APGNN

The Association of Pediatric Gastroenterology and Nutrition Nurses

45TH ANNUAL MEETING

Annual Meeting Program

November 3 - 4, 2017
Milano 1 - 2
Caesars Palace
Las Vegas, NV

APGNN
The Association of Pediatric Gastroenterology and Nutrition Nurses

Dear APGNN Meeting Participant:

Welcome to Fabulous Las Vegas! We are proud to present the 26th Annual APGNN Meeting, and are so glad you chose to join us! Maureen Egan, Program Chair, and her committee members have planned an informative conference. We hope you find the program educational and invaluable to your ongoing education. Please take time to complete the course evaluation. Your feedback is a valuable part of ensuring that our meetings are always of high quality. We also appreciate your topic suggestions and ask that you let us know what you would like to see at future programs by indicating this on your post- conference evaluations.

Our keynote speaker Minta Albietz, RN, MSN a Vegas local from Kindred Hospital will present on Leadership – Strategies for Life. Throughout the rest of the two-day meeting, there will be multiple concurrent sessions allowing you to tailor your experience to your personal and professional interests. All meeting participants can also chose attend NASPGHAN and CPNP lectures that are of interest to you.

The Annual Business Meeting will be held at 8:00 on Friday, November 3rd. The Annual Report will be presented at that time and we will be introducing you to your new board members during the meeting as well. Also, please plan to attend a committee meeting Friday afternoon (please see the schedule for details). We are sure you will find at least one APGNN committee that interests you. All levels of knowledge and expertise are welcome, and we look forward to learning from you and your expertise to improve the organization. This is a great way to become involved in APGNN. Our annual APGNN Social Event will be Friday evening, please plan to attend as several awards will be presented and this is a great time to network with your fellow members.

Speaking of membership, 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, Pat Chirinos and Christy Norcross. We know we cannot do this without their support and are grateful for their assistance.

Sincerely,

Emmala Ryan Shonce, FNP

Emmala Ryan Shonce, RN, MSN, FNP-C
APGNN President

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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, hepatology 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.

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2017 APGNN Educational Conference
Supported in part through restricted educational grants from:

Abbott

MeadJohnson Nutrition

Nestlē Health Science

NUTRICIA

PROMETHEUS Therapeutics & Diagnostics

Friday November 3, 2017

APGNN Annual Meeting
Program Chair Maureen Egan, APN

7:30am – 5:15pm
Milano 1 and 2

7:30am - 8:00am REGISTRATION/BREAKFAST/WELCOME

8:00am - 8:45am BUSINESS MEETING

8:45am - 9:30am LEADERSHIP: STRATEGIES FOR LIFE
Minta Albietz, RN, MS, Kindred Hospital
Learning objectives:
1. Identify leadership styles to consider in variable work place environments
2. Describe how leadership styles impact team dynamics
3. Illustrate best practices for team integration

9:30am - 10:00am FUSSY BABY
Jon Vanderhoof MD, Boston Children's Hospital
Learning objectives:
1. Understand why infants cry
2. Learn appropriate intervention in crying infants

10:00am - 10:15am BREAK Exhibit Hall

10:15am - 12:00pm CELIAC: THE LAS VEGAS TEAM

10:15am - 11:15am LIVING WITH CELIAC DISEASE
Teresa Carroll, APRN, Pediatric Gastroenterology and Nutrition Associates
Learning objectives:
1. Identify both GI and non-GI symptoms
2. Discuss updated in celiac health surveillance
3. Discuss food contamination risk in the home
4. Identify how to plan for social events, eating out and travel

11:15am - 11:45am EATING GLUTEN FREE: SEPARATING THE WHEAT FROM THE CHAFF
Holly Brewer MS, RDN, LD, Pediatric Gastroenterology and Nutrition Associates
Learning objectives:
1. List gluten-containing food groups
2. Name safe starches/grains that are gluten free
3. Identify cross-contamination risks and how to avoid

11:45am - 12:00pm QUESTIONS

12:00pm - 1:00pm POSTERS AND LUNCH Exhibit Hall

1:00pm - 3:00pm NUTRITION MODULE

1:00pm - 1:30pm MALNUTRITION A TEAM APPROACH
Natalie Navarre MS, RD, LD and Maureen Egan, APRN Nemours DuPont Pediatrics Division of Gastroenterology
Learning objectives:
1. Discuss common causes for malnutrition/FTT
2. Identify initial interventions to address nutrition concerns

1:30pm - 2:00pm THE NUTRITIONIST PHYSICAL EXAM
Carly Leon RD, Children's Hospital of Wisconsin
Learning objectives:
1. Identify at least 3 components of the Dietitian's Nutrition-Focused Physical Exam
2. Discuss the value of nutrition physical exam findings as they pertain to promoting and implementing nutrition recommendations.
3. Explain value of the mid-upper arm circumference and how it pertains to growth and pediatric malnutrition

2:00pm - 2:30pm BLENDERIZED TUBE FEEDINGS (BTF): WHAT NURSES NEED TO KNOW
Margaret Girten, RD, CSP, LDN, Children's Hospital of Philadelphia
Learning objectives:
1. Identify and compare commercial and home blended diets
2. Recognize traits of patients who might be suited for BTF
3. Recognize benefits and challenges BTF for the family and medical team

2:30pm - 3:00pm REFEEDING SYNDROME AND LAB VALUES
Stacie Townsend MS, RD, LDN, CSP, National Institutes of Health
Learning objectives:
1. Describe what refeeding syndrome is, to include signs, symptoms, lab assessment
2. Identify who is at risk for refeeding syndrome
3. Recognize how to prevent refeeding syndrome
4. Identify recommended treatments and standard of care to prevent and treat refeeding syndrome

3:00pm - 3:15pm BREAK

3:15pm - 4:15pm FPIES MODULE

3:15pm - 3:45pm FPIES
Glenn Furuta MD, Children's Hospital Colorado
Learning objectives:
1. Recognize the differential diagnosis of diarrhea in infancy
2. Identify role of gastroenterology in diagnosis of FPIES

3:45pm - 4:15pm FPIES: A PARENT'S PERSPECTIVE

Joy Meyer and Amanda Lefew Co-Directors The FPIES Foundation

Learning objectives:

1. Define Food Protein Induced Enterocolititis Syndrome
2. Recognize the parent perspective of having a child diagnosed with FPIES
3. Describe the quality of life adjustments for families living with FPIES

4: 15pm - 5:15pm ARE YOU SMARTER THAN A 5TH GRADER

Norberto Rodriguez-Baez MD, University of Texas Southwestern Medical Center

Learning objectives:

1. Know diagnostic and radiological studies used in common gastrointestinal diseases
2. Understand the mechanism of action of common medications used in pediatric gastroenterology and hepatology
3. Describe different pathogens causing diseases in the gastrointestinal tract

5:15pm CONFERENCE WRAP UP

5:15pm - 6:00pm COMMITTEE MEETINGS

6:00pm APGNN SOCIAL EVENT Neopolitan 3 - 4

APGNN Annual Meeting
Saturday November 4, 2017
8:00am – 5:15pm
Milano 1 - 2

8:00am BREAKFAST AND REGISTRATION

8:15am - 9:45am IBD MODULE

8:15am - 9:00am UPDATE ON IBD MEDICATIONS
Andrew Grossman MD, Children's Hospital of Philadelphia
Learning objectives:
1. Understand the various pharmacologic therapies used to treat IBD
2. Recognize the importance of nutritional therapy for IBD
3. Implement different treatment strategies (step up vs. top down approach)

9:00am - 9:45am PSYCHOLOGICAL HEALTH IN PEDIATRIC IBD: OPPORTUNITIES FOR MULTIDISCIPLINARY CARE
Bonney Reed-Knight PhD, Emory University School of Medicine
Learning objectives:
1. Describe psychosocial difficulties experienced by pediatric patients diagnosed with IBD
2. List evidence-based psychotherapies for pediatric anxiety, depression
3. Describe basic tenets of cognitive-behavioral therapy for anxiety and depression
4. Discuss treatment of anxiety and depression effectively with fellow providers and patients

9:45am - 10:00am BREAK

10:00am -11:30am MOTILITY MODULE

10:00am -10:30am CECOSTOMY AND CONE ENEMA
Jason Dranove MD, Levine Children's Hospital
Learning objectives:
1. Understand the different types of cecostomy tubes (intermittent catheterization, indwelling button, Chait Cecostomy) and large volume enema types (cone enema and Peristeen)
2. Discuss patient most likely to benefit for cone enema or Peristeen and briefly discuss their use
3. Understand timing and advancement of flushes after placement of cecostomy
4. Understand the different types of cecostomy flush regimens available
5. Learn how to assess response to flushes and whether they are working
6. Identify some common complications of cecostomies

10:30am - 11:00am ESOPHAGEAL MOTILITY
Samuel Nurko MD, Boston Children's Hospital
Learning objectives:
1. Identify indications for esophageal manometry testing
2. Gain a better understanding of the esophageal manometry procedure
3. Understand first line treatment for abnormal findings on manometry

11:00am -11:30am RUMINATION
Julie Snyder Christiana Psy.D, Boston Children's Hospital
Learning objectives:
1. Describe the rationale behind incorporating psychological/behavioral interventions into the treatment plan for a diagnosis of rumination
2. Identify specific psychological strategies that can be utilized for the management of rumination syndrome

11:30am – 11:45am ZEBRA: RICKETT'S, ITCHING AND POOR FEEDING: WHAT'S THE COMMON LINK?
Shabina Virani RN, MSN, CPNP
Learning objectives:
1. Discuss different ways liver disease presents in the GI clinic
2. Recognize cholestasis even if there is not jaundice present

11:45am - 12:30pm AWARDS/CONFERENCE WRAP UP
Susan G Moyer Nursing Research Award
Excellence in Education
Posters of Distinction

12:30pm - 2:00pm LUNCH AND POSTERS

2:00pm -3:30pm CONCURRENT SESSION - RESEARCH SKILLS Milano 5 - 6
Moderators: Edaire Cheng MD and Michael Rosen MD

PATHS TO SUCCESS IN CLINICAL TRANSLATIONAL RESEARCH
Samuel Nurko MD and Rachel Rosen MD, Boston Children's Hospital

PATHS TO SUCCESS IN QUALITY IMPROVEMENT SCIENCE
Shehzad Saeed MD, Dayton Children's Hospital and Chelly Dykes MD, Cincinnati Children's Hospital Medical Center

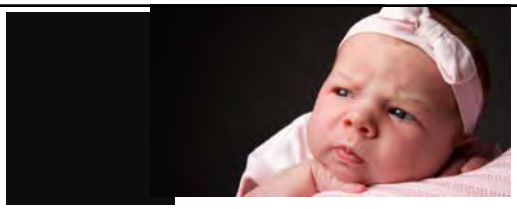
3:30pm -3:45pm BREAK

3:45pm - 5:15pm CLINICAL PRACTICE FORUM: CREATING A HIGHLY RELIABLE MULTIDISCIPLINARY TEAM Octavius 11
THE PEDIATRIC GASTROENTEROLOGIST AND MULTIDISCIPLINARY CARE
Ricardo Caicedo MD, Levine Children's Hospital/Carolinas HealthCare System

CREATING A CULTURE OF CARE
Jennifer Schurman PhD, ABPP, BCB, Children's Mercy Hospital

FIVE STRATEGIES FOR NAVIGATING AN MD/NP PARTNERSHIP IN A MULTIDISCIPLINARY TEAM
Robyn Robinson CPNP, CHOC Children's Gastroenterology and Nutrition

OVERCOMING CHALLENGES TO MULTIDISCIPLINARY CARE: THE RD PERSPECTIVE



The Irritable Baby

Jon A. Vanderhoof, M.D.
Division of GI/Nutrition
Boston Children's Hospital
Harvard Medical School

Disclosure

Former Medical Advisor for Mead Johnson
Consultant to I-health nutrition
And NUTEK nutrition

Why Babies Fuss And Cry

- Human babies are neither mobile to follow their mothers nor can they hold on to their mothers (like primates)
- Fuss/cry is an **evolutionary adaptation** to secure
  - Safety
  - Feeding
  - growth
  - Communication

Fussing And Crying Occurs In The Evening

HOURLY INCIDENCE OF FUSSINESS OF 68 INFANTS AT TIME OF POST-NATAL CHECK.

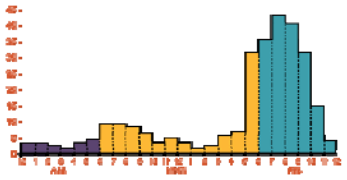


Fig. 1. Hourly incidence of fussiness of 68 infants at time of post-natal check.
©1954 American Academy of Pediatrics

Wessel MA, Cobb JC, Jackson EB, Harris GS, Detwiler AC. Paroxysmal fussing in infancy, sometimes called colic. *Pediatrics.* 1954;14:421-435.

Fuss/Cry and colic across countries

Fuss/Cry

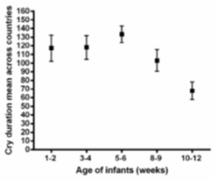
- In the first 6 weeks around 117-133 mins/day (on average)
- Fuss/cry reduces significantly after 8-9 weeks of age to about 60-70 mins from thereon
- There are large individual variations

Excessive Crying (Colic)

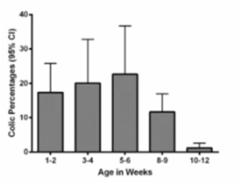
- 10-20% of babies in the first 3 months fuss/cry 3 or more hours per day
- Colic prevalence is higher in the first 6 weeks than in subsequent weeks

Wolke, D, Bilgin, A & Samara, M (under review). Meta-analysis of Fuss/Cry Duration and Colic Prevalence in Infants across Countries. Pediatrics

Normal versus abnormal fuss/cry



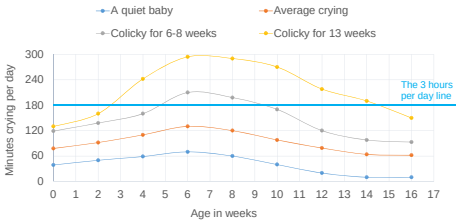
Universal fuss/cry curve in Developed Countries



Prevalence (%) of colic (Fuss/cry > 3hrs/day) in Developed Countries in the first 12 weeks of life

Wolke, D, Bilgin, A & Samara, M (under review). Meta-analysis of Fuss/Cry Duration and Colic Prevalence in Infants across Countries. Pediatrics

Daily crying at different ages



http://en.citizendium.org/wiki/Infant_colic/Draft

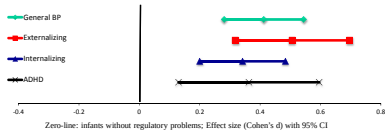
Outcome of colic in infants

Wt. gain delay	Transient/None
Allergy	None
Crying	Much reduced
Behavior disturbances	None
Temperament difficult	None, small
Sleep problems	None
Negative reactivity	None

Lehtonen L, Gormally S, Barr RG. Clinical pies, etiology and outcome in infants presenting with early increased crying. In Barr RG, Hopkins B, Green J (Eds). Crying as a signal, a sign, and a symptom: Developmental and clinical aspects of early crying behavior. London: Mac Keith Press; 2000.

4. When excessive Fuss/cry continues beyond 3 months of age: Regulatory Problems

- mostly co-occurring with sleeping or feeding problems: multiple regulatory problems
- Often persist into second year of life
- Associated with increased behavior problems in childhood (ADHD, externalizing, internalizing)

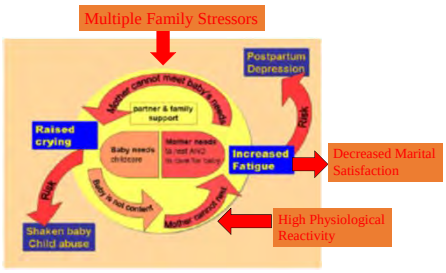


Hemmi MH, Wolke D, Schneider S. Associations between problems with crying, sleeping and/or feeding in infancy and long-term behavioural outcomes in childhood: a meta-analysis. *Arch Dis Child. 2011;96(7):622-629.*

Consequences for parents of colic crying

- Increased tiredness, stress, and anxiety (e.g. Postert et al, 2012; Wake et al, 2006; Kurth et al, 2012)
- Increased risk of postnatal depression symptoms (30-45%) (e.g. Martin et al, 2007; McMahon et al, 2001)
- Reduced Partner Relationship Quality

Danger Signs for a stressed relationship



Adapted and extended from: Kurth, E., Kennedy, H. P., Spichiger, E., Hösli, I., & Zemp Stutz, E. (2011). Crying babies, tired mothers: What do we know? A systematic review. *MIDWIFERY, 27(2), 187-194. doi:10.1016/j.midw.2009.05.012*

Consequences of abnormal crying in the first 3 months: Colic

For the infant

- Colic is usually self-limiting with most infants remitting by 4 months of age
- There are usually no long-term ill effects on the infant
- Some perceptions of "difficult temperament" may linger in parents' perceptions

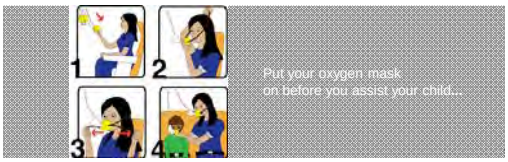
For parents

- Tiredness, depression and anxiety symptoms, loss of control – usually transient

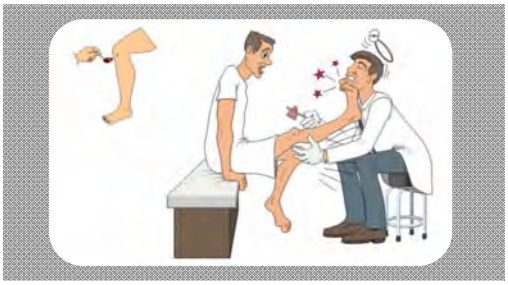
BUT

- Increased risk of Abusive Head Trauma (Shaken Baby Syndrome)

Only a “fit” mother can help her Infant



Pediatricians often respond with reflex actions



Reflex number one

- Start acid suppression
  - -PPI
  - -H2 receptor antagonist

Gastroesophageal Reflux

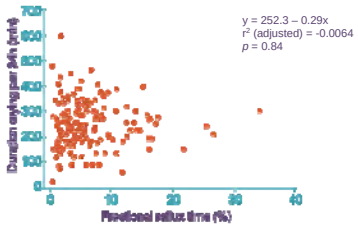
- Common cause of regurgitation, emesis
- Uncommon cause of irritability
- Overdiagnosed cause of irritable baby

PPI Impact on Irritability

% of patients	Lanzoprazole (n=81)	Placebo (n=81)
Symptom within 1 hour after feeding		
Crying, fussing or irritable	-19.9% (21.1)	-19.9% (22.8)
Spitting up/vomiting	-14.1% (24.4)	-11.4% (17.3)
Stopping feeding after starting	-6.8% (19.8)	-7.5% (14.8)

Orenstein SR, et al. *J Pediatr.* 2009;154:514.

GER and Crying Duration



Heine RG, et al. *J Paediatr Child Health.* 2006;42:134-9.

Back Arching

Table 3 Multiple linear regression analysis

	No. reflux episodes per 24 h			Fractional reflux time (%)		
Clinical predictors	Difference	95% CI	*P* value	Difference	95% CI	*P* value
Age under 3 months	8.94	4.3, 13.6	<0.001	−2.08	−3.98, −0.18	0.41
Feeding difficulties	−5.39	−10.1, −0.7	0.02	−2.35	−4.25, −0.45	0.02
Backarching	−2.17	−6.6, 2.5	0.36	−1.00	−2.89, −0.89	0.30

CI, confidence interval.

Conclusions: Investigation and treatment of GER in infants with persistent crying should be primarily directed at infants presenting with frequent regurgitation or feeding difficulties

Heine RG, et al. *J Paediatr Child Health*. 2006;42:134-9

Reflex number two

- Change the formula
  - -Lactose-free
  - -Hypoallergenic

Does Lactose Cause Irritability in Babies?

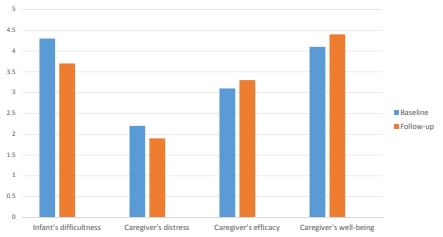
TABLE 2. Baseline and follow-up measures of caregiver-reported infant behavior and caregivers' distress by formula group

Measure	Control n = 102–103	Soy LF n = 92–93	Milk LF n = 94–95	*F*	*df*	*P*
Infant difficultness						
Baseline	4.17 (0.12)	4.24 (0.10)	4.19 (0.12)			
Follow-up	3.79 (0.08)	3.64 (0.09)	3.67 (0.09)	0.83	2,277	0.43
Parenting efficacy						
Baseline	3.01 (0.05)	2.99 (0.05)	2.92 (0.06)			
Follow-up	3.22 (0.04)	3.23 (0.04)	3.28 (0.04)	0.74	2,282	0.47
Caregiver psychological well-being						
Baseline	4.00 (0.10)	3.95 (0.10)	4.11 (0.10)			
Follow-up	4.32 (0.07)	4.37 (0.08)	4.48 (0.08)	1.07	2,285	0.34
Caregiver psychological distress						
Baseline	2.19 (0.09)	2.18 (0.08)	2.26 (0.09)			
Follow-up	1.92 (0.06)	1.99 (0.06)	1.88 (0.06)	0.80	2,285	0.45

Raw means [standard errors (SEs)] reported for baseline. Least squares means (SEs) reported for follow-up. *F*, *df*, and *P* values from analyses of covariance controlling for baseline scores and testing for differences in scores at follow-up by formula group. LF= lactose-free.

Walker L, et al. *JPGN*. 2015;61:119-24.

With and Without Lactose Data Combined



Walker L, et al. *JPGN*. 2015;61:119-24.

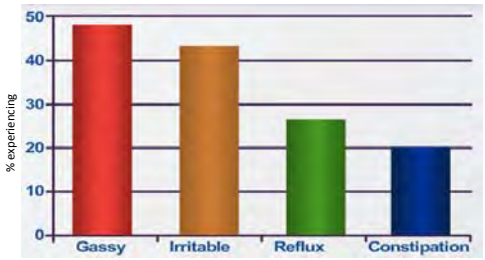
Why Lactose Matters

- It is the carbohydrate in breast milk
- It is nature's prebiotic
- It has a low glycemic index preventing large postprandial changes in blood glucose

Switching Formulas Seems to Work

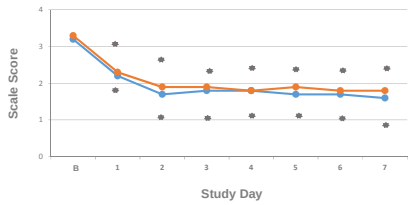
- Allergy or intolerance to CMP is not common (2-5%)
- Regardless of the initial feeding routine or potential CMP allergy or intolerance diagnosis:
  1. A high percentage of infants (estimated 30-50%) are switched to an alternate CMBF or experience a change to 1 or more nonstandard formulas due to parental perception of common infant symptoms
  2. Up to 80% of parents reported improved or resolved feeding intolerance due to formula replacement

Reasons for Switching Formula- USA



Source: NQF IF Usage and Experience Research, 2002

Results – Fussiness Score Week 1

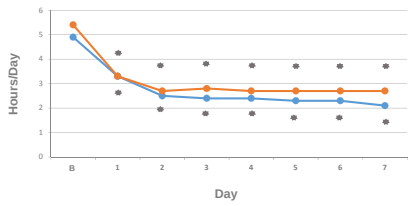


*P<0.001, Compared to baseline (B)
Mean ± SEM

PHWC = Partially Hydrolyzed 60:40 Whey:Casein
Teal = PHWC
Purple = Soy

Berseth CL, et al. *Clin Pediatr.* 2009;48:58-65.

Crying



*P<0.05 compared to baseline (B)
Mean ± SEM

Teal = Partially Hydrolyzed
Purple = Soy

Berseth CL, et al. *Clin Pediatr.* 2009;48:58-65.

Possible explanations for results

- Underlying allergy
- Placebo effect

Cow's Milk Formula as a Cause of Infantile Colic: A Double-Blind Study

Lasse Lothe, MD, Tor Lindberg, MD, and Irene Jakobsson, MD

From the Department of Paediatrics, Malmö General Hospital, University of Lund, Malmö, Sweden

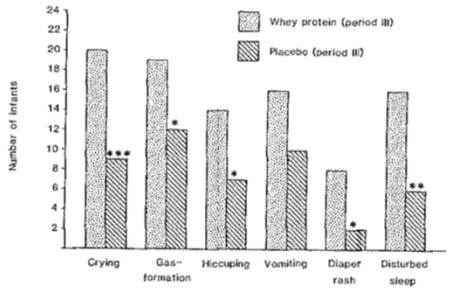
Sixty colicky infants were given a cow's milk containing formula and a **cow's milk-free soy for**mula
Symptoms of 17 infants (29%) could not be related to the diet
Eleven infants (18%) were **free of symptoms while receiving soy formula.**
Symptoms of 32 infants (53%) were unchanged or worse when they **were fed cow's** milk **formula and soy formula, but symp**toms disappeared when they were fed a formula containing hydrolyzed casein
A challenge with cow's milk-based formula after **one month (at approximately age 3 months) produced** symptoms of infantile colic in 22 infants (36%).
At age 6 months, a challenge with cow's milk was **positive in 11infants (18%) with epidermal and gastrointestinal symp**toms.
Eight infants (13%) at 12 months of age and five infants (8%) at 16 months of age were still intolerant to cow's milk

TABLE 1. Reaction to Cow's Milk-Based Formula and Soy-Based Formula Tested Double Blind in Infants with Infantile Colic

	No. of Infants
Spontaneous recovery	17 (29%)
Adverse reaction to cow's milk formula	11 (18%)
Adverse reaction to cow's milk formula and soy formula	32 (53%)
Total	60 (100%)

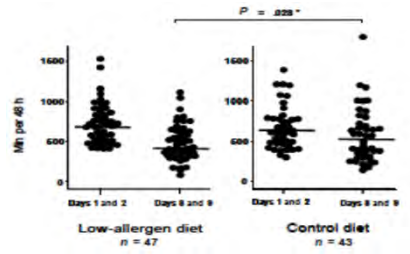
TABLE 3. Symptoms with Cow's Milk Challenge at 6 and 12 Months of Age in Infants with Infantile Colic

Infant	6 Months	12 Months	Other Foods Causing Adverse Reaction
S.S.	Abdominal pain	Abdominal pain, diarrhea	Orange
S.V.	Abdominal pain, diarrhea, exanthema	Abdominal pain, diarrhea	Fish, rose hip, strawberry
K.C.	Abdominal pain, diarrhea, exanthema,	Diarrhea, exanthema, fever	Tomato
P.K.	Vomiting	Vomiting, exanthema, urticaria	Soy, Nutramigen, beef, pork, lamb, wheat, berries, fruit
J.A.	Vomiting	Diarrhea, exanthema	Soy, Nutramigen, tomato, banana, peas, rose hip
E.C.	Vomiting	Vomiting, diarrhea, exanthema,	Orange, tomato, beef
M.C.	Vomiting	Vomiting, diarrhea	
A.A.	Diarrhea, exanthema	None	Strawberry
H.G.	Diarrhea, exanthema	None	
K.	Abdominal pain, exanthema	None	
M.W.	Diarrhea	Diarrhea, exanthema	Fruits



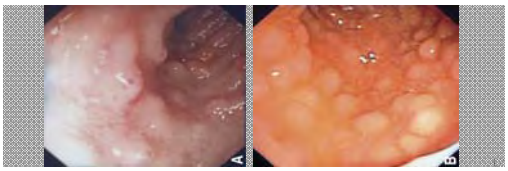
PEDIATRICS Vol. 83 No. 2 February 1989

Effect of a Low-Allergen Maternal Diet on Colic Among Breastfed Infants: A Randomized, Controlled Trial



Hill, D. Et. Al. PEDIATRICS Vol. 116 No. 5 November 2005

Duodenal Bulb Nodularity: An Endoscopic Sign of Cow Milk Protein Allergy in Infants



Al-Hussaini A, Khormi M, Fagih M. *Gastrointestinal Endoscopy.* 2012;75(2):450-453.

Allergy vs Colic

Allergy	Colic
Abnormal Stools	Normal stools
Poor weight gain	Normal weight gain
Feeds poorly	Feeds fine
Cries after eating	Cries in evening
Spits up a lot	Spits up rarely
Non-distractible	Soothable

When To Try Hypoallergenic Formula

- Failure to thrive
- Unremitting symptoms
- Presence of other symptoms
  - Diarrhea
  - Vomiting
  - Bloody stools
  - Feeding refusal

Clinical approach to fussy baby

- Careful history and physical
- Establish differential diagnosis
- Evaluate based on history and physical examination
- Treat appropriately once diagnosis is established

Does the baby have infantile colic?

- Does the history fit?
- Are there any red flags? (other symptoms, poor weight gain)
- Are there danger signs for infant suggesting risk?

If you suspect something else…

- Diagnostic evaluation as indicated especially if red flags
  - Reflux???????????
  - Metabolic disease
  - CNS
  - Renal, Other
  - Parental Issues
- Dietary restriction or hypoallergenic formula (AA or EHF) if symptoms suggest allergy

If the baby has infantile colic…

- Explain why babies cry
- Reassure the parents regarding other conditions
- Explain options to reduce crying (swaddling, soothing, repetitive stimulation)
- Explain other potential treatment options
- Schedule appropriate follow-up
- Be certain parents understand you are taking them seriously
- Other options
  - ?Probiotic
  - ?placebo
  - ?formula change

Lactobacillus reuteri DSM 17938 for the Management of Infantile Colic in Breastfed Infants: A Randomized, Double-Blind, Placebo-Controlled Trial

Table II. Primary outcomes

Outcome	Probiotic group (n = 40)	Placebo group (n = 40)	RR (95% CI)	NNT (95% CI)	*P* value*
Treatment success (reduction in the daily average crying time >50%)					
Day 7	6	0	-	7 (4-19)	.026
Day 14	30	7	4.3 (2.3-8.7)	2 (2-3)	<.001
Day 21	39	15	2.6 (1.8-4.0)	2 (2-3)	<.001
Day 28†	40	25	1.6 (1.3-2.1)	3 (2-5)	<.001
			Median difference (95% CI)		
Duration of crying (min/d) (median, IQR)					
Baseline	240 (210-270)	240 (203-278)	0.0 (−30 to 30)	N/A	.8
Day 7	180 (149-180)	180 (150-210)	0.0 (−60 to 0)	N/A	.002
Day 14	105 (101-120)	150 (120-180)	−45 (−75 to −30)	N/A	<.0001
Day 21	75 (60-90)	128 (116-150)	−53 (−83 to −45)	N/A	<.0001
Day 28†	52 (45-75)	120 (90-128)	−68 (−75 to −60)	N/A	<.0001

N/A, not applicable; NNT, number needed to treat.
*Fisher exact test or χ^2, or Mann–Whitney test, as appropriate.
†Follow-up visit 1 week after the termination of the intervention.

Hania Szajewska, MD, Ewa Gyrczuk, MD, and Andrea Horvath, MD; J Pediatr 2013;162:257-62

Probiotics for Infantile Colic: A Randomized, Double-Blind, Placebo-Controlled Trial Investigating Lactobacillus reuteri DSM 17938

Table II. Primary outcome: duration of crying and/or fussing times in the placebo and *L reuteri* DSM 17938 groups

	Duration of crying time, min/day, median (IQR)			Total crying/21 days, min, mean ± SD			
Time	Placebo (n = 28)	*L reuteri* (n = 24)	Median difference (95% CI)	Placebo (n = 28)	*L reuteri* (n = 24)	Mean difference (95% CI); RR (95% CI)	*P* value
Baseline	122 (103-88)	131 (149-84)	9 (−29 to 46)				.804*
Day 7	120 (149-91)	90 (129-53)	−30 (−65 to 5)				.032*
Day 14	103 (140-78)	75 (103-54)	−28 (−55 to 0)				.018*
Day 21	102 (148-61)	60 (99-35)	−42 (−74 to −10)				.045*
Total				2195 ± 764	1719 ± 750	477 (53-900); 0.78 (0.58-0.98)	.028†

RR, relative risk.
*Mann–Whitney U test.
†Student *t* test.

Kim Chau, MSc, Eddy Lau, MD,Saul Greenberg, MD, Sheila Jacobson, MD, Parvaneh Yazdani-Brojeni, MD, Natasha Verma, MD, and Gideon Koren, MD; J Pediatr 2015;166:74-8).

Treating infant colic with the probiotic *Lactobacillus reuteri*: double blind, placebo controlled randomized trial

- **What is already known on this topic**
  - Previous small trials suggest that the probiotic *Lactobacillus reuteri* effectively treats colic in breastfed infants
  - These studies, however, had limitations as they examined a highly selective group of infants with colic
  - The effects of *L reuteri* on formula fed infants with colic are unknown
- **What this study adds**
  - *L reuteri* treatment did not reduce crying or fussing in infants with colic, nor was it effective in improving infant sleep, maternal mental health, family or infant functioning, or quality of life
  - Probiotics therefore cannot be routinely recommended for all infants with colic
  - Further research is needed to identify which subgroups of infants with colic may benefit from probiotics

Valerie Sung, Mimi L K Tang, Fiona K Mensah Monica L Catherine Satzke, Ralf G Heine, Amanda Stock, Ronald G Barr, Melissa Wake
BMJ 2014;348:g2107 doi: 10.1136/bmj.g2107 (Published 1 April 2014)

Canis lupus familiaris

Synbiotic in the management of infantile colic: A randomized controlled trial

Table 2 Primary and secondary outcome measures

Primary outcome	Synbiotic group (n = 25)	Placebo group (n = 20)	NNT	P-value
Treatment success (reduction in the daily average crying time >50%)	—			
Day 7	80%	35%	2.1	<0.005
Day 30	87%	46%	2.5	<0.01
Secondary outcomes				
Symptom resolution (reduction in the daily average crying time >90%)	—			
Day 7	39%	7%	3	<0.03
Day 30	56%	36%	5.5	0.24
Duration of colic (minutes/day)	—			
Before intervention	193.04 ± 26	185.0 ± 24	—	0.635
Day 7	70.00 ± 10	97.5 ± 12	—	<0.001
Day 30	28.80 ± 9.7	63.46 ± 10	—	<0.001
Weight (gram)	—			
Before intervention	4300.2 ± 1098	4640.66 ± 916	—	0.320
Day 30	5269.8 ± 1736	5060.0 ± 743	—	0.057

—, inconclusive results; NNT, number needed to treat.

Journal of Paediatrics and Child Health 50 (2014) 801–805

Probiotics in infantile colic

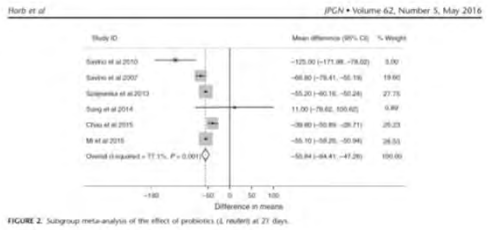
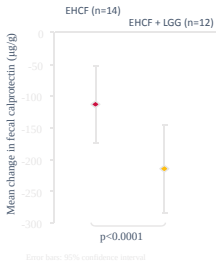


FIGURE 2. Subgroup meta-analysis of the effect of probiotics (*L reuteri*) at 21 days.

LGG in Infants with Cow's Milk Allergy
Fecal Calprotection

- 26 infants with cow' s milk allergic colitis
- Randomized to receive EHCF + or - LGG
- Calprotectin was significantly reduced with LGG, compared to control



Baldassarre ME et al. J Pediatr 2010;156:397-401

Oral hypertonic glucose solution in the treatment of infantile colic

Symptom score	Glucose treatment		Placebo	
	nn	%	*n*	%
0 = getting worse	0	0	0	0
1 = no improvement	9	36	13	52
2 = mild improvement	5	20	8	32
3 = moderate improvement	6	24	3	12
4 = marked improvement	5	20	1	4
5 = completely well	0	0	0	0

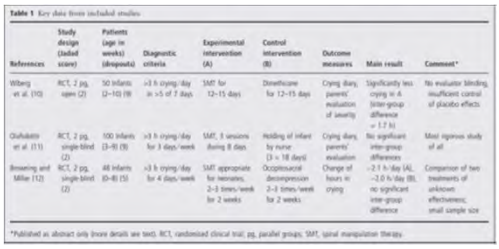
Pediatrics International (2006) **48**, 125–127

Nutritional Supplements and Other Complementary Medicines for Infantile Colic: A Systematic Review

- Few RCTs of CAM for IC are available, and many have methodological problems
- Although some encouraging results exist for fennel extract, mixed herbal tea, and sugar solutions, design flaws and the absence of independent replications preclude practice recommendations.
- The evidence for probiotic supplements and manual therapies does not indicate an effect.

