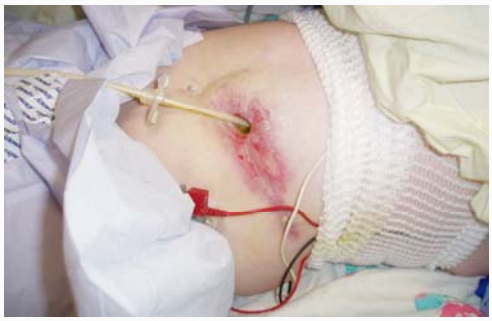
Post wall ulceration

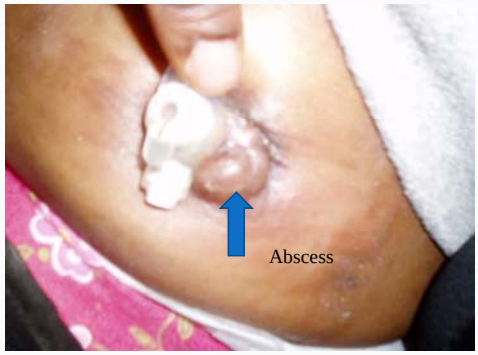


Prolapse of Stoma

This results from leakage of gastric contents onto the skin.

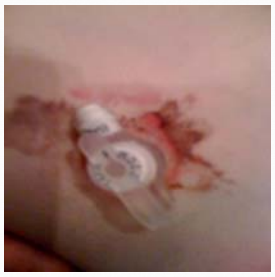
Erosion and skin breakdown





Abscess

Silver Nitrate burn



Always protect the peristomal surrounding skin

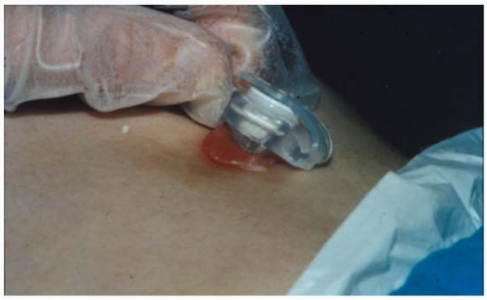
Prolapsed Gastric Mucosa

- Looks like granulation tissue but usually is larger and circumferential
- It will increase and decrease with changes in intra-abdominal pressure, such as, with coughing or use of BiPAP
- Very friable and does not respond to silver nitrate and bleeds more

Granulation Tissue

- Is a proliferation of capillaries that is manifested by exuberant red, beefy, tissue that extrudes from the stoma and may bleed easily and be painful.
- Often the granulation tissue oozes yellow, brown green or mucoid discharge. This discharge can result in spreading erythema, soreness or yeast infection of the peristomal skin. Protect peristomal skin with a skin barrier.
- It can take several weeks for resolution. Triamcinolone cream is also used for granulation
- Several new products are coming such as Granulotion, and Mesalt- check with wound care APNs

Granulation tissue



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Thank You

- Beth Goldberg, MSN, CRNP
- Judy Stellar, MSN, CRNP

Constipation once you leave Rome Management based on Phenotypes

John T. Boyle M.D.
10/16

Rome IV Criteria: Functional Defecation Disorders

- *Neonate/Toddler (Gastroenterology 2016;150:1443-1455)*
  - *Infant dyschezia*
  - *Functional constipation*
- *Children/Adolescents (Gastroenterology 2016;150:1456-1468)*
  - *Functional constipation*
  - *Nonretentive fecal incontinence*

Rome IV Criteria: Functional Constipation in neonate/toddler

1 month of at least 2 of the following in infants up to 4 years of age

- *2 or fewer defecations per week*
- *History of excessive stool retention*
- *History of painful or hard bowel movements*
- *History of large diameter stools*
- *Presence of large fecal mass in rectum*

In toilet-trained children, the following additional criteria may be used:

- *At least one episode/week of incontinence after the acquisition of toileting skills*
- *History of large diameter stools that may obstruct the toilet*

Rome IV Diagnostic Criteria: Functional Constipation in Childhood/adolescents

2 or more of following occurring at least once per week for minimum of 1 month with insufficient criteria for diagnosis of IBS

- *2 or fewer defecations in toilet per week in a child of developmental age of at least 4 years*
- *At least 1 episode of fecal incontinence per week*
- *History of retentive posturing or excessive volitional stool retention*
- *History of painful or hard bowel movements*
- *Presence of large fecal mass in rectum*
- *History of large diameter stools that can obstruct the toilet*

Rome IV Criteria

- *Great for diagnosing functional constipation*
- *Fail to clearly define phenotypes that direct specific management*

What are the chief complaints vocalized by parents/patients?

- *Decreased frequency of bowel movements/"no urge to defecate"*
- *Altered consistency or form of bowel movements (hard, pellet size, toilet stopper) (Bristol type 1 or 2)*
- *"Urge to defecate, but can't go" or sense of incomplete evacuation*
- *Fecal incontinence*

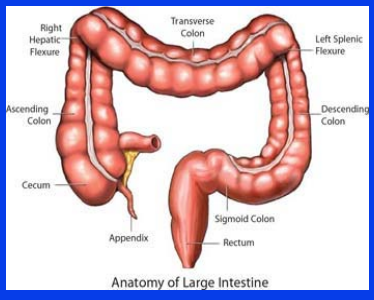
Definition of Constipation

- Altered frequency
- Altered consistency, form
- Incomplete evacuation

Differential Diagnosis of Functional constipation

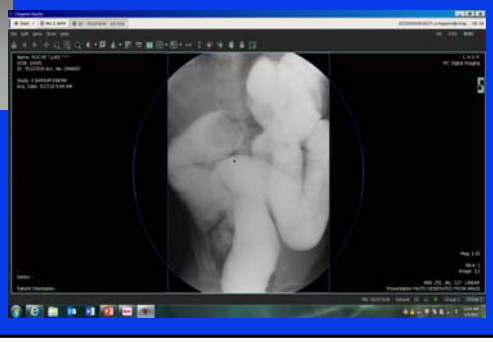
- Simple chronic constipation
  - Altered transit, efficiency of water absorption, signaling
- Outlet dysfunction constipation
  - Hirschsprung's disease, anal achalasia
  - Behavioral fecal retention
  - Disordered defecation dynamics
  - Altered conscious rectal sensitivity threshold secondary to acquired megarectum
- Slow transit constipation
  - Primary colonic dysmotility
  - Altered colon compliance
  - Progressive megarectum megacolon 2° outlet dysfunction

Variables: Efficiency, Transit

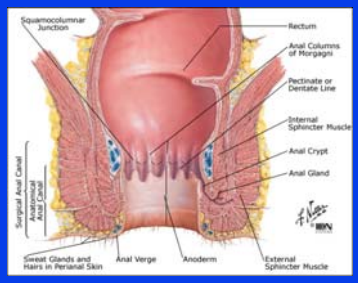


Anatomy of Large Intestine

Variable: Length (Redundant Colon)



Variable: Signaling



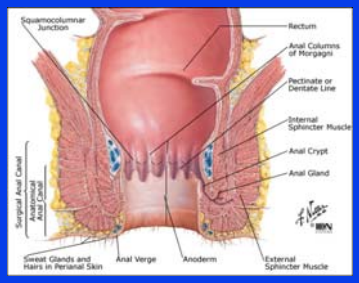
Chronic Simple Constipation

- *Potential causes:*
  - *very efficient colonic water absorption mechanism*
  - *normal variation in colonic transit time*
  - *variation in length of colon*
  - *variation in conscious rectal sensitivity threshold (Increased rectal compliance)*
- *Confounding variables*
  - *Dietary factors*
  - *Environmental stress or change*
  - *Specific medical conditions*
  - *Medication side-effect*
  - *Post-infectious irritable bowel syndrome*

When to Suspect Incomplete Evacuation

- *Infrequent, small caliber bowel movements*
- *Withholding behaviors*
- *Periodic passage of large caliber, "toilet stopper" bowel movements*
- *Pattern of small-small-large bowel movements*
- *Skid marks between bowel movements*
- *Perianal inflammation*
- *Rectal prolapse*
- *Encopresis*

