Common Infant Digestive Health Concerns and Useful Support Strategies

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Objectives

- Describe how the gastrointestinal (GI) tract develops
- Identify common infant digestive concerns
- Identify basic care plan ideas for infants coping with digestive issues

What IS gut health?

- Effective digestion and absorption
- Absence of GI illness
- Normal and stable intestinal microbiota
- Effective immune status
- State of well-being
- (Stephan Bischoff, 2011)

GI Development in Embryogenesis

- Wk 3-8: Gut tube forming, developing
- Wk 8-12: GI tract open mouth to anus. ENS, villi, muscular layers forming. Glandular organs bud out. Amniotic fluid swallowing begins.
- Wk 24: Fetal intestinal absorption begins
- Wk 32: Intestinal absorption now mature
- GI development occurs during critical stage in midline formation. Impacted by environment, parental health/nutrition, meds, stress, etc.

Digestion: From mouth to bum

- Mouth:
    - Lingual lipase, salivary amylase produced
    - Liver, pancreatic enzymes still developing in infants
- Esophagus:
    - Length doubles 0-3
    - Prolific nerves, helps peristalsis
- Lower esophageal sphincter (LES)
    - Connects esophagus to stomach
    - Relaxes with swallow
    - Stays open until peristaltic wave travels through LES
    - Transient opening can contribute to reflux
    - LES tone variables

- Stomach:
    - Three layers smooth muscle
    - Temporary storage
        - Term: 20mL
        - DOL 3: Gastric relaxation, increased capacity
        - Human milk: 1 hr emptying
    - Hydrochloric acid produced
        - Birth: pH 2-5
        - Aids digestion, kills pathogens
        - Mixed evidence: prematurity, C/S
        - Chronic stress, zinc/B vitamin deficiencies = decreased acid
    - (Bergman, 2013; Palla, 2018; Zangen, S., et al., 2001)
- Small Intestine:
    - Bile, pancreatic enzymes help break down fats/proteins
    - Villi increase absorption area, transport nutrients into blood
    - Epithelial lymphoid cells help develop intestinal mucosal immune system
- Colon:
    - Further absorbs fluids, nutrients
    - Produces some fatty acids
    - Hosts majority of the gut biome, 70% immune system d/t GALT

Enteric Nervous System

- GI tract = 100-500 million neurons
- Controls peristalsis, enzyme release, fluid/nutrient detection
- Receives input from central nervous system (CNS) via vagus, can function independently (2nd brain)
- Produces 30+ neurotransmitters: 90% serotonin , 50% dopamine
- Sensitive to environment, stress, parental health
- Gut microbes stimulate ENS to send signals to vagus + impact HPA axis, sleep quality, immune function, memory, mood, autoimmune/inflammatory disease
- Stress, inflammation, disease reduce enteric neurons, impact neurotransmitter function
- (Bates, 2002; Baudry, 2012; Breit, 2018; Carbanero, 2017; Furness, 2010; Galland, 2014; Mi, 2002; Nezami, 2013; Nijenhuis, 2012; Pasricha, 2011; Sasselli, 2012)

Early factors in digestive health

- Transgenerational inheritance
- "1,000 days period"
    - Conception – age 2, most active epigenetic DNA imprinting. Modulates adaptation to environment, influences lifelong health.
- Prenatal:
    - Parental flora: amniotic fluid, placenta, parental gut.
    - Parental health nutrition, medications (SSRIs, TCAs)
- Postnatal:
    - Delivery mode, skin contact, neonatal diet, anatomical/physiological variances
- (Backhed, 2010; Buddington, 2010; Grenham, 2011; Jimenez, 2008; Kim,2010; Moore,2011; Perez-Munoz, 2017: Sanz, 2011; Rautava, 2002; Round, 2009, Rupa, 2012; Stinson, 2019; Zimmerman, 2012)
- Epigenetic Matters: The Link between Early Nutrition, Microbiome, and Long-term Health Development (Indrio et al., 2017)