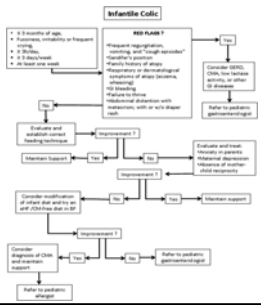
Rachel Perry, Katherine Hunt, and Edzard Ernst
PEDIATRICS Volume 127, Number 4, April 2011

Chiropractic spinal manipulation for infant colic: a systematic review of randomized clinical trials



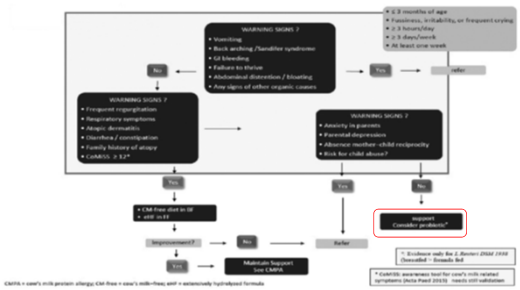
Int J Clin Pract, September 2009, 63, 9, 1351–1353

Practical algorithms for managing common gastrointestinal symptoms in infants



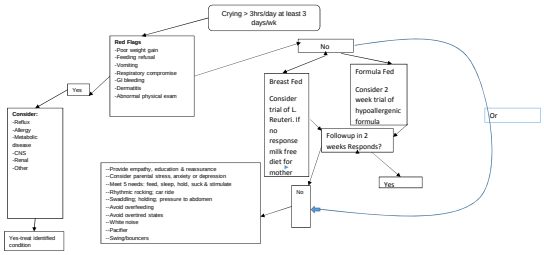
Yvan Vandenplas, Pedro Gutierrez-Castrellon, Carlos Velasco-Benitez, Jorge Palacios, Domingo Jaen, Hugo Ribeiro, Lynette Pei-Chi Shek, Bee-Wah Lee, Pedro Alarcon
Nutrition 29 (2013) 184–194

Algorithms for Common Gastrointestinal Disorders: Yvan Vandenplas
Infantile Colic.



JPGN Volume 63, Supplement 1, July 2016

Proposed Approach Fussy Infant



Important messages for caregivers about infant colic

- Baby is not sick – point out normal growth and development; parents are capable of caring for her
- Talk about variation in crying patterns in infants and differences in sensitivity and soothability
- Crying can be reduced by changes in how the infant is handled
- Does not need to be picked up each time she whimpers; needs to be put down when overtired
- Does need more soothing and to learn to self-soothe

Questions?

Definition

1

Definition

Celiac disease is an immune-mediated enteropathy caused by a permanent sensitivity to gluten in genetically susceptible individuals.

It occurs in symptomatic subjects with gastrointestinal and non-gastrointestinal symptoms, and in some asymptomatic individuals, including subjects affected by:

- Type 1 diabetes
- Down syndrome
- Turner syndrome
- Williams syndrome
- Selective IgA deficiency
- First degree relatives of individuals with celiac disease

2

Expanded Definition

- Celiac disease is an autoimmune condition
- Occurs in genetically susceptible individuals
  - DQ2 and/or DQ8 positive HLA haplotype is necessary but not sufficient
- A *unique* autoimmune disorder because:
  - both the environmental trigger (gluten) and the autoantigen (tissue Transglutaminase) are known
  - elimination of the environmental trigger leads to a complete resolution of the disease

3

Clinical Manifestations

4

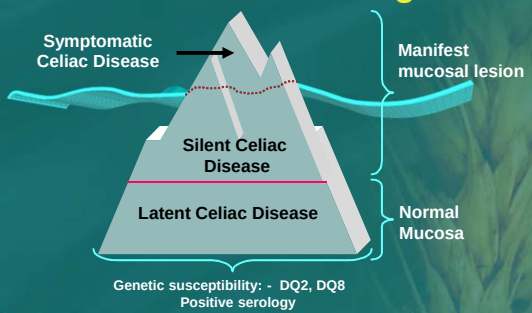
Clinical Manifestations

- Gastrointestinal *("classical")*
- Non-gastrointestinal *("atypical")*
- Asymptomatic

In addition, Celiac Disease may be associated with other conditions, and mostly with:
- Autoimmune disorders
- Some syndromes

5

The Celiac Iceberg



6

Gastrointestinal Manifestations ("Classic")

Most common age of presentation: 6-24 months

- Chronic or recurrent diarrhea
- Abdominal distension
- Anorexia
- Failure to thrive or weight loss
- Abdominal pain
- Vomiting
- Constipation
- Irritability

Rarely: Celiac crisis

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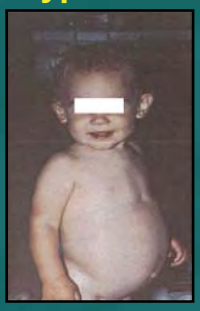
7

Typical Celiac Disease



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Non Gastrointestinal Manifestations

Most common age of presentation: older child to adult

- Dermatitis Herpetiformis
- Dental enamel hypoplasia of permanent teeth
- Osteopenia/Osteoporosis
- Short Stature
- Delayed Puberty
- Iron-deficient anemia resistant to oral Fe
- Hepatitis
- Arthritis
- Epilepsy with occipital calcifications

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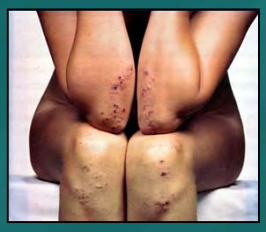
Listed in descending order of strength of evidence 9

Dermatitis Herpetiformis

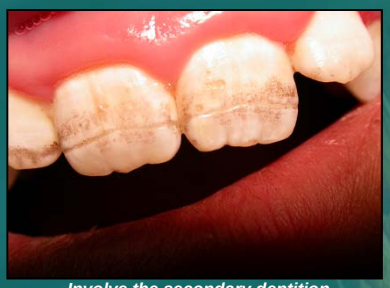


- Erythematous macule > urticarial papule > tense vesicles
- Severe pruritus
- Symmetric distribution
- 90% no GI symptoms
- 75% villous atrophy
- Gluten sensitive

Garioch JJ, et al. *Br J Dermatol*. 1994;131:822-6.
Fry L. *Baillieres Clin Gastroenterol*. 1995;9:371-93.
Reunala T, et al. *Br J Dermatol*. 1997;136-315-8.

10

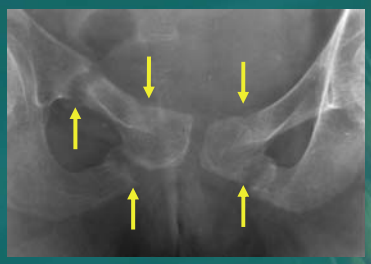
Dental Enamel Defects



Involve the secondary dentition
May be the only presenting sign of Celiac Disease

11

Osteoporosis



Low bone mineral density improves in children on a gluten-free diet.

12

Short Stature/Delayed Puberty

- Short stature in children / teens:
  - ~10% of short children and teens have evidence of celiac disease
- Delayed menarche:
  - Higher prevalence in teens with untreated Celiac Disease

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13

Fe-Deficient Anemia Resistant to Oral Fe

- Most common non-GI manifestation in some adult studies
- 5-8% of adults with unexplained iron deficiency anemia have Celiac Disease
- In children with newly diagnosed Celiac Disease:
  - Anemia is common
  - Little evidence that Celiac Disease is common in children presenting with anemia

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Hepatitis

- Some evidence for elevated serum transaminases (ALT, AST) in adults with untreated Celiac Disease
  - Up to 9% of adults with elevated ALT, AST may have silent Celiac Disease
  - Liver biopsies in these patients showed non-specific reactive hepatitis
  - Liver enzymes normalized on gluten-free diet

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Arthritis and Neurological Problems

- Arthritis in adults
  - Fairly common, including those on gluten-free diets
- Juvenile chronic arthritis
  - Up to 3% have Celiac Disease
- Neurological problems
  - Epilepsy with cranial calcifications in adults
  - Evidence for this condition in children with Celiac Disease is not as strong

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3 – Asymptomatic

Silent ↔ Latent

- **Silent:**
  No or minimal symptoms, "damaged" mucosa and positive serology

  Identified by screening asymptomatic individuals from groups at risk such:
  - First degree relatives
  - Down syndrome patients
  - Type 1 diabetes patients, etc.

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3 – Asymptomatic

Silent ↔ Latent

- **Latent: *No symptoms, normal mucosa***
  - May show positive serology. Identified by following in time asymptomatic individuals previously identified at screening from groups at risk. These individuals, given the "right" circumstances, will develop at some point in time mucosal changes (± symptoms)

18

Asymptomatic

- Asymptomatic patients are still at risk of osteopenia/osteoporosis
- Treatment with a gluten-free diet is recommended for asymptomatic children with proven intestinal changes of Celiac Disease who have:
  - type 1 diabetes
  - selective IgA deficiency
  - Down syndrome
  - Turner syndrome
  - Williams syndrome
  - autoimmune thyroiditis
  - a first degree relative with Celiac Disease

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Associated Conditions

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20

Associated Conditions

The prevalence of Celiac Disease is higher in patients who have the following:

- Certain genetic disorders or syndromes
- Other autoimmune conditions
- Relative of a biopsy-proven celiac

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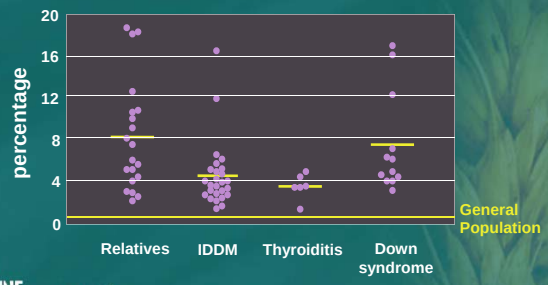
21

Associated Conditions



22

Genetic Disorders

- Down Syndrome: 4-19%
- Turner Syndrome: 4-8%
- Williams Syndrome: 8.2%
- IgA Deficiency: 7%
  - Can complicate serologic screening

23

Prevalence of Celiac Disease is Higher in Other Autoimmune Conditions

Type 1 Diabetes Mellitus:	3.5 - 10%
Thyroiditis:	4 - 8%
Arthritis:	1.5 - 7.5%
Autoimmune liver diseases:	6 - 8%
Sjögren's syndrome:	2 - 15%
Idiopathic dilated cardiomyopathy:	5.7%
IgA nephropathy:	3.6%

24

Relatives

- Healthy population: 1:133
- 1st degree relatives: 1:18 to 1:22
- 2nd degree relatives: 1:24 to 1:39

Fasano, et al, *Arch of Intern Med*, Volume 163: 286-292, 2003

25

Type 1 Diabetes

Patients are often asymptomatic

Nocturnal hypoglycemia with seizures

TTG may be falsely positive

Gluten–free diet challenging

2 U.S. studies in pediatrics:

- 218 patients. 7.7% EMA+. 4.6% biopsy + *(Aktay et al. JPGN 2001;33:462-465)*
- 185 patients. 5% EMA+. 4/5 biopsy + *(Talal et al. AJG 1997;92:1280-84)*

26

Which Came First?

27

Celiac Disease and Autoimmunity

- Prevalence of autoimmune disorders in celiac disease related to duration of gluten exposure
  - Diagnosed before 2 years of age: 5%
  - Age 2-10 years: 17%
  - Greater than age 10 years: 24%
- Increased incidence of autoimmune disease in patients with IDDM and 'silent' Celiac Disease and their first degree relatives who were EMA+

Ventura et al, Gastro 1999; *Not , Diabetologia* 2001

28

Complications

29

Major Complications of Celiac Disease

- Short stature
- Dermatitis herpetiformis
- Dental enamel hypoplasia
- Recurrent stomatitis
- Fertility problems
- Osteoporosis
- Gluten ataxia and other neurological disturbances
- Refractory celiac disease and related disorders
- Intestinal lymphoma

30

Mechanisms of Celiac Disease Complications

- Intestinal malabsorption
  - protein-caloric malnutrition
  - deficiency of specific nutrients
- Genetic background
- Autoimmunity
- IEL clonal proliferation

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Celiac Disease Associated Disorders

- Autoimmune diseases: type 1 diabetes, Hashimoto's thyroiditis, autoimmune hepatitis, adrenal failure
- Down syndrome
- IgA deficiency
- Turner syndrome
- Williams syndrome

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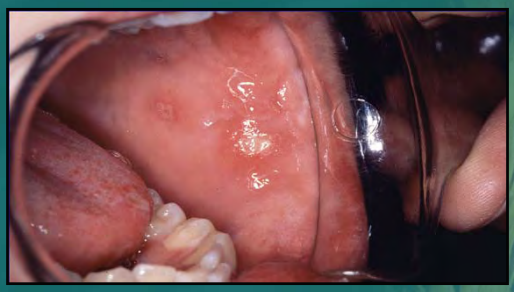
32

Recurrent Aphtous Stomatitis



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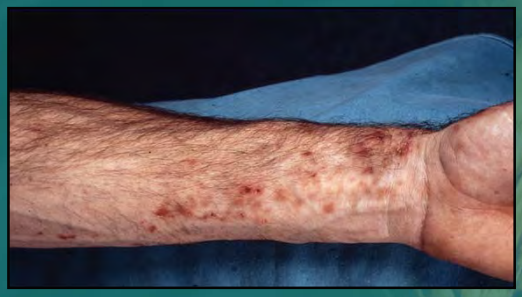
By permission of C. Mulder, Amsterdam (Netherlands)

33

Dermatitis Herpetiformis



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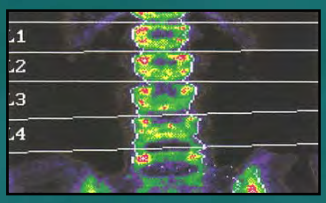
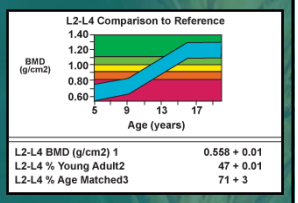
Low Bone Mineral Density (DXA) in a Child With Untreated Celiac Disease



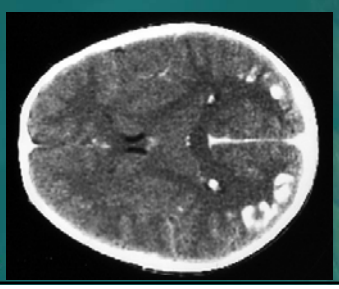


L2-L4 BMD (g/cm2) 1	0.558 + 0.01
L2-L4 % Young Adult2	47 + 0.01
L2-L4 % Age Matched3	71 + 3

By permission of Mora S, Milan (Italy)

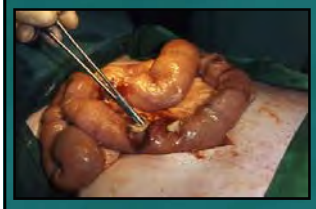
35

CT Scan Showing Occipital Calcifications in a Boy with Celiac Disease and Epilepsy



36

Celiac Disease Complicated by Enteropathy-Associated T-cell Lymphoma (EATL)



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Epidemiology

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Epidemiology

The "old" Celiac Disease Epidemiology:

- A rare disorder typical of infancy
- Wide incidence fluctuates in space (1/400 Ireland to 1/10000 Denmark) and in time
- A disease of essentially European origin

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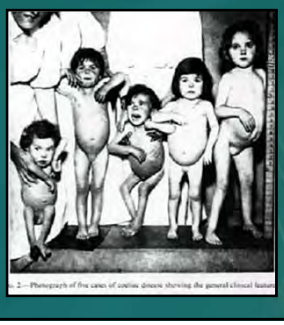
Celiac Disease in London, Year 1938



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The Changing Celiac Epidemiology

The availability of sensitive serological markers made it possible to discover Celiac Disease even when the clinical suspicion was low.

AGA	EMA	TTG
1980	1990	2000

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"Mines" of Celiac Disease Were Found Among:

Relatives

Patients with

short stature, anaemia, fatigue, hypertransaminasemia

Associated diseases

autommune disorders, Down s, IgA deficiency, neuropathies, osteoporosis, infertility

"Healthy" groups

blood donors, students, general population

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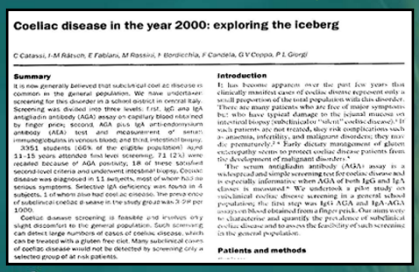
The First Picture of the Celiac Iceberg



Coeliac disease in the year 2000: exploring the iceberg

C Catassi, I M Rätsch, E Fabiani, M Rossini, F Bordicchia, F Candela, G V Coppa, P L Giorgi

Summary

It is now generally believed that subclinical coeliac disease is common in the general population. We have undertaken screening for this disorder in a school district in central Italy. Screening was divided into three levels: first, IgC and IgA antigliadin antibody (AGA) assay on capillary blood eluted by finger prick; second, AGA plus IgA anti-endomysium antibody (AEA) test and measurement of serum immunoglobulins in venous blood; and third, intestinal biopsy. 3351 students (65% of the eligible population) aged 11-15 years attended first level screening. 71 (2%) were recalled because of AGA positivity, 18 of these satisfied second-level criteria and underwent intestinal biopsy. Coeliac disease was diagnosed in 11 subjects, most of whom had no serious symptoms. Selective IgA deficiency was found in 4 subjects, 1 of whom also had coeliac disease. The prevalence of subclinical coeliac disease in the study group was 3·34 per 1000.

Coeliac disease screening is feasible and involves only slight discomfort to the general population. Such screening can detect large numbers of cases of coeliac disease, which can be treated with a gluten free diet. Many subclinical cases of coeliac disease would not be detected by screening only a selected group of at risk patients.

Introduction

It has become apparent over the past few years that clinically manifest cases of coeliac disease represent only a small proportion of the total population with this disorder. There are many patients who are free of major symptoms but who have typical damage to the jejunal mucosa on intestinal biopsy (subclinical or "silent" coeliac disease).[1] If such patients are not treated, they risk complications such as anaemia, infertility, and malignant disorders; they may die prematurely.[2-4] Early dietary management of gluten enteropathy seems to protect coeliac disease patients from the development of malignant disorders.[4]

The serum antigliadin antibody (AGA) assay is a widespread and simple screening test for coeliac disease and is especially informative when AGA of both IgG and IgA classes is measured.[5] We undertook a pilot study on subclinical coeliac disease screening in a general school population; the first step was IgG AGA and IgA AGA assays on blood obtained from a finger prick. Our aims were to characterise and quantify the prevalence of subclinical coeliac disease and to assess the feasibility of such screening in the general population.

Patients and methods

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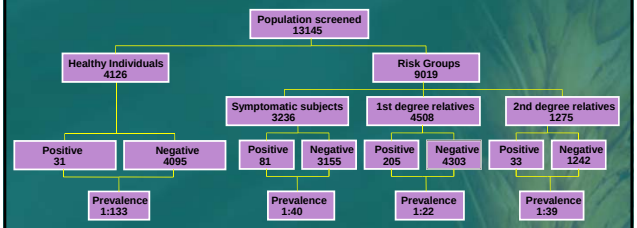
Celiac Disease Epidemiological Study in USA



Projected number of celiacs in the U.S.A.: 2,115,954
Actual number of known celiacs in the U.S.A.: 40,000
For each known celiac there are 53 undiagnosed patients.

A. Fasano et al., *Arch Int Med* 2003;163:286-292.

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Celiac Disease Prevalence Data

Geographic Area	Prevalence on clinical diagnosis*	Prevalence on screening data
Brasil	?	1:400
Denmark	1:10,000	1:500
Finland	1:1,000	1:130
Germany	1:2,300	1:500
Italy	1:1,000	1:184
Netherlands	1:4,500	1:198
Norway	1:675	1:250
Sahara	?	1:70
Slovenia	?	1:550
Sweden	1:330	1:190
United Kingdom	1:300	1:112
USA	1:10,000	1:133
Worldwide (average)	1:3,345	1:266

*based on classical, clinical presentation

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Fasano & Catassi, *Gastroenterology* 2001; 120:636-651.

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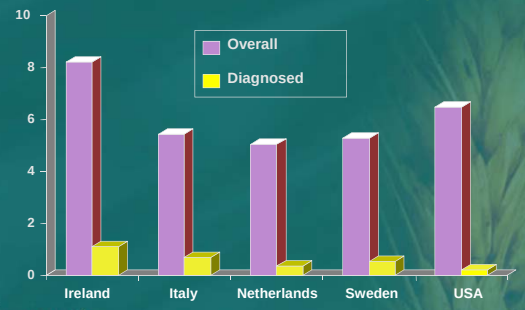
Celiac Societies Data in Europe and USA

(approximate estimates)

Country	Celiac Society members (n)	Population	Frequency of CD membership
United Kingdom	48,000	55,500,000	1:1146
Italy	25,000	57,000,000	1:2280
Sweden	18,000	8,700,000	1:483
Germany	15,000	80,000,000	1:5333
Finland	11,000	5,100,000	1:464
Spain	8,000	38,500,000	1:4812
Norway	6,000	4,300,000	1:716
Netherlands	4,500	15,100,000	1:3355
France	3,700	57,000,000	1:15405
Belgium	1,800	10,000,000	1:5555
Austria	2,400	7,800,000	1:3250
Switzerland	2,300	6,900,000	1:3000
Ireland	2,400	3,500,000	1:1458
Denmark	1,100	5,200,000	1:4727
Europe	149,200	354,600,000	1:2377
USA	40,000	281,421,906	1:7035

A. Catassi, A. Fasano . *Curr Gastroenterol Rep* 2002;4:238-243. 46

Celiac Disease Icebergs



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In Italy the Celiac Case-Finding is Increasingly Efficient

Incidence of CD on 1000 newborns in the March (Middle Italy)

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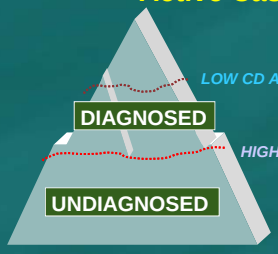
The Size of the Submerged Iceberg is Decreasing in Many Countries Due to Active Case-Finding



Even an intensive policy of Celiac Disease case-finding will leave at least 50 % of celiacs without a diagnosis.

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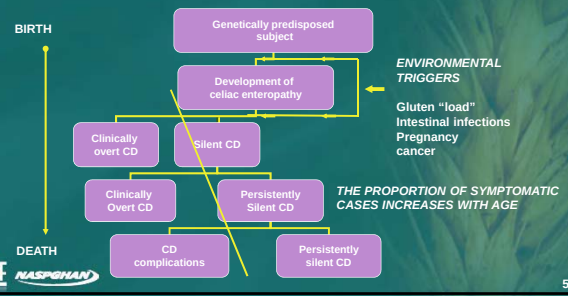
Natural History Of Celiac Disease At Glance



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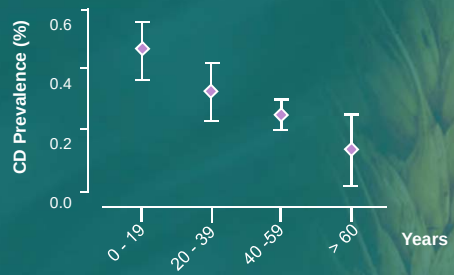
Where Have The Aging Celiacs Gone?



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Increased Overall Mortality In Adult Life

AUTOIMMUNE DISEASES
OSTEOPOROSIS
LIVER DISEASES
CANCER

ORIGINAL INVESTIGATION

Causes of Death in Patients With Celiac Disease in a Population-Based Swedish Cohort

Ulrike Peters, PhD, MPH; Johan Askling, MD; Gloria Gridley, MS; Anders Ekbom, MD, PhD; Martha Linet, MD

Mortality in patients with coeliac disease and their relatives: a cohort study

Giovanni Corrao, Gino Roberto Corazza, Vincenzo Bagnardi, Giovanna Brusco, Carolina Ciacci, Mario Cottone, Carla Sategna Guidetti, Paola Usai, Pietro Cesari, Maria Antonietta Pelli, Silvano Loperfido, Umberto Volta, Antonino Calabrò, Maria Certo, for the Club del Tenue Study Group

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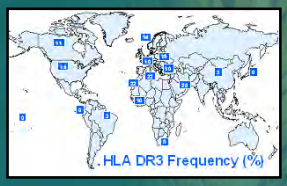
Risk Factors

The Grains

The Genes



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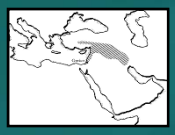
Spreading of Agriculture and Celiac Disease

1
Cereals domestication started 10,000 years ago in the Fertile Crescent…



INVERSE RELATIONSHIP BETWEEN CD FREQUENCY AND LENGHT OF TIME SINCE THE INTRODUCTION OF AGRICOLTURE ?

2
Catalhuyuc,
The first town in the world was built 9,000 y ago

3
Agricolture slowly spread with a East-West gradient (1 Km/y)…

4
CD genes confer disadvantage in areas of high cereal consumption

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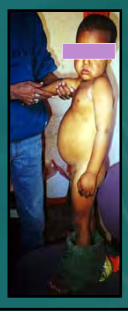
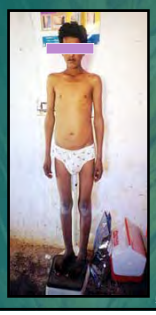
Celiac Disease in the Saharawis

- 1:18 children are affected with Celiac Disease
- Diarrhea, stunting, anemia
- EMA pos, typical jejunal damage
- High frequency of DR3/DR3 and DR3/DR4
- High mortality (especially in summer)





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Celiac Disease in Iran

- The prevalence of Celiac Disease among 2000 Iranian blood donors is one of the highest in the world (1:166).
- Celiac Disease is a common finding among patients labelled as irritable bowel syndrome (11 %).
- The theory on the East-West increasing gradient of Celiac Disease prevalence does not hold.

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Celiac Disease in India

- Common cause of chronic diarrhea both in children and in adults
- Long diagnostic delay
- "Hypertypical" clinical presentation
- Strong association with DQ2 etherodimer and with DR3 Asian haplotypes (A26-B8-DR3)

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Celiac Disease in Developing Countries

- Worldwide circulation of gluten-containing food could cause epidemics of Celiac Disease
- Largely underestimated (e.g. along the “silk road”)
- Typical symptoms and stunting (nutritional dwarfism)
- Celiac Disease serological markers still reliable
- Formidable treatment difficulties

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The Global Village of Celiac Disease

- In many areas of the world Celiac Disease is one of the commonest, lifelong disorders affecting around 1% of the general population.
- Most cases escape diagnosis and are exposed to the risk of complications.
- Active Celiac Disease case-finding is needed but mass screening should be considered.
- The impact of Celiac Disease in the developing world needs further evaluation.

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Pathogenesis

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Pathogenesis

- Genetic predisposition
- Environmental triggers
  - Dietary
  - Non dietary?

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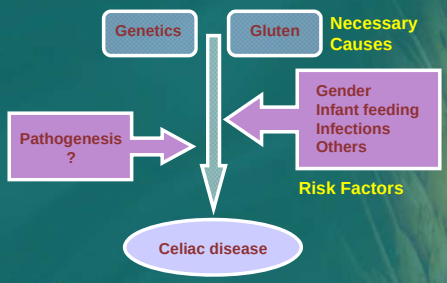
Pathogenesis



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Genetics

- Strong HLA association
- 90 - 95% of patients HLA-DQ2 – also found in 20 - 30% of controls
  - Most of the remainder are HLA - DQ8
- 10% of patients have an affected first degree relative

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Genetics

- Concordance in monozygotic twins is 70%
- Concordance in HLA-identical siblings 30 - 40%, suggesting other genes involved
- Protein binding receptors on antigen presenting cells

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Genetics

- Several genes are involved
- The most consistent genetic component depends on the presence of HLA-DQ (DQ2 and / or DQ8) genes
- Other genes (not yet identified) account for 60 % of the inherited component of the disease
- HLA-DQ2 and / or DQ8 genes are necessary (No DQ2/8, no Celiac Disease!) but not sufficient for the development of the disease

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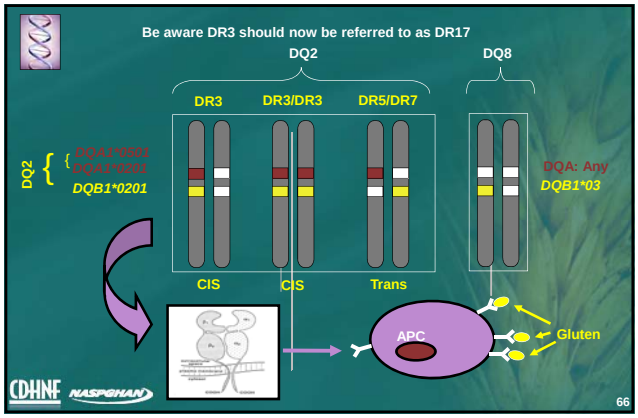

66

Genetics

- Non-HLA Related Factors
  - Concerns about HLA factors
    - < 2% of all DQ2 carriers have Celiac Disease
    - concordance for HLA matched siblings (30-40%) is lower than for monozygotic twins (~70%)
  - Data suggests additional non HLA genes
  - Inheritance of Celiac Design most likely multigenic
  - Conflicting data for non HLA genes

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Genetics

- Genetic factors associated with effector T-cell reactivity
  - CTLA-4 - negative regulation of T-cell activation
  - CTLA-4/CD28 gene locus linked to autoimmune disease (IDDM, Graves, Celiac Disease)
  - CTLA-4 polymorphism in Finnish and French patients with Celiac Disease but not in Italian and Tunisian families

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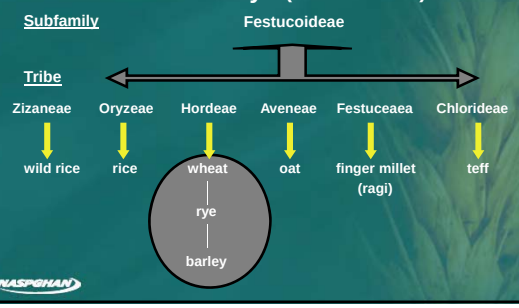
Dietary Factors

The Grass Family - (GRAMINEAE)



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Dietary Factors

- Wheat - (15% protein, 75% starch)

Gluten

Gliadin (alcohol soluble) Prolamine ⟷ **Glutenin** (alcohol insoluble)

- Rye prolamines - secalins
- Barley prolamines - hordeins
- ? Oats prolamines - avenins

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Dietary Factors

Amino acid sequence of A-gliadin is rich in proline (P) and glutamine (Q).

P = 15%

Q = 30%

No specific peptide activates disease in all Celiac Disease patients.

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Dietary Factors

- 33 amino acid peptide in gliadin contains critical epitopes – high in glutamine and proline
- Resistant to digestion in lumen
- Penetrates epithelial barrier
- Modified by the enzyme tissue transglutaminase – deamidates glutamine residues to glutamic acid
- Resulting higher affinity binding to HLA DQ2 molecule on the surface of antigen-presenting cells

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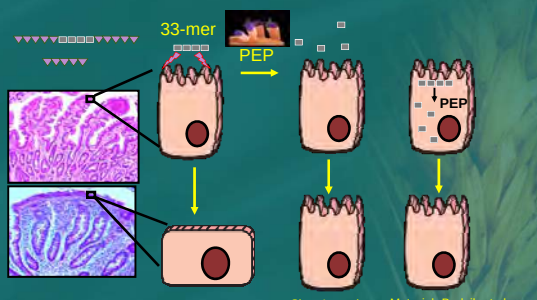
Toxic Peptides Digestion



Shan L. et al *Science* 2002

Matysiak-Budnik et al *Gastroenterology* 2003

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Non Dietary Factors

- Infections
  - Viral infections
    - sequence homology between α-gliadin & adenovirus type 12 & 7, rubella and human herpesvirus 1
  - Parasitic infestations
    - sequence homology between a-gliadin & Plasmodium yoelli
  - Other ?