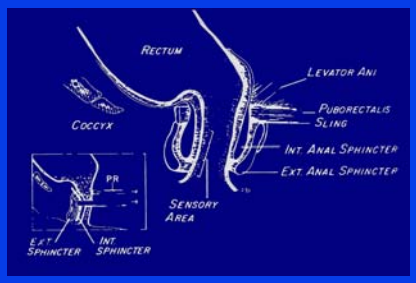
Variable: Signaling



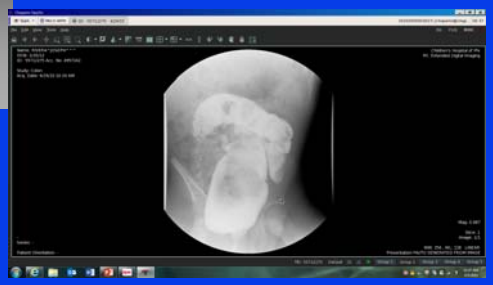
Behavioral Fecal retention

- *Causes:*
  - *voluntary withholding triggered by functional constipation*
  - *situational withholding*
    - *Resistance of toilet training/ toilet phobia*
    - *ADHD*
    - *too busy playing*
    - *fear of using bathrooms outside the home*
- *Patients behavioral with chronic fecal retention may seem to have regular bowel movements, but incomplete evacuation over time leads to acquired megarectum.*

Colorectal Anatomy and Physiology of Defecation



Acquired Megarectum



Complication of Acquired Megarectum

- *Altered conscious rectal sensitivity threshold*
- *Failure of toilet training*
- *Encopresis*

Secondary Slow transit constipation

- *Acquired more proximal colonic dysfunction secondary to long-standing outlet dysfunction constipation associated with megarectum.*
- *May also be secondary to chronic colonic distension secondary to aerophagia*

Concept of "progression"

- *Simple functional constipation can lead to outlet dysfunction constipation caused by*
  - *behavioral fecal retention*
  - *or altered defecation dynamics*
  - *or both*
- *which can lead to acquired megarectum*
- *which in turn can lead to slow transit constipation*

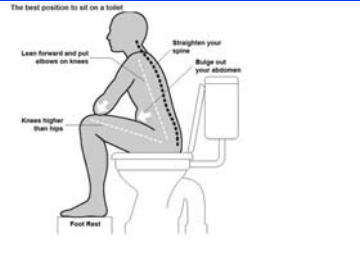
Management & Testing

- ***Management is based on where GI Consultation enters the progression***
- ***In general, stage in progression is a clinical diagnosis based on history, physical exam, and response to previous therapy***
- ***Testing helps to objectively identify where in the progression patient is***

Management of Simple Chronic Constipation in Infant/toddler's

- *Education*
  - *Definition of constipation*
  - *Pathophysiology*
  - *Symptoms of incomplete evacuation*
- *Behavior modification*
  - *Understanding toilet training readiness, tactics*
  - *Proper toilet sitting position*
  - *Structured toilet sitting*
- *Goal: Prevent progression to outlet dysfunction constipation*

Proper toilet sitting position



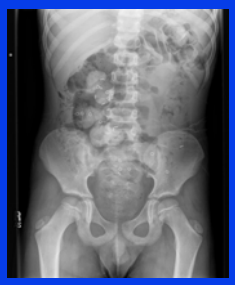
Step-up Treatment of Simple Chronic Constipation

- ***Target stool consistency, colon transit***
  - ***Adequate fiber diet (age (yrs) + 5)***
  - ***Adequate hydration***
  - ***Non-stimulant osmotic laxative to soften bowel movement, enhance stool volume to induce prokinetic effect on transit***
    - *Polyethylene glycol, lactulose, milk of magnesia, prune juice (sorbitol)*
  - ***Prosecretory agents to soften bowel movement, enhance stool volume to induce prokinetic effect on transit***
    - *Lubiprostone, Linaclotide*
- ***Target colon transit, signaling***
  - ***Stimulant laxative to increase frequency & amplitude of colonic motor activity***
    - *senna, bisacodyl*

Tests to Evaluate Outlet Dysfunction Constipation

- *Radiopaque marker study*
- *Anal manometry*
- *Balloon Expulsion test*
- *EMG assessment of defecation dynamics*
- *Barium enema*

Radiopaque Marker Study

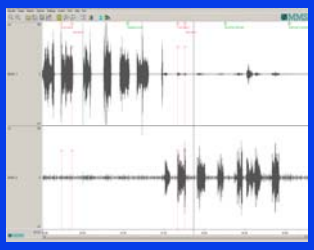


What can you learn from Anorectal Manometry?

- *Resting anal sphincter pressure*
- *Rule out Hirschsprung's disease*
- *Squeeze pressure: measures strength & endurance of external anal sphincter*
- *Assess intact spinal reflex: Cough reflex*
- *Conscious rectal sensitivity threshold: sensation of progressive increase in volume of rectal balloon*
  - *1st sensation*
  - *Sustained urge to defecate*
  - *Discomfort*
- *Simulated defecation: ability to increase rectal pressure & decrease sphincter pressure during bear down maneuver*

Additional tests to assess Defecation Dynamics

- *Balloon Expulsion Test*
  - *Ability to expel a rectal balloon filled with 50 ml of warm saline within 5 minutes*
  - *Normal < 1 minute (Mayo Clinic)*
- *EMG assessment of defecation dynamics*



Treatment of Outlet Dysfunction Constipation

- Key to initial management is colon cleanout *with* serial enemas.
- Behavioral fecal retention
  - Behavioral therapy
- Abnormal defecation dynamics
  - Behavioral therapy
  - Biofeedback
- Acquired megarectum
  - Step-up therapy

Step-up Therapy for Acquired Megarectum

- *Education*
- *Behavior modification*
- *Non-stimulant laxative*
- *Stimulant laxative*
- *Structured suppository, mini-enema*
- *Intrasphincteric Botox injection*
- *High colonic enemas*
- *Antegrade enemas*
- *Sacral nerve stimulation*
- *Diverting colostomy or ileostomy*
- *Partial colectomy*

2016 WORLD CONGRESS OF PEDIATRIC GASTROENTEROLOGY, HEPATOLOGY AND NUTRITION
MONTRÉAL ✦ CANADA

Gastroparesis

Jose M Garza MD. MS
Gi Care for Kids
Medical Director Neurogastroenterology and Motility
Children's Healthcare of Atlanta

Disclaimer

- Speaker for Abbott Nutrition

Integrity of gastric function requires a coordination between

- Enteric Nervous System (ENS)
- Gut muscle
- Autonomic Input
  - Vagus nerve fibers (afferent neurons that transmit sensory information)

ENS

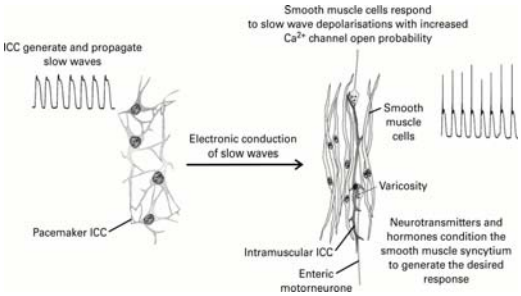
- Vast and complex network of neurons and glial cells
- **Serves as an intrinsic nervous system for the gut**
  - controlling most of the functions of the intestine independently
- Contains approx. 100 million neurons

ENS

- Responsible of the regulation of intestinal motility, absorption, secretion and blood flow
- **Ganglionated Plexus**
- **Enteric Neurons**
- **Interstitial Cells of Cajal (ICC)**

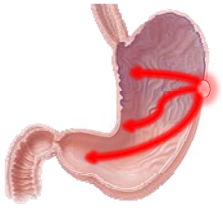
ICCs and Smooth Muscle Cells

- Spontaneous pacemaker activity (slow waves) organizes contractile patterns into phasic contractions that are the basis for peristaltic or segmental motility patterns
- Low resistance electrical coupling between ICCs and smooth muscle cells is essential for the functions of ICC in GI muscles



Slow waves and spikes regulate the timing, maximum frequency, amplitude and duration of contractions

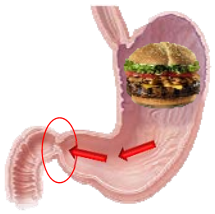
- Rate of 3 per minute
- Present independent of motor activity

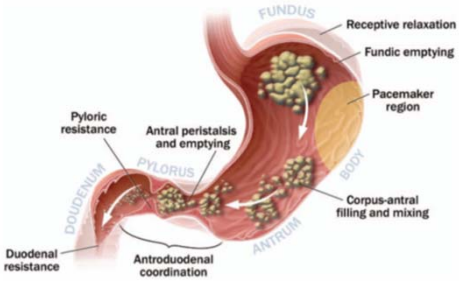


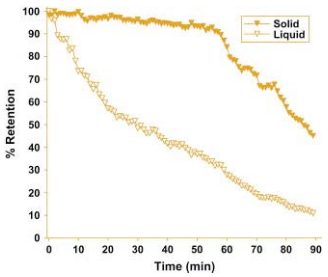
Cucchiara Dig Dis Sci 1999

Stomach

- Mix the ingesta with gastric secretions
- Agitate the mixture to break down the food into small-sized particles
- Empty them into the duodenum at a rate that allows efficient digestion and absorption







Rate is tightly regulated, result of neural and hormonal feedback triggered by interaction of nutrients with small intestine.