Human Milk…

- Contains secretory IgA
    - Promotes healthy biofilm
    - Helps develop gut mucosa, immune system
    - Prevents bacteria, foreign dietary antigens from passing through epithelium
    - May promote lifelong intestinal homeostasis
- Contains beneficial bacteria, HMOs
    - Milk microbiome varies, diet thought to minimally impact taxonomic composition
    - Parent diet does impact human milk oligosaccharides. HMOs indigestible by infant, substrate for bacteria
- Contains numerous anti-inflammatory properties
- Contains anti-tumor properties
    - HAMLET (human alpha-lactalbumin made lethal to tumor cells), kills tumor cells, but normal cells unaffected.
- Contains neurotrophic factors and cytokines for ENS development which…
    - Increase enteric neurons that aid in motility, enzymes and neurotransmitter production, absorption
    - Increase neurite outgrowth which extend out from neurons and innervate ENS lining
    - Increase glial cell proliferation, which support and protect neurons

- (Boehm,2003; Brandtzaeg, 2010; Burns, 2016; Fichter, 2011; Matin, 2012; Oddy, 2002; Wold 2000; Seferovic, 2020; Svanborg, 2003; Wold, 2000; Zhang, 2012)

Lactating mammary glands…

- Part of the secretory immune system
    - MALT: mammary associated lymphoid tissue
    - GALT (gut)
    - NALT (nasal, nasopharynx)
- Human milk antibodies specific to environment, exogenous antigens, infectious agents, can invoke immune response
- Human milk = 1st source antigen-specific GI tract protection
    - Intestinal homeostasis requires healthy relationship between gut microbiota and host immune system.
- Immunological integration of parent and child
- (Brandtzaeg, 20110; Rogier, 2014)

Functional Gastrointestinal Disorders (FGIDs)

- 1/2 all infants 0-6mos =1+ FGIDs
- Most common FGIDs:
    - Regurgitation
    - Rumination
    - Colic
    - Constipation
    - Diarrhea
    - Dyschezia (pain with stooling despite normal consistency)
    - Cyclic vomiting
- (Vandenplas et. al, 2019)

FGIDs may cause…

- Parental anxiety
- Poor quality of life
- Short and long-term health consequences
- Shortened duration of full breast/chest feeding
- Numerous medical consultations, increased healthcare costs
- (Vandenplas et. al, 2019)

Possible Causes of FGIDs

- Physiological: Immaturity, dysmotility, dysbiosis, gut hormones, food allergy/sensitivity
- Behavioral: Inadequate parent-infant interaction, parental anxiety, difficult infant temperament
- Environmental & genetic predisposition: Flora/fecal pH changes, parental health/dietary factors, changes in environment, birth, feeding practice

Possible Digestive Health Cues

- Optimal Stooling: Frequent, unstrained
- Suboptimal Stooling: Infrequent, strained, excessive mucous, explosive
- Optimal Skin: Less prone to inflammation, dermatological issues
- Suboptimal Skin: Prone to rashes, eczema, yeast
- Optimal Sleep: More restful, wakes in regular intervals
- Suboptimal Sleep: Restless, frequent waking with pain/gas, frequent congestion
- Optimal Behavior: Can be soothed, periods of calm/alert, healthy social engagement
- Suboptimal Behavior: Excessive fussiness, crying, hard to settle
- Optimal Growth: Nutrients absorbed, good weight gain
- Suboptimal Growth: Malabsorption, poor weight gain

What's Normal?

- Gastric emptying, gut motility developed by 30 wk
- 2009 study of healthy, human milk fed babies
    - 24% stool 3+x/day
    - 42% stool 2x/day
    - 31% stool 1+x/day
    - "Nearly all normal infants being breastfed should defecate at least once daily"
- (Ameh, 2009; Hassan, 2002)
- 1995 study:
    - Newborns: 1+x/day, avg 3.3 BM/day
    - 4-6 yo: Avg 1+x/day
    - "Compared to Western children, Thai kids pass larger, softer, more frequent stools". Fiber difference?
- N=198, 2014 parent questionnaire
    - 37% infants had 1+ episode infrequent stool (> 24hr)
    - 19% infants < 1 mos
- (Courdent, 2014; Osatakul, 1995)

A pooping baby is a happy baby!