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Role of Cytokines

- Mucosal cytokines
  - upregulation of IL2 receptor expression
  - increased γ interferon mRNA expression
  - involvement of IL15
  - in vitro gluten stimulation of mucosa from treated Celiac Disease patients
    - γ interferon mRNA
    - IL2 mRNA

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T Cells Activation

- Presentation of modified gliadin peptide in context of HLA-DQ2 leads to activation of CD4+ lamina propria T cells
- Gliadin-specific T cells have a Th1 functional phenotype with high secretion of IFN-γ

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Mucosal Events

- Epithelial cell infiltration
  - increased IEL's - (>90% CD8, <10% CD4)
  - increased mucosal γ/δ T cells (nl <10%)
  - role of γ/δ cells in Celiac Disease unknown
- Mucosal surface alterations
  - loss of epithelial cells
  - proliferation of crypt epithelial cells

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Humoral Response

- Humoral response
  - enhanced antibody production
    - Anti-tissue transglutaminase
    - Anti-gliadin
    - ? other autoantigens (anti-actin)
  - mechanism of antibody production unknown

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Tissue Transglutaminase (TTG)

- Normal gut enzyme released during injury and stabilizes the cross-linking of proteins in granulation tissue
- Role in Celiac Disease
  - Modification of gliadin epitopes
  - Autoantibodies against TTG correlate with active Celiac Disease - ? involved in pathogenesis

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Pathophysiology Sequelae

- Malabsorption of nutrients, especially iron, folate, calcium, and vitamin D
- Increased intestinal permeability may permit entry of other toxins which might induce autoimmune diseases

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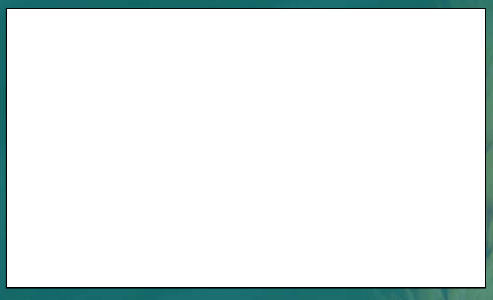
Hypothesis



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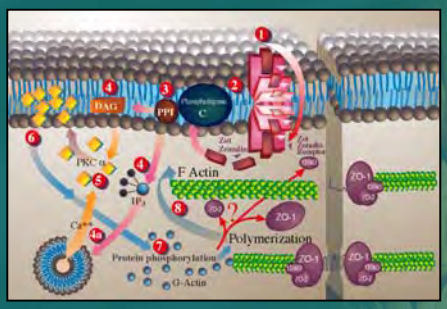
Proposed Zonulin Mechanism of Action



Fasano, J. Ped. Gastroenterol. Nutr., Vol. 26: 520-532, 1998

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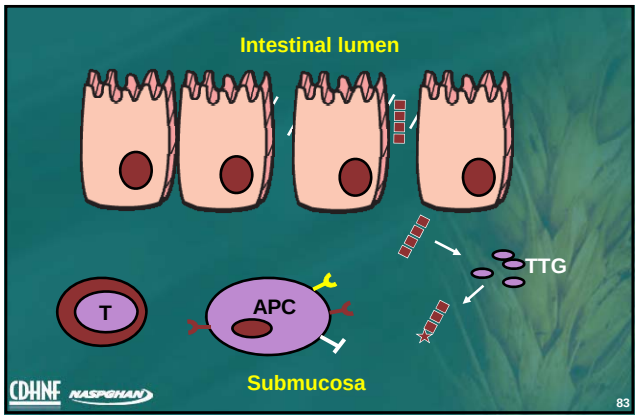

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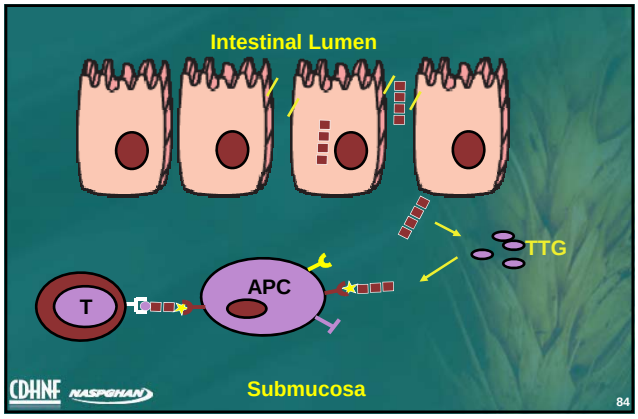

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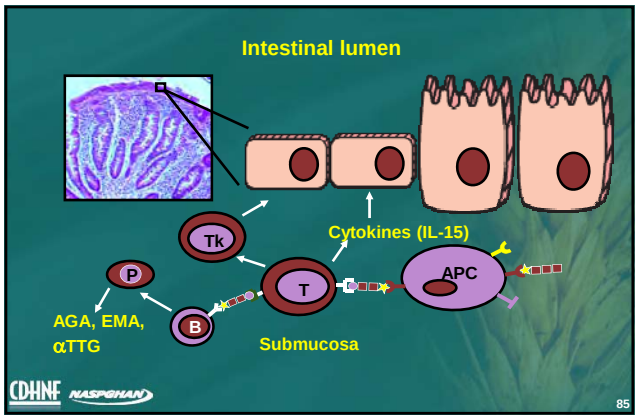

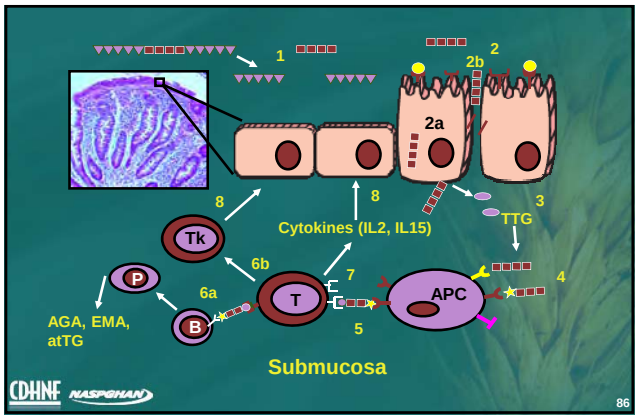

Pathogenesis:
Unanswered Questions

Questions:

- Mechanisms for failure of gliadin tolerance
- Role of innate immunity
- What are immunodominant epitopes
- Does gluten have direct effect on mucosa
- How is mucosal TH1 response induced/maintained
- Mechanism and role of IEL's
- How is mucosal remodeling induced
- What is the role of autoantibodies

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Diagnosis

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Diagnosis

Diagnostic principles

- Confirm diagnosis before treating
  - Diagnosis of Celiac Disease mandates a strict gluten-free diet for life
    - following the diet is not easy
    - QOL implications
- Failure to treat has potential long term adverse health consequences
    - increased morbidity and mortality

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Diagnosis

- Diagnosis of Celiac Disease requires:
  - characteristic small intestinal histology in a symptomatic child
  - complete symptom resolution on gluten-free diet
- Serological tests may support diagnosis
- Select cases may need additional diagnostic testing

ESPGAN working group. Arch Dis Child 1990;65:909

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Serological Tests

Role of serological tests:

- Identify symptomatic individuals who need a biopsy
- Screening of asymptomatic "at risk" individuals
- Supportive evidence for the diagnosis
- Monitoring dietary compliance

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Serological Tests

- Antigliadin antibodies (AGA)
- Antiendomysial antibodies (EMA)
- Anti tissue transglutaminase antibodies (TTG)
  - first generation (guinea pig protein)
  - second generation (human recombinant)
- HLA typing

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Antigliadin Antibodies

- Antibodies (IgG and IgA) to the gluten protein in wheat, rye and barley
- Advantages
  - relatively cheap & easy to perform
- Disadvantages
  - poor sensitivity and specificity

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Endomysial Antibody - EMA

- IgA based antibody against reticulin connective tissue around smooth muscle fibers
- Advantages
  - high sensitivity and specificity
- Disadvantages
  - false negative in young children
  - operator dependent
  - expensive & time consuming
  - false negative in IgA deficiency

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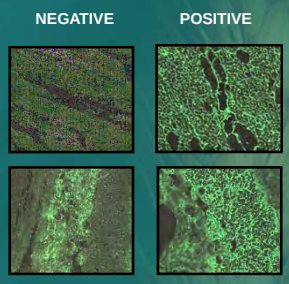
Endomysial Antibody - EMA

Antibodies against the outer layer of the smooth muscle of monkey esophagus



95

Tissue Transglutaminase - TTG

- IgA based antibody against tissue transglutaminase (Celiac Disease autoantigen)
- Advantages
  - high sensitivity and specificity (human TTG)
  - non operator dependent (ELISA/RIA)
  - relatively cheap
- Disadvantages
  - false negative in young children
  - false negative in IgA deficiency
  - possibly less specific than EMA

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Serological Test Comparison

	Sensitivity %	Specificity %
AGA-IgG	69 – 85	73 – 90
AGA-IgA	75 – 90	82 – 95
EMA (IgA)	85 – 98	97 – 100
TTG (IgA)	90 – 98	94 – 97

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Farrell RJ, and Kelly CP. Am J Gastroenterol 2001;96:3237-46.

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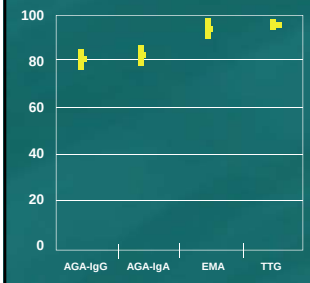
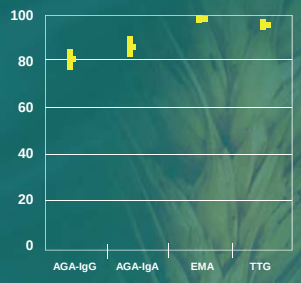
Sensitivity



Specificity



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Serum IgA Level

- Individuals with IgA deficiency are at increased risk for Celiac Disease
- IgA deficient individuals will have negative EMA-IgA & TTG-IgA
- Check IgA levels with Celiac Disease serology in all symptomatic individuals
- Consider IgG based tests (EMA-IgG & TTG-IgG) in IgA deficiency

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HLA Tests

HLA alleles associated with Celiac Disease

- DQ2 found in 95% of celiac patients
- DQ8 found in remaining patients
- DQ2 found in ~30% of general population

Value of HLA testing

- High negative predictive value
  - Negativity for DQ2/DQ8 excludes diagnosis of Celiac Disease with 99% confidence

Schuppan. Gastroenterology 2000;119:234
Kaukinen. Am J Gastroenterol 2002;97:695

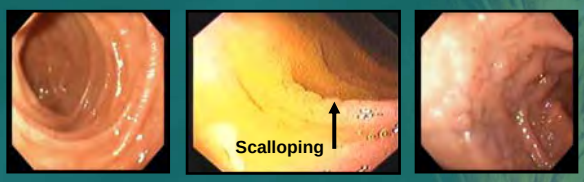
100

HLA Tests

- Potential role for DQ2/DQ8
  - asymptomatic relatives
  - Down, Turner & Williams syndrome
  - type 1 diabetes
  - diagnostic dilemmas

101

Endoscopic Findings



Normal Appearing | Scalloping | Nodularity

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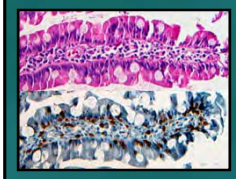
Biopsy Diagnosis



- Histologic Features:
  - Increased IEL's (> 30/100 enterocytes)
  - Loss of nuclear polarity
  - Change from columnar to cuboid
  - Lamina propria cellular infiltrate
  - Crypt elongation and hyperplasia
  - Increased crypt mitotic index
  - Progressive villous flattening

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Patterns of Mucosal Immunopathology

Type 0	Type 1	Type 2	Type 3
Normal	Infilitrative	Hyper plastic	Flat destructive
Celiac Diseae (latent)	Celiac	Celiac	Celiac
	Giardiasis	Giardiasis	Giardiasis
	Milk intolerance	Milk intolerance	Milk intolerance
	Tropical sprue	Tropical sprue	Tropical sprue
	Marasmus	Marasmus	Marasmus
	GVHR	GVHR	GVHR

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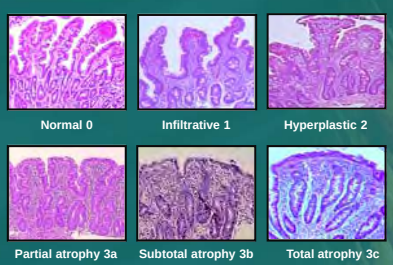
Marsh, *Gastroenterology* 1992, Vol 102: 330-354 104

Histological Features



Normal 0 | Infiltrative 1 | Hyperplastic 2

Partial atrophy 3a | Subtotal atrophy 3b | Total atrophy 3c

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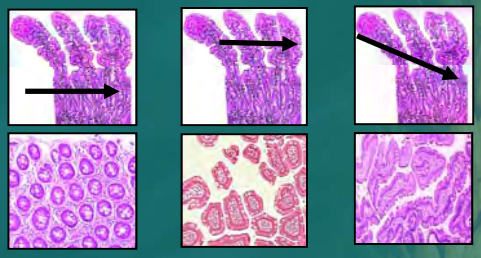
Horvath K. Recent Advances in Pediatrics, 2002. 105

Diagnostic Pitfalls

Poor Orientation



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Nutritional Exam and Review of Systems

- Dimorphic Anemia
- Peripheral Neuropathy
- Ricketts in Children
- Bone Pain
- Tetany
- Acrodermatitis
- Peripheral Neuropathy
- Easy bruising
- Coagulopathy
- Night Blindness

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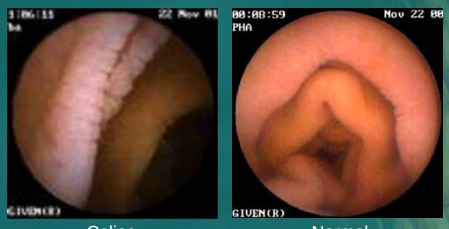
Fantastic Voyage



Celiac Normal

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Treatment

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Treatment

- Only treatment for celiac disease is a gluten-free diet (GFD)
  - Strict, lifelong diet
  - Avoid:
    - Wheat
    - Rye
    - Barley

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Gluten-Containing Grains to Avoid

Wheat	Bulgar	Filler
Wheat Bran	Couscous	Graham flour
Wheat Starch	Durum	Kamut
Wheat Germ	Einkorn	Matzo
Flour/Meal	Barley	Emmer
Semolina	Barley Malt/ Extract	Faro
Spelt	Rye	Triticale

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Sources of Gluten

- OBVIOUS SOURCES
  - Bread
  - Bagels
  - Cakes
  - Cereal
  - Cookies
  - Pasta / noodles
  - Pastries / pies
  - Rolls

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Sources of Gluten

- POTENTIAL SOURCES
  - Candy
  - Communion wafers
  - Cured Pork Products
  - Drink mixes
  - Gravy
  - Imitation meat / seafood
  - Sauce
  - Self-basting turkeys
  - Soy sauce

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Ingredients to Question (*may* contain gluten)

- Seasonings and spice blends or mixes
- Modified food starch
- Malt/ malt extract/ flavoring
- Modified hop extract and yeast-malt sprout extract
- Dextrin
- Caramel color

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Gluten-Free Grains and Starches

- Amaranth
- Arrowroot
- Buckwheat
- Corn
- Flax
- Millet
- Montina
- Oats*
- Potato
- Quinoa
- Rice
- Sorghum
- Tapioca
- Teff
- Flours made from nuts, beans and seeds

*for possible cross-contamination with gluten containing grains

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Safe Ingredients

- Starch
- Maltodextrin
  - Made from cornstarch, potato starch, or rice starch, but not from wheat
- Vinegar and Alcohol
  - Distilled vinegar and distilled spirits are gluten-free, however avoid malt vinegar and malt beverages (e.g. beer)

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Other Items to Consider

- Lipstick/Gloss/Balms
- Mouthwash/Toothpaste
- Play Dough
- Stamp and Envelope Glues
- Vitamin, Herbal, and Mineral preparations
- Prescription or OTC Medications

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Potential Nutritional Complications in Untreated Celiac Disease

- Low Iron
- Low Folate
- Low Vitamin B-12
- Low Vitamins ADEK
- Low Thiamine
- Low Niacin
- Low B6 (rare)
- Low Beta-carotene
- Low Zinc
- Essential Fatty Acid Deficiency

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Potential Nutritional Complications in Untreated Celiac Disease

- Prolonged PT
- Hypocalcaemia
- Elevated PTH
- Increased Alkaline Phosphatase
- Hypophosphatemia
- Hypomagnesaemia
- Hypoalbuminemia
- Re-feeding syndrome

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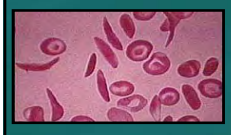
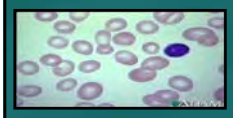
Anemia in Celiac Disease





- Microcytic anemia - iron absorption most efficient in the duodenum
- Megaloblastic/Macrocytic anemia – folate is absorbed primarily in the proximal third of the small intestine (location of folate hydrolases)
- Vitamin B-12 deficiency occurs rarely

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Importance of Folic Acid Supplementation

- Folate hydrolases are needed in the brush border for absorption
- Best absorbed in proximal 3rd of duodenum.
- Increased use of folate in apoptosis
- Low folate impairs cell division

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Importance of Folic Acid Supplementation

- Low folate increases irritability & forgetfulness
- Celiac Disease increases risk of GI malignancies
  - Folate supplement may have anti-cancer effect as needed for DNA replication
- Supplement Celiac Disease patients with 1 mg folic acid

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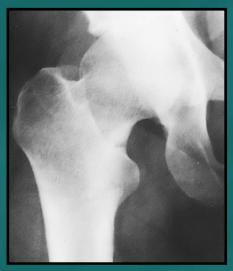
Bone Disease in Celiac Disease



- Arthritis
- Osteoporosis
- Osteopenia
- Osteomalacia
- Rickets

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Calcium and Vitamin D Requirements

- 800 to 1200 mg/day of Calcium for low bone mineral density (LBMD) in males
- 1200-1500 mg/day of Calcium for treatment of LBMD in females
- 400 IU of Vitamin D daily
- Up to 2/3 of patients on a gluten-free diet have suboptimal calcium intake

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Lactose Intolerance & Celiac Disease: Incidence

- Secondary lactase deficiency is estimated to be 20-40%
- Increasing lactose Intolerance with delayed diagnosis
- Increased incidence in patients with GI symptoms in Celiac Disease
- Decrease calcium and vitamin D intake in lactose intolerance

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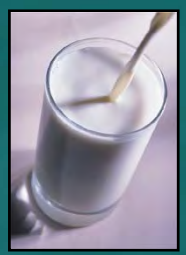
Lactose Intolerance & Celiac Disease: Treatment



- Gluten free diet
- Temporary lactose-reduction
- Lactase enzymes
- Lactose-free milk
- Gluten-free milk substitute
- Supplement with calcium & vitamin D where appropriate

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Nutrients Speculated to Play a Role in Celiac Disease Infertility and Pregnancy Outcomes

Low Levels of:

- Iron
- Zinc
- Folic Acid
- Vitamin B-12
- Protein
- Vitamin K
- Vitamin B-6
- Vitamin E

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Nutritional Exam and Review of Systems

- Dimorphic Anemia
- Peripheral Neuropathy
- Ricketts in Children
- Bone Pain
- Tetany
- Acrodermatitis
- Peripheral Neuropathy
- Easy bruising
- Coagulopathy
- Night Blindness

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Nutritional Exam and Review of Systems

- Amenorrhea, Infertility
- Impotence
- Cheilosis
- Glossitis
- Stomatitis
- Purpura
- Follicular Hyperkeratosis
- Hyperpigmented dermatitis
- Edema
- Ascites

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Possible Causes of GI Symptoms on a Gluten-Free Diet

- Acidic foods
- Sorbitol
- Olestra
- Guar gums
- Antibiotics
- Lactose
- Alternate flours made from beans or nuts
- Food Allergens such as Milk Protein, Soy, Nuts, Egg, Corn
- Food Intolerance to fructose Foods high in salicylates and amines

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Eating Healthy on the Gluten-Free Diet

- Similar to a normal diet
  - Moderate cholesterol
  - Moderate protein
  - Low fat, sodium, alcohol, and concentrated sugars
  - High fiber
- Variety of foods for good nutrient balance

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Improving Nutrient Density

- Nutrient density and quality of the gluten-free diet can be improved:
  - Use nutrient-rich grains/seeds

Amaranth	Montina
Bean	Rice Bran
Buckwheat	Quinoa
Teff	Sorghum
Millet	Soy

- These grains are:
  - higher in protein and amino acids
  - moderate carbohydrates
  - good sources of calcium
  - some are higher in iron that wheat
  - low sodium.

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Improving Nutrient Density

- When limiting the use of gluten-free flours to the most common sources (rice, corn), nutrient deficiencies may occur due to low fiber content and excess calories
- Rapid increases in fiber intake may lead to increased GI distress

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Living Gluten-Free

- You can have a positive outlook
- Learning to live:
  - Gluten-free foods are better tasting than ever before
  - The diet gets easier as patients adjust to it
  - It is not necessary to restrict the patient's lifestyle, it is just a different way of eating
- Don't make it harder than it needs to be
  - Why following a strict gluten-free diet is vital to living a full, healthy life
- Weight management may become a concern

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Dietary Adherence: A Common Problem

- Only 50% of Americans with a chronic illness adhere to their treatment regimen including:
  - diet
  - exercise
  - medication
- Dietary compliance can be the most difficult aspect of treatment

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Health Beliefs of Adults with Celiac Disease

- Survey of 100 people in Celiac Disease support group (Buffalo, NY)
  - Number of people who agreed with following statements:
    - "If I eat less gluten I will have less intestinal damage." –51%
    - "I've lived this long eating gluten, how much will the gluten-free diet really help me now?" –33%
    - "My doctor should be the one to tell me when I need follow up testing." –26%
    - "Scientist/doctors still haven't proven that gluten really hurts them." –16%

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Barriers to Compliance

- Ability to manage emotions – depression, anxiety
- Ability to resist temptation – exercising restraint
- Feelings of deprivation
- Fear generated by inaccurate information

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Barriers to Compliance

- Time pressure – time to plan, prepare food is longer
- Planning – work required to plan meals
- Competing priorities – family, job, etc.
- Assessing gluten content in foods/label reading
- Eating out – avoidance, fear, difficult to ensure food is safe

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Barriers to Compliance

- Social Events – Not wanting to look/be different
- Support of Family and Friends – "Just a little bit – it won't hurt you"

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Factors that Improve Adherence

Internal Adherence Factors Include:

- Knowledge about the gluten-free diet
- Understanding the risk factors and serious complications can occur to the patient
- Ability to break down big changes into smaller steps
  - Ability to simplify or make behavior routine
- Ability to reinforce positive changes internally
- Positive coping skills
- Ability to recognize and manage mental health issues
- Trust in physicians and dietitians

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The Key to Dietary Compliance is Follow Up Care

- NASPGHAN Guidelines apply to adults and children
- The health effects are motivation
  - When one believes they are real
  - Testing measures the health effects of eating gluten
- Follow up testing provides important feedback

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The Key to Dietary Compliance is Follow Up Care

- Test results are a powerful motivator
  - especially those who do not have symptoms when they eat gluten
- Patients/parents look to the physician to tell them when follow-up testing is needed
  - Proactive follow-up measures can reinforce adherence

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Resources

- Reputable websites
  - Celiac.Com (www.celiac.com)
  - National Institutes of Health (www.niddk.nih.gov)
  - American Dietetic Association (www.eatright.org)
- Local Support Groups
  - Celiac.Com (www.celiac.com)
- National Support Groups
  - The Gluten Intolerance Group – GIG (www.gluten.net)
  - Celiac Disease Foundation – CDF (www.celiac.org)
- Research and Information
  - Center for Celiac Research (www.celiaccenter.org)

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Resources

- Cookbooks
  - Hagman, Bette, "The Gluten-Free Gourmet Cooks Fast and Healthy"
  - Saros,Connie, "Wheat-free Gluten-free Cookbook for Kids and Busy Adults"
  - Books and Magazines
  - Case, Shelley, "Gluten-Free Diet: A Comprehensive Resource Guide"
  - Gluten-Free Living
  - Sully's Living Without (www.livingwithout.com)
- Product information
  - www.glutenfreemall.com

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Prevention & Future Directions

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Celiac Disease-Diagnosis: The Future

- Diagnosis Strategies
  - Mass population screening
    - Not cost effective (research tool)
    - Benefits uncertain
- Active case finding
  - Selective serological testing
  - Biopsy confirmation

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Celiac Disease-Diagnosis: The Future

- Non biopsy diagnosis
  - Characteristic clinical subgroups
  - Refined (standardized) serological tests
  - Use of HLA typing
  - Discovery of biomarkers
  - Specific gene identification

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Celiac Disease-Management: The Future

- Gluten free diet remains best treatment
- Refined understanding of “gluten free”
- FDA mandates better food labeling
- Commercial recognition of the “value” of gluten free products

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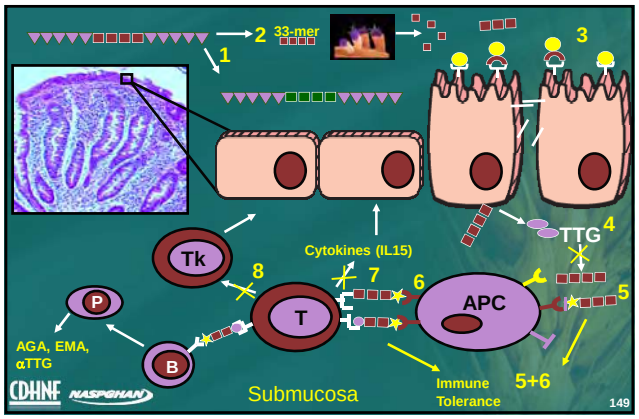

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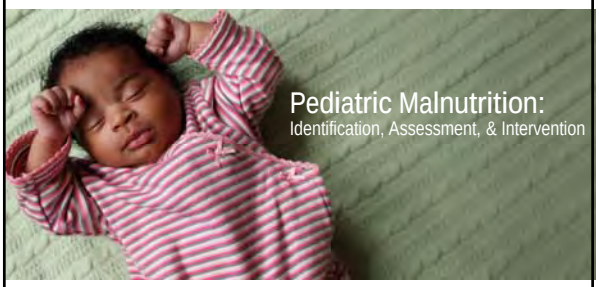

Pediatric Malnutrition:
Identification, Assessment, & Intervention

Maureen Egan, APRN, MSN
Natalie Navarre, MA, RD, CSP, LDN

Nemours, Alfred I. duPont Hospital for Children

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Objectives

- Define pediatric malnutrition/FTT and identify common causes
- Discuss methods of identifying and classifying pediatric malnutrition
- Identify initial nutrition interventions to address malnutrition
- Coordinating Care: GI & Nutrition

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Disclosure

- We do not have any financial disclosures.

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Defining Malnutrition

- Pediatric malnutrition (undernutrition) is "an imbalance between nutrient requirements and intake that results in cumulative deficits of energy, protein or micronutrients that may negatively affect growth, development and other relevant outcomes"
  -Mehta et al., 2013
- Prevalence rates reported between 24% and 50% worldwide

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Malnutrition vs. Failure to Thrive (FTT)

Malnutrition

- Can be used as a diagnosis
  - E44.1 = mild malnutrition
  - E44.0 = moderate malnutrition
  - E43 = severe protein/calorie malnutrition
- Has a clear definition
- Consensus on indications for identifying and documenting malnutrition

Failure to Thrive

- A sign of malnutrition (undernutrition), not a diagnosis
- FTT is a term used to describe inadequate growth or the inability to maintain growth
- Lacks a clear definition
- No consensus on what criteria should be used to define FTT

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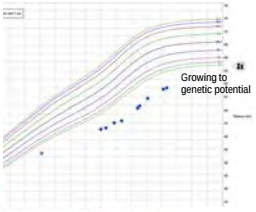
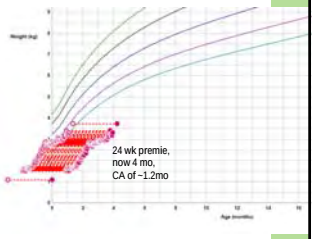
Look at full clinical picture, not just the growth chart !

- Children of small parents growing to their genetic potential (short stature)
- LGA infants who regress toward the mean
- Children with constitutional delay in growth (versus stunting)
- Premature infants with normal growth when corrected for age
- Children with special needs





6

Common Causes for Malnutrition

- Etiology of malnutrition
  - Illness related: disease or trauma
  - Non-illness related: environmental or behavioral
- Increased caloric demand
  - Cancer
  - Chronic infection (HIV)
  - Chronic lung disease
  - Congenital heart defects
  - High muscle tone
  - Hyperthyroidism
  - Thyroid disease
- Inadequate caloric intake
  - Compromised feeding skills
  - Food aversion
  - Food insecurity
  - GERD
  - Medication-induced anorexia
  - Pyloric stenosis
- Inadequate caloric absorption, metabolism, or utilization
  - Celiac disease
  - Cystic fibrosis
  - Diabetes
  - Inborn errors of metabolism
  - Inflammatory bowel disease
  - Liver disease
  - Milk protein allergy
  - Short gut

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Screening Labs

- Common initial diagnostic screening labs:
  - CBC with dif and plt
  - Comprehensive metabolic panel
  - Sed rate
  - Celiac Panel
  - Lead level
  - Urinalysis and culture
  - Fecal Calprotectin
  - Stool studies if indicated
- Adjust to meet individualized needs of the patient

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Identifying Malnutrition

- In 2014, Academy of Nutrition and Dietetics (AND) and the American Society for Parenteral and Enteral Nutrition (ASPEN) published a consensus statement on the identification and documentation of pediatric malnutrition
- Indicators:
  - Food/Nutrient intake
  - Assessment of energy and protein needs
  - Growth parameters
  - Weight gain velocity
  - Mid-upper arm circumference (MUAC)
  - Handgrip strength
  - Documentation of tanner stage

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1. Food/Nutrient Intake

- Major determinant of nutritional status
- Accurate assessment of intake and estimation of adequacy is critical
  - Necessary in order to determine the degree of the deficit and the extent/acuity of the deficit
- *Primary concern: Is the child's current intake adequate to meet his/her nutrition needs in the context of his/her current clinical situation, growth pattern, and developmental level?*

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2. Assessment of Nutrient Needs

- Equations are *estimates*
- GOLD STANDARD: Indirect Calorimetry
- Calories:
  - RDA for infants and toddlers 0-3yr
  - WHO REE x Activity Factor for children older than 3 years of age
- Protein:
  - RDA for all ages
- Catch-up growth:
  - 0-3 yrs: Calorie and protein needs based on RDA x ideal body weight / actual weight
  - Calories for children older than 3 = Activity factor of 1.5-1.7
- Vitamin/Minerals:
  - Dietary reference intakes (DRI) for age
    - Recommended Dietary Allowance (RDA), Adequate Intakes (AI), UL (Tolerable Upper Intake Level)

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3. Growth Parameters

- Growth is the primary outcome measure of nutritional status in children
- Children 0-2 years:
  - length-for-age
  - weight-for-age
  - head circumference-for-age (up to 36 months)
  - weight-for-length
- Children 2-20 years:
  - standing height-for-age
  - weight-for-age
  - BMI-for-age

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Growth Charts

- Designed to observe growth trends over time and for early detection of growth problems
  - Not intended as a sole diagnostic instrument
- WHO growth charts for children ages 0-2 years
  - Developed in 2006, multicenter study, 6 countries
  - Depicts normal human growth under optimal environment conditions (BF for at least 4 months, still BF at 12 months)
  - Standards for growth
- CDC Growth charts for children ages 2-20 years
  - Data obtained from NHANES surveys from 1963-1994
  - Measurements of height change from recumbent length to standing height
  - Reference for typical growth in US
- Premature infants
  - Plot for corrected age; weight (until 24mo), length (until 40mo), HC (36mo)

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Growth Charts: Percentiles vs Z-scores

Percentiles

- Indicates the portion of the reference population that lies above or below the child being measured
- Does not reveal the degree of deviation from population norms

Z-scores

- If above or below "average," it measures how "atypical" the data point is
- Reveals the degree of deviation from the mean
- Allows for more precision describing anthropometric status compared to percentiles

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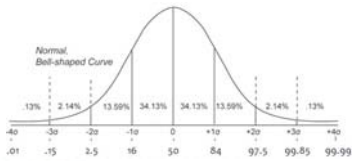
Z-Scores

- Recommendation for monitoring and assessing nutritional status in pediatric population
- "A statistical measure that tells how a single data point compares with normal data and, if above or below "average," how atypical the measurement is" -Becker et al., 2015



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Adapted from Ehrenfeld, 2009

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4. Weight Gain Velocity

- Growth velocity: rate of change in weight or length/height over time
- Can be used as an early sign of healthy or unhealthy response to the nutritional environment

Age	Weight (grams per day)	Length/Height (cm per wk)
0-4 months	23-34	0.8-0.93
4-8 months	10-16	0.37-0.47
8-12 months	6-11	0.28-0.37
1-3 years	4-10	0.16-0.25
4-6 years	5-8	0.11-0.18

**Ages 2-6 years, average gain of 2-3kg/year and growth of 5-8cm/year*

Pediatric Nutrition Reference Guide. 10th Ed. Texas Children's Hospital.

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Classification of Malnutrition

- Previous Recommendations:
  - Percentage of ideal body weight (Gomez Classification and Waterlow Criteria)
  - Defining undernutrition and FTT as decreases in 2 percentiles or faltering growth as weight below the 5th%ile
- Current Recommendations:
  - Using Z-score, decline in Z-score, and negative Z-score to identify and document pediatric malnutrition

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Classification of Malnutrition

- Acute Malnutrition:
  - Less than 3 months
  - Weight loss or lack of weight gain
- Chronic Malnutrition:
  - 3 months or longer
  - Stunting in height-for-age
- Mild
  - Usually due to acute event
  - Presentation: unintentional weight loss or suboptimal weight gain velocity
- Moderate
  - Undernutrition of a significant duration
  - Presentation: weight-for-length or BMI-for-age below normal range
- Severe
  - Prolonged undernutrition
  - Presentation: declines in rates of linear growth that result in stunting

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	MILD MALNUTRITION	MODERATE MALNUTRITION	SEVERE MALNUTRITION
Individual Growth Points			
Weight-for-length	-1.0 to -1.9 z score	-2.0 to 2.9 z score	≤ -3 z score
BMI-for-age	-1.0 to -1.9 z score	-2.0 to 2.9 z score	≤ -3 z score
Mid Upper Arm Circumference [A]	-1.0 to -1.9 z score	-2.0 to 2.9 z score	≤ -3 z score
Growth Trends			
Weight gain velocity [B] (0-24 months)	<75% expected	<50% expected	<25% expected
Deceleration in weight-for-length	Decline of 1.0-1.9 z score	Decline in 2.0-2.9 z score	Decline in 3.0 z score or greater
Deceleration in BMI-for-age	Decline of 1.0-1.9 z score	Decline of 2.0-2.9 z score	Decline of 3.0 z score or greater
Weight loss (2 – 20 years)	Loss of 5 to 7.49% usual body weight	Loss of 7.5 to 9.99% usual body weight	Loss of 10% or greater usual body weight
Nutrient Intake			
Inadequate nutrient intake (energy/protein)	51-75% estimated need	26-50% estimated need	≤25% estimated need

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Nemours Malnutrition Identification Guide, 2015

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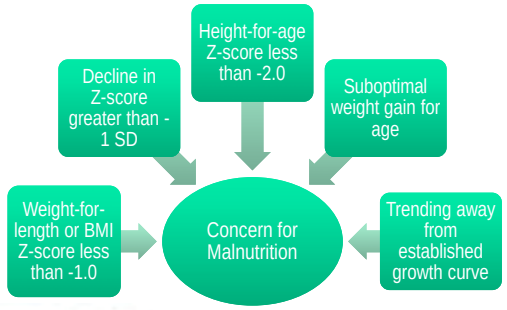
Key Elements in Assessment of Growth for Malnutrition



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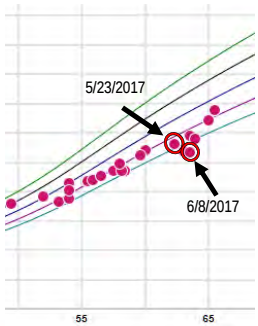
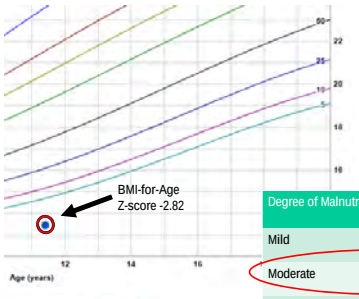
Mild Malnutrition: Decline in z-score



- Use of growth trends
- 5/23/2017
  - Weight-for-length z-score of -1.56
- 6/8/2017
  - Weight-for-length z-score of -2.63
- Decline in z-score of 1.07 standard deviations = MILD MALNUTRITION

Degree of Malnutrition	Growth Trends: Deceleration in W-for-L
Mild	Decline of 1.0 to 1.9 z-score
Moderate	Decline of 2.0 to 2.9 z-score
Severe	Decline of 3.0 z-score or greater

Moderate Malnutrition: BMI-for-Age



- Use of individual growth point
- BMI-for-age z-score of -2.82 = MODERATE MALNUTRITION

Degree of Malnutrition	Individual data point: BMI-for-age
Mild	-1.0 to -1.0 z score
Moderate	-2.0 to -2.0 z score
Severe	≥ -3.0 z score

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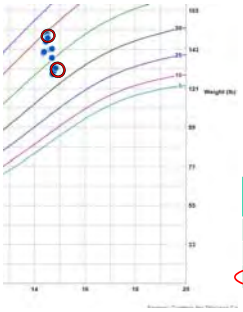
Severe Malnutrition: % Weight Loss



- 3/13/17 – 14.5y
  - 68.9kg
- 7/18/17- 14.8y
  - 60.2kg
- % Weight Loss: 13%

Degree of Malnutrition	Growth Trends: Weight Loss
Mild	-5 % usual body weight
Moderate	-7.5 % usual body weight
Severe	> -10% usual body weight

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Initial Interventions

- Treat and manage any underlying medical etiology for malnutrition
- Improve nutrition status

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Nutrition Interventions: Breastfed Infants 0-3 months

Breastfeeding Support

- Lactation consultation
- Pump after feedings to stimulate production
- Feed entirely on one breast before switching to ensure intake of both fore and hindmilk
- Maintain positive feeding environment

Increase calorie intake

- Offer fortified expressed breast milk/formula after each feeding
- Offer supplemental fortified formula feeds if breast milk supply is low
- If production is adequate but intake is minimal, offer hind milk prior to foremilk
- Give 1-2 30-60mL high calorie bottles in between breastfeeding

Adequacy of intake

- Document intake of expressed breast milk
- Document frequency and length of feedings
- Monitor frequency of wet diapers and stools
- Implement feeding schedule with a daily minimum goal and guidelines for frequency and volume per feed
- Wake up for overnight feeds if sleeping thru the night

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Nutrition Interventions: Formula Fed Infants 0-3 months

Increase calorie intake

- Increase calorie concentration of formula (will need to provide mixing instructions)

Tolerance of formula

- Consider changing formula if indicated
  - Sensitive varieties, Hydrolyzed varieties, Elemental varieties
- Offer less volume, more frequently (especially if spitting up)

Adequacy of intake

- Implement feeding schedule with a daily minimum goal and guidelines for frequency and volume per feed
- Wake up for overnight feedings if not waking up

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Nutrition Interventions: Infants 4-12 months

- Prior recommendations
- Always offer breast milk or formula before solid foods
- Make rice cereal with fortified breast milk
- Add rice cereal or formula powder to purees
- Add oil to baby foods (1/4 to 1/2 tsp per 2oz)
- Offer high calorie infant foods
  - avocado, bananas, mango, sweet potatoes, squash

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Nutrition Interventions: Toddlers/Older Children