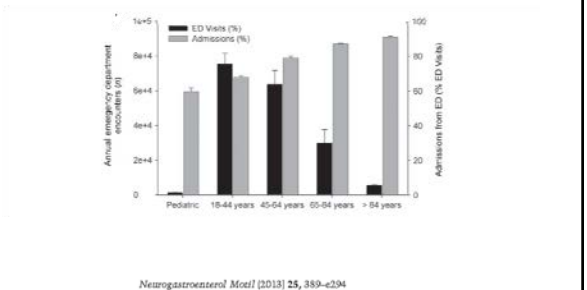
Feedback is caloric load dependent and regulates the rate to about 2 to 3kcal/min

- Gastric emptying rate varies according to
  - Volume
  - Consistency (liquid, solid, semi-solid)
  - Caloric content
  - Osmolality
  - Temperature
  - Chemical properties
  - Metabolic state
  - Diurnal variation

Gastroparesis

Delayed gastric emptying in the absence of any mechanical obstruction to the stomach

- Prevalence in children is unknown



Neurogastroenterol Motil (2013) **25**, 389–e294

Etiology

- In children, a majority of the causes are considered to be idiopathic or post viral
  - Idiopathic 70%
  - Drugs
    - Alfa-2 adrenergic agonists, TCA, Ca Channel blockers, etc
  - Post surgical
    - fundoplication
  - Post infectious
    - Tend to have the best prognosis

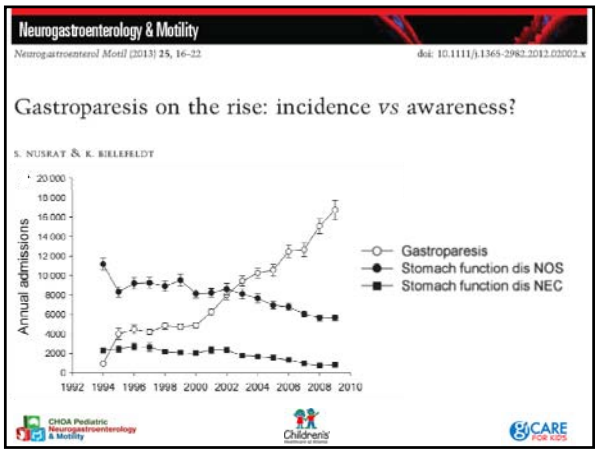
Most common comorbidities

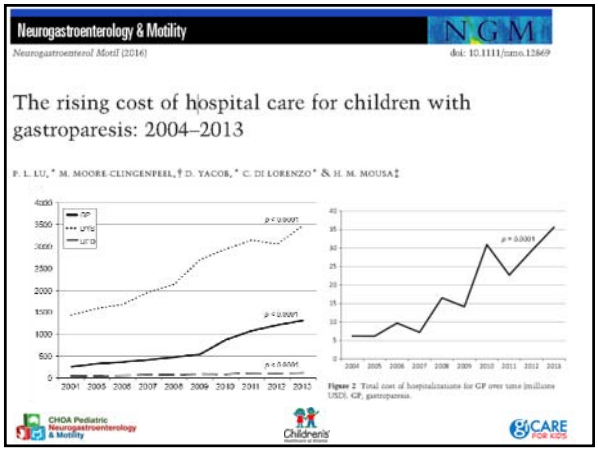
- Post viral gastroparesis (18%)
- GERD (14%)
- Mitochondrial dysfunction (8%)
- Diabetes Mellitus (2%)
- Hypothyroidism (0.4%)

Rodriguez, JPGN 2012

- Higher proportion of males (61%) in infants
- 1:1 male: female in children (52%)
- Higher predominance for females in adolescents (77%)

Rodriguez, JPGN 2012



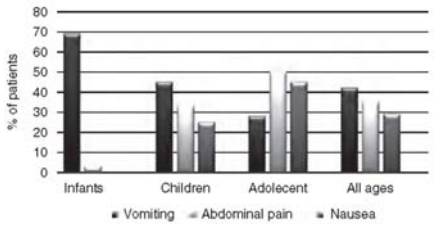


Most common symptoms of gastroparesis in children include

- Vomiting (42-68%)
- Abdominal pain (35-51%)
- Nausea (28-29%)
- Postprandial fullness
- Early satiety
- Anorexia

(*JPGN* 2012;55: 166–172)
(*JPGN* 2012;55: 185–190)

Symptoms change by age



(*JPGN* 2012;55: 185–190)

Ann Gastroenterol 2013; 26 (3): 204-211

Symptoms	Functional dyspepsia (% of children)	Gastroparesis (% of children)
Nausea	70	28
Abdominal pain	70	5
Bloating	30	7
Vomiting	55	68
Early satiety	10	25

Functional Dyspepsia

Must include 1 or more of the following bothersome symptoms at least 4 days per month:

- Postprandial fullness
- Early Satiation
- Epigastric Pain or burning not associated with defecation
- After appropriate evaluation, the symptoms cannot be fully explained by another medical condition

47% of pediatric patients with functional dyspepsia have slow gastric emptying

Criteria fulfilled for at least 2 months before diagnosis

Overlap between functional Dyspepsia and gastroparesis

- Vomiting cardinal symptom in gastroparesis
- Abdominal pain and nausea are more predominant in FD
- Those with predominant pain specially those requiring opiate treatments there should be skepticism as to the relationship of the pain to the gastric emptying

J Pediatr. 2014 July ; 165(1): 85–91.e1. doi:10.1016/j.jpeds.2014.02.063.

Relationship of Gastrointestinal Symptoms and Psychosocial Distress to Gastric Retention in Children

Gregory K. Wong, MD[1,2], Robert J. Shulman, MD[1,2,3], Hoda M. Malaty, MD, MPH, PhD[4,5], Danita Czyzewski, PhD[1,2], Victor J Seghers, MD[1,2], Deborah Thompson, PhD[1,3], and Bruno P. Chumpitazi, MD, MPH[1,2]

Severity of GI symptoms and psychosocial distress do not differ between children with or without gastroparesis who are undergoing Gastric emptying scan

- Prevalence of pain is higher in those with heightened perception of gastric distention vs those with normal sensation

Karamanolis G, e al Gut 2007;56: 29-36

Neurogastroenterol Motil (2013) 25, 427–e301 doi: 10.1111/nmo.12091

Factors related to abdominal pain in gastroparesis: contrast to patients with predominant nausea and vomiting

W. L. HASLER,*,[1] L. A. WILSON,† H. P. PARKMAN,‡ K. L. KOCH,§ T. L. ABELL,¶ L. NGUYEN,** P. J. PASRICHA,** W. J. SNAPE,†† R. W. MCCALLUM,‡‡ I. SAROSIEK,‡‡ G. FARRUGIA,§§ J. CALLES,§ L. LEE,† J. TONASCIA,† A. UNALP-ARIDA† & P. HAMILTON¶¶

Neither 2 hour or 4 hour gastric retention correlated with pain/discomfort in gastroparesis

Compared to predominant nausea/vomiting, predominant pain/discomfort was associated with impaired quality of life, greater opiate and less antiemetic use, but similar severity and gastric retention

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THE JOURNAL OF PEDIATRICS • www.jpeds.com ORIGINAL ARTICLES

Nausea Predicts Delayed Gastric Emptying in Children

Hilary Jericho, MD[1], Papa Adams, BA[2], Gang Zhang, PhD[3], Karen Rychlik, MS[3], and Miguel Saps, MD[2]

(J Pediatr 2014;164:89-92)

Assess whether gastroparesis cardinal symptom index is associated with delayed gastric emptying in children

GCSI score was Not associated with delay in gastric emptying

Table III. Correlation between symptoms and delayed gastric emptying scans (n = 46)*

Symptom	Number chart	P value	Word chart	P value
Nausea, Mean (SD)	2.20 (1.2)	.04	1.87 (1.2)	.02
Vomiting, Mean (SD)	0.96 (1.3)	.65	0.85 (1.3)	.24
Retching, Mean (SD)	0.80 (1.3)	.23	0.72 (1.2)	.09
Stomach fullness, Mean (SD)	2.22 (1.4)	.50	1.91 (1.3)	.67
Unable to finish meal, Mean (SD)	2.35 (1.3)	.75	2.00 (1.3)	.62
Loss of appetite, Mean (SD)	2.02 (1.3)	.34	1.76 (1.3)	.20
Feeling excessively full after meals, Mean (SD)	2.13 (1.5)	.10	1.98 (1.3)	.37
Bloating, Mean (SD)	1.72 (1.6)	.24	1.48 (1.5)	.17
Stomach or belly visibly larger, Mean (SD)	1.50 (1.6)	.39	1.22 (1.6)	.56
Pain, Mean (SD)	2.87 (1.1)	.36	2.61 (1.2)	.44
GCSI				
With retching, mean (SD)	1.72 (0.8)	.86	1.46 (0.7)	.87
Without retching, mean (SD)	1.80 (0.8)	.76	1.57 (0.8)	.82

*Severity of symptom: 0 = none, 1 = mild, 2 = moderate, 3 = severe, 4 = very severe.