Feeding Environment	Mealtime Behaviors	Optimizing Calorie Intake
Structured meal schedule to minimize grazing – 2 meals + 2-3 snacks	Positive reinforcement of preferred behaviors	Switch to full fat milk and dairy – 2-3 servings daily
Maintain positive eating environment	Ignore non-preferred behaviors; avoid negative reinforcement	Limit juice to no more than 6-8oz/day
Minimize distractions	Offer both preferred and non-preferred foods at meals	Utilize calorie boosting techniques (slides to follow)

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Nutrition Interventions: Toddlers/Older Children

Increasing caloric density of meals/snacks

- Add fats wherever possible – big calorie bang for your buck!
  - Add splash of heavy cream to milk
  - Butter toast before adding jelly or peanut butter, butter toasted hot dog or burger buns
  - Add oil to frozen foods before baking
  - Toss pasta in butter or olive oil before adding red sauce
- Promote naturally higher calorie foods
  - Whole milk, full fat yogurt, cheese
  - Nuts, nut butters, trail mix
  - Granola
  - Avocado, guacamole, hummus, sour cream
- Fine tune healthy foods
  - Pair raw veggies with dip or a higher calorie food (ex. cheese)
  - Add butter/cheese to cooked veggies
  - Pair fresh fruit with cheese, yogurt, or peanut butter
  - Add heavy cream, butter, brown sugar to oatmeal

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Calorie boosters: increasing the caloric density of each bite/sip of food/beverage

Heavy whipping cream -1 Tbsp = 50kcal -add to smoothies, cream sauce, scrambled eggs, etc.	Oil and butter: -1 tsp= ~30-40 calories -add oils/butters to vegetables, pasta, bread, etc.	Dry milk powder -1/4 cup= 60kcal, 5gm protein -add to milk, pudding, recipes that call for milk, etc.
Half and Half -1 Tbsp = 20kcal	Duocal (CHO + Fat) powder -1 scoop= 25kcal -add to beverages, batters, scrambled eggs, yogurt, soup, sauce, etc. -Nutricia	Benecalorie (Fat + Pro) -330kcal, 7gm pro per 1.5oz -add to purees, creamy sauces, pasta, smoothies -contains milk protein -Nestle
Canned coconut milk -1 Tbsp = 25kcal	Ground flaxseed -1 Tbsp = 35kcal, 1.5gm protein -add to smoothies, batters, oatmeal	Cheese, mayo, avocado, nut butters, cream cheese, sour cream, ghee

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Nutrition Interventions: Toddlers/Older Children

- Oral supplementation
  - Only after other strategies have been exhausted
  - Can result in decreased intake of age appropriate foods
  - Should not be a first line intervention
    - Special consideration: severe malnutrition, developmental delay limiting food intake, severe food refusals in setting of malnutrition
- Intended as an oral "supplement"
  - Should be providing *additional* calories in the diet, NOT *replacing* calories

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Medical Nutrition Therapy – Toddlers/Older Children

Nutrition Supplements – Standard Cow's Milk Based

Pediasure
240 calories
7g protein
$1.83 per bottle

Parent's Choice (WALMART) Nutritional Shake
240 calories
7g protein
$1.41 per bottle

Carnation Breakfast Essentials (RTF)
240 calories
10g protein
$1.00 per bottle

Carnation Breakfast Essentials**
280 calories
13g protein
$0.61 per serving

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**based on mixing 1 packet with 1 cup whole milk

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Medical Nutrition Therapy – Toddlers/Older Children

Nutrition Supplements – Soy Milk Based, Clear Liquid, Modular

Bright Beginnings
Soy Formula
240 calories
7g protein
$1.42 per can
(must purchase online)

Boost Breeze
Milk Protein/Clear Liquid
250 calories
9g protein
$1.50 per container
(must purchase online)

Duocal
Hypoallergenic
25 cal/scoop
42 cal/Tbs
$24.50 per can - $0.31/scoop
(must purchase online)

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Case Study – BS

- GI Visit #1, November 2016
  - Age: 6 months
  - Referred to GI at 6 months for FTT
  - PO Diet: Breast milk + expressed breast milk (estimating 25-30oz/day) + some baby foods
  - History of reflux, taking omeprazole
  - Diagnoses: FTT, Gastroesophageal reflux disease in infant
  - Recommendations:
    - UGI
    - Stool studies: fecal fat, parasites, fecal elastase
    - Blood work: CBC, serum chemistries, serum lactate, thyroid function tests
    - Referral to dietitian – parent preference for alternative to formula for fortification
    - Optimize omeprazole dose
    - Consider 1tsp cereal/oz expressed breast milk

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Case Study – BS

- GI Visit #2, January 2017
  - Age: 7 months
  - Anthropometrics:
    - Weight gain of 215gm x ~2 months (avg of +4gm/day)
    - W-for-L Z-score = -2.41
    - Moderate malnutrition for -2.41 W-for-L Z-score + less than 50% of expected weight gain for age
  - Workup unremarkable
  - Vomiting daily, several times per daily
  - Recommendations:
    - Optimize treatment of reflux:
      - Start EES suspension prior to meals and bedtime
      - Continue Omeprazole
    - Weekly weight checks
    - Nutrition visit in 1 week

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Case Study – BS

- Nutrition Visit #1, January 2017
  - Age: 7 months
  - Anthropometrics:
    - Slight improvement in weight and W-for-L Z-score since GI visit x 1 week
  - PO intake:
    - Breastfeeding at home x 3
    - ~18oz EBM during the day (adding 1tsp rice cereal:1oz)
    - Increased intake of purees; Adding oil
    - Small, frequent feeds to avoid emesis
  - Parent preference to avoid use of formula to fortify expressed breast milk
  - Recommendations:
    - Add ½ to 1 tsp oil to 2oz puree (d/c if increased emesis)
    - At home, add ½ Tbsp oatmeal cereal to 2oz of puree
    - Add 1tsp of duocal : 3oz EBM to make 24kcal/oz
    - Start poly-vi-sol 1mL/day

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Case Study – BS

- Coordinated GI (#3) and Nutrition (#2), February 2017
  - Age: 8 months
    - Weight gain of 17.8gm/day (meeting catch-up goals)
    - W-for-L Z-score increased from -2.06 to -1.44
      - Malnutrition improved from moderate to mild
  - Interim:
    - Increased intake of purees and finger foods; Intake of breastmilk remains the same
    - Increased reflux with increased oil; now only adding it to large homemade mixture
    - Adding ½ Tbsp of oatmeal cereal to each puree
    - Adding 1 scoop duocal per puree, but not to EBM
    - Continued emesis and reflux
  - RD impression: likely inadequate caloric intake due to frequent daily emesis
  - Recommendations:
    - Wean EES due to no improvement in symptoms
    - Continue omeprazole
    - Continue duocal + oatmeal cereal + oil added to purees

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Case Study – BS

- Coordinated GI (#4) and Nutrition (#3), April 2017
  - Age 10 months
  - Gained average of 21.3gm/day since February f/u – exceeding catch-up weight gain goal
  - Age appropriate growth velocity in length
  - W-for-L Z-score increased from -1.44 to -0.56 – no longer meeting criteria for malnutrition
  - Intake of breast milk decreased by ~3oz, intake of age appropriate solids increased
  - RD had discontinued duocal in March due to improved rate of weight gain based on weight checks at PCP office
  - No longer adding oils to purees
  - Adding oatmeal cereal to purees
  - Recommendations:
    - Wean oatmeal cereal with transition off of purees
    - Wean omeprazole at 12 months of age to every other day
    - Continue weight checks for 2-3 months with weaning of calorie modulars

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Case Study – BS in Summary

- Catch-up weight gain was achieved
- No longer meeting criteria for malnutrition
- Interventions: optimization of reflux management and caloric intake

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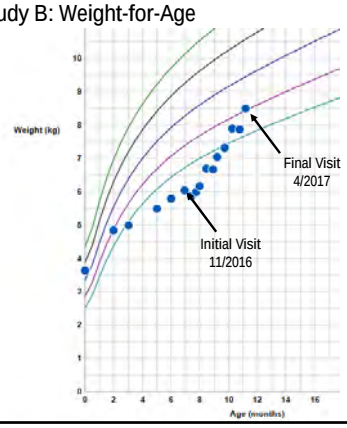
Case Study B: Weight-for-Age



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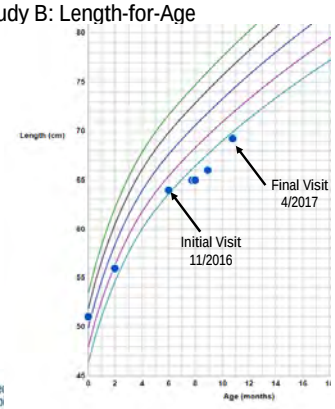
Case Study B: Length-for-Age



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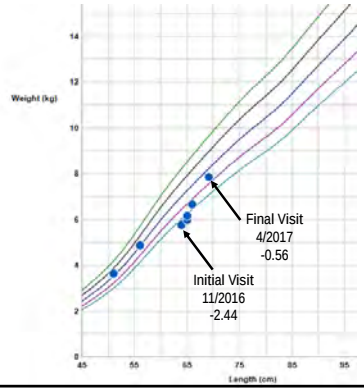
Case Study B: Weight-for-Length



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Initial Visit
11/2016

Final Visit
4/2017

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Resources

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THE DIETITIAN'S NUTRITION-FOCUSED PHYSICAL EXAM

Carly Leon MS RD CD CNSC
Clinical Dietitian Specialist
Children's Hospital of Wisconsin

DISCLOSURES

- Trainer for Hands on Training Nutrition Focused Physical Exam Workshop for the Academy of Nutrition and Dietetics
- Speaker for Abbott Nutrition Speaker Bureau
  - Medical Nutrition Therapy for Pediatric Liver Disease

WHAT IS NFPE AND WHY DO IT?

- Physical Exam designed to identify changes with body specifically linked to nutrition
  - Provides invaluable information when…
    - Laboratory values may not reflect nutrition status
    - Anthropometric measurements may be inaccurate, unreliable or unavailable
- Integral part of completing a thorough nutrition assessment
- Monitor responses to nutrition intervention
- Adds complexity and depth to our nutrition recommendations
- Provides backbone for nutrition recommendations
- Standard of Practice

Used with Permission from: The Academy of Nutrition and Dietetics, Nutrition Focused Physical Exam Training, 2016

DIETITIAN RESPONSIBILITY

Identify

- Dietitians are uniquely positioned to identify malnutrition

Document

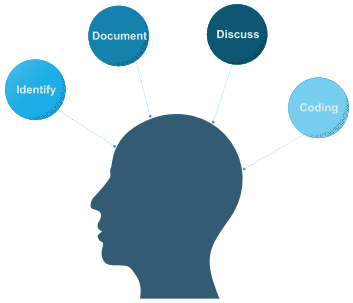
- Thoroughly document our findings in the medical record
- Apply indicators of malnutrition to diagnosis

Discuss

- Communication with the larger medical team
- Diagnosis and recommended nutrition based treatment

Ensure Proper Coding

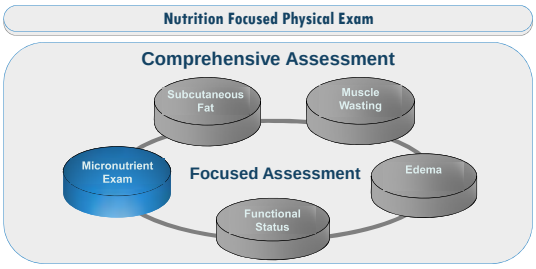
- Choosing the best fit with the ICD-10 terminology
- Mild, moderate, or severe protein calorie malnutrition



DIETITIAN TRAINING

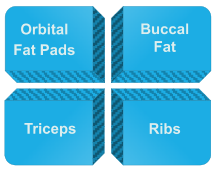
- Training occurs …
  - Undergraduate programs & supervised internship curriculums
  - On the job training
  - Continuing education programs
    - Academy of Nutrition and Dietetics (AND) and Associate for Enteral and Parenteral Nutrition (ASPEN)
    - Various programs available via medical and formula companies
- Focused Techniques:
  - Inspection & Palpation
    - Observation: Movement, color, shape, size, edema, affect, behavior
    - Tactile Examination: texture, size, tenderness, temperature
    - Verbal interview and chart review

NUTRITION FOCUSED PHYSICAL EXAM

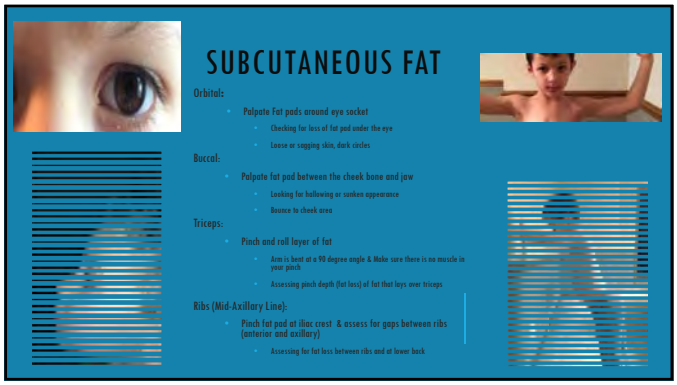


SUBCUTANEOUS FAT, WHAT AM I LOOKING FOR?

- Fat Loss
  - Assessing fat "pads" under the skin and usually cover bony prominences or muscle
- Use bones or muscles as landmarks to accurately assess
  - Bones prominent? Muscular outlines?
- Look for loose or hanging skin
  - Assessing space between fingers when you are pinching
    - Should feel like "bread dough"
- Subjective



Litchford M. Nutrition Focused Physical Assessment: Making Clinical Connection s. 2013

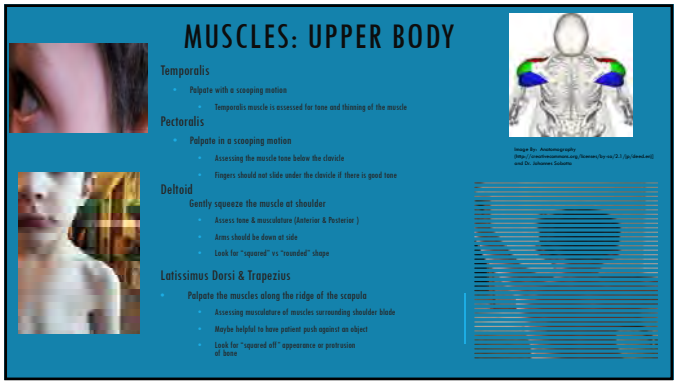


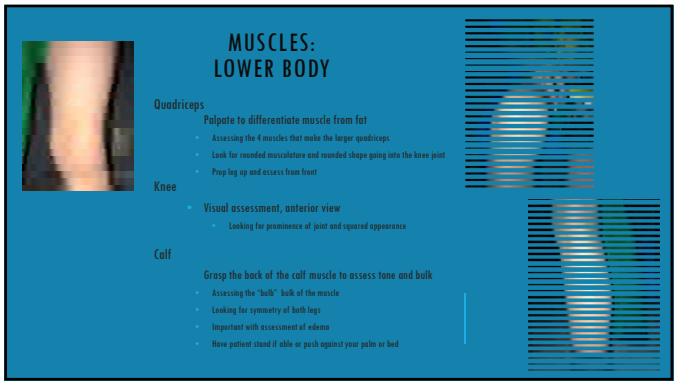
MUSCLE WASTING, WHAT AM I LOOKING FOR?

Upper Body
Temporalis
Pectoralis
Deltoid
Latissimus Dorsi & Trapezius
Lower Body
Quadriceps
Knee
Calf

- Bulk and tone in musculature
  - Should be firm and give bounce/resistance when palpated
- Prominent or protruding bones
- Muscle Atrophy
  - Flat or concave muscle
  - "Squared-off" appearance
- Upper Body usually looses mass before lower body

Litchford M. Nutrition Focused Physical Assessment: Making Clinical Connections. 2013





MID-UPPER ARM CIRCUMFERENCE

- Incorporated in standard assessment
  - Does not require weight
  - Not affected by fluid status
  - Simple and accurate
  - Reflection of malnutrition
- MUAC is more sensitive to changes in muscle and fat than BMI
  - Z Scores available for 6-59 months (WHO Standards)
    - Peditools.org
  - Reference Tables available for > 5 years of age
    - Located at www.cdc.gov/nchs/data

Addo OY, et al. Am J Clin Nutr. 2016 Nov 2. 142190. Frisancho AR. Am J Clin Nutr. 1981;34:2540-2545

MUAC TECHNIQUE

Step 1

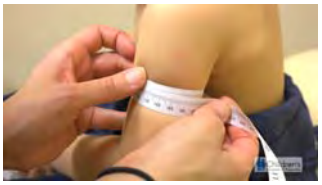
- Ask patient to face away from you
- Bend right arm at 90 degree angle at elbow with palm facing up
- Measure from posterior acromion process to elbow (olecranon process)
- Average two measurements
- Mark midpoint

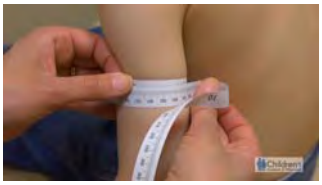
Step 2

- Relax marked arm at side
- Locate midpoint marking on arm
- Wrap tape around the arm at midpoint
  - Flush with arm
    - Do not compress fat or have fat "spilling" over tape measure
    - Ensure its not loose or gapping
- Record circumference in nearest 0.1cm

www.cdc.gov/nchs/data/nhanes/nhanes_11_12/ Anthropometry_Procedures_Manual.pdf

MUAC





MICRONUTRIENTS

- Micronutrient Deficiency
  - Primary or secondary deficiency
- Is there a medical reason for a deficiency?
  - Medications, medical diagnosis
- Is Inflammation Present?
  - An elevation in inflammatory markers may warrant delay in checking for nutrient levels
  - Markers: CRP, SED rate, WBC

Litchford M. Nutrition Focused Physical Assessment: Making Clinical Connections. 2013

MICRONUTRIENT EXAM

MICRONUTRIENTS

Hair

- Assess hair from root to tip
  - Look for dry, brittle, lack luster hair
  - Can it be plucked easily?
  - Bald or thinning spots
- Assess scalp
  - Healthy skin or any waxy build-up?
    - Seborrheic dermatitis
- Compounding Factors
  - Medications
  - Illnesses
  - Stress
  - Genetics & Hormones

Images: CDC Image Library, PHIL

Eyes

- Assessing the sclera of the eye
  - Color, dryness, or plaques
  - Look at patient at eye level and have them move eyes to one side
- Make a sweeping "W" motion with Pen light
- Switch Sides
- Assessing Conjunctiva of the eye
  - Assess color or paleness of lower eye lid
  - Gently roll/pull lower eye lid down

Bickley, L. Bates Guide to Physical Examination, 2009, Litchford M. Nutrition Focused Physical Assessment: Making Clinical Connections. 2013

MICRONUTRIENTS

Nails

- Assessing uniformity, texture and shape
- Check for artificial nails
- Clinical Finding should appear on all nails
  - 1 or 2 nails more likely trauma related

By Lynn McCleary

By Bierenard

Skin

- Assessing the skin
  - Temperature
  - Texture
  - Color
  - Integrity
- Assessed in conjunction w/other areas of NFPE

CDC Image Library

Bickley, L. Bates Guide to Physical Examination, 2009. Litchford M. Nutrition Focused Physical Assessment: Making Clinical Connections. 2013

MICRONUTRIENTS

Oral Cavity

- Assessing the mouth & lips
  - Ask patient to open wide
  - Overview of oral hygiene
  - Dry or cracking lips
  - Sores
- Assessing Teeth and Gums
  - Dental Caries or missing teeth
  - Pull lower lips towards chin, assess gums
    - Sore or bleeding gums
- Assessing Tongue
  - Ask patient to stick out tongue
  - Checking for color and texture of the tongue
- In infants and small children may see signs of teething and/or thrush




Images: CDC Image Library, PHIL.

Bickley, L. Bates Guide to Physical Examination, 2009. Litchford M. Nutrition Focused Physical Assessment: Making Clinical Connections. 2013

HYDRATION STATUS

Dehydration

- Laboratory
  - ↑ Serum Na, Cl
  - ↑ BUN/Creat
  - ↑ Serum osmolality & Spec Gravity
- Clinical Findings
  - ↓ BP, ↑ Heart Rate
  - ↑ Temp and prolonged capillary refill
- Physical Findings
  - Clammy skin, cracked lips
  - Poor Skin Turgor
  - Sunken eyes
  - Dark urine, decreased UOP

Overhydration

- Laboratory
  - ↓ Serum Na, Cl
  - ↓ BUN/Creat
  - ↓ Serum osmolality & Spec Gravity
- Clinical Findings
  - ↑ BP, Central Venous Pressure
- Physical Findings
  - Puffy eyes, moist skin
  - Light Colored Urine
  - Anasarca
  - ↑ Weight

EDEMA & MALNUTRITION

- Bilateral Assessment:
  - Identify Mild, Moderate or Severe Edema
  - Assessment based on depth and/or rebound time
  - Most commonly assess at feet (pedal)
    - Other sites: scrotal
  - Not all fluid accumulation is nutrition related

Normal	Mild	Moderate	Severe
• No signs of fluid accumulation	• 1+ pitting • Depth < 2mm • Duration: 0-15 seconds	• 2+ Pitting • Depth: 2-4 mm • Duration: 15-30 seconds	• 3+ or 4+ pitting • Depth: > 4 mm • Duration: > 30 seconds • Appears Swollen/weeping

FUNCTIONAL STATUS & DEVELOPMENTAL MILESTONES

- Assess Functional status: Hand Grip Strength (Dynamometer)
  - Correlates with loss of total protein and BMI
    - Shows earlier response to nutritional changes than labs or anthropometrics in adults
    - Does not quantify severity of malnutrition
    - There are physical and/or mental limitations
- Alternative to using a dynamometer
  - Collaboration with physical therapy or occupational therapy
  - Monitor Developmental Milestones
    - www.MilestoneMoments.CDC.gov
- Ask Questions!
  - Is your child able to do things that he enjoys?
  - Has your child needed some help doing things they used to do on their own?
  - How is your child's energy level?

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BLENDERIZED TUBE FEEDINGS…
WHAT NURSES NEED TO KNOW

Mimi Girten, RD, CSP, LDN
Pediatric Dietitian
The Children's Hospital of Philadelphia
November 3, 2017

DISCLOSURES

Nothing to Disclose

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OBJECTIVES

- Understand rationale for using blenderized tube feedings (BTF).
- Recognize traits of patients who might be a candidate for BTF.
- Identify & compare commercial and home blended diets.
- Recognize benefits and challenges of blenderized tube feedings for family and medical team.

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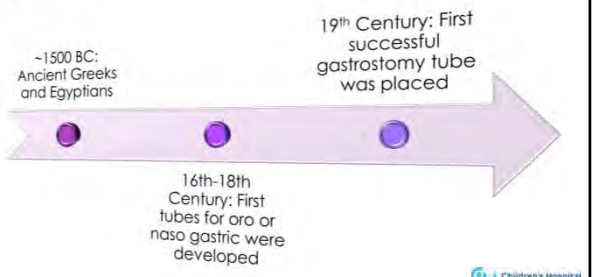
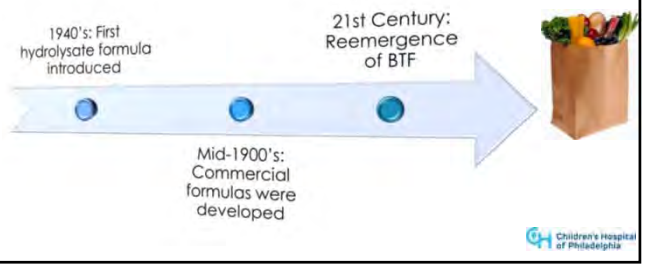
In the Beginning…



And Back Again…



WHAT'S IS A BLEND?

Blenderized tube feeding (BTF) is defined as whole foods that are liquefied in a blender with water, juice, broth, or various types of milk, and administered by syringe bolus in feeding tubes.

COMMERCIAL PRODUCTS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HOME BLENDED FOOD





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THIN BLENDS

Use:
- Natural / Holistic Option
- Formula Intolerance
- Volume Tolerant
- Oral Aversions / Delayed Oro-motor skill

Description:
- Medium/Thin Liquid
- Moderate Free Water
- 20-30 kcal/oz Formula

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THICK BLENDS

Use:
- Gagging
- Refluxing
- Nissen Fundoplication
- Volume Intolerance

Description:
- Thick/Pasty Liquid
- High Caloric Density (> 30 kcal/oz)
- Minimal Free Water

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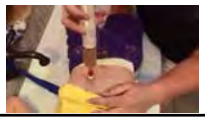
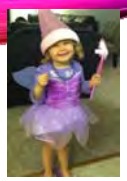
PUREED BY GASTROSTOMY TUBE(PBGT) DIET IMPROVES GAGGING AND RETCHING IN CHILDREN WITH FUNDOPLICATION

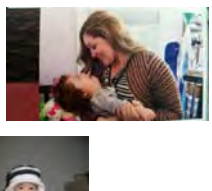
- 52% reported a 76 to 100% decrease in gagging and retching.
- Symptoms resolved almost immediately after beginning a PBGT diet.
- No parents reported a worsening in symptoms.
- 57% reported an increase in oral intake on PBGT

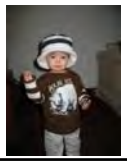


JPEN

WHO IS A GOOD FIT







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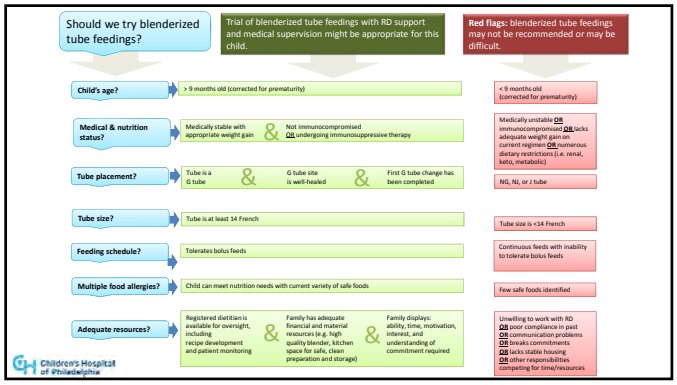
Should we try blenderized tube feedings?
Trial of blenderized tube feedings with RD support and medical supervision might be appropriate for this child.
Red flags: blenderized tube feedings may not be recommended or may be difficult.
Child's age?
> 9 months old (corrected for prematurity)
< 9 months old (corrected for prematurity)
Medical & nutrition status?
Medically stable with appropriate weight gain
&
Not immunocompromised OR undergoing immunosuppressive therapy
Medically unstable OR immunocompromised OR lacks adequate weight gain on current regimen OR numerous dietary restrictions (i.e. renal, keto, metabolic)
Tube placement?
Tube is a G tube
&
G tube site is well-healed
&
First G tube change has been completed
NG, NJ, or J tube
Tube size?
Tube is at least 14 French
Tube size is <14 French
Feeding schedule?
Tolerates bolus feeds
Continuous feeds with inability to tolerate bolus feeds
Multiple food allergies?
Child can meet nutrition needs with current variety of safe foods
Few safe foods identified
Adequate resources?
Registered dietitian is available for oversight, including recipe development and patient monitoring
&
Family has adequate financial and material resources (e.g. high quality blender, kitchen space for safe, clean preparation and storage)
&
Family displays: ability, time, motivation, interest, and understanding of commitment required
Unwilling to work with RD OR poor compliance in past OR communication problems OR breaks commitments OR lacks stable housing OR other responsibilities competing for time/resources
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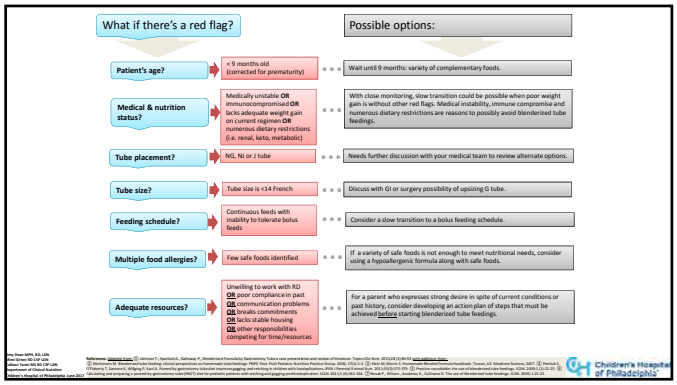
What if there's a red flag?
Possible options:
Patient's age?
< 9 months old (corrected for prematurity)
Wait until 9 months: variety of complementary foods.
Medical & nutrition status?
Medically unstable OR immunocompromised OR lacks adequate weight gain on current regimen OR numerous dietary restrictions (i.e. renal, keto, metabolic)
With close monitoring, slow transition could be possible when poor weight gain is without other red flags. Medical instability, immune compromise and numerous dietary restrictions are reasons to possibly avoid blenderized tube feedings.
Tube placement?
NG, NJ or J tube
Needs further discussion with your medical team to review alternate options.
Tube size?
Tube size is <14 French
Discuss with GI or surgery possibility of upsizing G tube.
Feeding schedule?
Continuous feeds with inability to tolerate bolus feeds
Consider a slow transition to a bolus feeding schedule.
Multiple food allergies?
Few safe foods identified
If a variety of safe foods is not enough to meet nutritional needs, consider using a hypoallergenic formula along with safe foods.
Adequate resources?
Unwilling to work with RD OR poor compliance in past OR communication problems OR breaks commitments OR lacks stable housing OR other responsibilities competing for time/resources
For a parent who expresses strong desire in spite of current conditions or past history, consider developing an action plan of steps that must be achieved before starting blenderized tube feedings.
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HOME BLEND
VS.
WHOLE FOOD BLENDS
nourish
Compleat pediatric
Children's Hospital of Philadelphia

CONSIDERATIONS BEFORE CREATING A RECIPE

VS

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RECIPES DEVELOPMENT

Adult studies
- 53% create their own recipes
- 47% recipe is provided by RD

Currently
- ~50% create their own recipes
- ~50% recipe is provided by RD

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HOME RECIPE

2 C organic chicken broth
1.5 C filtered water
1 C cooked quinoa
4T almond butter
1 hard boiled egg
1T goat butter
1 C goat kefir
½ C goat milk powder
1T olive oil
1T Udo-3-6-9 oil
½ C applesauce
1 banana
1 pitted prune
Fresh grated ginger and cinnamon

Reported to prepare:
1350 ml free water
65.7 gm protein
99 gm fat
1854 kcal/day
1.4 kcal/ml

CHOP Analysis:
643 ml free water
41.2 gm protein
80 gm fat
1458 kcal/day
.75 kcal/ml

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OVERVIEW-LIQUID HOPE®

Liquid Hope® is a nutritionally complete, organic, real food, whole foods enteral formula and oral meal replacement.

Liquid Hope® has a two year shelf life without preservatives.

Liquid Hope® is processed in a FDA/USDA registered facility with USDA inspector on site. SID#: 2013-06-12/001

Perfect for anyone who may be looking to increase daily nutrition. This product is plant based, dairy free, gluten free, soy free, corn free, non-GMO and packaged in a BPA free pouch.

Liquid Hope® meets all food safety requirements and meets all GRAS, HACCP, CGMPS standards.

SUMMARY POINTS

Features	Considerations
Higher fiber content	Nutrient content not as complete
Non-GMO	Less free water
Dairy, soy, corn, gluten free	Higher fiber content
Higher calorie/ml (1.3)	Contains nuts

NestléHealthScience

COMPLEAT®

COMPLEAT PEDIATRIC®

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Overview-Compleat® Compleat Pediatric®

A blend of ingredients from real foods.

No corn or soy ingredients.

Meets the 2011 IOM recommendations for calcium and vitamin D.

Contains protein from dehydrated chicken powder, milk protein concentrate, and pea protein isolate.

A convenient alternative to blenderized, homemade tube feedings.

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SUMMARY POINTS

Features	Considerations
Covered by insurance	
No corn or soy products	Not vegetarian
Nutritionally complete	Less fiber than some blended products
Blend of real foods	Contains milk

SUMMARY POINTS

Features	Considerations
Covered by insurance	
Nutritionally complete	Not vegetarian
No corn or soy products	Less fiber than some blended products
Lower calorie/ml available	Contains milk

REALFOOD BLENDS™
MEALS FOR TUBE-FED PEOPLE

Children's Hospital of Philadelphia

OVERVIEW-REAL FOOD BLENDS©

- These blenderized meals are intended to give tube-fed people easy access to 100% real food.
- 4 meal varieties with 7 real food ingredients.
- Produced in an FDA and USDA regulated facility.
- No refrigeration requires.
- Blended meals give a convenient option when blending isn't possible or becomes a logistical challenge (traveling, hospitalized, at work or school, etc.)
- Our meals are NOT formula – they are simply meals of real food that have been pureed to fit through a feeding tube!
- No Corn Syrup or Preservatives.

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SUMMARY POINTS

Features	Considerations
Convenient	Not nutritionally complete
Provides variety	50% of kcal are from fat
Improved tolerance	Hang time of 2 hours
Improved Stool pattern	May not be suitable for food allergies
1 vegetarian meal option	Less fiber than others
	Not consistently covered by insurance
	3 year shelf life

NOURISH®

Overview-NOURISH®

Functional Formularies NOURISH® is a nutritionally complete, organic, real food, whole foods enteral formula and oral meal replacement optimized for pediatrics.

Perfect for anyone who may be looking to increase daily nutrition. This product is plant based, dairy free, tree nut free, gluten free, soy free, corn free, non-GMO and packaged in a BPA free pouch.

NOURISH® has a two year shelf life without preservatives.

SUMMARY POINTS

Features	Considerations
Higher fiber content	Not consistently covered by insurance at this time
Non-GMO	Documented to meet DRI's of only 4 to 8 yr. old
Dairy, nut, soy, corn, gluten free	Less free water
Higher calorie/ml (1.1)	Processed in a plant that process gluten and nuts

Overview-Kate Farms ®

Core Essentials 1.0®

A ready-to-use oral and tube-feeding formula.

Does not contain any of the common allergens (milk, wheat, soybeans, eggs, peanuts, tree nuts, fish, shellfish) or corn products

Pending Organic, Non-GMO, Kosher, Halal

Each 325 mL carton provides 325 calories and delivers 24 vitamins and minerals and 29 antioxidant-rich superfoods.

CHO: Brown rice syrup, agave.
Pro: organic pea, rice protein.
Fat: coconut, sunflower.