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Diferential Diagnosis

- Exclude mechanical obstruction
- Rumination
- GERD
- Achalasia
- Cyclical vomiting
- Increase intracranial pressure

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Work UP

Tests should be tailored towards findings on history and physical exam to rule out other potential comorbid conditions

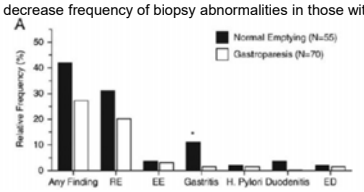
J Clin Gastroenterol. 2014 March ; 48(3): 231–235. doi:10.1097/MCG.0b013e318299c8dd.

Decreased Relative Diagnostic Yield of Esophagogastroduodenoscopy in Children with Gastroparesis

Gregory K. Wong, MD[1,2], Robert J. Shulman, MD[1,2,3], Eric H. Chiou, MD[1,2], and Bruno P. Chumpitazi, MD, MPH[1,2]

125 children included
-56% had gastroparesis

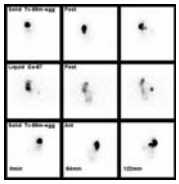
Trend toward a decrease frequency of biopsy abnormalities in those with gastroparesis



Gastric Emptying Scan

- Technetium-99m Sulphur colloid radiolabeled meal

- Two scrambled eggs
- Two pieces of white toast
- Jam
- 120ml of water



- Abnormal >90 retention at 1 hour or <30 retention at 1 hour
- >60 retention at 2 hours
- >10 retention at 4 hours

ORIGINAL ARTICLE: GASTROENTEROLOGY

Gastroparesis in Children: The Benefit of Conducting 4-hour Scintigraphic Gastric-Emptying Studies

Ashish Chogle and Miguel Saps

(*JPGN* 2013;56: 439 442)

	Abnormal GES at 2 h	Normal GES at 2 h
Abnormal GES at 4 h	32	8 (23%)
Normal GES at 4 h	4 (11%)	27

23% increase in yield

Increasing duration of GES improved the PPV, of the test

	1 h		2 h		3 h	
	Normal	Delayed	Normal	Delayed	Normal	Delayed
Normal at 4 h	139	11	133	18	130	10
Delayed at 4 h	36	13	19	29	14	34
Positive predictive value		0.35		0.60		0.71
Negative predictive value		0.93		0.87		0.93

Neurogastroenterol Motil (2015) 27, 356–362

Neurogastroenterology & Motility

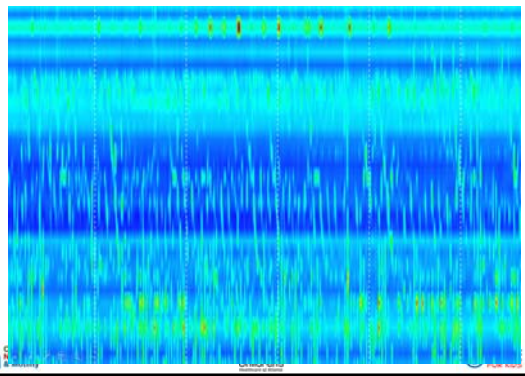
Gastric emptying scintigraphy results in children are affected by age, anthropometric factors, and study duration

G. E. WONG,*,† R. J. SHULMAN*,†,‡ & B. P. CHUMPITAZI*,†

	Normal emptying (n = 140)	Delayed gastric emptying (n = 48)	p-value
Gender	86F (61%)	34F (71%)	0.242
Age (years)	12.9 ± 3.5	11.3 ± 3.8	0.011
Weight (kg)	48.5 ± 18.4	40.4 ± 18.8	0.010
Height (cm)	151.6 ± 18.3	142.2 ± 20.2	0.003
BMI (kg/m^2)	20.3 ± 4.7	18.8 ± 4.7	0.066
BMI (percentile)	58.6 ± 31.4	50.0 ± 33.6	0.135
BSA (m^2)	1.41 ± 0.35	1.25 ± 0.37	0.008

Mean ± SD. BMI, body mass index; BSA, body surface area.

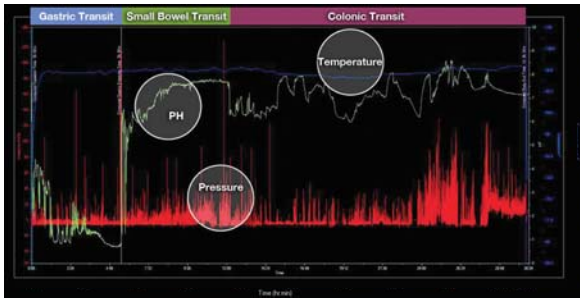
Antroduodenal Manometry



- Abnormal antral contractions during fasting and antral postprandial hypomotility
- Disruption of normal relationship between antral, pyloric and duodenal waves
- Abnormal organization of post prandial antropyloroduodenal pressure waves occurs frequently in patients with non-surgical gastroparesis

J Gastrointest Mot 1993 5,165-175

Wireless Motility Capsule



Treatment

- Dietary modifications
- Prokinetics
- Antiemetics
- Surgery
- Alternative therapy

Dietary Modification

- Low Fat
- Low fiber
- Small volume, frequent meals
- Liquids > solids
- Avoid carbonated beverages
- NO lying down for 2h following meals
  - To move food from fundus to antrum
- Chew foods well since antrum's grinding capacity is altered

Neurogastroenterology & Motility

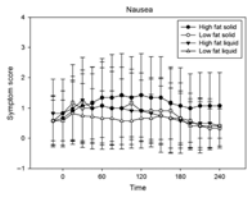
Neurogastroenterol Motil (2015) 27, 501–508 doi: 10.1111/nmo.12519

Effect of dietary fat and food consistency on gastroparesis symptoms in patients with gastroparesis

High fat solid > low fat solid > high fat liquid > low fat liquid

C. J. HOMKO,* F. DUFFY,† F. K. FRIEDENBERG,‡ G. BODEN* & H. P. PARKMAN‡

Meal/foods	Calories	Fat (g)
High fat breakfast (45%)		
2 medium eggs	140	8
1 slice toast	85	1
1 tsp butter	35	4
1 cup water	0	0
Total	260	13
Low fat breakfast (5%)		
4 oz eggbeaters	60	0
1 slice toast	85	1
1½ tsp jelly	25	0
1 cup skim milk	90	0.5
Total	260	1.5
Liquid high fat breakfast (45%)		
High fat shake (1 cup whole milk and 3 fl oz ice cream)	260	13.0
Liquid low fat breakfast (5%)		
Fruit juice smoothie (4 oz vanilla Boost® & 8 oz. fruit nectar)	260	2.0



- Optimize glycemic control
  - Acute hyperglycemia may cause delayed gastric emptying in both healthy individuals and individuals with diabetes even when the autonomic nervous system is intact
- Adequate nutrition
- Symptomatic relief does not correlate with gastric emptying

Prokinetics

Promote gastric emptying by stimulating antral motility, correcting gastric dysrhythmias and enhancing antroduodenal contraction

Cisapride

- 5-HT4 agonist
- Compasionate use only
- Cardiac side effects
  - 1993-2000 reported 270 cases of serious cardiac arrhythmias
  - July 2000 only available through limited access program

Metoclopramide

- Less selective 5-HT4 effects
  - Stimulates cholinergic neural pathways
- Dopamine 2 receptor antagonist
- Increases tone and amplitude of gastric contractions, relaxes pyloric sphincter
- Antiemetic properties

Metoclopramide

- High incidence of side effects (in a study 80% patients were non responsive and 24% had side effects)
  - Headaches, vomiting, behavioral changes, dystonia, movement disorders, drowsiness, dizziness and galactorrhea
- BLACK BOX WARNING for Tardive dyskinesia (associated with duration of treatment and cumulative dose)

Domperidone

- Dopamine 2 receptor antagonist
- Antiemetic properties
- Enhances antral-duodenal contractions
- No cholinergic activity
- Highest resolution rate with decreased number of side effects

Domperidone

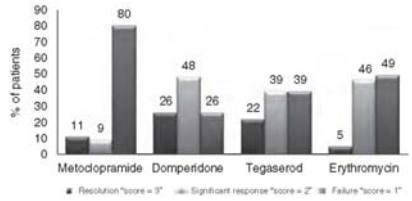
- Does not cross blood-brain-barrier
  - Decreased CNS side effects
- Prolonged QTc
  - Infants and those with high K serum level
- Galactorrhea (hyperprolactinemia)