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SUMMARY POINTS

Features	Considerations
Meets or exceed >90% of DRI's for children ages 1-8 yr. old in 975ml and 9-13 yr. old in 1400ml	Not consistently covered by insurance at this time
Organic plant based protein	Less free water
Milk, wheat, soybean, egg, peanut, tree nuts, fish, shellfish, corn free	Exceeds some DRI's

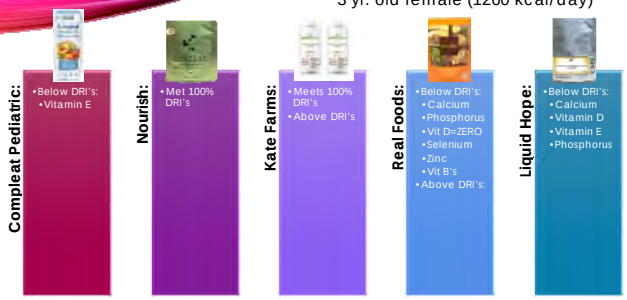
CLOSER LOOK

Formula	Price /Unit, $	Price /100 kcal
Homemade, Conventional	2.48 per daily [b](700 kcal)	0.36
Homemade, Organic	4.29 per daily recipe [b](700 kcal)	0.61
Standard pediatric enteral formula Pediasure(Abbott Nutrition[9])	2.04 per can (240kcal)	0.85
Compleat (Nestle Nutrition[9])	3.99 per tetra (265 kcal)	1.50
Compleat Pediatric(Nestle Nutrition[9])	3.12 per tetra(250 kcal)	1.25
Real Food Blends[10]	4.16 per pouch (330kcal)	1.26
Liquid Hope (Functional Formularies[11])	7.99 per pouch (450 kcal)	1.78
Nourish (Functional Formularies[11])	12.50 per pouch(400kcal)	3.13
Kate Farms® Core Essentials 1.0®	3.88 per tetra (325 kcal)	1.19

Adapted from: Walia, C, Van Horn, M, Edlbeck, A, Feuling, MB. The Registered Dietitian Nutritionist's Guide to Homemade Tube Feeding. Journal of the Academy of Nutrition and Dietetics. 2016.Kate Farms-https://shop.katefarms.com/collections/all

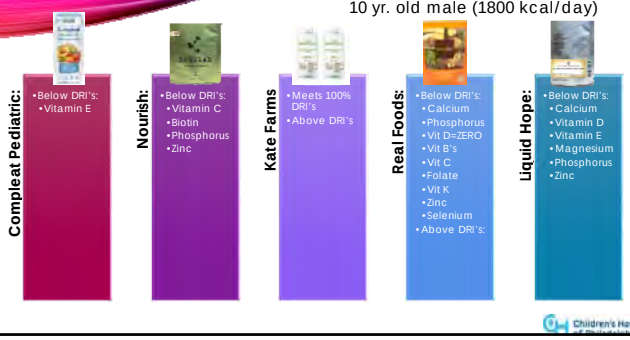
Product Comparison

3 yr. old female (1260 kcal/day)



Product Comparison

10 yr. old male (1800 kcal/day)



Product Comparison

14 yr. old male (2200 kcal/day)

Compleat Pediatric:
- Below DRI's:
- Vitamin E

Nourish:
- Below DRI's:
- Vitamin E
- Phosphorus
- Chromium

Kate Farms
- Meets 1000% DRI's
- Above DRI's

Real Foods:
- Below DRI's:
- Vit C
- Folate
- Vit D=ZERO
- Vit K
- Vit B's
- Calcium
- Iron
- Magnesium
- Phos
- Zinc
- Selenium
- Above DRI's:

Liquid Hope:
- Below DRI's:
- Vitamin C
- Vitamin E
- Calcium
- Magnesium
- Phosphorus
- Selenium
- Zinc

BENEFITS OF BTF

- Physiologic
- May aid in transition to oral diet
- Considered a natural product
- Adds variety
- Improve GI symptoms
- Improve quality of life
- Tailor to meet specific nutritional needs
- Inclusive with family meals

BENEFITS OF BTF

Prospective cross-sectional study in 54 enterally fed adults

- 50% used BTF
- 80% expressed a desire to use BTF

Motivation for using BTF

- Natural (43%)
- Eating what the family eats (33%)
- Better tolerance (30%)

CHALLENGES…FOR THE FAMILY

- Medical team
- Insurance reimbursements
- Supplies
- Recipe development
- **TIME**

CHALLENGES…FOR THE FAMILY

- Preparation of blend
- Ingredient trials / transition
- Storage/Food Safety
- Administration of feeds
- Monitor & communicate

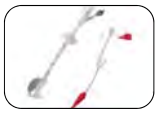
BUMPS IN THE ROAD…

Inpatient admissions

Insurance issues

Emergencies

BUMPS IN THE ROAD…



Tube clogging/degradation

Reactions/Intolerance

Nutrient shortfalls

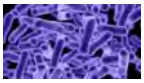
BUMPS IN THE ROAD…

Poor weight gain +/- growth

Vacation and travel

CHALLENGES…FOR PROVIDERS

- Variability in nutritional content
- Microbial contamination
- Increase clinician time



CHALLENGES….FOR PROVIDERS

- Tube clogging and degradation
- Provider/facility support
- Insurance issues
- Noncompliance

NURSING PEARLS

Need RD Support
- For adequacy and management

Constipation
- Many products have a greater fiber content then standard formulas
- Less free water in products

Fluids
- Assure adequate free water is being provided

Calories
- Often 15-20% more calories are required when using a BTF

NURSING PEARLS

Bolus Syringe
- 60-90 ml slowly over 10-15 minutes

Gravity Syringe
- Must be very thin to flow easily

Tubes
- ASPEN safe practices for enteral nutrition recommends at least a 14F to minimize clogging risks

NURSING PEARLS

Pump

- Feeding pump manufacturers (Moog and Medtronic) specify only commercially prepared feeding solutions
- BTF are not recommended for use on these pumps
- Infusion providers are noting pump failure due to use of BTF against manufacturer recommendations

Hang Time

- Hang times are listed on individual products
- Food Safety Standards recommend no longer than 2 hours

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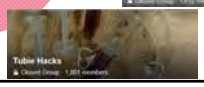
FUTURE OF BTF

There is and will continue to be increasing popularity

More research is needed

More education and training for clinicians



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QUESTIONS

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Refeeding Syndrome in the Pediatric Patient

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Outline

- ❑- Definition and Incidence of Refeeding Syndrome (RS)
- ❑- Who is at risk for Refeeding Syndrome
- ❑- How to spot Refeeding Syndrome
- ❑- How Refeeding Syndrome occurs
- ❑- How to prevent Refeeding Syndrome
- ❑- How to manage and treat Refeeding Syndrome

What is Refeeding Syndrome?

- Group of metabolic and clinical complications that occur to a malnourished and / or starved individual once nutrition rehabilitation / support is initiated
- → if severe, can lead to death
- → caused by fluid and electrolyte shifts
- Usually see symptoms 2-5 days after nutrition is re-initiated
- First discovered in the 1940s in World War II prisoners of war (cardiac failure, edema)
- Discrepancies exist re: definition, symptoms, evaluation, and treatment
  - Difficult to study Refeeding Syndrome in pediatrics
  - Poor recognition of the condition

Incidence of Refeeding Syndrome

- Difficult to determine
- Up to 25% of oncology patients receiving nutrition support
- Up to 10% of ICU eating disorder patients (Vignaud et al 2010)
- UK study – only 50% of those identified at risk for RS were correctly identified
- Some elements of RS can be seen in up to 50% of high risk patients
- 80% of patients experience hypophosphatemia, hypokalemia and hypomagnesemia if vigorously refed

Who is at risk for Refeeding Syndrome?

Conditions associated with increased risk of RS:

1. Low nutrient intake
- Eating disorders
- Depression
- Chronic drug / ETOH use
- Failure to thrive
- Cancer + associated treatments
- Chronic infectious disease
- Chronic kidney disease; diuretic use
- Catabolic illness
- Post-op
- Uncontrolled DM
- Social issues
- Extreme dieting
- Critically Ill

2. Increased nutrient losses / decreased nutrient absorption
- Chronic pancreatitis
- Chronic liver disease
- Congenital heart disease
- Chronic antacid use
- Chronic high dose diuretics
- Cystic Fibrosis
- Pregnancy
- Bariatric Surgery
- GI disease

Symptoms associated with increased risk of RS:

1. Weight status
- >10% loss in 1-2 months*
- <70-80% IBW*
- Muscle wasting

2. Low nutrient intake
- Poor PO/EN/PN >/= 7 days*
- Chronic dysphagia
- Persistent N / V / D limiting PO intake

* May be less in infant/small child

Symptoms of Refeeding Syndrome

- Hallmark of RS – hypophosphatemia (usually see 2-3 days after re-feeding)
- Also see hypokalemia, hypomagnesemia, thiamine deficiency, BG intolerance
- Possibly see hyponatremia and fluid overload
- Decreases in K+, Mg and Phos occur due to increase in basal metabolic rate
- How to diagnose?
  - Onset of clinical symptoms?
  - But many fluid and electrolyte abnormalities happen in absence of clinical symptoms

Can occur with reinitiating any type of nutrition (PO, EN, PN, dextrose IVF).

Characteristics of Refeeding Syndrome

- **Electrolyte Disturbances**
  - Hypophosphatemia
  - Hypomagnesemia
  - Hypokalemia
- **Hyperglycemia**
- **Cardiac issues**
  - Heart failure
  - Arrhythmia
- **Respiratory issues**
  - Diaphragm fatigue
  - Respiratory failure
  - Difficulties weaning from mechanical vent
- **Hematologic issues**
  - Anemia
  - RBC lysis
- **Immunologic issues**
  - Immune suppression
  - Infection risk / complications
- **Neurologic issues**
  - Wernicke's encephalopathy
- **Musculoskeletal issues**
  - Weakness
  - Rhabdomyolysis

From Byrnes and Stangenes 2011

Incidence of Hypophosphatemia

- Increased incidence w/eating disorders, <68% of IBW or BMI <15.1 kg/m2
- Up to 27.5% of eating disorder pts within 1st week of nutrition rehabilitation
- All-cause mortality of 18.2% compared with 4.6% among those w/no hypophosphatemia
- In adult ICU-level care: increased rates of mechanical ventilation and LOS with hypophosphatemia (Oud 2009)
- 30-38% of patients receiving parenteral nutrition (who were previously unfed)
  - 100% of these patients will develop hypophosphatemia if no Phos is added to PN

Some specific / clinical symptoms of RS

HYPOPHOSPHATEMIA

Cardiac – sudden death, arrhythmia, heart failure, hypotension, shock

Pulmonary – dyspnea, respiratory failure

Musculoskeletal – weakness, myalgia, rhabdomyolysis

Hematologic – hemolysis, thrombocytopenia, leukocyte dysfunction

Neurologic – confusion, delirium, paresthesias, paralysis, seizures, hallucinations, tetany, coma

Other – metabolic acidosis, insulin resistance, acute tubular necrosis, lethargy

HYPOKALEMIA

Cardiac – arrhythmia

Pulmonary – respiratory failure

Musculoskeletal – weakness, rhabdomyolysis, muscle necrosis

GI – nausea, vomiting, constipation

Neurologic – paralysis

Other – death

Adapted from A.S.P.E.N. Fluids, Electrolytes, and Acid-Base Disorders Handbook 2015; Pulcini, Zettle and Srinath 2016

Some specific / clinical symptoms of RS

HYPOMAGNESEMIA

Cardiac – arrhythmia

Musculoskeletal – weakness

GI – nausea, vomiting, diarrhea

Neurologic – tremor, tetany, seizures, AMS, coma

Other – refractory hypokalemia and hypocalcemia, death

THIAMINE DEFICIENCY

Cardiac - encephalopathy

Other - lactic acidosis, death

FLUID OVERLOAD / SODIUM RETENTION

Cardiac – heart failure

Musculoskeletal – edema

Other - death

Adapted from A.S.P.E.N. Fluids, Electrolytes, and Acid-Base Disorders Handbook 2015; Pulcini, Zettle and Srinath 2016

Some specific / clinical symptoms of RS

HYPERGLYCEMIA

Cardiac – hypotension

Pulmonary – respiratory failure

Musculoskeletal – weakness, rhabdomyolysis, muscle necrosis

GI – Nausea, vomiting, constipation

Neurologic - paralysis

Other – infection, death

TRACE ELEMENT DEFICIENCY

Cardiac – arrhythmia, heart failure

Neurologic – encephalopathy

Other – metabolic acidosis

Adapted from A.S.P.E.N. Fluids, Electrolytes, and Acid-Base Disorders Handbook 2015; Pulcini, Zettle and Srinath 2016

Starvation – first 72 hours

1. BG levels decrease
2. Decrease insulin; increase in glucagon and growth hormone
3. Liver uses non-CHO sources to produce glucose
   - glycogen for energy
   - skeletal muscles break down → release amino acid for gluconeogenesis
4. Goal: maintain BG levels for brain, erythrocytes, renal medulla

Starvation - Prolonged

- Glycogen stores are depleted, so metabolic pathways shift
- Ketones are produced to obtain energy
  - Free fatty acids are increased to prevent further skeletal muscle breakdown
  - Anaerobic metabolism of glucose to ATP
- Muscle wasting affects vital organ function
  - Atrophy of myocardium; liver wasting; GI atrophy; kidneys lose ability to concentrate urine
- Body tries to maintain serum electrolyte levels (decrease excretion, volume constriction)
  - Phos plays major role in glucose metabolism
- Vitamins/minerals also become depleted
- Decreased basal metabolic rate by 20-25%
- Prolonged starvation (30+ days) → muscle catabolism of lean muscle → death

Initiating Nutrition After Starvation

- Increase in insulin secretion
  - This causes electrolytes to migrate intracellularly (severity depends on degree of malnutrition + electrolyte depletion) → Electrolyte demand > supply
  - Also leads to decreased renal excretion of sodium and water → ECF expansion / fluid retention / pulmonary edema / CHF
- Inhibit glucagon release
- Slowed anabolic pathways increase
- Shift from lipolysis to lipogenesis

Why is Phosphorus so important?

- Involved in all intracellular processes and structural integrity of all cells (phospholipids, nucleoproteins, nucleic acids)
- Required for the production of energy (ATP)
- Structural component of 2,3-diphosphoglycerate (2,3-DPG)

Treatment of Refeeding Syndrome

- Prevent it!
- ***First and foremost*** determine who is at risk for refeeding syndrome!
- ***Then*** – check serum electrolytes and correct any electrolyte abnormalities before initiating any type of nutrition support (whether PO, EN, PN)
- Do not begin nutrition support just to treat electrolyte and acid-base abnormalities
  - Adjustments can be made to your PN regimen to more adequately meet electrolyte needs and minimize abnormalities
- Once electrolytes are repleted, maintain homeostasis (especially with K+, Phos, Mg, Na, fluid)
- ***Rule of Thumb:*** low and slow
- Multidisciplinary Team is **KEY**

Treatment of Refeeding Syndrome: Macronutrients (PO, EN, PN)

START:

- At maximum of 25 – 33% of kcal goal for high risk patients
- Can start at 50% of goal for lower risk patients
- EN/PO is preferred over PN
- Lack of consensus for initiating / advancement
- Don't forget kcals from Propofol, IVF!
- Macronutrients: 50-60% CHO, 15-25% PRO, 20-30% FAT

ADVANCE:

Over *at least* 3 – 5 days, but can go as slow as 7 – 10 days (depending on clinical response)

- typically advance kcals by 10 – 25% daily

- OK to still increase macronutrients even if:
  - minor and asymptomatic electrolyte abnormalities
  - Active treatment of low electrolytes
  - Gradual increase in kcal intake

Macronutrient advancement cont'd:

ENTERAL FEEDS

Start at 25-50 mL/hour

Advance 10 – 25 mL q 8 – 24 hours as tolerated to goal

Monitor:

- free water
- pulse
- BP

PO DIET

- **Calorie intake:**
  - Start at 1000 kcal/day
  - Advance by 200 – 250 kcal/day to goal
- **Fluid intake:**
  - Start fluids at ~50% of goal (~1200 mL in adolescent)
  - Advance by 200 mL/day as tolerated to goal

A.S.P.E.N. Pediatric Core Curriculum, 2nd edition 2015

What to do if you see RS as you advance?

Decrease / suspend	Decrease / suspend nutrition until symptoms are corrected / resolved
Correct	Correct electrolyte abnormalities and give supportive measures
Restart	Once symptoms improve, restart at 50% OR LESS of previous rate (when you started to see symptoms)
Monitor	Monitor electrolytes, vital signs

Treatment of sodium / fluid

Those at risk for RS may accumulate Na and fluid, so monitor fluid intake daily

For pediatric patients:

- No specific recommendations
- Start with maintenance fluid needs, but no more than 1000 mL/day
- May need to restrict Na to <20 mEq/L
- Monitor Na intake; restrict fluid if edema develops

For adolescents / adults:

- Maintenance = 1 – 2 mEq/kg/day Na
- For those at risk for fluid overload (cardiac, pulmonary issues), limit Na to 1 mEq/kg/day and fluid to <1000 mL/day

Treatment of Refeeding Syndrome: Electrolytes, Vitamins, Minerals

IN GENERAL

- ❑ - patients at risk for RS may need 120 – 150% of requirements for K+, Mg, and Phos to maintain WNL
- ❑ - may need to adjust goals based on underlying disease, renal function and replacement therapy, abnormal losses
- ❑ - may need IV replacement due to common GI side effects of PO/EN K+, Mg and Phos supplements (and if risk for malabsorption)
- ❑ - check for other nutrient deficiencies

Monitoring

SERUM LEVELS:

- q 8-12 hours for the first 5 – 7 days, then daily
- All electrolytes, but specifically Na, K+, Mg and Phos
  - May need to decrease repletion PRN
- Most electrolyte abnormalities occur within the first 2 – 3 days of refeeding, but can occur for up to 7 – 10 days
- Also monitor BG, renal function daily
- Baseline and weekly hepatic enzymes, lipid panel, coags, and TG if on PN
- ?Prealbumin, albumin, zinc, urinary electrolytes

OTHER:

- Continuous cardiorespiratory monitor (concerning cases) and full vital signs q 4 hours and adjust PRN
- Daily:
  - detailed physical (focus on neuro and cardiac)
  - I/O's
  - Calorie count
  - Weight

Treatment of hypophosphatemia

For children:

PO:

- maintenance dose = 0.3 – 0.6 mM/kg/day
- repletion dose = 0.3 – 0.6 mM/kg/day*

IV:

- repletion dose = 0.08 – 0.24 mM/kg over 6 – 12 hours*
- maximum dose = 15 mM/kg (ONCE) OR 1.5 mM/kg daily
- measure Phos 2-4 hours after infusion ends

Recall:

- 1 mM K+Phos = 1.47 mEq K+
- 1 mM NaPhos = 1.33 mEq Na

For adolescents / adults:

IV:

- repletion doses:
  - 0.8 mM/kg (if Phos 2.3-2.7 mg/dL)
  - 0.16 mM/kg (if Phos 1.5-2.2 mg/dL)
  - Increase dose by 25-50% if persistent hypophosphatemia
- maximum dose = 0.24 mM/kg/dose
- maintenance = 10-15 mM / 1000 kcal or 20-40 mM / day *(assumes adequate renal function)*

For PN:

- may need to decrease Ca to allow increase in Phos
- typically NaPhos contains less aluminum than K+Phos

* Decrease by 50% for impaired renal function

Treatment of hypokalemia

Different levels of deficiency but repletion does not differ

For children:

PO:

- maintenance dose = 1 – 2 mM/kg/day
- repletion dose = IV repletion recommended

IV:

- repletion dose = 0.3 – 0.5 mEq/kg/day, as long as urine output is >/= 0.5 mL/kg/hour
- maximum dose = 30 mEq/dose (ONCE)
- infuse over >/= 1 hour
- measure K+ level 2 hours after infusion ends

For adolescents / adults:

IV:

- Repletion = 0.3 – 0.5 mEq/kg/dose
- Maximum dose = 30 mEq/dose
- Maintenance = 1-2 mEq/kg/day

(assumes adequate renal function)

IV forms:

- KCl
- K+ acetate
- K+ Phosphate

Treatment of hypomagnesemia

For children:

PO:

- maintenance dose = 0.2 mM/kg/day
- repletion dose = 25 – 50 mg/kg per PO dose (0.2 – 0.4 mEq/kg per dose; decrease by 50% if impaired renal function)
- maximum dose = 16 mEq (ONCE) PO

IV:

- no recs given but infuse over 4 hours

For adolescents / adults:

IV:

- repletion =
  - 1 gm q 6 hours x 4 doses (if Mg level 1.0 – 1.8 mg/dL)
  - Give 8 – 12 gm/day in divided doses (if Mg level <1 mg/dL)
- maintenance = 8-20 mEq / day OR

0.1 – 0.4 mEg/kg/day *(assumes adequate renal function)*

IV + PO form:

- Magnesium sulfate (1 gm = 8.1 mEq Mg)

Treatment of other deficiencies

THIAMINE SUPPLEMENTATION

- Typically empiric:
  - **Pediatric patients:**
    - 10 – 25 mg/day IV or IM (extremely ill)
    - 10 – 50 mg/dose PO daily x 2 weeks and then 5-10 mg/day x 1 month
  - **Adolescents / adults:**
    - 5 – 30 mg dose 3 times/day IV or IM (extremely ill)
    - Then 5 – 30 mg/day PO x 1 month
  - Supplement prior to dextrose administration and electrolyte supplementation to prevent electrolyte depletion

VITAMINS/MINERALS

Empiric supplementation of folic acid = 1 mg/day x 3-7 days

Multivitamin (+/- iron) should be administered orally or IV ASAP

Acid-base issues

Evaluate for acid-base disturbances

Minimize underlying acid-base disorders

Normal Cl:acetate = 1:1 to 1.5:1

If giving PN for those at risk for RS:

- if pt at risk for metabolic acidosis:
  - Increase acetate
  - Decrease chloride
  - Keep Cl:acetate to < / = 1.2:1

- if pt at risk for metabolic alkalosis:
  - Increase chloride
  - Decrease acetate
  - Keep Cl:acetate to > / = 2:1

Adapted from A.S.P.E.N. Fluids, Electrolytes, and Acid-Base Disorders Handbook 2015; Pulcini, Zettle and Srinath 2016

In Summary

- ❑Refeeding Syndrome is complex!
- ❑Know what patients are at risk
- ❑Feed at low kcal, low fluid and slowly
- ❑Check and replete electrolytes prior to initiating re-feeding
- ❑Team / communication is key!

Thank you!

QUESTIONS / CONCERNS / COMMENTS:

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Food Protein Induced Enterocolitis Syndrome-

What are the goals of the gastroenterology team?

APGNN Annual Meeting
Las Vegas, NV
November 3, 2017

Glenn T. Furuta
University of Colorado School of Medicine
Digestive Health Institute
Gastrointestinal Eosinophilic Diseases Program
Children's Hospital Colorado
Aurora, CO

Disclosure

Co-Founder of EnteroTrack LLC

Research Funding from National Institutes of Health and Nutricia

Consultant for Shire and GSK

Royalties from UpToDate

Not an allergist

Learning objectives

- **Review differential diagnosis of infants with vomiting and diarrhea**
- **Recognize the clinical manifestations of FPIES**
- **Identify role of gastroenterologist and nurses in diagnosis of FPIES**

Causes of infantile vomiting

Common

- Gastroesophageal reflux
- Eosinophilic Esophagitis
- Allergic disease
- Infections

Rare

- Anatomic malformations
- Metabolic diseases / inborn errors in metabolism
- Increased intracranial pressure
- FPIES

Causes of infantile diarrhea

Common

- Infectious enteropathy
- Post-infectious enteropathy
- Allergic enteropathy

Rare

- Transport defects
  - chloride-bicarbonate exchanger (chloride-losing diarrhea)
  - sodium-hydrogen exchanger (congenital sodium diarrhea)
  - ileal bile acid receptor defect
  - sodium-glucose cotransporter (glucose-galactose malabsorption)
- Micronutrient deficiency
  - acrodermatitis enteropathica (zinc deficiency)
- Enzyme deficiency
  - enterokinase deficiency
- Inflammatory bowel diseases
- Microvillus inclusion disease
- Tufting enteropathy
- Autoimmune enteropathy / IPEX syndrome
- FPIES

Food Protein Induced Enterocolitis Syndrome (FPIES)

Gastroenterologists view

Milk Induced Colitis in an Infant

Chronic diarrhea and the passage of blood and mucus in the stools are frequent manifestations of cow's milk allergy.[1,2] Rubin in 1940 first presented the classical description of intestinal hemorrhage in the newborn as a manifestation of allergy to cow's milk,[3] and, more recently, Wilson, Heiner, and Lahey[4] have related anemia and occult blood loss in the stools of infants to the ingestion of cow's milk. Although these findings are highly suggestive of disease of the large bowel, the reaction of the colon of the allergic infant to the ingestion of milk has not been well defined.

The following report describes an infant who developed shock and fulminating colitis on three occasions after the ingestion of commercial infant formulas which contained cow's milk proteins.

Grboski Pediatrics 1966
Powel et al J Pediatr 1976

Case Report

N. L., a Caucasian male infant, was delivered after a normal full-term pregnancy and weighed 3,600 gm. He took Similac formula well and had no difficulties until 1 week of age when his stools became loose. The stools gradually increased in frequency and in water content until by 37 days of age he was having 15 blood-streaked mucoid stools per day. He became severely dehydrated

Hospital course

- **Developed pneumonia and made NPO**
- **Physical examination-distended abdomen**
- **Treated with antibiotics**
- **Day 6-cow's milk formula started**

Hospital course

formula (Table I). Within 2 hours he was in shock. His pulse rose to 150 per minute and his abdomen became distended and tense. He passed an explosive movement of blood and mucus which contained identifiable sheets of tissue. Sigmoidoscopy to 8 cm visualized a rough, purple-red hemorrhagic mucosa. During the procedure thin sheets of tissue exuded from the rectum about the sigmoidoscope.

Hospital course

- **Stabilized and made NPO**
- **Sigmoidoscopy improved 3 days later**
- **Stool cultures negative**

Hospital course

He gained weight slowly while taking Nutramigen and had normal formed stools until the twenty-first hospital day when Enfamil was unintentionally substituted for a feeding. Within 30 minutes he passed copious liquid stools and within 1 hour he became ashen, hypothermic, and passed blood, mucus, and colonic tissue per rectum. Transfusion and

3 month old male

- Son of an otolaryngologist who was exclusively breastfed
- 4 weeks- Ingestion of cows milk formula
- One month later- Persistent vomiting, intermittent loose stools and poor weight gain
- Seen by pediatrician and changed back to breastfeeding alone

3 month old male

- 3 months of age- challenged with of cow's milk formula
- 1 hour later- developed profuse and repetitive vomiting, dehydration and lethargy
- Metabolic disease ruled out, sepsis work up unremarkable, UGI was normal
- Intravenous resuscitation and antibiotic administered
- Changed to an elemental diet

3 month old male

- 1 year later-Re-challenged with cows milk was tolerated
- 2 year follow up- normal growth and development

J ALLERGY CLIN IMMUNOL
DECEMBER 2010

Guidelines for the Diagnosis and Management of Food Allergy in the United States: Summary of the NIAID-Sponsored Expert Panel Report

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J ALLERGY CLIN IMMUNOL
APRIL 2017

Position paper

International consensus guidelines for the diagnosis and management of food protein–induced enterocolitis syndrome: Executive summary—Workgroup Report of the Adverse Reactions to Foods Committee, American Academy of Allergy, Asthma & Immunology

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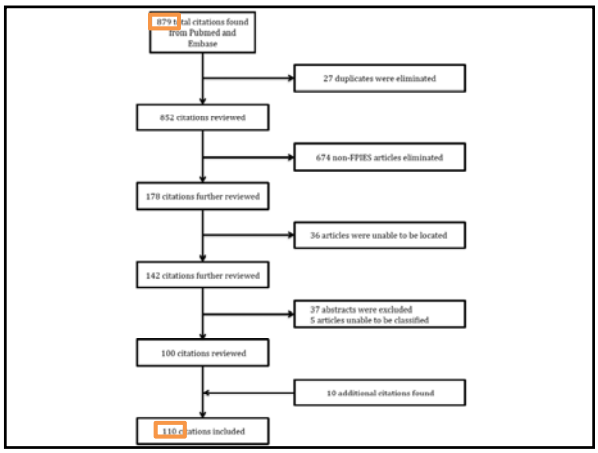
Author composition and process

- Allergists, Gastroenterologists (4), Dietitians, Advocates
- International
- Review of the literature and expert opinion
- 30 Summary statements



Food protein–induced enterocolitis (FPIES) is a non-IgE cell-mediated food allergy that can be severe and lead to shock.[1] Despite the potential seriousness of reactions, awareness of FPIES is low; high-quality studies providing insight into pathophysiology, diagnosis, and management are lacking; and clinical outcomes are poorly established.

FPIES Definition

- **Typically less than 9 months of age**
- **Exposure to food elicits delayed severe vomiting and diarrhea**
- **Removal of causative food results in resolution of symptoms**
- **Re-exposure or oral food challenge elicits typical symptoms within 4 hrs**

Nowak-Wegrzyn et al JACI 2017

FPIES Subtypes

TABLE I. Proposed defining features for clinical phenotyping of FPIES

FPIES subtypes	Defining features
Age of onset	
Early	Younger than age 9 mo
Late	Older than age 9 mo
Severity	
Mild-to-moderate	Repetitive emesis with or without diarrhea, pallor, mild lethargy
Severe	Repetitive projectile emesis with or without diarrhea, pallor, lethargy, dehydration, hypotension, shock, methemoglobinemia, metabolic acidosis
Timing and duration of symptoms	
Acute	Occurs with intermittent food exposures, emesis starts usually within 1-4 h, accompanied by lethargy and pallor; diarrhea can follow within 24 hours, with usual onset of 5-10 h. Usual resolution of symptoms within 24 h after elimination of the food from the diet. Growth is normal, and child is asymptomatic during food trigger elimination.
Chronic	Occurs with daily ingestion of the food (eg, feeding with CM- or soy-based formula in an infant); symptoms include intermittent emesis, chronic diarrhea, poor weight gain, or FTT. Infants with chronic FPIES usually return to their usual state of health within 3-10 d of switching to a hypoallergenic formula, although in severe cases temporary bowel rest and intravenous fluids might be necessary. Subsequent feeding of the offending food after a period of avoidance results in acute symptoms.
IgE positivity	
Classic	Food specific, IgE negative
Atypical	Food specific, IgE positive

Acute FPIES

- Acute onset of symptoms following ingestion of cow's milk X 3 in an infant
- Rapid, severe, life threatening
- Responsive to removal of cow's milk

Chronic FPIES

- <4 months
- Cow's milk or soy protien
- Vomiting and diarrhea +/- failure to thrive
- More common in Japan and Korea

TABLE E1. Age of onset or diagnosis of FPIES (CM/soy vs solid-food triggers)*

Reference	Country	Only CM/soy FPIES investigated	Overall age of onset/ diagnosis (mo)	Age onset/ diagnosis of CM/ soy FPIES (mo)	Age onset/ diagnosis of solid-food FPIES (mo)
Nomura et al[11]	Japan	Yes (CM)	—	0.28 (0.1-0.82)‡ 0.59 (0.34-1.20)†	—
Powell[12]	United States	Yes (CM)	—	0.46 (0.14-2.39)	—
Grybeski[13]	United States	Yes (CM)	—	0.25 (0.07-4)	—
Katz et al[14]	Israel	Yes (CM)	—	1 (0-6.4)	—
Nowak-Wegrzyn et al[15]	United States	No	—	1 (0.08-12)	5.5 (3-7)
McDonald et al[16]	United States	Yes (CM/soy)	—	1 (0.04-3)	—
Hwang et al[17]	South Korea	Yes (CM/soy)	—	1.28 (0.46-2.1)	—
Chung et al[18]	South Korea	Yes (CM)	1.75 (—)	1.75 (—)	—
Sicherer et al[3]	United States	No	2 (0.25-108)	2.0 (0.25-108)	6 (5-24)
Fogg et al[19]	United States	No	2 (0.25-9)	2 (0.25-4)	4.5 (4-9)
Sopo et al[20]	Italy	No	5.1 (5.10)	3.5 (2.40)‡	10.6 (6.70)
Mehr et al[5]	Australia	No	5.6 (2.70)	4.9 (2.60)	6.1 (1.70)
Caubet et al[21]	United States	No	4 (2-6)	5 (2-10)	7 (6-12)
Ruffner et al[4]	United States	No	9.7 (10.20)	7 (0.70)	12.1 (1.10)

Clinical features

- **Vomiting-1-4 hours**
- **Diarrhea-5-10 hours**
- **Lethargy and pallor, hypotension and hypothermia**
- **ER visit(s)**
- **Well when not eating offending food**

Table 2. Incidence of common symptoms in acute food protein-induced enterocolitis syndrome

	Mehr *et al.* [14] ($n = 66$ all FPIES)	Katz *et al.* [3▪] ($n = 28$ CM-FPIES)
Vomiting	100%	100%
Lethargy	85%	77%
Pallor	67%	14%
Diarrhea	24%	25%
Bloody diarrhea	4.5%	NA
Temperature <36°C	NA	24%

CM, cow's milk; FPIES, food protein-induced enterocolitis syndrome.

Leonard et al Curr Op Pediatr 2012

Clinical manifestations

- First few days of life to 6 months
  - Early onset- Cow / soy milk- 30 days
  - Later onset- Solid food-5.5 months
- Of 35 children with 66 acute episodes seen over a 16 year period, ***2 received correct diagnosis at initial presentation.***
- ***Otherwise well who has repeated episodes of GI symptoms of undetermined etiology***

Mehr et al Pediatrics 2009
Morita et al Allerg Intl 2013
Fiocchi et al Curr Opin Allergy Clin Immunol 2014

Clinical manifestations

- 75% appear severely ill and 15% develop hypotension
- Responds to elimination of commonly ingested proteins (cow's milk, soy, rice)
- Atopic diseases- atopic dermatitis-65%, asthma- 20%,
- FH of atopic disease- 40-80%

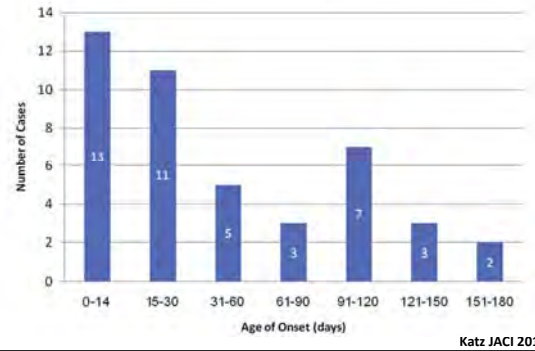
Mehr et al Pediatrics 2009
Morita et al Allerg Intl 2013
Fiocchi et al Curr Opin Allergy Clin Immunol 2014

Prevalence

- 13,019 infants
- Dx criteria-sxs, <9 months of age, no other IgE mediated problems, removal lead to remission, OFC positive
- 0.34% had FPIES
  - Vomiting, lethargy
  - First 6 months
  - Cows milk

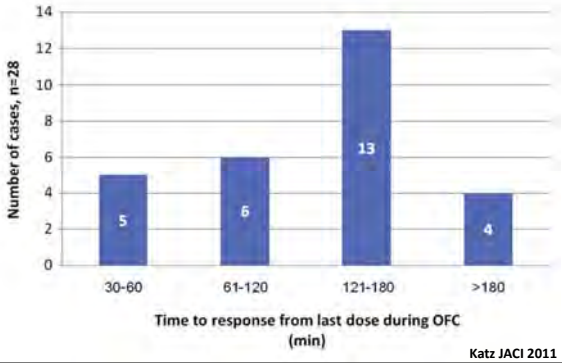
Katz et al JACI 2011

Age of onset



Katz JACI 2011

Course of response



Katz JACI 2011

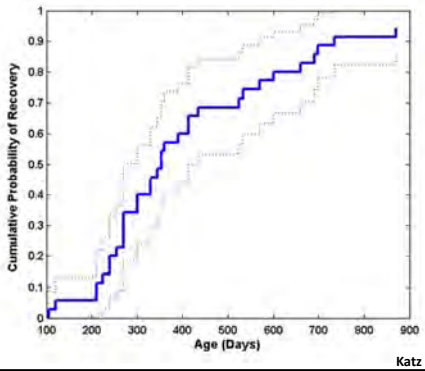
Rice: a common and severe cause of food protein-induced enterocolitis syndrome

S S Mehr,[1,2] A M Kakakios,[1] A S Kemp[1,2]

- **Rice (n=14) compared to cow's milk (n=17)**
- **Longer delay in diagnosis**
- **More severe reactions**

Mehr et al Arcg Dis Child 2009
Caminti et al Ital J Pediatr 2013

Natural History



Katz et al JACI 2011

Cow's milk and soy induced responses are outgrown by 10 months to 3 years

- 60%-3 years in US
- 60% by 10 months in Korea
- 90% by 3 years in Israel
- 100% by 2 years in Italy

Hwang et al Arch Dis Child 2009
Sopo et al Clin Exp Allergy 2012

Onset of tolerance

- 2001-2011
- 160 subjects
- 6 months to 45 years
- 54% male
- 15 months (median age at diagnosis)

Caubet et al J Allerg Clin Immunol 2014

Onset of tolerance

- **Median age when tolerance developed**
  - **Milk- 5.1 years**
  - **Soy-6.7 years**
  - **Rice- 4.7 years**
  - **Oat-4 years**

Caubet et al J Allerg Clin Immunol 2014

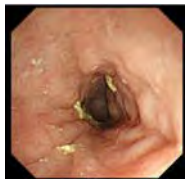
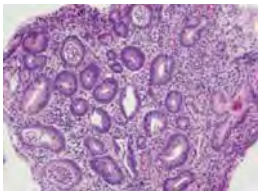
Laboratory testing is non-specific

- **Labs**
  - **Dehydration**
  - **Peripheral eosinophilia**
  - **Methemoglobinemia**
  - **Thrombocytosis**
  - **Stool PMN or Eos, heme positive**
- **IgE levels may not be elevated**
  - **Cows milk/soy-30%**

Endoscopic and Histologic are non-specific

- **Friable mucosa, normal**
- **Villous atrophy**
- **Crypt abscesses**
- **Lymphocytes, mast cells and eosinophils**

Endoscopic and Histologic are non-specific

Ishige et al GI Endoscopy 2014

Management-acute

- Oral rehydration fluids, if mild
- Intravenous fluids, if moderate to severe: 20 ml/kg boluses of isotonic saline
- Intravenous steroids: methylprednisolone 1 mg/kg (max 60–80 mg)
- Vasopressors for hypotension if severe or unresponsive to fluids
- Bicarbonate for acidemia
- Methylene blue for methemoglobulinemia

Leonard et al Curr Op Pediatr 2012
Jarvinen et al J Allergy Clin Immunol 2013

Management-chronic

- Removal of causative food from diet
- Intravenous fluids if dehydrated
- For cow's milk-FPIES: use soy alternative (following a supervised oral food challenge), casein hydrolysate or elemental formula
- Bicarbonate for acidemia
- Methylene blue for methemoglobulinemia

Observation for feeding difficulties
Letter for family to carry with them

Leonard et al Curr Op Pediatr 2012
Meyer et al J Gastroe terol Hepatol 2014

GASTROENTEROLOGY
Journal of Gastroenterology and Hepatology 29 (2014) 1764–1769

Feeding difficulties in children with food protein-induced gastrointestinal allergies

Rosan Meyer,* Nathalie Rommel,†,‡ Lukas Van Oudenhove,† Catharine Fleming,¶ Robert Dziubak* and Neil Shah*,†

*Gastroenterology, Great Ormond Street Children's Hospital, London, UK, †Translational Research Centre for Gastrointestinal Disorders (TARGID) and ‡Neurosciences, ExpORL, KU Leuven, §Gastroenterology, Neurogastroenterology & Motility, University Hospital Leuven, Leuven, Belgium; and ¶Sydney Children's Hospital, Centre for Children's Cancer and Blood Disorders, Sydney, Australia

Table 2 The differences in proportions of symptoms between children with and without feeding difficulties

Symptom	Children without feeding difficulties	Children with feeding difficulties	Statistical difference between groups
Abdominal pain	90.9%	92.5%	< 0.37
Diarrhea	80%	81.1%	0.76
Abdominal distension/Bloating	68.7%	81.8%	< 0.002*
Vomiting	36.5%	74.4%	< 0.0001*
Weight loss	45.8%	67.6%	< 0.0001*
Constipation	36.9%	60.7%	< 0.0001*
Rectal bleeding	31.5%	42%	0.025*

*Statistically significant < 0.05.

Differential diagnoses

- **Infections / Sepsis-*febrile***
- **Anaphylaxis-*minutes***
- **Allergic proctocolitis -*not as sick***
- **Celiac sprue-*respond to gluten removal***

Differential diagnoses

- **Inflammatory bowel diseases-*systemically ill***
- **Autoimmune- diarrhea severe and *systemically ill***
- **Obstruction /pyloric stenosis / Hirschprung disease**
- **Eosinophilic gastrointestinal disease-*not as sick***

What is the role of the gastroenterologist and nurse in the care of the patient with presumed FPIES?

a. ***Recognize symptoms*** **and initiate evaluation**
b. **Provide consultation to identify alternative diagnosis for symptoms**
c. **Contribute to understanding the pathogenesis of FPIES**
d. **Refer to allergist for long term management**
e. **All of the above**

The FPIES Foundation

www.thefpiesfoundation.org
contact@thefpiesfoundation.org

Slide 1

FPIES: A Parent Perspective

Presented by:
Amanda LeFew and Joy Meyer
Co-Directors of The FPIES Foundation

Learning objectives:

•Describe the quality of life adjustments for families living with FPIES

•Recognize the parent perspective of having a child diagnosed with FPIES

•Learn ways you can help a family living with FPIES

Slide 2

About the Presenters:

Amanda LeFew has a Bachelors degree in Music Therapy is a board-certified music therapist (MT-BC), with additional training in Neurological Music Therapy. She is a mom to two energetic daughters; both girls, ages 5 and 8, have FPIES. Amanda is a Foundation founding member and Executive Co-Director of The FPIES Foundation.

Joy Meyer has an Associates degree in Nutrition and is a Registered Dietetic Technician (DTR). Joy is a busy wife and mother of four sons, the youngest who is 8yrs.old continues to live with FPIES on a limited diet. Joy has a love for Nutrition and a passion for helping others. Joy is a Foundation founding member and Executive Co-Director of The FPIES Foundation.

Slide 3

What is FPIES?

Food Protein-Induced Enterocolitis Syndrome (FPIES) is a Non-IgE mediated food allergy affecting the gastrointestinal (GI) tract.

Slide 4

Finding Our Voices: A Patient Registry

As a parent of children affected by FPIES, advocacy quickly becomes a 24hr-a-day job!

We parents are always seeking new ways for our voices to be heard in hopes of bettering day-to-day life for our kids.

Affected families often express:

- Feelings of isolation,
- Being misunderstood
- Experiencing inadequate care

Altavoice's free patient registry platform gave us the opportunity to create a home-base for our community's voices-- a place to be seen and heard by practitioners and researchers, worldwide.

Slide 5

A Foundation for FPIES Voices

The Registry in Numbers

- 600+ registered participants
- Participants connect from 48 states, from six different continents
- Seven available surveys can be completed more will be added
- Participation is **free** for patients, providers, and researchers!

www.fpiesregistry.com

The **FPIES Global Patient Registry** engages our community in surveys:

- General Health Information
- Family History
- Diagnosis-Specific Information
- Quality of Life Impact

Slide 6

Meaningfulness of Quality of Life (QOL) Survey

Offers a snapshot of life with this chronic health condition to practitioners and researchers on the registry portal

Offers validation and solidarity to affected families sharing their experiences and reflecting on the shared challenges of other families

Reported FPIES Impact:

- Experiences of Pain
- Developmental Milestones
- Emotional/ Coping skills
- Social/Community Life
- Financial resources

Slide 7

A Life Altering Diagnosis

- The Diagnosis
  - Easily misunderstood
  - No medical tests
  - Few specialists
- Not your Typical Food Allergy
  - Delayed food allergy
  - Less treatment plans
  - Rare/"Invisible Illness"
- Advocate and Educate
  - Family/Friends
  - Community
  - Daycare/school
  - Doctors

Slide 8

FPIES In The Everyday

- Accidental exposure risk
- ED aware
- Food trial anxiety
- Shopping & label reading
- Creative food prep
- No simple meals
- Always plan ahead

Slide 9

Living on an Island

"FPIES isn't a diagnosis for us, it's an island".
Alliyson, parent of a child with FPIES

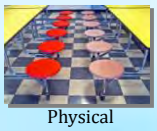
Slide 10

FPIES: A Chronic Condition?

Though acute FPIES reactions may be brief in nature, management of FPIES is an ongoing, daily process that is best addressed with multifaceted approaches, as is often the case with chronic conditions.

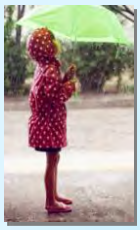

Nutrition Dynamics


Social/Family Dynamics


Physical Environments

Slide 11

A Multifaceted Approach for a Chronic Condition



- **FPIES at Home--** Explore potential modifications in family life
- **FPIES in the Community--** Explore ways to educate community members and to create safe spaces for children to engage with their communities
- **FPIES at School/Age-Appropriate Social Settings--** Encourage inclusion and support education of child's peers and adult facilitators

Slide 12

Ongoing Care

Because **FPIES impacts multiple aspects of daily life**, viewing it as a chronic condition (until the time it is outgrown) can help clinic communities to better explore the nature of support needed by families between and during reactions.

Slide 13

How to Help

- Help prevent accidental exposures
- Treating reactions
- Empower
- Validate
- Referrals
- Individualize care

Slide 14

Offer Words of Encouragement

- Acknowledge
- Be optimistic but realistic
- Choose your words carefully

Slide 15

The Positive Impact

- Healthy eating
- Celebrating food passes
- New recipes
- Family meals
- Food free events
- Inclusion
- Validation

Slide 16

Resources

- **FPIES Registry**
- **FPIES Provider Database**
- **Patient & Provider packets**
- **Websites:**
  - www.fpiesfoundation.org
  - www.acaai.org
  - www.foodallergy.org
  - www.globalgenes.org
  - www.rarediseases.org
  - www.themighty.com
- **Support groups**

FPIES Toolbox:
- Awareness
- Food Journals
- Healthcare professionals
- Medical Literature
- Cooking & Nutrition
- Emergency care
- For Kids/School
- Webinars & online learning
- Bilingual resources

Slide 17

Questions or Comments?

Update on Pediatric IBD Therapy

Andrew B. Grossman MD
Co-Director, Center for Pediatric Inflammatory Bowel Disease
Associate Professor of Clinical Pediatrics
Division of Gastroenterology, Hepatology, and Nutrition

Children's Hospital of Philadelphia

Perelman School of Medicine
University of Pennsylvania

Disclosures

- None

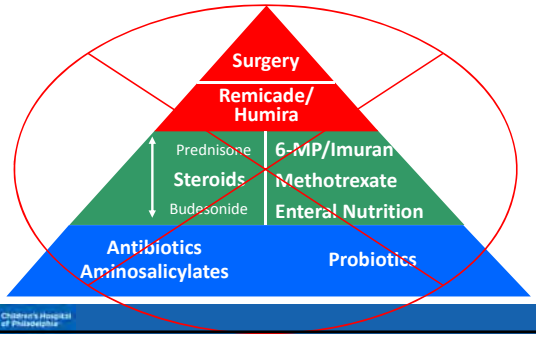
Objectives

- Review pharmacologic options available for treatment of pediatric IBD
- Discuss nutritional therapies and diets for pediatric IBD
- Present basis for "top-down" therapy
- Introduce recently approved therapies
- Review most recent safety data

Pediatric IBD: Shifting Therapeutic Goals

Previous Goals	Newer Goals
• Induce and maintain clinical remission • Improve quality of life • Minimize drug toxicity • Optimize surgical outcomes	• Heal mucosa • Modify natural course of disease – To prevent disease complications

Traditional Pediatric IBD "Step-Up" Algorithm



Efficacy of 5-ASA's

Ulcerative Colitis

- Oral therapy effective for induction and maintenance of remission
- Rectal, oral + rectal → More effective than just oral for distal disease

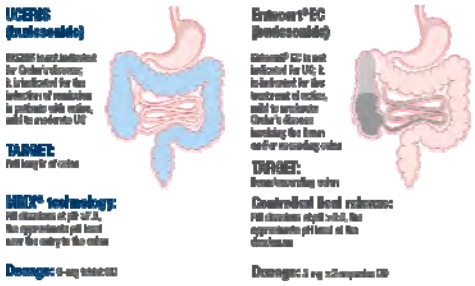
Crohn's disease

- Efficacy unclear for induction or maintenance of remission

Systemic Corticosteroids

- Oral (prednisone), IV (methylprednisolone), rectal
- Suppress active inflammation
- Indication: Acute UC or Crohn's flare
- Provide immediate symptomatic relief
  - Do not promote healing of GI tract
- **Not** indicated for maintenance therapy
  - Lose efficacy, side effects

Budesonide



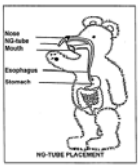
Immunomodulators

- Suppress immune response that triggers intestinal damage in IBD
- Maintenance of remission
- Steroid-sparing

6-MP/Imuran	Methotrexate
• Daily dosing • Oral administration • 3-4 months for max. efficacy • CD and UC	• Once weekly dosing • Oral or subcutaneous • 6-8 weeks for max. efficacy • Minimal UC data

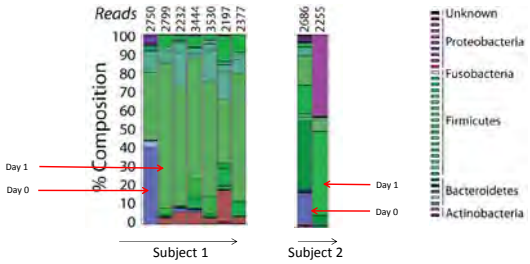
Enteral Nutrition

- Improves nutrition for **all** IBD
- Effective **therapy** for pediatric Crohn's
- Replace **all** or **the majority** of calories with formula and excluding/limiting food
- UC → Not shown to be effective
- Often requires NG tube
- Proposed mechanism: Modulation of intestinal bacteria



Bacterial populations in pediatric IBD subjects on semi-elemental diet

(16S rDNA sequencing)



Conclusion: Rapid change in gut bacterial populations upon initiating diet

Enteral Nutritional Therapy: Traditional Protocol

Induction

- Exclusive enteral nutrition with an elemental, semi-elemental, or polymeric formula
  - Duration: 4 – 12 weeks

Maintenance

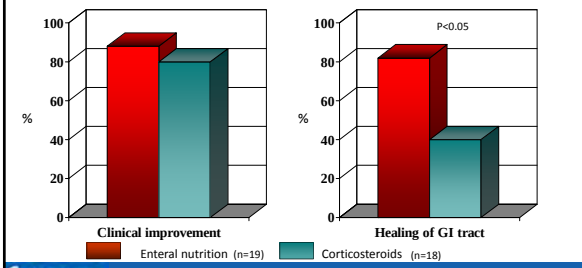
- **Nutritional therapy**: Repeat 4 week cycle of exclusive enteral nutrition every 3 – 4 months or 50% EN daily

OR

- **Medical therapy:** 6-MP/AZA/MTX

Enteral Nutrition vs. Steroids for Active Crohn's Disease

Enteral Nutrition → As effective as steroids for improving symptoms, **more effective** for healing of GI inflammation



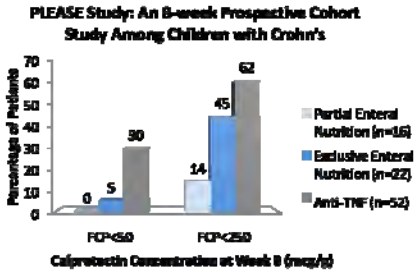
Borrelli O, et al. *Clin. Gastroenterol. Hepatol.*; 2006

CHOP Partial EN Experience

- 80%-90% of estimated caloric needs from formula
  - 10-20% from food (limited)
- Nocturnal NG feeds
- Induction
  - 7 days per week for 8-12 weeks
- Maintenance
  - Lower calories (decrease days, volume)
  - Simultaneously increase calories from food

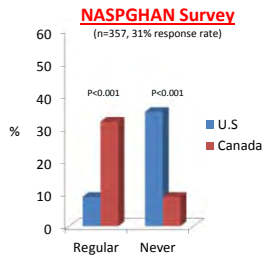
Gupta K et al. *Inflamm Bowel Dis* 2013: 19: 1374-8

Greater Mucosal Healing with More Restrictive Diet During Induction Phase



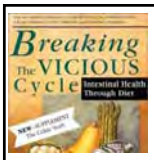
Lee D et al. *Inflamm Bowel Dis* 2015: 21: 1786-1793

How Prevalent is EN Implementation?



Currently (OR 38.5) or previously (OR 7.9) working at center that uses EN regularly increases EN use

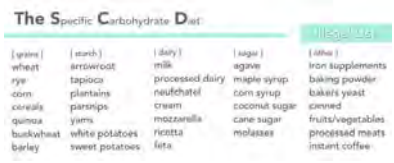
Stewart M et al. *J Pediatr Gastroenterol Nutr* 2011; 38-42



The Specific Carbohydrate Diet

- Principle that disaccharides and polysaccharides pass undigested into the colon, which causes bacterial and yeast overgrowth, thereby leading to overproduction of mucus and intestinal injury

- Mostly anecdotal evidence supporting efficacy
- Scientific literature includes only small, uncontrolled studies in children (7-10 patients)
- No well-designed randomized trials

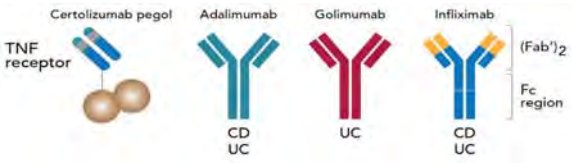


Suskind et al. *JPGN*. 2014;58(1):87-91.
Cohen et al. *JPGN*. 2014;59(4):516-521.

Other Exclusion Diets

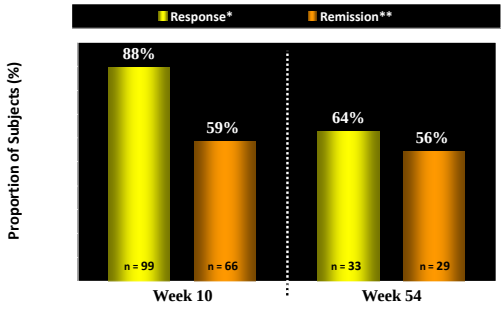
- Semi-vegetarian diet
- IBD-AID
- Crohn's Disease Exclusion Diet
- Paleolithic diet
- Low FODMAP diet
- UC diet

Anti-TNF Biological Therapies for IBD



REACH (Pediatric Crohn's Disease Study)

Clinical Remission

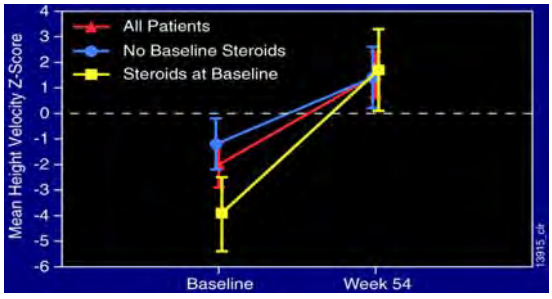


* ↓ from baseline of ≥ 15 points in PCDAI score & PCDAI score ≤ 30
** PCDAI score ≤ 10

Hyams, et al. *Gastroenterology* 2007;132:863-73

REACH

Improved Growth with Infliximab



Hyams, et al. *Gastroenterology* 2007;132:863-73

Anti-TNF Therapy in Pediatric IBD

- Moderate to severe Crohn's disease
  - Decreases steroid requirement
  - Mucosal healing
  - Healing of perianal disease
  - Improvement of growth
  - Bone health
  - Prevention of post-operative recurrence
- Ulcerative colitis
  - Treatment of moderate to severe disease
  - Prevention of surgery

Anti-TNF Therapeutic Monitoring

- Measure trough level/antibodies against medicine
- "Sub-therapeutic drug level"
  - Less likely to be effective
  - Increase dose and/or decrease interval
- Antibodies against medication
  - Less likely to be effective
  - Can optimize dose
  - Might have to switch agents
  - Add immunomodulator

Factors Affecting Pharmacokinetics of Monoclonal Antibodies

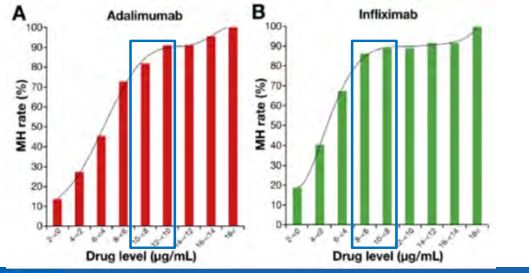
	Impact on pharmacokinetics
Presence of ADAs	Decreases serum (mAbs) Threefold-increased clearance Worse clinical outcomes
Concomitant use of IS	Reduces ADA formation Increases serum (mAbs) Decreases mAbs clearance Better clinical outcomes
High baseline (TNF-α)	May decrease (mAbs) by increasing clearance
Low albumin	Increases clearance Worse clinical outcomes
High baseline CRP	Increases clearance
Body size	High body mass index may increase clearance
Gender	Males have higher clearance

ADA, antidrug antibody; CRP, C-reactive protein; IS, immunosuppressive agent; mAb, monoclonal antibody; TNF-α, tumor necrosis factor-α. Terms in parentheses refer to serum concentration.

Ordas I et al. *Clin Pharmacol Ther.* 2012;91:635

Assessing Optimal Anti-TNF Levels for Mucosal Healing

Retrospective, observational cohort adult study (n=145; 78 IFX, 67 adalimumab; 111 CD; 34 UC)

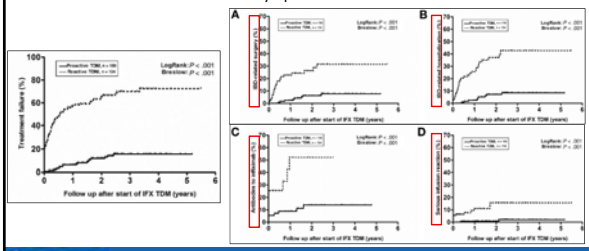


Ungar B et al. *Clin Gastroenterol Hepatol* 2016; 14:550-557

Proactive vs. Reactive TDM in Clinical Practice

Multi-center, retrospective cohort of adult IBD patients (n=264) who responded to IFX induction therapy

- Proactive: TDM prior to active disease; titrate to goal trough
- Reactive: TDM due to active symptoms or intolerance



Papamichael R, et al. *Clin Gastroenterol Hepatol* 2017; epub ahead of print

What Are Biosimilars?

- WHO: "Biotherapeutic product *similar* in terms of quality, safety, and efficacy to a licensed biotherapeutic product"
- Primary amino acid sequences of biosimilar and originator are same, but are not identical
  - Differences in glycosylation, protein structure
- Must not be clinically different in quality, safety, efficacy, or potency from originator biologic agent

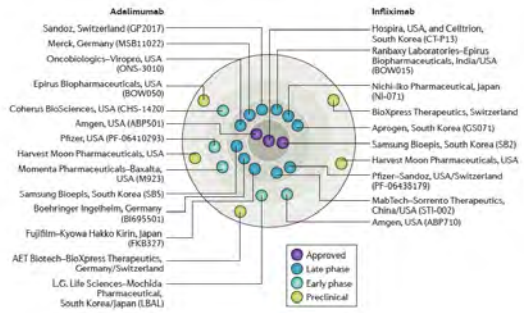
Ben – Horin S, *et al.* 2016. *Clin Gastro Hepat*
Danese S, *et al.* 2016. *Nature Rev Gastro Hep*

How Do Biosimilars Differ from Generics?

- Generics
  - Small molecule drugs
  - Identical to original drugs
- Biosimilars
  - Much larger molecular structure
  - Heterogeneic from originator
  - Sensitive to changes in manufacturing (living cell lines)

De Ridder L *et al.* 2015. *JPGN*
Ha C and Kornbluth A. 2016. *Inflamm Bowel Dis*

Current Biosimilars



Danese S, *et al.* 2016. *Nature Rev Gastro Hepatol*

Inflectra™ (infliximab-dyyb) – First FDA Approved Biosimilar for IBD

- From same cell line as infliximab
  - Same amino acid sequence
  - Comparable pharmacokinetics, anti-TNF binding, and cytotoxic activity to infliximab
- Studied in RA
- Extrapolated to current GI indications for infliximab
  - Adult and pediatric Crohn's disease
  - Adult UC

https://www.fda.gov/newsevents/newsroom/pressannouncements/ucm494227.htm

Crohn's and Colitis Foundation Position Statement on Biosimilars (Endorsed by NASPGHAN)

Safety and Effectiveness:

Human testing	Interchangeability	Immunogenicity and cross reactivity	Unique name/ identifier
			
Undergo thorough human testing and meet highest safety standards	Provide reasonable proof that switching would not incur immunogenicity or loss of response to innovator (vice versa)	Risk of cross reactivity of anti-drug antibodies from innovator agent to biosimilar must be clearly understood, defined and listed on the label and prescribing information	Each biosimilar should have unique identification number, name or else use international non-proprietary name standards to eliminate patient and provider confusion.

http://www.crohnscolitisfoundation.org/assets/pdfs/advocacy/biosim-position.pdf

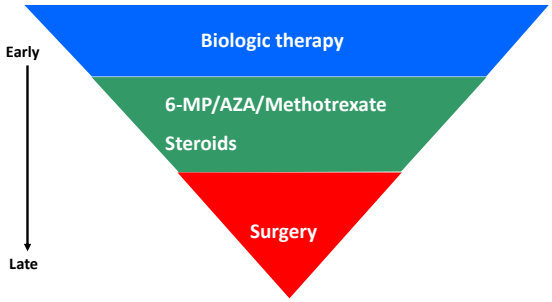
Crohn's and Colitis Foundation Position Statement on Biosimilars (Endorsed by NASPGHAN)

Shared-Decision Making and Transparency:

Notification to Prescribing Provider	Prevention of Substitution
	
The prescribing provider should be notified of the substitution of the innovator agent with a biosimilar (or vice versa).	The prescriber should be able to prevent substitution by indicating "dispense as written" or "brand medically necessary."

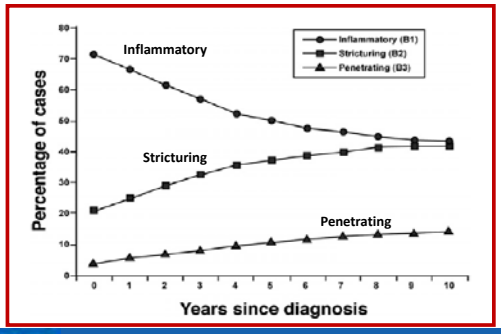
http://www.crohnscolitisfoundation.org/assets/pdfs/advocacy/biosim-position.pdf

Does Early Use of Biological Therapy Improve Efficacy? Growth?



Risk of Treating vs. Not Treating

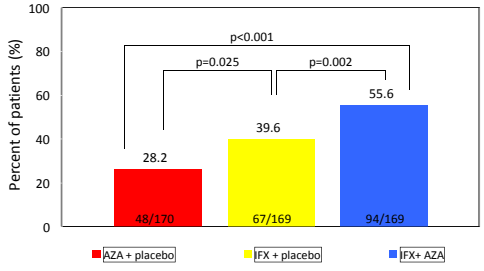
Long-Term Evolution of Pediatric Crohn Disease is Structural Damage



Vernier-Massouille G et al. *Gastroenterology* 2008

SONIC Trial

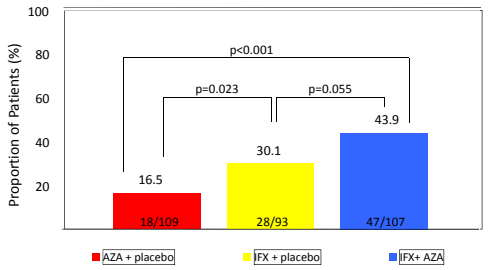
Corticosteroid-Free Clinical Remission at Week 50



Colombel JF et al. *N Eng J Med.* 2010; 362:1383-1395

SONIC Trial

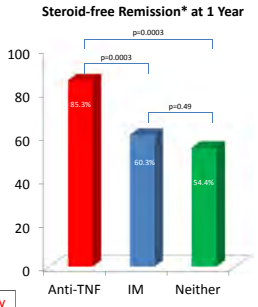
Mucosal Healing at Week 26



Colombel JF et al. *N Eng J Med.* 2010; 362:1383-1395

Early Anti-TNF Therapy in Pediatric Crohn Disease

- Observational cohort of pediatric CD patients (inflammatory)
- Propensity score analysis matched patients on baseline characteristics in 68 triads
  - Early anti-TNF (<3 mo)
  - Early immunomodulator
  - Neither
- Early anti-TNF
  - Higher remission rate
  - Improved height z-score



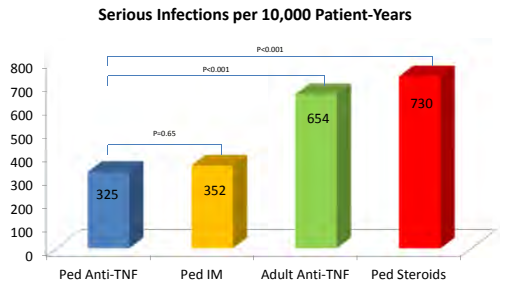
*Remission: PCDAI≤10, steroid free, no surgery

Walters TD et al. *Gastroenterology* 2014; 146:383-391

Immunomodulators and Biologics – Common Toxicities

- Leukopenia
- Liver toxicity
- Increased infection risk
- Slightly increased risk of malignancy
  - HSTCL

Pediatric IBD Risk of Serious Infection: A Systematic Review

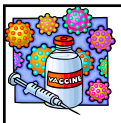


Dulai PS et al. *Clin Gastroenterol Hepatol* 2014; 12: 1443-1451

Meta-Analysis: Biological Therapies and Risk of Infection

- 49 randomized, placebo controlled trials
  - 14,590 participants
- For all studies, patients on biological therapy:
  - 19% increased risk of "all infections"
  - Serious infections **not** increased
  - Higher risk of opportunistic infections (including Tb)
- For studies deemed "low risk of bias"
  - Serious infections **decreased** in biologic exposed

Bonovas S et al. *Clin Gastroenterol Hepatol* 2016; 14:1385-1397



Vaccination

- Ensure that vaccines are up to date at time of diagnosis
- All non-live vaccines should be given
  - Annual flu shot
  - HPV vaccine
- Avoid live vaccines if immunosuppressed
  - MMR, Varicella, intranasal flu, others
  - Try to confirm Varicella immunity prior
  - Consider pneumococcal vaccine

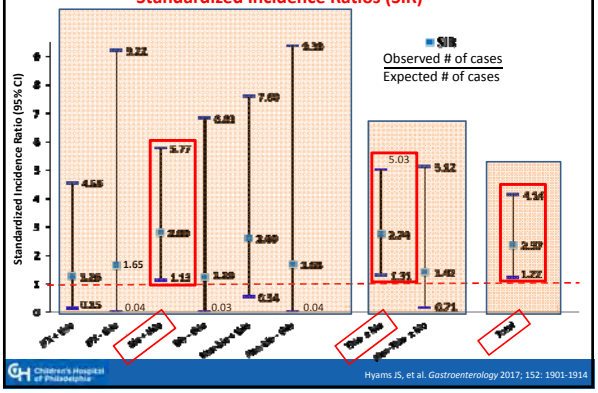
Pediatric Develop Registry

- Largest prospective pediatric IBD safety cohort
  - Patients assessed every 6 months, followed for 20 years
  - 5,691 patients enrolled with > 20,000 PY of F/U
- Infliximab exposed **do not** have higher rate of malignancy than non-exposed
- Statistically significant increased rate of malignancy in thiopurine exposed

Hyams JS, et al. *Gastroenterology* 2017; 152: 1901-1914

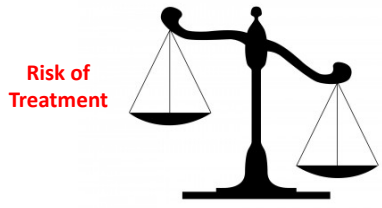
Malignancy Risk in Pediatric IBD

Standardized Incidence Ratios (SIR)

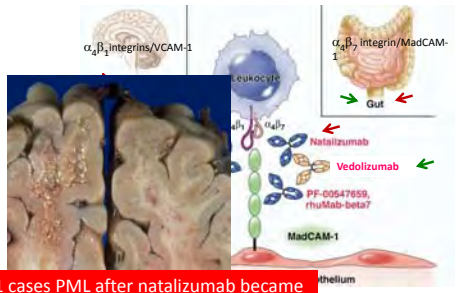


Hyams JS, et al. *Gastroenterology* 2017; 152: 1901-1914

Risk of Disease Often Greater than Risk of Treatment



Leukocyte Adhesion

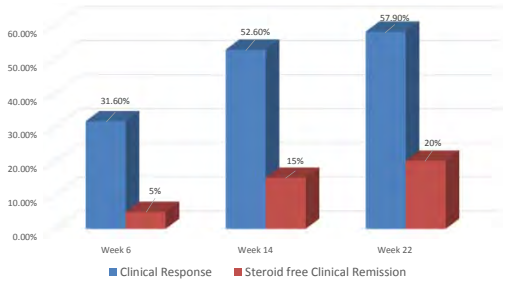


201 cases PML after natalizumab became available for prescription in July 2006

Adapted from Rutgeerts et al. Gastro 2009;136:1182

Vedolizumab (Entyvio) – CHOP Experience

Gut selective anti-integrin $\alpha_4\beta_7$ (approved 2014)



Conrad MA et al. *Inflamm Bowel Dis.* 2016; 22:2425-2431

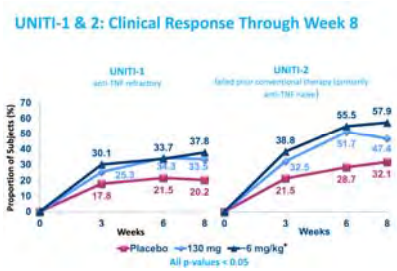
Ustekinumab (Stelara®) for Active Crohn Disease

Prevents binding of IL-12 and IL-23 to receptors

- Showed promise for adult CD patients with anti-TNF failure
- 09/2016: Approved for treatment of Crohn disease
- Side effect profile seems favorable
- **Induction:** Single IV weight-based dose
- **Maintenance**: 90 mg SQ q8 weeks

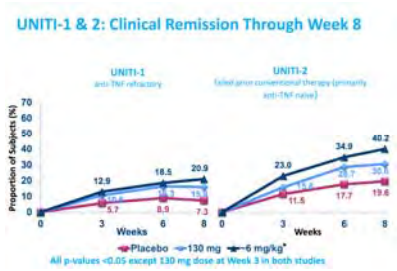
Sandborn WJ et al. *N Engl J Med* 2012; 367:1519-1528

Ustekinumab for Crohn's disease:
UNITI-1 and UNITI-2



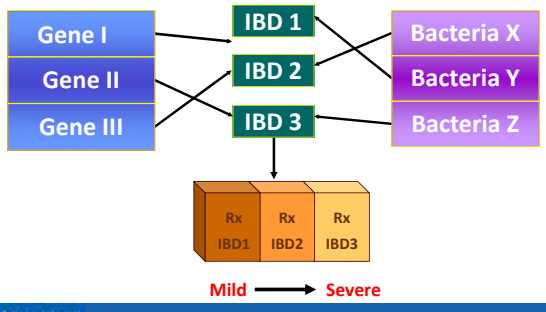
Sandborn WJ, et al. CCFA 2015

Ustekinumab for Crohn's disease:
UNITI-1 and UNITI-2



Sandborn WJ, et al. CCFA 2015

The Key to the Future: Targeting Therapy



"There is nothing permanent except change"
-Heraclitus, c. 500 BC

Psychosocial Health in Pediatric IBD: Opportunities for Multidisciplinary Care

Bonney Reed-Knight, PhD
Pediatric Psychologist

Learning Objectives

1. Describe psychosocial difficulties experienced by pediatric patients diagnosed with IBD
2. List evidence-based psychotherapies for pediatric anxiety, depression
3. Describe basic tenets of cognitive-behavioral therapy for anxiety and depression
4. Discuss treatment of anxiety and depression effectively with fellow providers and patients

Teen art

Disclosures

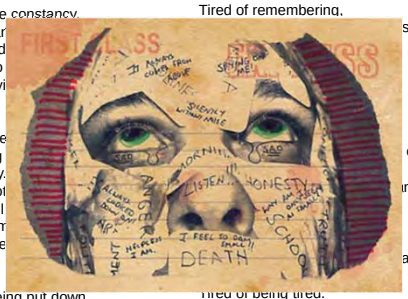
No conflicts of interest or disclosures

I'm Tired
By Kristen Ottesen

I'm tired.
Tired of the constancy,
the constar
Tired of hid
hiding who
Tired of tryi

I'm tired.
Tired of pre
pretending
to do is cry.
Tired of not
let go of all
consume m
Tired of fee

I'm tired.
Tired of being put down,
put down by the people I felt closest to.
Tired of dreaming,
dreaming of a life I will never have.
Tired of not being good enough.



I'm tired.
Tired of remembering.
so happy.

can hear.

nd alone.

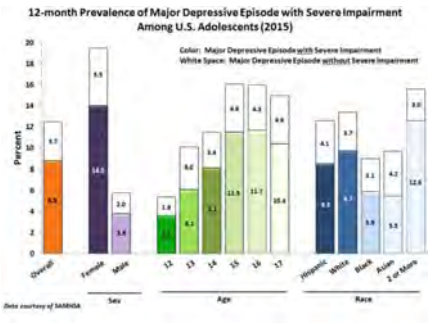
ant to do is

Tired of being tired.
Tired of being me.