- Not available in US
  - Needs IND (investigational New Drug Application)

Erythromycin

- Motilin agonist
  - Regulates phase III MMC

- Pyloric stenosis risk in infants
- Prolonged QT
- Tachyphilaxis
  - Can be overcome by cycling therapy
- Drug interactions
- Possibility of resistance



(*JPGN* 2012;55: 185–190)

Antiemetics

Ondasertron

- 5-HT3 receptor antagonist
- Strong central anti-emetic effects
- Can help reduce visceral sensation to meal ingestion
- Slows down motility

Cyproheptadine

- Useful for:
  - Nausea
  - Early satiety
  - anorexia

Table 1. Synopsis of Prokinetics Use and Limitations in Pediatrics

Drug	Evidence for Pediatric Use?	Limitations
D-2 Antagonists		
Metoclopramide	Yes. 0.1-0.2 mg/kg (maximum, 10 mg/dose) 4× daily	Cannot use for >12 weeks due to tardive dyskinesia and other adverse effects
Domperidone	Yes; displayed best results. Reduced gastric emptying time with 0.1-0.2 mg/kg (maximum, 10 mg/dose) 4× daily	QTc prolongation; available only through IND due to cardiovascular adverse effects
Itopride	Unknown	Not available in United States
Motilin agonists		
Erythromycin	Mixed. Improved gastric motility in infants at 15-30 mg/kg per day; 3 mg/kg 4× daily did not resolve symptoms in children (4-15 yrs old), but 0.15 mg/kg is effective in reducing post-operative nausea	Antibiotic resistance, arrhythmia, CYP3A4 interactions, tachyphylaxis
Azithromycin	Unknown.	Antibiotic resistance, tachyphylaxis, risk of cardiac arrhythmia
Mitemcinal	Unknown.	Still in development
5HT-4 receptor agonist		
Cisapride	No. 0.2 mg/kg showed to delay gastric emptying time	Available only through compassionate use and IND from manufacturer
Alternative therapies		
Ghrelin agonists	Unknown	Still in development
CCK agonists	Unknown	May be limited to treating dysmotility subsequent to lipid meals
Botulinum toxin	Yes. Symptomatic improvements with 6 units/kg	Data only for refractory gastroesophageal reflux patients; safety studies are lacking
Baclofen	Yes. Reduced gastric emptying time at 0.5 mg/kg	Only trial limited to gastroesophageal reflux patients
Bethanechol	Yes. Dosage of 0.25 mg/kg/dose 30 min prior to breastfeeding resolved symptoms and allowed for increased daily feeding	Less effective than other agents, cholinergic adverse events

J Pediatr Pharmacol Ther 2016 Vol. 21 No. 2

Surgical therapy

- Pyloric botox
- Gastric Electrical Stimualtor
- Gastrostomy tube
- Gastro/jejunostomy tube

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Use of *Clostridium botulinum* toxin in gastrointestinal motility disorders in children

- Toxins cause paralysis by blocking presynaptic release of acetylcholine at the neuromuscular junction
- Use should be limited to patients that fail medical therapy with prokinetics and before more invasive interventions
  - G tube, GJ, GES

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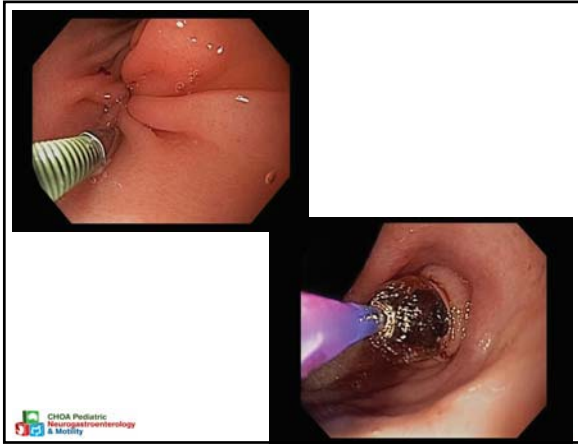

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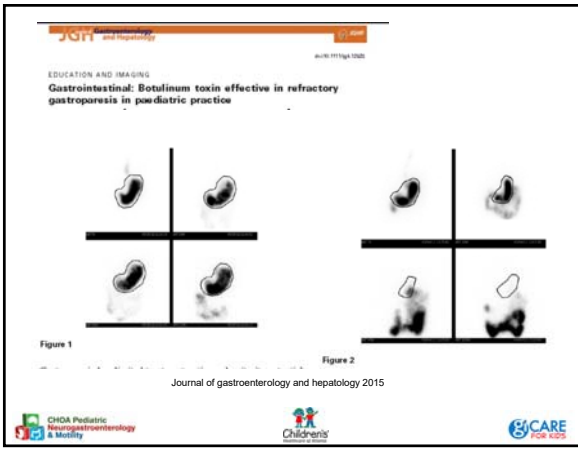

EDUCATION AND IMAGING

Gastrointestinal: Botulinum toxin effective in refractory gastroparesis in paediatric practice

Figure 1

Figure 2

Journal of gastroenterology and hepatology 2015

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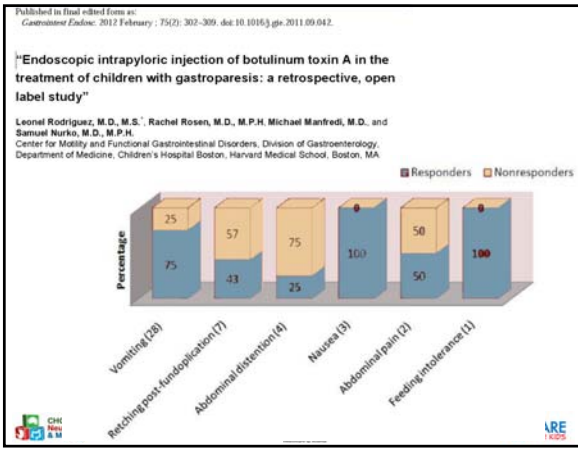


Published in final edited form as:
Gastrointest Endosc. 2012 February ; 75(2): 302–309. doi:10.1016/j.gie.2011.09.042.

"Endoscopic intrapyloric injection of botulinum toxin A in the treatment of children with gastroparesis: a retrospective, open label study"

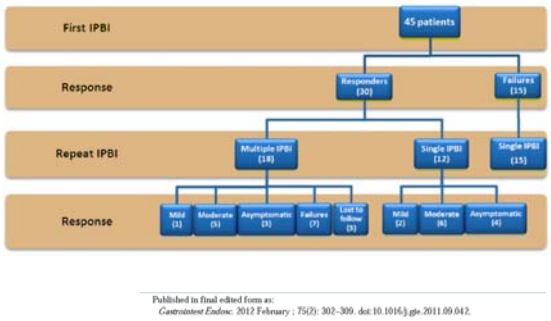
Leonel Rodriguez, M.D., M.S.[*], **Rachel Rosen, M.D., M.P.H.**, **Michael Manfredi, M.D.**, and **Samuel Nurko, M.D., M.P.H.**
Center for Motility and Functional Gastrointestinal Disorders, Division of Gastroenterology, Department of Medicine, Children's Hospital Boston, Harvard Medical School, Boston, MA

Responders Nonresponders

Percentage

25 75 | 57 43 | 75 25 | 0 100 | 50 50 | 0 100

Vomiting (28) | Retching post-fundoplication (7) | Abdominal distention (4) | Nausea (3) | Abdominal pain (2) | Feeding intolerance (1)



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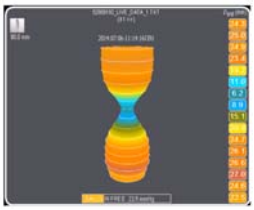
Neurogastroenterology & Motility
NGM

Evaluation of the pylorus with concurrent intraluminal pressure and EndoFLIP in patients with nausea and vomiting

W. J. SNAPE, M. S. LIN, N. AGARWAL & S. S. SHAW

-Elevated basal pyloric pressure occurs in 42% of patients with nausea and vomiting and delayed emptying

-Decreased pyloric distensibility occurs with nausea, vomiting and delayed gastric emptying



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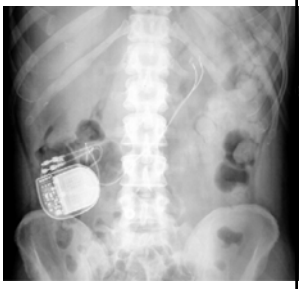
Gastric Electrical Stimualtor

Implanted neurostimulator that delivers high frequency, low energy electrical stimulation through electrodes implanted in the gastric muscle wall