Source:
http://www.familyfriendpoems.com/poem/im-tired-4

4

12-month Prevalence of Major Depressive Episode Among U.S. Adolescents (2015)



National Survey on Drug Use and Health

Single-Item Response: Felt So Sad or Helpless for ≥ 2 Weeks In Prior Year (2011)

- 29.9 % high school students
- 39.8% females
- 20.3% males
- 35.3% Hispanic
- 28.3 % white non-Hispanic
- 25.2% black non-Hispanic

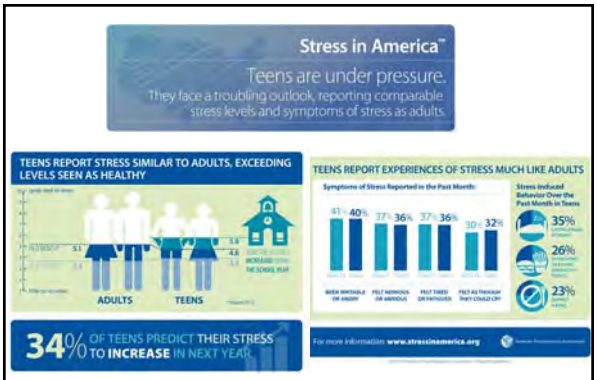
Youth Risk Behavior Survey (YRBS)

6

Sadness ≠ Depression

- Sadness is a normal response to difficult life events.
- Depression affects our emotions, thoughts, behaviors, and physiology in pervasive and chronic ways.
- The Loss of Sadness: How Psychiatry Transformed Normal Sorrow into Depressive Disorder
  - By Allan V. Horwitz, Jerome C. Wakefield

7



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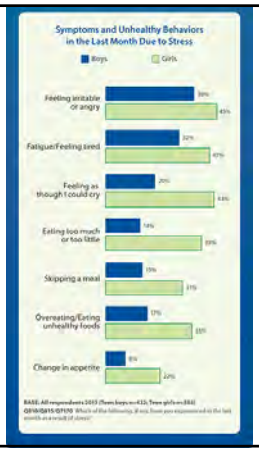


9

Inflammatory Bowel Disease

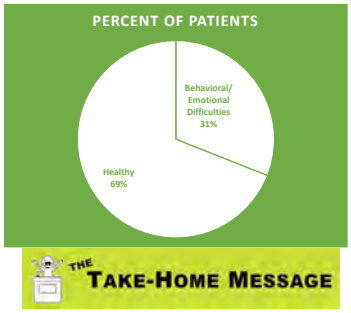
Inflammatory bowel disease

- Emotional functioning
  - Compared to healthy children:
    - More symptoms of anxiety/depression (internalizing symptoms)
      - Separately, symptom domains not higher
    - Higher risk for diagnosis of depression
      - Rates up to 25%
  - Adults
    - Higher risk for anxiety disorders (OR = 2.18)

Greenley et al. A meta-analytic review of the psychosocial adjustment of youth with IBD. *J Ped Psychol.* 2010;35:857-869.
Mackner et al. Psychosocial issues in pediatric IBD: Report of the North American Society for Pediatric Gastroenterology, Hepatology, and Nutrition. *J Ped Gastro Nutr.* 2013;56:449-458.
Fuller-Thompson, E., et al., Robust association between inflammatory bowel disease and generalized anxiety disorder: Findings from a nationally representative Canadian Study. *Inflamm Bowel Dis.* 2015:

Emotional Functioning

	Current	Lifetime
Depressive Symptoms	7-25%	
Depressive Disorder	10-20%	25%
Anxiety Symptoms	Up to 50%	
Anxiety Disorder	4-28%	11%
Depression and Anxiety Combined (Internalizing Symptoms)	13-31%	



Reed-Knight, Mackner, & Crandall. Psychological aspects of inflammatory bowel disease in children and adolescents. In Pediatric Inflammatory Bowel Disease, 3rd ed. Springer; 2017: 615.

Inflammatory bowel disease

- Psychosocial functioning and adherence
  - Symptoms of depression, anxiety, and behavioral/emotional problems associated with worse adherence
  - High depression/anxiety – barriers predict much worse adherence

LeLeiko et al. Rates and predictors of oral medication adherence in pediatric patients with IBD. *Inflamm Bowel Dis.* 2013;19:832-839.
Gray et al. Treatment adherence in adolescents with IBD: The collective impact of barriers to adherence and anxiety/depressive symptoms. *J Ped Psychol.* 2012;37:282-291.

Emotional Functioning

- Risk factors for depression
  - Stressful life events
  - Maternal depression
  - Family dysfunction
  - Parenting Stress
  - Steroid treatment
  - Ostomy
  - Disease Activity (mixed findings)

Classifying Depressive Episode

ESSENTIAL FEATURE(S)	OTHER SYMPTOMS
- Depressed mood OR irritability - Anhedonia - Low energy/fatigue	- Change in appetite - Hypersomnia or insomnia - Psychomotor agitation or retardation - Guilt/worthlessness - Difficulty concentrating - Suicidal ideation/thoughts of death

Mild: 2+ essential feature + 1-2 other symptoms

Moderate: 2+ essential feature + 2-3 symptoms

Severe: 3 essential features and >3 other symptoms with severe functional impairment

Assessment Logistics

Screen for depressive symptoms using validated questionnaire (e.g., PHQ-9)

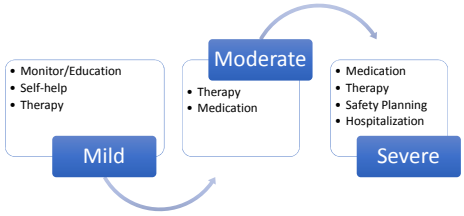
Score in clinic, additional assessment, and triage

Education, Safety Planning, Refer as needed

Document and Rescreen

Triage

- Use shared decision making to determine most desirable course of action



How can I make a difference with my IBD patients?

Symptom Presentation

- Younger children more likely to present with somatic symptoms (e.g., aches and pains); adolescents more likely to present with cognitive symptoms (e.g., sense of worthlessness, guilt, suicidal ideation)
- In adolescence, females more likely to present with symptoms than males
- Does my patient have risk factors for depression/anxiety in IBD?

Course of Depression

- 50-75% depressive episodes triggered by recent exacerbating event
- 50-80% remission in 12 months
- 30-70% relapse within 5 years

Effective treatment associated with quicker recovery and lower relapse rates

Assessment Logistics

- When possible, assess apart from caregiver
- Review limits of confidentiality
- Normalize
- Be direct & ask open-ended questions (e.g., "tell me the last time you had thoughts of killing yourself" vs. "have you ever…")

Post-Assessment Youth Talking Points

- ***Remove fault****: Depression isn't your fault.*
- ***Destigmatize****: Depression is often associated with an imbalance of neurotransmitters, or chemicals in the brain. It can also be associated with stress, traumatic life experiences, a family history of depression, IBD symptoms, etc. Depression can happen to anyone.*
- ***Support:*** *I will help you with this.*
- ***Empower:*** *There are things you can do to support yourself in getting better. This is not forever.*

Prophylactic/Tier 1 Advice for Teens

- Behavioral activation
- Get enough sleep
- Find an outlet to express your feelings
- Limit social media
- Be physically active
- Associate with friends who have positive goals
- Identify and target barriers to adherence for IBD

Caregiver Assessment

Assessment Logistics

- Concordance rate between parent and youth report of mental health functioning is fair at best.
- Parents have unique insights into youth functioning (may counteract impression management)
- Opportunity for clinicians to model healthy communication between teens and parents.

Caregiver Talking Points

- ***Educate:***
  - *Depression is the most common mental health disorder in the U.S. among teens and adults.*
  - *Patients with IBD are at higher risk for symptoms of anxiety and depression*
  - *Depression is associated with other at-risk behaviors.*
  - *Depression may re-occur.*
- ***Emphasize importance:*** *Treatment is successful in 80% of teens but only 1 in 3 teens gets help.*

Prophylactic/Tier 1 Advice for Caregivers

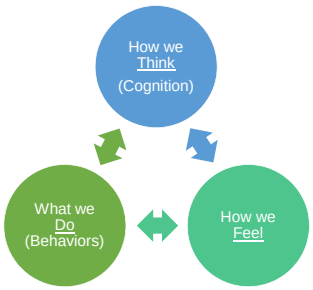
- Listen
- Don't minimize child's subjective experience
- Normalize distress within context of development and disease
- Allow child to make mistakes
- Keep the lines of communication open
- Elicit support from close friend or family member your child is close with
- Be firm in setting rules and calm in enforcing them
- Manage your own mental health issues as needed

Referring for treatment

Referring for Treatment

- Active support and monitoring
  - Mild depressive symptoms
- Evidence-based psychotherapies
  - Moderate/Severe depressive symptoms
- Antidepressant medications
  - Moderate/Severe depressive symptoms
    - American Academy of Pediatrics
      - Policy Statements on Guidelines for Adolescent Depression
        - https://www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/Mental-Health/Pages/AAP-Policy-Statements.aspx
      - Improve Care Now
        - Depression Screening Toolkit

Cognitive Behavioral Therapy



Treatment Efficacy: Anxiety and Depression

- Anxiety:
  - CBT > wait-list or active controls
  - CBT = Sertraline (but less side effects!)
  - CBT + Sertraline > single modality
- Depression:
  - CBT and IPT > supportive therapy
  - CBT = Fluoxetine by 18 weeks
  - CBT + Fluoxetine initially > single modality

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Summary

https://www.instagram.com/p/BDFjCXZLCSK/

Acknowledgments

- GI Teams at Children's Healthcare of Atlanta
- Society of Pediatric Psychology: GI Special Interest Group
- ImproveCareNow Psychosocial Professionals' Group

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Carolinas HealthCare System
Levine Children's Hospital

High Yield Bowel Evacuation: Cecostomy and Trans-anal Irrigation

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Overview

- Suppositories/Standard Enemas
- Cecostomy Overview
  - Post Op
  - Getting Started
  - Maintenance
  - Troubleshooting
- Trans-anal Irrigation (large volume enemas)
  - Cone Enema
  - Peristeen
- Q / A

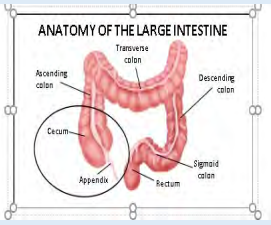
Basic Rectal Therapy -- Suppository

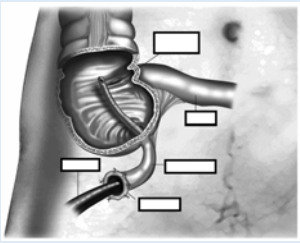
- Suppositories
  - Solid Glycerin Suppository
    - < 2 YO = ½ Pediatric Size Glycerin Supp
    - 2-5 YO = 1 Pediatric Size Glycerin Supp
    - 6 YO and up = 1 Adult Sized Glycerin Supp
  - Liquid bulb Glycerin Suppository
    - 2-5 YO = Pediatric Size Liquid Glycerin Supp
    - 6 YO and up = Adult Size Liquid Glycerin Supp
  - Bisacodyl Suppository
    - One Size only = 10 mg
      - If Glycerin Supp ineffective use ½ to 1 suppository

Basic Rectal Therapy -- Enemas

- Sodium Phosphate Enema
  - < 2 YO = not recommended
  - 2-5 YO = ½ of a Pediatric Enema (33 ml)
  - 6-11 YO = 1 Pediatric Enema (66 ml)
  - 12 YO and up = 1 Adult Enema = 133 ml
- Bisacodyl Enema
  - 10 mg/37 ml
  - No concrete dosing instructions
    - Roughly 0.2 mg/kg but in general can start with ½ bottle in younger patients < 5-6 YO and use whole bottle if older

What is a cecostomy



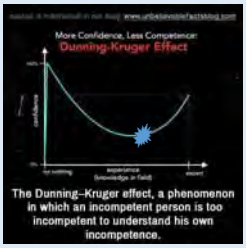


Who has a cecostomy

- Myelomeningocele
- Spinal Cord Injury
- Tethered Spinal Cord
- Anorectal Malformations / Imperforate Anus
- Hirschsprung's Disease
- Functional Constipation +/- Fecal Incontinence
- Nonretentive Fecal Incontinence

The Golden Hammer

What I feel like



Courtesy of RA Caicedo

Goals of Cecostomy Flushes

- Eliminate or Greatly Improve Fecal Incontinence
- Prevent Recurrent Hospitalizations / Manual Disimpaction
- Improve Quality of Life
- Prevent or delay more invasive surgeries such as ostomy or resections
- Minimun Age
  - Technically no minimum age or size, but relatively very rare less than 3 YO
- Relative Contraindications
  - Older / larger child unable to sit on toilet
    - May tolerate enemas better

Methods of Cecostomy Administration

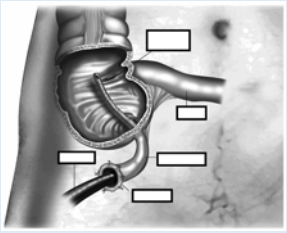
Placement

- Surgical
  - Approximate Cecum to Abdominal Wall and create a tunnel
  - Appendico-cecostomy
    - Most commonly known as MACE
      - Malone Antegrade Continent Enema
- Endoscopic
  - Percutaneous Endoscopic Cecostomy
  - Interventional Radiology Placement

Administration

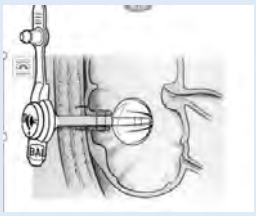
- Intermittent Catheterization
- Indwelling Gastrostomy button or Regular Button Gastrostomy
- Chait Cecostomy

In and Out Catheterization



- More common in Spina Bifida or patients with poor sensation
- Usually 8 to 10 French Catheter (can be smaller or larger)
- Must be able to tolerate
  - Anxiety
  - Visceral hypersensitivty

Indwelling Button



- Initial placement may be with a standard Gastrostomy balloon or with a Foley with a balloon
- Allows for eventually changing at home and low profile for improved aesthetics

Chait Trapdoor Cecostomy

- Some surgeons prefer
- Change once q 6 months
  - Some require anesthesia
  - Hard to replace at home if comes out
  - Tract is only 10 Fr so can close up easier if removed
  - Very low profile for aesthetics
  - Anecdotally less granulation tissue and leakage problems

Variation in Management

- --22% did not require minimum age. Range from any age , 1, 4, , or 7
- --only 26% required colonic manometry. Less than 60% require ARM or biopsy
- --variation in when to start flushes, whether to use additive, duration of infusion, time on toilet

Kuizenga Wessel et al. JPGN 62-1-2016

Pre-operative

- Educational material
- Consultation with surgeon
- Possible admission for cleanout prior to surgery

Post-operative

- Typicaly 1-2 day stay after surgery
- Will have either a long button gastrostomy, a low profile gastrostomy, a Chait Cecostomy, or rarely a foley catheter through the stoma
- Start 10 ml NS flush bid day after surgery x 2 weeks, then advance to larger volume flushes
- Continue PO meds until closer to goal volume
- Order Supplies

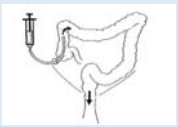
Necessary Supplies

- 60 ml syringes (2 per month)
- Extension set (2 per month)
- Gravity Bag with Roller Clamp (1 per day)
- Split Gauze
- Paper tape
- Replacement button (as soon as know button size)
- Tegaderm for swimming

Initial Followup

- Hands on Demonstration
- If long tube is in, patient will be sized by surgeon and appropriate button placed or ordered by surgeon
- If I/O catheterization, indewelling tube can be removed and I/O caths started
- Make plan to start and/or advance flushes
- Plan to wean off of PO meds

Antegrade Enema (Washout)



- Recommend after dinner
- Flush runs in over 5 to 15 minutes
- Total sitting time at least 30 mins, Avg 45 minutes

Flush Composition

- Base of the flush is warm water mixed with salt (1/2 to ¾ tsp per 500 ml)
- Start 300 to 500 ml depending on size
  - Good initial goal is 20 to 25 ml/kg
    - Advance to goal by 50 ml increase q 3 days
    - Usually Max 600-700 no matter size, but can go up to 1000 ml
- Avoid water alone as will have higher chance of being reabsorbed and ineffective
  - Rare cases can cause water intoxication
- Some advocate always starting with stimulant in flush
  - More necessary in pts with Idiopathic Constipation

Possible Additives

- Osmotic
  - PEG 3350
    - For little extra strength, short of using a stimulant
  - Substitute Golytely for Saline if fail Saline + additive flushes
- Stimulant
  - Bisacodyl
    - 5 mg tablet
    - Can crush and mix directly into the flush solution
    - Can mix 1 or 2 crushed tablets with 10 to 30 ml and flush directly before or after the main flush
    - Can use Liquid Enema 10 mg/37 ml
      - More inconvenient as usually need to order online and usually not covered
  - Glycerin
    - 5 to 30 ml

Initial Flush not working

- Rule out Fecal Impaction
- Rule out severe backup in 2 week post op before flushes begin
- May need manual disimpaction vs. inpatient cleanout
  - Depending on timing post op, might need a large volume cleanout per cecostomy

Complications

Early

- Seperation of cecum from abdominal wall
- Granulation Tissue
- Perforation or false tract with I/O cath
- Leakage while healing
- Infection / Abscess
- Retraction of tube into tract if too short

Later

- Granulation Tissue
- Leakage
- Inability to flush
- Stenosis of tract for I/O
- Perforation or false tract with I/O cath
- Retraction of tube into tract if too small
- Infections can be tricky to dx
- Pain with flush even though flush works
  - Hyoscyamine
  - Gabapentin

General Troubleshooting

Poor Output

- Increase Volume
- Add Stimulant before or after
- Flush bid (difficult logistically)
- Add PEG 3350 or Change to Golytely
- Empiric Cleanout
- Compliance
- Dysmotility preventing movement of flush through colon

Leakage

- Button tube or Chait Too long
- Tube too short
  - Fluid comes out in tract and moves retrograde through tract
- Granulation Tissue
- Poorly Healed tract
- Fecaloma in cecum
- Balloon underfilled

Flush not going in

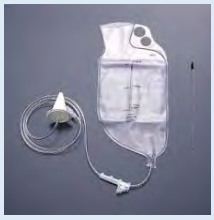
No Pain

- Tube clogged or blocked
  - Try to change tube
- IMHO
  - Being backed up should not cause the flush to not go in

Pain

- Tube pulled up into tract
  - Too Short
  - Balloon deflated and retracted
  - Similar concept to buried bumper of a PEG tube
  - Chait coils visible
  - False tract or perforation
  - Difficulty flushing with pain can be from cecal distension

Cone Enema



- Less Invasive option than Cecostomy
- Better for Spina Bifida / Tethered Cord due to poor sensation
- Hard for highly anxious kids
- Not palatable long term solution for many
- Failure does not preclude a cecostomy

Peristeen ®

Team

- Gastroenterologist
- Invested and Interested Surgeon
- Radiology for Chait Changes
- GI RN
- Home Health Nursing / Discharge Planners
- Motility Nurse
- Social Worker for 504 plan
- RD on occasion
- Need to educate colleagues who will cover patients on call

Esophageal manometry

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OBJECTIVES

- Discuss when esophageal manometry should be used in the clinical setting
- Advances in the performance of esophageal manometry (HRM)
- Discuss the relevance of combining impedance testing and high-resolution manometry.

DYSPHAGIA

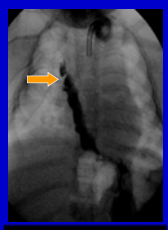
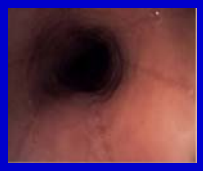
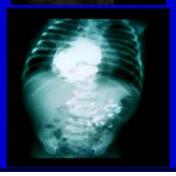
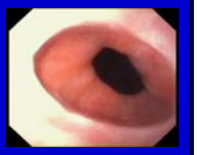
- Difficulty swallowing is very common
- It may be related to anatomic/mechanical or functional problems
- History is an important part of clinical assessment, but bedside assessment alone is often inadequate in achieving a diagnosis

IS THERE A MOTILITY DISORDER?

- Exclude anatomic obstruction
- Evaluate transit
- Look for an etiology
- Motility testing

EVALUATION

- X-ray studies
  - Anatomy
- Endoscopy
  - Anatomy and mucosal disease
- Scintigraphy
  - Transit
- Motility testing
  - Esophageal function
  - Transit

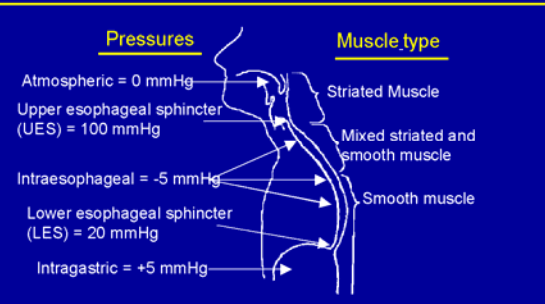
DYSPHAGIA

- These symptoms may be indicative of an underlying esophageal motility disorder potentially caused by impaired esophageal propulsion or
- Increased resistance to bolus flow at the esophago-gastric junction (EGJ).

ESOPHAGEAL MANOMETRY

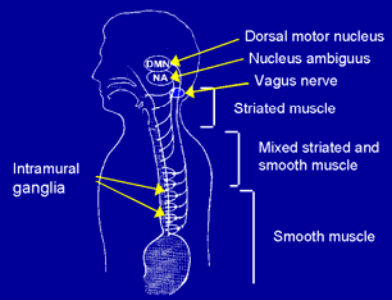
- **Manometry is the most sensitive and accurate technique to diagnose esophageal motility disorders**
- **Three functional regions of interest:**
  - **Upper esophageal sphincter (UES)**
  - **Esophageal body**
  - **Lower esophageal sphincter (LES) & Gastro-esophageal junction (GEJ)**

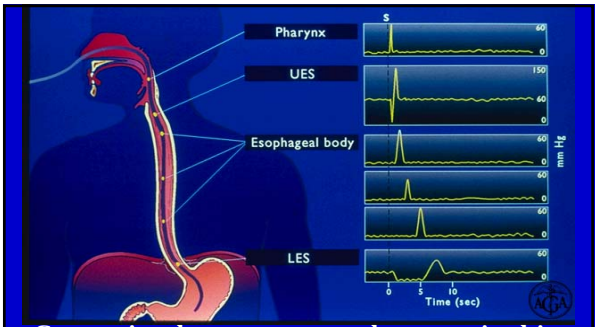
THE BOUNDARIES OF THE ESOPHAGUS ARE DEFINED BY SPHINCTERS



•Sphincters prevent influx of air and reflux of gastric contents into the esophagus

EFFERENT NEURAL PATHWAYS DIFFER IN STRIATED AND SMOOTH MUSCLE REGIONS OF THE ESOPHAGUS

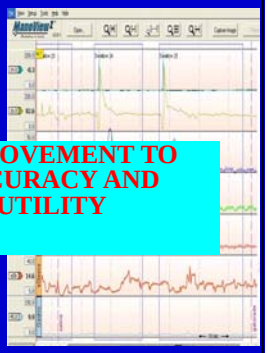




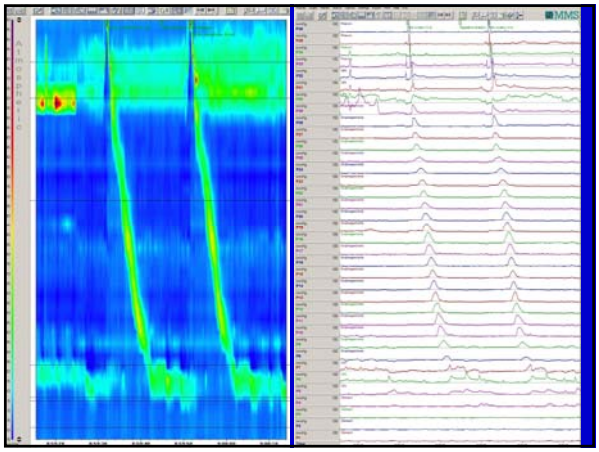
Conventional manometry evaluates peristaltic function in the esophagus over a series of pressure transducers spaced at defined intervals (2-5 cm depending on the size of the patient)

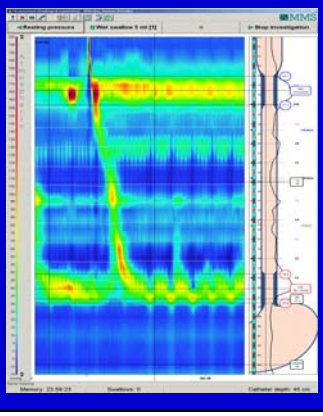
Standard esophageal manometry

- Lack of standarization and lack of consensus regarding the optimal spacing
- Problems with inter-observer variability
- Achieving consensus on what is no… time…
- Very… defi… with…
- Diffi… esophageal motor patterns and symptoms
  - Inability to assess esophageal transit



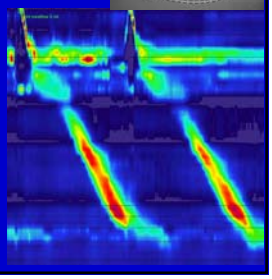
NEED FOR IMPROVEMENT TO INCREASE ACCURACY AND CLINICAL UTILITY





HIGH RESOLUTION MANOMETRY

The basic concept being that by vastly increasing the number of recording sites and decreasing the spacing between them, one can completely define the intraluminal pressure environment without spatial gaps between recording sites and, consequently, with minimal movement-related artifacts.

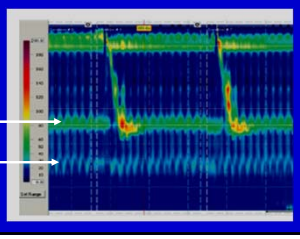


HRM

- HRM recordings with esophageal pressure topography (EPT) enable features of peristalsis, such as the pattern and integrity of the contraction, as well as the extent of EGJ relaxation to be more easily determined via objective metrics

Proposed Advantages of HRM

- Simultaneous assessment of sphincters and esophageal body
  - Separation of LES, crural diaphragm



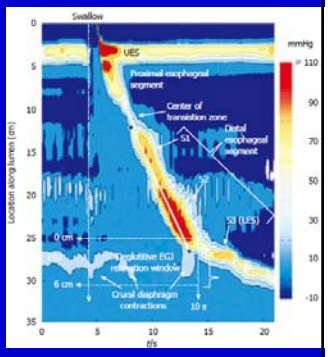
Hiatal hernia

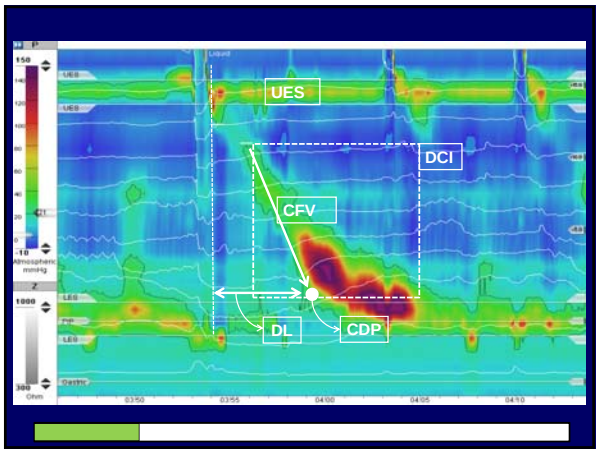
Proposed Advantages of HRM

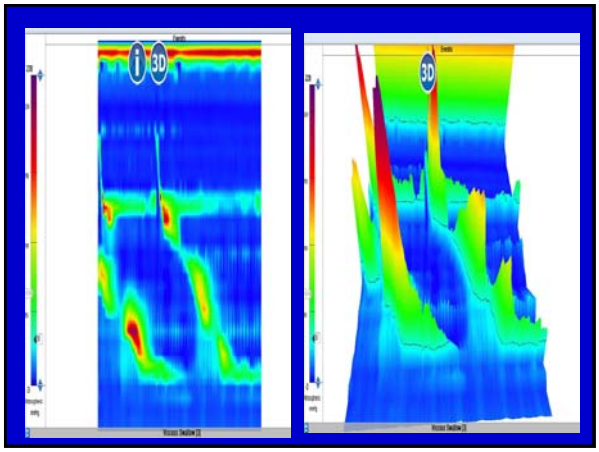
- Simultaneous assessment of sphincters and esophageal body
  - Separation of LES, crural diaphragm
  - New parameters
- More standardized measures of peristalsis and sphincter function

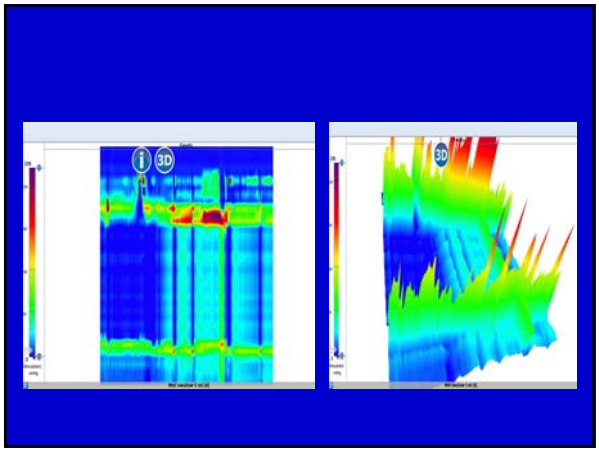
HRM

- Easier to perform
- Eliminates movement artifact
- Provides functional anatomy
- Improve measurement of GEJ junction
  - Separation of LES, crural diaphragm
- New parameters that were not previously apparent
  - Transition zone
  - Different segments
  - New variables
    - IRP (integrated relaxation pressure)
    - CVF (contractile front velocity)
    - DCI (Distal contractile integral)
    - Others




UES
DCI
CFV
DL
CDP





Proposed Advantages of HRM

- Simultaneous assessment of sphincters and
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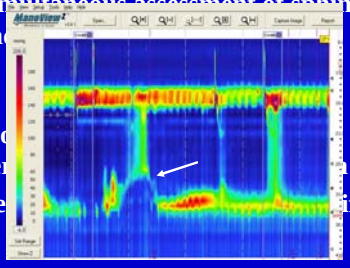


CHICAGO CLASSIFICATION v3.0

- Hierarchical approach, sequentially prioritizing:
- (i) disorders of esophagogastric junction (EGJ) outflow,
- (ii) other major disorders of peristalsis, and
- (iii) minor disorders of peristalsis.

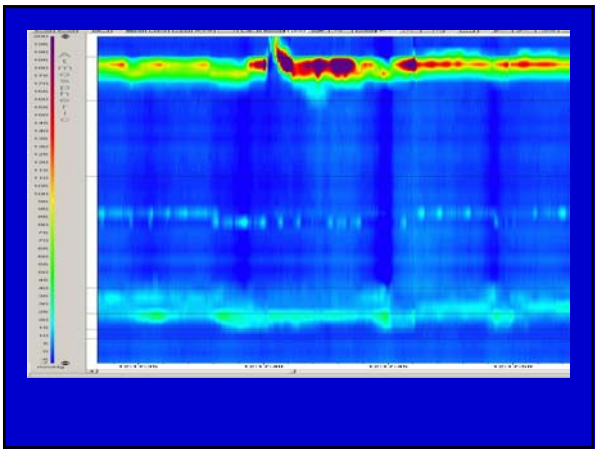
NGM (2015) 27, 160–174

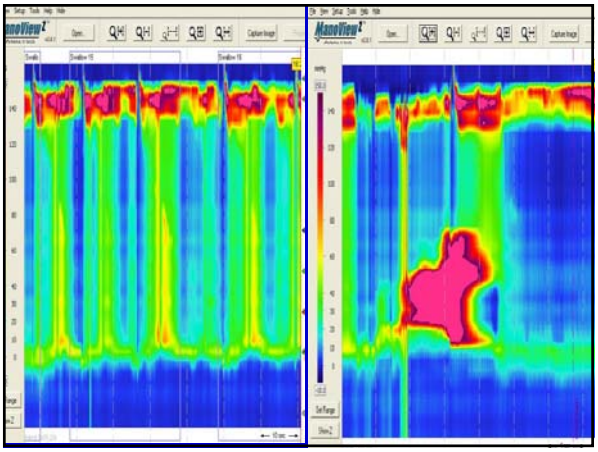
CHICAGO CLASSIFICATION v3.0

Table 4 The Chicago Classification of esophageal motility v3.0

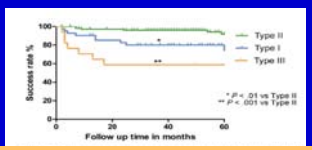
Achalasia and EGJ outflow obstruction	Criteria
Type I achalasia (classic achalasia)	Elevated median IRP (>15 mmHg*), 100% failed peristalsis (DCI <100 mmHg·s·cm) *Premature contractions with DCI values less than 450 mmHg·s·cm satisfy criteria for failed peristalsis*
Type II achalasia (with esophageal compression)	Elevated median IRP (>15 mmHg*), 100% failed peristalsis, panesophageal pressurization with ≥20% of swallows *Contractions may be masked by esophageal pressurization and DCI should not be calculated*
Type III achalasia (spastic achalasia)	Elevated median IRP (>15 mmHg*), no normal peristalsis, premature (spastic) contractions with DCI >450 mmHg·s·cm with ≥20% of swallows *May be mixed with panesophageal pressurization*
EGJ outflow obstruction	Elevated median IRP (>15 mmHg*), sufficient evidence of peristalsis such that criteria for types I-III achalasia are not met[†]
Major disorders of peristalsis	(Not encountered in normal subjects)
Absent contractility	Normal median IRP, 100% failed peristalsis *Achalasia should be considered when IRP values are borderline and when there is evidence of esophageal pressurization* *Premature contractions with DCI values less than 450 mmHg·s·cm meet criteria for failed peristalsis*
Distal esophageal spasm	Normal median IRP, ≥20% premature contractions with DCI >450 mmHg·s·cm*. Some normal peristalsis may be present.
Hypercontractile esophagus (jackhammer)	At least two swallows with DCI >8000 mmHg·s·cm*,[‡] *Hypercontractility may involve, or even be localized to, the LES*
Minor disorders of peristalsis	(Characterized by contractile vigor and contraction pattern)
Ineffective esophageal motility (IEM)	≥50% ineffective swallows *Ineffective swallows can be failed or weak (DCI<450 mmHg·s·cm)* *Multiple repetitive swallow assessment may be helpful in determining peristaltic reserve*
Fragmented peristalsis	≥50% fragmented contractions with DCI > 450 mmHg·s·cm
Normal esophageal motility	Not fulfilling any of the above classifications

NGM (2015) 27, 160–174





OUTCOME AND TYPE OF ACHALASIA



A higher percentage of patients with type II achalasia are treated successfully with PD or LHM than patients with types I and III achalasia.
Success rates in type II are high for both treatment groups but significantly higher in the PD group.
Patients with type III can probably best be treated by LHM.

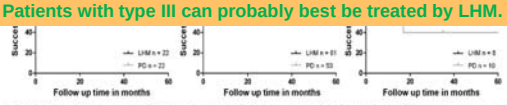


Figure 4. Kaplan–Meier curves comparing PD and LHM are shown for the 3 subtypes for up to 60 months after treatment. Success rates are comparable in type I achalasia ($P = .84$). Pneumodilation has a significantly higher success rate in type II achalasia ($P = .03$). Success rates, however, are high for both treatments. In type III patients the largest difference is observed, which, however, is not statistically significant ($P = .12$).

Proposed Advantages of HRM

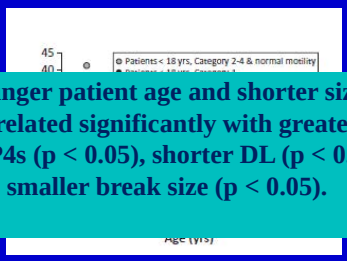
- Simultaneous assessment of sphincters and esophageal body
  - Separation of LES, crural diaphragm
  - New parameters
- More standardized measures of peristalsis and sphincter function
- Decreased movement-related artifact
- ***Easier to perform and shorter study duration***

HRM in children

- **Easy to perform**
- **Advances:**
  - **Microperfused catheters**
  - **Solid state catheters**
- **Limited information in pediatrics**
  - **Do we need to use the adult measurements?**

Is the Chicago Classification applicable to children?

IRP AND AGE



Younger patient age and shorter size correlated significantly with greater IRP4s ($p < 0.05$), shorter DL ($p < 0.001$) and smaller break size ($p < 0.05$).

NGM 2014; 26:1333

Chicago Classification	Original criteria (*n* studies, %)	Revised criteria – based on age (*n* studies, %)	Revised criteria – based on length (*n* studies, %)
Category 1 - Achalasia	2 (2.6)	2 (2.6)	2 (2.6)
Achalasia type I	0 (0)	0 (0)	0 (0)
Achalasia type II	2 (2.6)	2 (2.6)	2 (2.6)
Achalasia type III	0 (0)	0 (0)	0 (0)
Category 2			
EGJ outflow obstruction	13 (17.1)	5 (6.6)	4 (5.3)
Category 3	13 (17.1)	3 (3.9)	6 (7.9)
Distal esophageal spasm	11 (14.5)	1 (1.3)	4 (5.3)
Absent peristalsis	2 (2.6)	2 (2.6)	2 (2.6)
Hypercontractile esophagus	0 (0)	0 (0)	0 (0)
Category 4	22 (28.9)	28 (31.5)	28 (31.5)
Weak peristalsis with large breaks	11 (14.5)	12 (15.8)	12 (15.8)
Weak peristalsis with small breaks	8 (10.5)	12 (15.8)	12 (15.8)
Frequent failed peristalsis	2 (2.6)	2 (2.6)	2 (2.6)
Rapid contractions with normal latency	2 (2.6)	2 (2.6)	2 (2.6)
Hypertensive peristalsis	0 (0)	0 (0)	0 (0)
Normal	26 (34.2)	38 (50.0)	36 (47.4)

Chicago classification Adjusted criteria

NGM 2014; 26:1333

CC IN CHILDREN

- **66% of pediatric cohort showed abnormal motility when applying standard CC criteria.**
- **Adjustment for age and size reduced this to 50% and 53% respectively, with the largest reduction being in the IRP4s- and DL dependent disorders EGJ outflow obstruction and diffuse esophageal spasm (13% to 7% and 5% and 14% to 1 and 5%, respectively).**

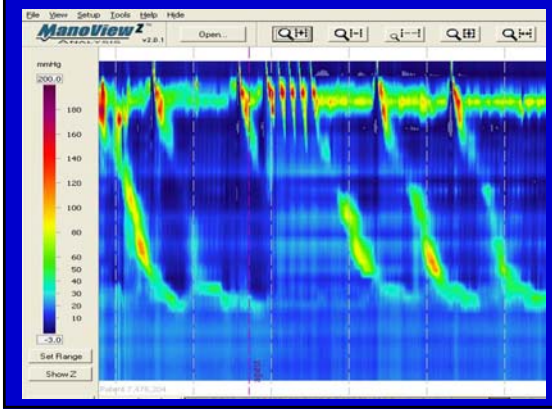
Chicago classification

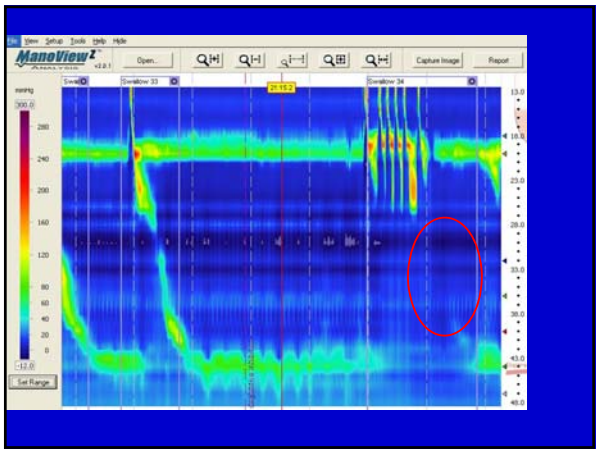
- Applying the 2012 Chicago Classification (CC) of esophageal motility disorders to pediatric patients may be problematic as it relies upon adult-derived criteria

IS IT REPRODUCIBLE?

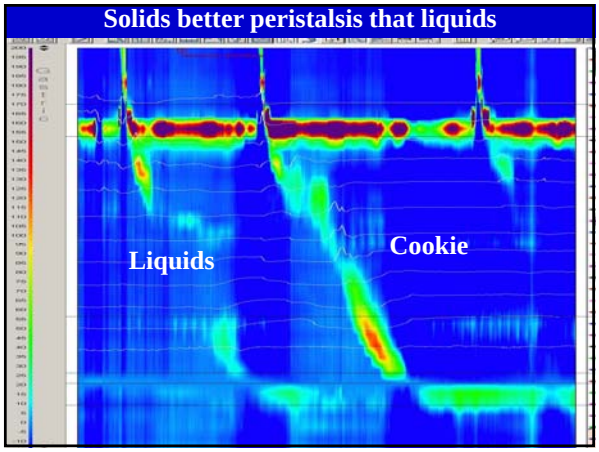
- **Intra- and inter-rater reliability of software generated CC diagnosis was *substantial* (mean κ=0.69 and 0.77 respectively) and *moderate-substantial* for subjective CC diagnosis (mean κ=0.70 and 0.58 respectively).**
- **Agreement on software-generated and subjective diagnosis of Normal motility was high (k=0.81 and k=0.79). Intra- and inter-rater agreement was *excellent* for IRP4s, DCI and BS.**
- **Amongst experts the agreement for the subjective diagnosis of achalasia and EGJ outflow obstruction was *moderate-substantial* (κ=0.45 - 0.82).**

DEGLUTITIVE INHIBITION





Solids better peristalsis that liquids



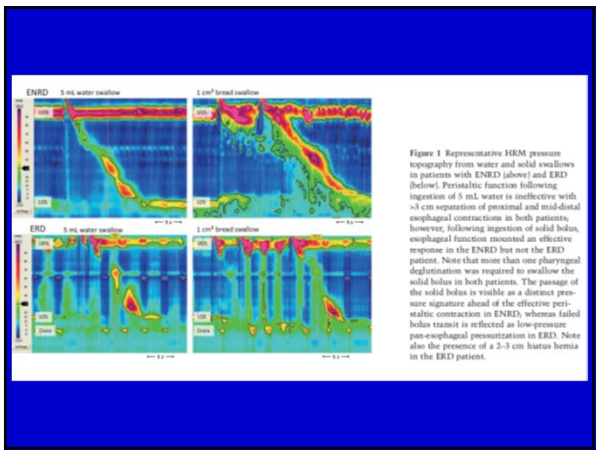


Figure 1 Representative HRM pressure topography from water and solid swallows in patients with ENRD (above) and ERD (below). Peristaltic function following ingestion of 5 mL water is ineffective with >3 cm separation of proximal and mid-distal esophageal contractions in both patients; however, following ingestion of solid bolus, esophageal function mounted an effective response in the ENRD but not the ERD patient. Note that more than one pharyngeal deglutination was required to swallow the solid bolus in both patients. The passage of the solid bolus is visible as a distinct pressure signature ahead of the effective peristaltic contraction in ENRD, whereas failed bolus transit is reflected as low-pressure pan-esophageal pressurization in ERD. Note also the presence of a 2–3 cm hiatus hernia in the ERD patient.

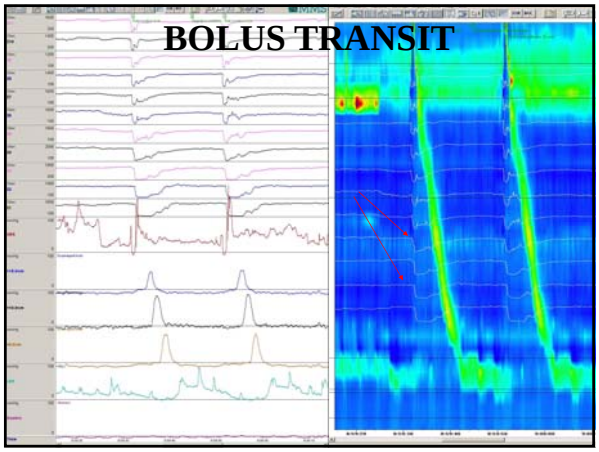
Esophageal Transit PRESSURE / FLOW

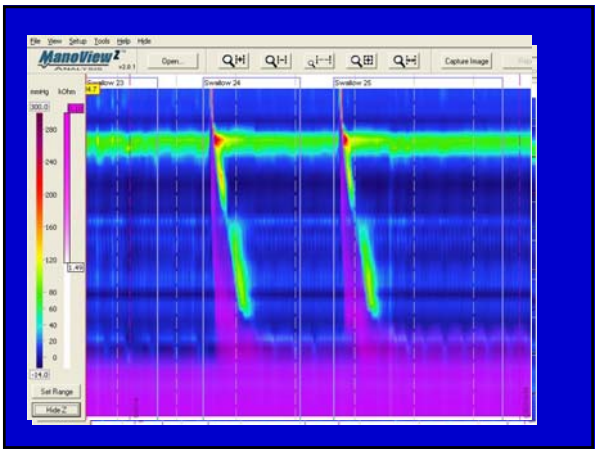
- The relationship between esophageal contractile patterns and bolus transport disruption, leading to bolus hold up perception and symptoms, is far from clear, even in adults.
- Symptoms of dysphagia correlate poorly with conventional manometric findings , and the underlying cause of these symptoms still remains unclear in a large proportion of dysphagia patients .

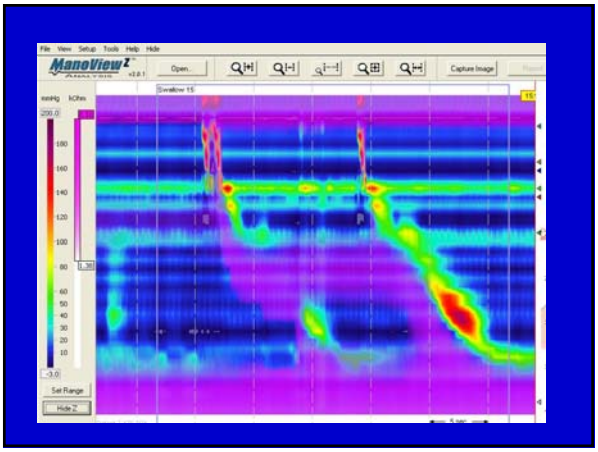
Eur J Peds 2015

- Manometry as a standalone technique may not be sensitive enough to elucidate esophageal motility events underlying ineffective esophageal bolus clearance and/or dysphagia
- Combining esophageal pressure patterns with bolus flow measured by intraluminal impedance was proposed to assess bolus transport throughout the esophageal lumen and across the EGJ

BOLUS TRANSIT







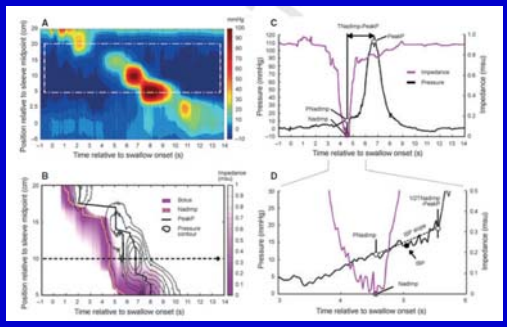
HRM AND IMPEDANCE

- **May allow the classification of motility abnormalities and their impact on bolus transit**
- **May allow the understanding of the pahtophysiology of esophageal motor abnormalities, and may provide better treatments**

AIM

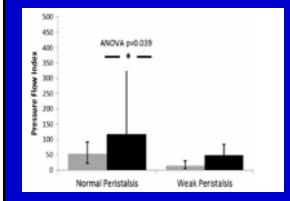
- Bolus flow characteristics as measured by impedance are combined with esophageal contractile characteristics
- Different measures are extracted, such as the intrabolus pressure (IBP), the slope of the IBP over time, and time from nadir impedance to peak contraction.
- From these, the dysphagia risk index is derived

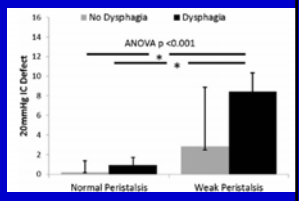
Automated Impedance Manometry analysis (AIM)



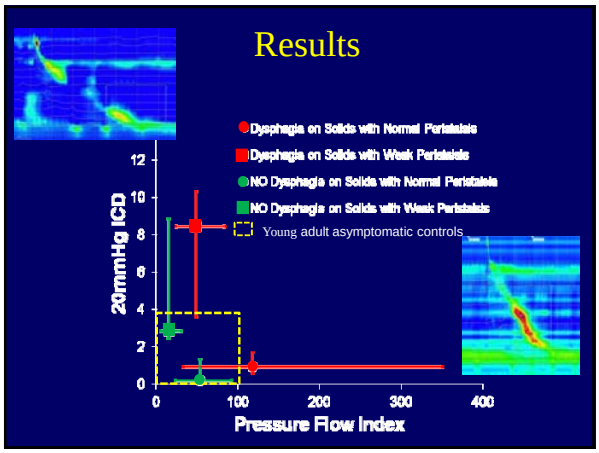
NGM 2012

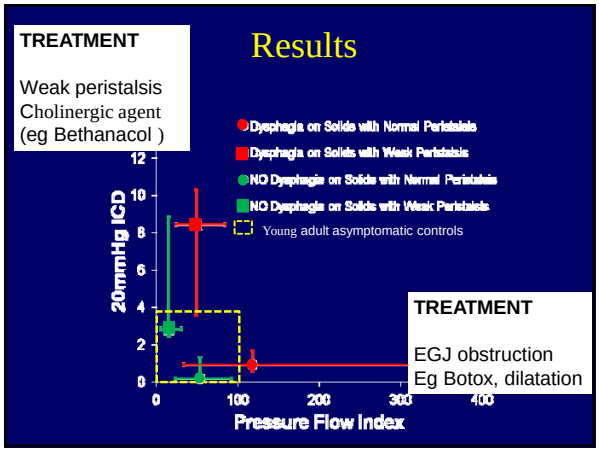
DYSPHAGIA
Pf index and weak peristalsis

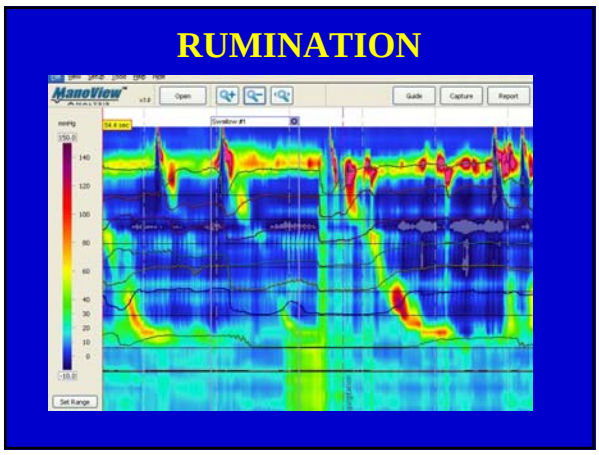


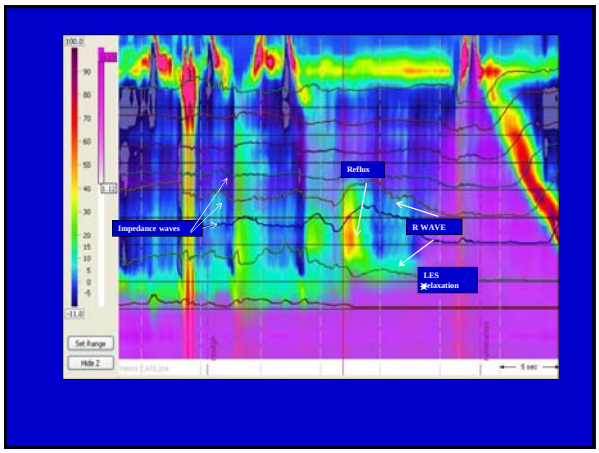


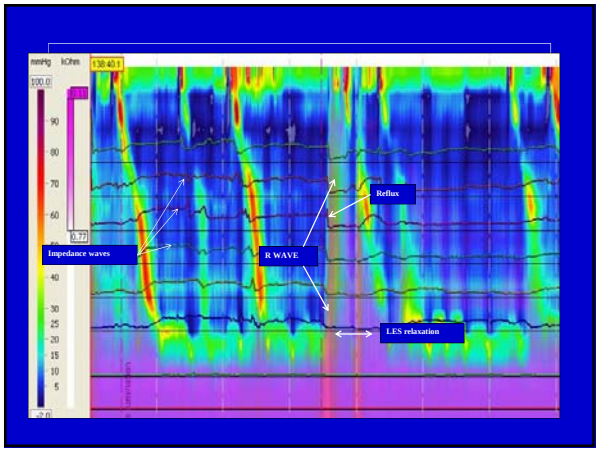
Eur J Peds 2015

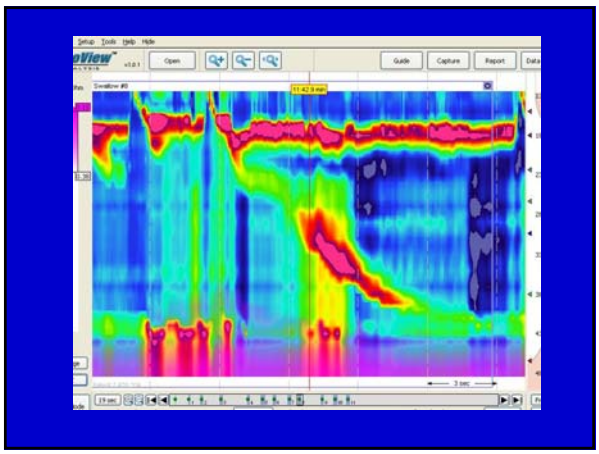

Results
Dysphagia on Solids with Normal Peristalsis
Dysphagia on Solids with Weak Peristalsis
NO Dysphagia on Solids with Normal Peristalsis
NO Dysphagia on Solids with Weak Peristalsis
Young adult asymptomatic controls
20mmHg ICD
Pressure Flow Index


TREATMENT
Weak peristalsis
Cholinergic agent
(eg Bethanacol)
Results
Dysphagia on Solids with Normal Peristalsis
Dysphagia on Solids with Weak Peristalsis
NO Dysphagia on Solids with Normal Peristalsis
NO Dysphagia on Solids with Weak Peristalsis
Young adult asymptomatic controls
20mmHg ICD
Pressure Flow Index
TREATMENT
EGJ obstruction
Eg Botox, dilatation


RUMINATION
ManoView


Reflux
Impedance waves
R WAVE
LES
relaxation


Reflux
Impedance waves
R WAVE
LES relaxation



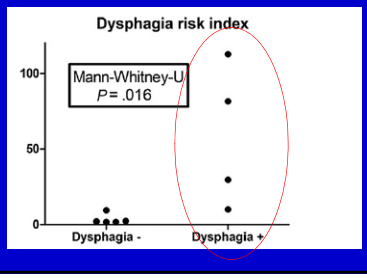
SPECIAL POPULATIONS

- Preop
- TEF
- Rumiantion

CAN BASELINE HRM PREDICT OUTCOME AFTER SURGERY?

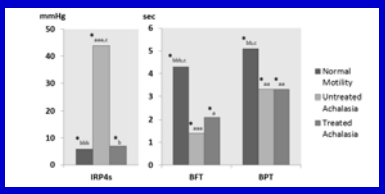
FUNDOPLICATION

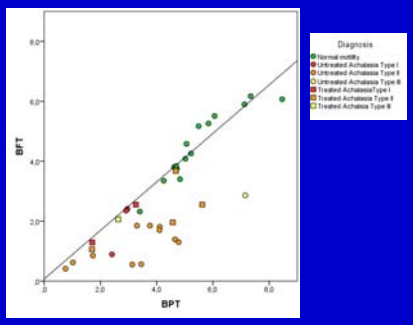
- 10 children ; 4 developed dysphagia



J Peds 2013

Impedance achalasia





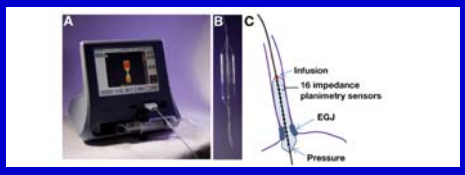
- **Calculation of BPT and BFT may help to determine whether esophageal bolus transport to the EGJ and/or esophageal emptying through the EGJ are aberrant. For achalasia this may detect flow resistance at the EGJ, potentially improving both diagnosis and objective assessment of therapeutic effects.**

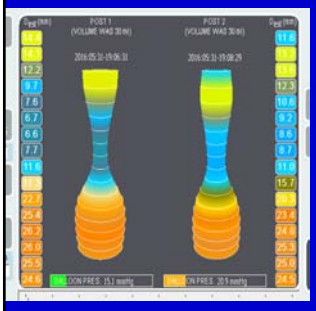
ESOPHAGEAL MOTILITY

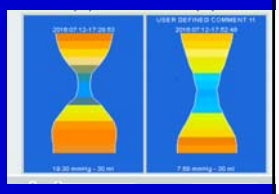
- Diagnosis of achalasia and other primary esophageal motor disorders
- Assess esophageal motor function in patients dysphagia, odynophagia or non-cardiac chest pain
- To support the diagnosis of connective tissue diseases, or other systemic illness
- To localize LES before ph probe placement in patients with abnormal anatomy (like hiatal hernia, etc)
- To evaluate effect of pharmacologic or surgical therapy
- To diagnose rumination

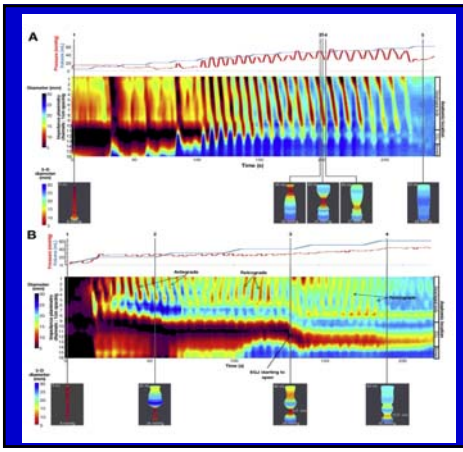
Neurogastroenterol Mot 2002; 14:411-420

FLIP









CGH 2017

HRM

- HRM simplifies the performance of esophageal motility in children
- Impedance measurement is a must
  - New analysis
- Will it change the diagnosis? Will it provide useful information?

Psychological Treatment of Rumination Syndrome

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Pediatric Psychologist
Department of Gastroenterology
Boston Children's Hospital

Disclosures

* I have nothing to disclose!

Rumination Defined

* Repetitive regurgitation of small amounts of food from the stomach that is then re-chewed and re-swallowed or expelled (Dalton & Czyzewski, 2009)

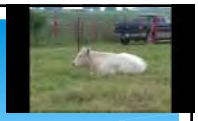
Presentation Objectives

- Describe the rationale behind incorporating psychological/behavioral interventions into the treatment plan for a diagnosis of rumination
- Identify specific psychological strategies that can be taught and utilized for the management of rumination syndrome

Outline of Presentation

- Brief History
- Diagnostic Criteria
- Prevalence Rates
- Pathophysiology
- Making the Diagnosis/Clinical Features
- Treatment

History of Rumination



- Well known to occur in animals with compartmentalized stomachs (e.g. sheep, cattle, goats)
- First case reports of this disorder in humans dates back to the 17th century
  - Physician in the 19th century, Edouard Brown-Sequard, documented that he experienced rumination as a result of "experimenting" on himself

(Malcolm, et al. 1997)

Rome IV Criteria for Rumination Syndrome in Children/Adolescents

- Must include all of the following:
  1. Repeated regurgitation and re-chewing or expulsion of food that:
     - a. Begins soon after ingestion of a meal
     - b. Does not occur during sleep
  2. Not preceded by retching
  3. After appropriate evaluation, the symptoms cannot be fully explained by another medical condition. An eating disorder must be ruled out

  Criteria fulfilled for at least 2 months before diagnosis

Prevalence Rates

- Estimated to occur in about 6-10% of patients diagnosed with developmental delays (Singh, 1981; Winton & Singh, 1983)
- Prevalence rates of 17-20% in patients previously diagnosed with bulimia (Fairburn & Cooper, 1984)

Prevalence

- Almost no studies assessing prevalence rates of rumination in typically developing children and adolescents
  - Continued difficulties with recognizing/making a diagnosis of rumination makes it harder to understand the prevalence of this disorder
  - Symptoms overlap with the symptoms of more recognizable conditions

Rajindrajith, et al. (2012)

- Prevalence of rumination in cohort of Sri Lankan children
- N=2163
  - 55% of sample were males
  - Children ages 10-16 (mean age: 13.4)
  - Excluded children with neurological problems, developmental delays/autism, and other chronic diseases

- 110 (5.1%) children fulfilled diagnostic criteria for rumination
  - 5.1% male; 5.0% female
  - 11.8% missed school because of rumination
- 74% said they re-swallowed regurgitation; 26% said they spit it out
- 95% reported rumination occurred within first hour after meal
- Frequency of symptoms:
  - 63% at least once/week
  - 29% several times per week
  - 8% daily symptoms

Pathophysiology

- "Trigger" may be present right before the onset of rumination
  - Illness or emotional stressor
    - Stressor resolves, but behavior persists
    - Resembles a"tic"
- Gastric motor/sensory abnormalities
  - Increased intragastric pressure that results from contracting of abdominal muscles and is associated with lower esophageal sphincter (LES) relaxation
    - When LES relaxes the regurgitation occurs
    - On high resolution manometry "r" waves are representative of increase in intra-abdominal pressure
  - Regurgitation occurs due to an increase in abdominal pressures that results in displacement of gastroesophageal junction (GEJ) into the thorax

- Regurgitation serves the purpose of relieving epigastric discomfort/dyspeptic symptoms (nausea, bloating, feeling of fullness, pressure) given hypersensitivity to LES relaxation
  - Rosen, Rodriguez & Nurko, 2016: 40% of patients reported sensation right before R wave
    - Over time, regurgitation becomes a learned response to food/liquid ingestion
      - "learned anticipation or possibly hypersensitivity to the sensations associated with food in the stomach causes the individual with rumination syndrome to contract the abdominal wall, opening the lower esophageal sphincter and upper esophageal sphincter with cessation of esophageal body peristalsis, prior to a regurgitation event" (Chitkara et al., 2006)

Making the Diagnosis

- Rumination may be confused with other diagnoses
- When differentiating rumination from another GI disorder, consider the following:
  - You can diagnose rumination by history alone
  - It typically starts during or immediately after a meal
  - Reports are that regurgitated food looks undigested and still "tastes good"
  - Volume of what is regurgitated is small (in comparison to vomiting)
  - Retching before regurgitation is not reported
  - Nausea also not reported (prodromal, vasomotor symptoms also not reported such as heart palpitations, sweating, light-headedness)
  - Patients will report that the regurgitation persists after eating, sometimes up to 1-2 hours
  - Rumination happens with most meals, regardless of what is eaten
  - Liquids also result in rumination

(Tack et al., 2011)

Table 38.1 Differential diagnosis of rumination syndrome from other conditions presenting with emesis in adolescents

	Vomiting	Esophagitis	Prokinetics	Fundoplication
Rumination	During or minutes after meal	No	Not helpful	Not helpful
Achalasia	Hours after meal	Often (from stasis)	Not helpful	Contraindicated
GERD	After large meals or when lying down	Often	Helpful	Helpful
Gastroparesis	Hours after meal	No	Helpful	Not helpful
Cyclic vomiting	Intermittent, unrelated to meal	During episodes	Not helpful	Not helpful

Alioto & DiLorenzo (2013)

Potential Consequences of Rumination

- Weight loss
- Malnutrition
- Dental erosions
- Halitosis
- Electrolyte abnormalities
- Functional Disability
- Embarrassment/Anxiety
- Parental Annoyance

Treating Typically Developing Patients

- Keep in mind that you are treating a functional GI disorder
  - Provide reassurance
  - Take the time to describe that the diagnosis is made based on signs and symptoms
  - Explain, in developmentally appropriate terms, what is happening in rumination
  - Explain a biopsychosocial treatment approach

- Ways to explain rumination:
  - A learned "habit"
    - Patients may experience an "urge" in response to what the stomach begins to do after eating, which results in certain parts of the digestive system contracting (stomach) and relaxing (LES)- the end result is regurgitation
    - Operant conditioning-regurgitation diminishes the urge in the moment, but the positive experience of getting rid of the urge with regurgitation increases the likelihood that the person will repeat the behavior in the future

* A "tic"
  * Tends to make the most sense when a trigger event has been identified
  * Even though the trigger has been removed, the vomiting/regurgitation behavior persists
  * As a consequence, when food/liquid enters stomach, body has learned to contract abdominal muscles, which pushes food back up

Treatment of Rumination

* Medication
* Diaphragmatic Breathing
  * Reduces intragastric pressure/increases EGJ pressure
    * Changes seen during esophageal manometry studies in adults (Halland, Parthasarathy, Bharucha, & Katzka, 2016)
* 3 non-randomized, retrospective studies in children and adolescents:
  * Chial et al., 2003: 54 patients treated for average of 3 sessions; resolution of symptoms in 30%, improvement in 55%, no change in 15% at 10 months

* Khan, Hyman, Cocjin, & DiLorenzo, 2000: 12 patients, 7 of who were treated with breathing/biofeedback (other 5 treated with pain management interventions and psychopharmacological treatment)
  * 10 children noted to "improve" but separate results not reported for breathing/biofeedback group

* Green, Alioto, Mousa, & Di Lorenzo, 2011: 5 patients (4 female)
  * Sx occurred anywhere between 5 months and 4 years before diagnosis was made
  * Feeding sources: TPN, NJ, NG, GJ, and PO
  * All had gastroduodenal manometry prior to admission (showing the characteristic R waves)

TABLE 2. Inpatient management.

Patient	Distraction techniques used	Medications used	Days until off supplemental nutrition	Nutritional source at discharge	Additional complications	Days admitted
1	DB	Ond, cyclog TPN	10	PO		11
2	DB, BF, VG	Ond, cyproh	7	PO		9
3	DB	Ond	7	PO		11
4	DB, R, M	Prmet	10	PO		13
5	DB, R, W	Ond, cyproh	27	PO	Supraganic belching, headaches, conversion disorder	31

BF = biofeedback; Cyproh = cyproheptadine; DB = diaphragmatic breathing; M = music; Ond = ondansetron; PO = oral; Prmet = promethazine; R = reading aloud; TPN = total parenteral nutrition; VG = video game; W = walking.

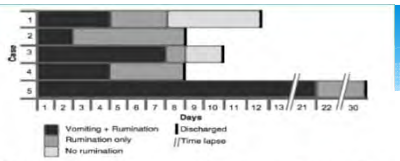


FIGURE 2. Duration of rumination symptoms during the hospitalization in the patients we report. The patients were typically off supplemental nutrition 3 to 4 days before discharge.

* Some patients discharged with continued rumination, yet able to maintain weight
* Periods of stress resulted in occasional return of symptoms
* At one year follow-up, 0 patients needed to return to supplemental nutrition

Teaching Diaphragmatic Breathing

* Learn technique in sitting or supine position
* One hand on chest; other hand on stomach
  * Asked to take a deep breath in (with most patients able to notice that they tend to breath with their chest)
  * Asked to "switch" their breathing
    * Slowly breathe in through the nose, thinking about filling belly up with air (like blowing up a balloon)
    * Slowly breathe out through pursed lips, thinking about deflating the balloon
    * Place object on stomach to make sure patients sees belly moving up and down

Practice and Follow-through

- Practice daily for a few days to ensure proper use of the breathing
- Breathe mid-way, immediately after, and every time that rumination occurs

Habit Reversal Protocol

- 1. Become more aware of the behavior
  - Daily log to track rumination episodes and any sensations that happen right before rumination occurs
  - Biofeedback to note contraction of abdominal wall
- 2. Increase aversiveness of rumination
  - Swallow food back down every time
  - Get rid of garbage cans, vomit basins
- 3. Teach diaphragmatic breathing
  - Involves relaxation of abdominal muscles so it serves as a competing response to this abdominal wall contraction
  - This breathing also decreases autonomic arousal (major player in functional GI diagnoses) by promoting the relaxation response
- 4. Distraction
  - Divert attention away from physical sensations to decrease anxiety (which could exacerbate rumination)
- 5. Social Support

Treating Severe Rumination

- When significant weight loss and/or functional impairment consider multidisciplinary approach inpatient or outpatient
  - Gastroenterology, Psychology, Nutrition, other disciplines
  - Alioto, Yacob, Yardley, & Di Lorenzo (2015): Retrospective analysis
    - 55 patients completing inpatient program
    - Intervention: Medical management of GI symptoms (gastroenterologist), set nutritional goals (dietician), address physical deconditioning (recreation therapist), massage, adjustment to program (child life), habit reversal combined with relaxation/diaphragmatic breathing (psychologist)

- 91% white females
- Average duration of illness: 22.6 months
- 58% started on enteral or parenteral nutrition
- Average length of hospitalization: 9 days
- Mental health diagnoses in patients:
  - 40% GAD
  - 27% Depression
  - 5.5% ED NOS
- Results:
  - At time of discharge 87% were retaining at least 80% of daily caloric intake requirement (but 93% continued to ruminate)
  - Comorbid mental health disorder more likely in those not achieving set intake goal
  - 91% of patients on supplemental nutrition were discharged without feeds

- Benefits of gradual refeeding process
  - Allows patient to practice self management skills when trying to comply with challenge of eating increasing quantities of foods
  - Increases ability to tolerate discomfort associated with gastric distention
  - Frequent/small food trials permits repeated exposure to stressful stimulus (food)
  - Instills confidence in patients as they make progress with keeping food down

(Green, Alioto, Mousa, Di Lorenzo, 2011)

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Rickets, itching and poor feeding: What's the common link?

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Initial Presentation

- 13 month old Hispanic male with history rickets, eczema and poor weight gain/ "picky eater"
- Had intermittent diarrhea between birth and 4 months of age that seemed to have improved.

History

- Previously treated for eczema with creams and vitamin D deficiency by PCP
- Diagnosed with rickets by PCP in the previous month.
- Refused to eat any solids except pureed sweet potatoes. Drank about 36-42 ounces of Lactaid milk
- FHx: Gallstones: mother, eczema: brother

Physical Exam

- VS stable
- Alert and active
- WT: 7.9 kg (3.54%)
- HT:70.7 cm (1.5%)
- WT for length: 18.87%
- Skin with scratch marks from itching.

Work up

- EGD: Normal
- Initial labs:
  - Albumin: ↓3.1, Alk Phos ↑: 1407, ALT: ↑188 , AST: ↑111, T.Bili: 0.7, D.Bili: 0.24, GGT: 8, Phos: ↑6.8,
  - Vitamin A: ↓0.64, Vitamin D: ↓16, Vitamin E: ↓3.0, and PT/INR: 11.2/0.8
  - Serum Bile acids: ↑310 (0-10)
  - Jaundice chip: Heterozygous for mutation in the ABCB11 gene

Differential

- Infective
- Obstructive
- Genetic
- Endocrine
- Metabolic

- Always obtain GGT in cholestatic children

Diagnosis

- Progressive Familial intrahepatic cholestasis type 2

Progressive Familial Intrahepatic Cholestasis (PFIC)

- Group of genetic disorders involving the hepatocanalicular transporters.
- Characterized by cholestasis, pruritus and jaundice in infancy and childhood.
- There are 3 types: PFIC 1, 2 and 3.
- PFIC1 caused by mutation in the ATP8B1
- PFIC2 caused by mutation in the ABCB11
- PFIC3 caused by mutation in the ABCB4

Progressive Familial Intrahepatic Cholestasis Type 2 (PFIC 2)

- Autosomal recessive disease caused by mutation of the ABCB11 gene on chromosome 2q24. This gene is responsible for the canalicular bile salt export protein (BSEP).
- BSEP is the main exporter of bile acid from hepatocytes to the canaliculi across different concentration gradients.

PFIC 2

- Defective or nonfunctional BSEP can result in reduced bile salt secretion followed by decreased bile flow, leading to accumulation of bile salts in hepatocytes and hepatocellular damage.
- Presents with cholestatic jaundice, pruritus and poor growth.
- Labs: elevation in alkaline phosphatase and serum bile acids, but GGT remains in normal range.

PFIC 2

- PFIC 1 and 2 are very similar with low GGT levels but PFIC 2 is more severe. The evolution and progression is faster than PFIC 1 and could be fatal in the absence of liver transplantation.

Treatment

- Nutritional support
  - Fat soluble vitamin supplement.
  - Supplemental formula with high MCT oils.
- Medical management of pruritus
  - Ursodiol, rifampin or cholestyramine.
- Surgical Intervention
  - Partial biliary diversion can delay the progression to end stage liver disease.
  - Ultimately, Liver transplantation

Prognosis

- Liver transplantation is usually successful, however, recurrences have been reported in literature