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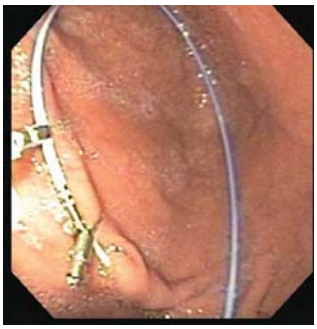

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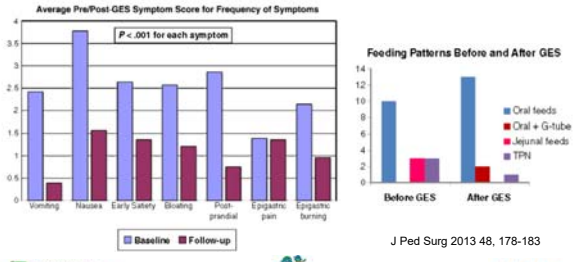
Efficacy of permanent gastric electrical stimulation for the treatment of gastroparesis and functional dyspepsia in children and adolescents

Steven Teich [a,*], Hayat M. Mousa [b], Jaya Punati [b], Carlo Di Lorenzo [b]

[a]Department of Surgery, Division of Pediatric Surgery, The Ohio State University College of Medicine and Nationwide Children's Hospital, Columbus, OH, USA
[b]Department of Gastroenterology, The Ohio State University College of Medicine and Nationwide Children's Hospital, Columbus, OH, USA



J Ped Surg 2013 48, 178-183

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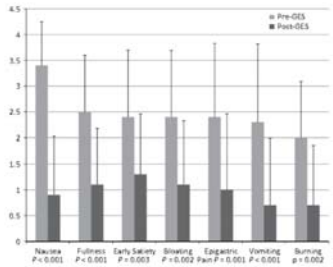
Neurogastroenterology & Motility

Improvement of quality of life and symptoms after gastric electrical stimulation in children with functional dyspepsia



CHOA Pediatric Neurogastroenterology & Motility

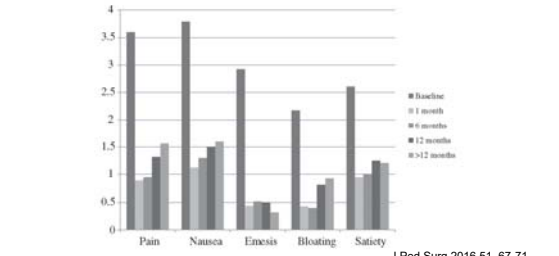
Children's

CARE FOR KIDS

Long-term outcomes of gastric electrical stimulation in children with gastroparesis

Saleem Islam [a,*], Jillian McLaughlin [a], Justine Pierson [b], Christopher Jolley [c], Archana Kedar [d], Thomas Abell [e]

[a] Division of Pediatric Surgery, Department of Surgery, University of Florida College of Medicine, Gainesville, FL, United States
[b] Division of Plastic Surgery, Department of Surgery, University of Florida College of Medicine, Gainesville, FL, United States
[c] Division of Pediatric Gastroenterology, Department of Pediatrics, University of Florida College of Medicine, Gainesville, FL, United States
[d] Internal Medicine, University of Mississippi Medical Center, Jackson, MS, United States
[e] Division of Gastroenterology, Department of Medicine, University of Louisville, Louisville, KY, United States



J Ped Surg 2016 51, 67-71

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Alternative therapy

- Acupuncture
- Hypnosis
- Biofeedback
- Iberogast
- Ginger

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Neurogastroenterol Motil (2013) 25, 389–e294 doi: 10.1111/nmo.12079

Factors influencing admission and outcomes in gastroparesis

E. KELEFELDT

Division of Gastroenterology, University of Pittsburgh Medical Center, Pittsburgh, PA, USA

Diagnosis of gastroparesis does not come with a high mortality risk, most deaths are due to comorbid conditions

Risk benefit considerations as the use of more aggressive therapies (gastrostomies, enterostomies, nutritional support) is associated with significant morbidity and mortality

Although gastrostomies and or nutritional support were used in only a minority of admissions, the associated increase in morbidity and mortality highlights the need to carefully select the right candidate

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ORIGINAL ARTICLE: GASTROENTEROLOGY

Clinical Presentation, Response to Therapy, and Outcome of Gastroparesis in Children

*Leonel Rodriguez, †Katayun Irani, ‡Hongyu Jiang, and †Allan M. Goldstein

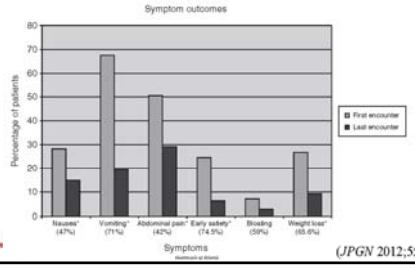
- Factors associated with resolution of symptoms
  - Younger age
  - Post viral
  - Shorter duration of symptoms
  - Response to promotility agent
  - Nausea
  - Absence of mitochondrial disorder

(*JPGN* 2012;55: 185–190)

Spectrum of Gastroparesis in Children

*Shamaila Waseem, †Saleem Islam, †Genie Kahn, †Baharak Moshiree, and ‡Nicholas J. Talley

Despite different treatment modalities the study found a statistically significant improvement in ALL of the symptoms at the end of the mean 2 year follow up, with similar results in both sexes.

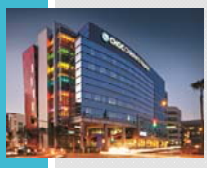


(*JPGN* 2012;55: 166 172)

Questions

The Role of the APN in an Interdisciplinary Feeding Team

Robyn Robinson CPNP, MSN
CHOC Children's Hospital
Multidisciplinary Feeding Program



Objectives:

1. Describe at least three skills which uniquely qualify a GI APN for participation in an interdisciplinary feeding team.
2. List two common conditions a GI APN diagnoses and treats which significantly impact disordered feedings.
3. Identify 2-3 areas of nutritional intervention a GI APN would be likely to recommend to children with feeding problems.

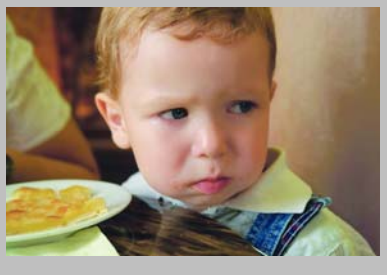
The GI APN in the Multidisciplinary Feeding team.

Nurse Practitioner Roles

GI Clinic	Multidisciplinary Feeding Team
• Evaluate and treat children with GI and Nutrition disorders	• Evaluate and treat children with GI and Nutrition disorders which are barriers to feeding
• Consult with other members of the GI team	• Directly confer with other members of the feeding team
• Refer for appropriate supportive and therapeutic services	• Collaborate regarding appropriate supportive and therapeutic services
• Document services provided	• Document services provided

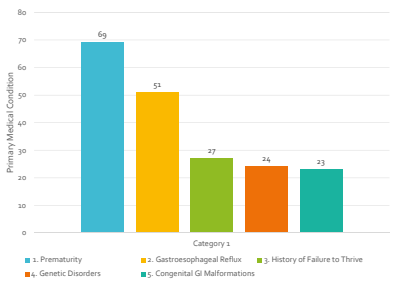
20% of all parents report their child is "often or always selective with food."

Micali et al (2016). *J Dev Behav Pedr* o:1-8



How common are GI conditions among children with feeding problems?

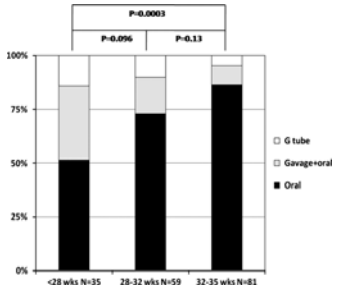
The Top 5 conditions which interfere with feeding



1.Prematurity

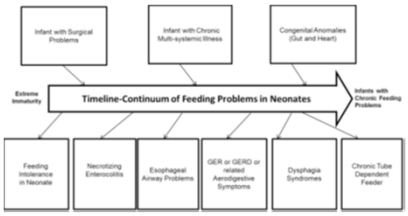
1. Neurodevelopmental delay
2. Poor aerodigestive coordination (dysphagia)
3. Higher risk of comorbid medical conditions
4. Impaired respiratory function
5. Higher risk of reflux

How gestational age effects feeding status at discharge



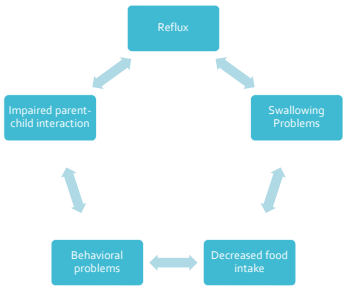
Jadcherla, SR et al. Impact of prematurity and co-morbidities on feeding milestones in neonates: a retrospective study. *J Perinatol*, 2010, Mar; 30(3): 201-208

How prematurity and comorbid conditions lead to chronic feeding problems



Jadcherla, SR. Dysphagia in the high-risk infant: potential factors and mechanisms. *Am J Clin Nut* 2016; 103 (Suppl): 622S- 8S.

2.Reflux



Mathisen, B et al. (1999) Feeding Problems in Infants with gastro-oesophageal reflux disease: A controlled study. *J Paediatr Child Health* 35, 163-169.

3. Early Diagnosis of Failure to thrive

"Feeding problems and poor growth in the first year of life show high continuity into childhood restrictive eating."

Micali et al. Early Predictors of Childhood Restrictive Eating. *J Devel Behv Peds*, 2016: 0, 1-8

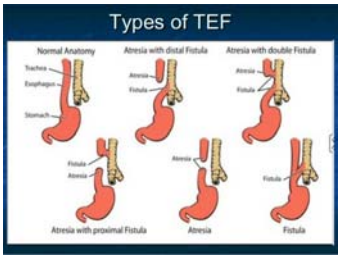
4. Genetic Conditions and syndromes

Noonan Syndrome and Feeding Problems

- Evaluated 25 children with genetically verified Noonan Syndrome (median age 3.2 yrs.)
- 16/25 severe gastroesophageal reflux based on pH probe studies
- 50% had poor motility in both the stomach and the upper small intestine (similar to 32-35 week preterm infants.)
- 4/5 who underwent electrogastrography had disorganized electrical activity in their stomachs.

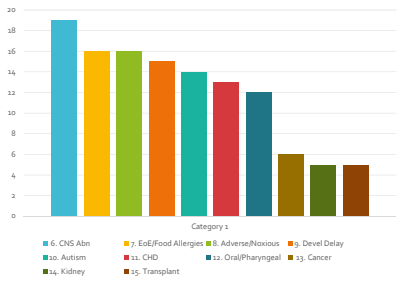
Shah et al. Feeding difficulties and foregut dysmotility in Noonan's syndrome. *Arch Dis Child* 1999, 81: 28-31

5. Congenital or Perinatal malformations



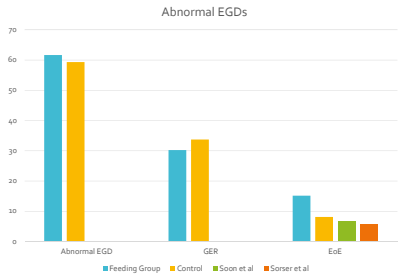
TEF, Congenital Diaphragmatic Hernia, Omphalocele, NEC/Intestinal Perforation, Malrotation, Imperforate Anus/Hirschsprungs, Jejunal atresia, Volvulus

The next 10 most common conditions which interfere with feeding



Interventions to improve appetite

Resolve underlying medical conditions

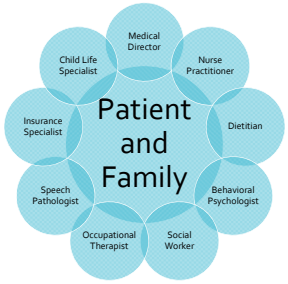


Other strategies to improve appetite

1. Resolve or stabilize all other GI conditions (reflux, constipation, EoE, etc).
2. Consolidate feedings with structured mealtimes or bolus feedings.
3. Consider use of an appetite stimulant (cyproheptadine).
4. Work with RDs to transition to blenderized tube feedings in appropriate patients.
5. Overall nutritional adequacy and hydration profoundly effect appetite.

Managing complex feeding problems in a team setting

"Effective interdisciplinary teams complement, expand, and enrich not only patient care but the experience of providing that care as well. "



Weis, J. (2015). Why Interdisciplinary Teams Ten Years Later? Journal of Palliative Medicine. 18 (2) 193-4.

A nurse practitioner and a social worker walk into a clinic…

…and see a burned out light bulb.

The Whole is Greater than the Parts

Advantages to working in a team setting:

1) more rapid scientific advancement

2) enhanced cross-disciplinary insights

3) increased competitiveness for external funding

4) a greater potential for resolving intractable healthcare process problems.

Snyder et al. (2013). Effective Healthcare Process Redesign through an Interdisciplinary Team Approach. IMIA and IOS Press. Doi:10.3233/978-1-61499-289-9-1138.

www.choc.org/feedingprogram




Behavioral aspects of feeding problems

World Congress of Pediatric Gastroenterology Hepatology and Nutrition

Montreal, October 7, 2016

Maria Ramsay, PhD
Pediatric Psychologist, Pediatric Feeding Program, McGill University

Objectives

- Origins of behavioral problems related feeding
- How to assess and treat behavioral problems related feeding

I have nothing to declare

Is that a behavioural feeding problem?

What do we know about feeding

- Universal
- Same in infants, children and in adults
- Like other sensori-motor skills, develops over time from birth on
- Unlike other sensori-motor skills, it must be present at birth
- Unlike other sensori-motor skills, maternal involvement is immediate and crucial right after birth

WHY?

Feeding is more than a sensori-motor skill

- Something needs to trigger feeding
- Something needs to maintain feeding
- Something needs to maintain feeding long enough to drink/eat adequate amounts for growth

What is that something?

Appetite regulation

- Appears around 6-8 weeks of age
  - In rats it appears around 2-3 weeks of age
- If appetite is not there at birth, how does feeding happen in the newborn?

Mammalian world at birth:reflexes

- To survive, a newborn in the mammalian world needs to have **immediate** energy balance
  - Heat loss through the skin and energy need for HR and RR is high
  - Newborn does not have "appetite" but the energy loss triggers reflexive crying, rooting and reflexive sucking
  - Mother responds by feeding infant
  - Energy equilibrium regained
  - Baby sleeps (which also requires energy output)…… and the cycle restarts

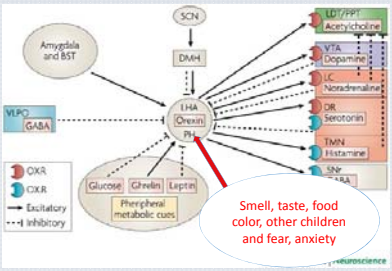
When a baby is born: primitive and immature

- Bundle of reflexes, brain stem functions
- Thalamus- sensory info: taste (sweet), odor
- Cerebellum-coordinates motor movements (HR, suck, swallow, sleep)
- GI and breathing not well regulated until ~ 3mos.
- Least mature of all mammals, smallest brain relative to adult brain (25-50%)
- 4th trimester ? Anthropological and/or nutritional

Development of appetite regulation among mammals

Energy depletion +	Brain reorganization +	Environmental & learned cues
	Appetite regulation: levels***	
Reflexes	Cortically mediated control	
	(long sleep spindles)	
Reflexive crying	Crying:hunger cues (& others)	Multiple other cues
Reflexive sucking	Voluntary sucking	influence appetite
No taste discrimination	Full development of taste	level (smell,color,sound)
Birth →	2-4 months →	4 years+ Worry about obesity

Appetite regulation in the hypothalamus



Food tastes: a lot of genetics

- Genetic predisposition for **basic tastes**
- **Genetic influences: neophobia**
  - Minimal in infancy, ↑ in early childhood, ↓ till adulthood
  - Familial (parents:67%)
- **Genetic variations in food taste** affect food preferences (recessive genes) → number of taste buds on tongue
  - Non-tasters (25%)
  - Medium tasters (50%)
  - **Supertasters** (25%) Refusal of Brussels sprouts, cabbage, peas, spinach, tomatoes, onion, cooked carrots

Behavioural feeding problems vs. behaviours reflecting feeding problems

- Turning head away from the bottle or spoon?
- Tighten lips at food touching?
- Screaming when trying to put infant into the highchair?
- Refusing to come to the table?
- Running around or watching TV as being fed?
- Pushing plate with non-favored food away?
- Eating small amount then chatting with parents?
- NOTE: these behaviours do become learned in order to avoid feeding, but calling it behavioural feeding problems does not explain the underlying feeding pathology

	Feeding behaviors					
Physiology	Turns head	Tightens lips	Pushes food	Spits food	Cries/screams	Hits/runs
Appetite (hypothalamic)	X	X	X	X	X	X
Oral-sensory (oral cavity, tongue, lips)	X	X	X	X	X	X
Taste (tongue)	X	X	X	X	X	X
Oral-motor delay	X	X	X	X	X	X

Thus, the behaviors tell you that there is a feeding problem, but does not tell you the type of feeding problem or how much of it is physiological and how much is learned avoidance

Without appetite, particularly in tube-fed infant and children, difficult to assess the other physiologies

Clinical symptoms of low appetite

- Does not signal appetite
- Does not concentrate on feeding
- Does not eat age appropriate portions
- Eats longer than 30 minutes

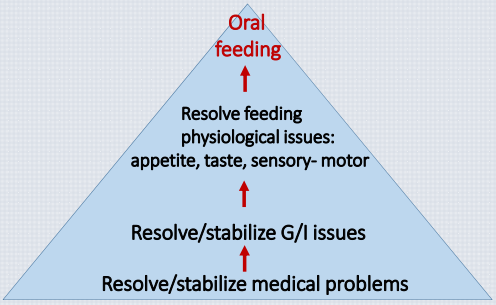
Treatment of low appetite

- Make sure that the meals are regular
- Put smaller portion (size matters!) on child's plate initially and praise
- **To change behavious**:
- Use liked food as reward for less liked food (despite behavioral psychologists)
  - 1bite to 1 bite..then, 2 bites..to 1 bite (can use puzzle piece by piece as a reward)
- **Nutritional involvement** (higher caloric diet)
- If needed: cyproheptadine, an appetite stimulant to increase appetite

GI symptoms and feeding in young children

- Chronic/cyclic vomiting … acidy taste (low appetite children less likely to eat)
- Slow gastric emptying …… eats tiny amounts
- Short bowl: complications with TPN and continuous feeds
- EA and other g/i issues

- Before any feeding can be considered, Gi issues need to be stable
- Fears that the child "forgets to suck or feed" are unfounded
- The rush to get them eat before they are ready medically is not helpful and creates more negativity



One week later: Same child-different feeding behavior

Any questions ?

maria.ramsay@muhc.mcgill.ca

Beyond Vitamins:
Managing Nutritional Risk in the Low Appetite Child

Abigail Brodovitch, P.Dt.
Montreal Children's Hospital, Pediatric Feeding Program
McGill University Health Network

Hôpital de Montréal pour enfants
Centre universitaire de santé McGill
Montreal Children's Hospital
McGill University Health Centre

"The shared meal elevates eating from a mechanical process of fuelling the body to a ritual of family and community, from the mere animal biology to an act of culture."

— Michael Pollan, In Defense of Food: An Eater's Manifesto

Agenda

- **Introduce the Montreal Children's Hospital (MCH) Paediatric Feeding Program**
  - Who we are and what we do
  - Overview of feeding problems
  - Particular considerations for the dietitian
- **Review nutritional care within the program**
  - Enrichment, nutritional analyses, meal scheduling
  - Degavage (weaning from tube feeds)
  - Use of appetite stimulants
- **Case Study**
- **Challenges and opportunities for feeding children with low appetite**
- **Questions**

Paediatric Feeding program goals:

Support families and children with living with feeding disorders and associated issues

- Low appetite
- Inadequate weight gain
- Suboptimal nutritional status
- Transition from tube feeding to oral feeding
- Disruptive mealtime behaviours

Paediatric Feeding Program: Our Team

- Psychologists
- Nutritionists
- Occupational therapists
- Paediatric gastroenterologist

Feeding problems/challenges

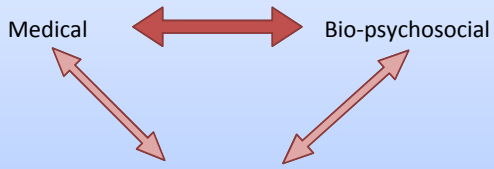
- Affect up to 25%-50% of healthy infants/toddler/children
  - usually transient in nature
  - 3-10% will lead to more severe problems
- Estimated prevalence of up to 80% in children with special needs[1]
- ***Can*** result in "Failure to Thrive"
- Cause and perpetuate stress which increases food refusal and negative feeding dynamic

[1] Fishbein et al.. Mealtime disruption and caregiver stress in referrals to an outpatient feeding clinic. *Journal of Parenteral and Enteral Nutrition*. 2016; 40(6): 636-645.

Food refusal: a broad spectrum

- Dysphagia
- Feeding aversion
- Oral defensiveness
- Hyper/hyposensitivity (tactile sensitivity)
- Oral-motor issues
- Underlying medical issues and special needs
- Selectivity (20-30 foods accepted/refusal of entire food groups or textures)
- Low appetite

Feeding problems



Altered mealtime behaviour

Nutrition is more than just vitamins!

"Failure to thrive"

- General term to describe a child who is not growing as expected (reference Abdelhadi et al).
- Does not always consider level of malnutrition (mild/moderate/severe)
- Underscores the link between diet and development
- Not all patients are FTT

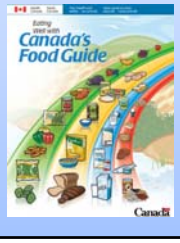
Within the feeding program, the role of the dietitian

- **Assess intake:**
  - % from enteral feeds (or PO) nutritional supplement
  - % from solid foods
  - nutritional value of each vs. daily requirements
- **Optimize appetite**
  - meal schedules
  - appetite stimulant
  - minimize vomiting/constipation
- **Encourage and foster positive mealtime interactions**
  - Foster appropriate attitudes/expectations around food
  - Consolidate the various factors that influence meal choices
- **Provide strategies for enrichment**
  - review nutrient-dense food choices
  - provide recipes for enriched formula or breastmilk
- **Collaborate with families to transition from enteral to fully oral feeding, "*degavage*"**

Low appetite

- Road block to nutritional intervention
  - intake remains low, despite enrichment
  - parental effort increases
  - stress increases
  - nutritional status at risk of deterioration
  - increased "dependence" on nutritional supplements
  - further decreased appetite….

A fine balance



Gavage weaning: specific considerations

- Child is **medically stable**
  - Optimized reflux and DGE management
- Good, **consistent weight gain** prior (initial weight loss is expected)
- Adequate **hydration**
- Child is able to **tolerate bolus feeds** at least 120-150cc in 20-30 minutes and daytime only.
- Use of **appetite stimulant** -cyproheptadine
  - Dose and cycle is optimized
- Patient demonstrates sufficient **feeding skills** to eat some food and drink some liquid safely.
- Patient demonstrates tolerance of a **variety** of foods from each food group (at least 20) and age appropriate food textures.

Degavage case study:

Previous medical history:

- Ex-28 weeker
- Now 3 year old girl
- Medical issues:
  - PDA, BPD, GER, bowel puncture and duodenal tear
  - History of sepsis
  - Fundoplication (~12 months CGA)

AB1

Nutritional management @ 14 months CGA:

Gavage:

- Compleat Pediatric, 5 feeds/day 200ml/feed
  - **Intake** ~84 kcals/kg/day
  - **Requirements**: ~80 kcals/kg/day
    - Gavage over 60 minutes via GT
- Vomiting +/-

PO: Solids/Liquids

- OT assessment reveals some exploration by mouth (licks fingers, "accidentally" eats mashed potato). Can hold small piece Gerber puff in mouth before expelling.
- Meltable solids suggested (cheerios, puffs, crackers)
- VFSS reveals aspiration on thin liquids
- Liquids thickened until ~24 months CGA
- Transitioned to thin, no issues

Impression:

- Weight gain adequate
- Gavage interfering with appetite
- Illness prone
- Observed feeding skills show promise, with obvious barriers
  1. Gavage meeting ~100% of requirements
  2. Limited appetite
  3. Delayed feeding skills
  4. Possible food intolerances (lactose/CMPI)
  5. Unsafe with liquids
  6. Low motivation
  7. Ongoing vomiting

Plan:

- Degavage started @ 24 months
- ↓50% feeds (cut 1 full feed, then another)
- Gavage to provide ~45% of calculated requirements
  - (between September-December, gavage provides 40-60% of requirements)
  - gavage and intake of nutritional supplement varies depending on health
- Timing is everything! 12h/24h
  - New schedule: 8h/17h30/20h30
  - Decreased feeding time (60 minutes → 45 minutes…)
- Appetite stimulant started
- Enrichment encouraged + fluid PO
- Behavioral and motivational strategies coached ("contingencies")
- Weekly follow-up scheduled

2 months later…

- ↓ interest in food
- Weight loss
- Vomiting more frequent
- Hiccupping and burping noticed
  - GI issues (?reflux)
- Mom very emotional @ perceived set-back
  - Gavage @200 ml x 5 over 60 minutes
- Illness

And then…

- Bounce back from illness:
  - Nutren jr. 500 ml/day by mouth
  - 4-6 ficello/day
  - 1-7 minigo/day
  - Apple sauce
  - tangerines +++
  - Table foods

    ★self-feeding!

In conclusion

- Paediatric feeding problems are widely prevalent and highly individualized
- Growth and nutrition are intricately connected
- Children with feeding problems require adequate nutrition to support growth and optimize development

In conclusion

- A multidisciplinary approach is helpful in this population
- Combination of nutrition modification and behavioural techniques, considering:
  - medical diagnosis
  - feeding schedule
  - parent-child interaction
  - sensory issues
  - physical and behavioural aspects
  - oro-motor skills

Questions?