- Colic: Unexplained fussing, crying lasting ≥ 3hr/d/wk
- 2008 Tunc, et al. Babies with colic stooled less than happier babies.
- 1st mos median defecation: all babies 6x/day
- 2nd mos: 60.7% stooled 1+x/day, 39.3% < 1 stool/day
- 2nd mos – 24 mos = Stooling pattern remained steady
- Notes: solids into slightly changed stooling frequency, exclusively Bf babies stooled more frequently
- CONCLUSION: Babies with colic first 2 mos = less frequent BMs first 2 yr. 2nd mos = unique point, stooling patterns dramatically shifted in babies.

Diaper Detective

- Delayed Stooling
    - Enough food?, inflammation, impaired motility/gastrocolic reflex
- Excessive mucous in stool
    - Irritation, inflammation, proctocolitis, virus, teething
- Blood in stool
    - Colitis, stress (20% NICU babies – infantile peptic ulcer), swallowed maternal blood, anal fissures, coagulation issues, vascular abnormalities (hemangioma?), Abx/Rx
- Green stool
    - Rapid elimination (bile), irritation, virus, teething, occasionally foremilk/hindmilk imbalance, food/Rx
- Oily Stool
    - Not breaking down fats, pancreatic issues, cystic fibrosis
- Pasty white, grey stool
    - Lack of bile excretion, possible bile obstruction
- Absent stooling
    - Impaired innervation (Hirschsprung's), anal stenosis/atresia

Why all these sluggish poopers?

- Pediatric colonic motility disorders are controversial
- Common thoughts:
    - Infants use up human milk so efficiently
    - It is normal to go up to 10+ days without stooling
    - If baby is uncomfy, just use prune juice, suppositories, laxatives, etc
- Literature states infants have active gastrocolic reflex early on. May stool with every meal
- If no medical issues like Hirschsprung's, stool frequency may slow down over but should still be regular
- My theory: Increase in suboptimal ENS development, poor gastrocolic reflex

M is for Motility!

- Gastrocolic reflex controls lower GI motility after eating
    - Colon increases motility in response to stretch of stomach with food ingestion
    - Allows room for consumption of more food via peristaltic movement of food towards rectum ending in defecation.
- Gastrocolic reflex is multisystemic, multifactorial and involves:
    - ANS, ENS, GI tract cells
    - Neurological, mechanical, paracrine mediators
    - Neuropeptides: cholecystokinin, serotonin, neurotensin, gastrin
    - Myogenic, hormonal, neural control factors
- (Mallone, 2020)

Support strategies for motility

- Massage
- Movement
- Acupressure
- Reduce inflammation
- Probiotics
- Vagal tone support
- Older babies, children: targeted supplements

Impact on digestion: Food Allergies

- Food allergies=evolving public health epidemic
- IgE-mediated food allergy = 10% of infants
- Parent with allergies? 70% kids will too
- Causes of epidemic?
    - Changing environment, diet, gut flora
    - Environmental factors causing changes in gene expression
- "Epigenetics has recently been considered as a potential mechanism involved in the development of…allergic diseases….unraveling the environmental drivers is critical to curtail a potential tsunami of allergic disease."
- (Institute for Quality and Efficiency in Health Care [IQEHC], 2008; Prescott & Allen, 2011, Tezza et al., 2013).

Is it an allergy or an intolerance?

- IgE ('allergy') most common reactions:
    - IgE antibodies bind to antigen, signal mast cells to release histamine
- IgE ('allergy') body's response and info:
    - Immediate reaction (minutes to hours)
    - GI hypersensitivity: vomiting, cramping
    - Oral allergy syndrome
    - Hives
    - Airway, systemic inflammation, potential anaphylaxis
- IgG and IgA ('intolerance/sensitivity') most common reactions:
    - IgG antibodies bind directly to antigen as it enters blood, no mast cells involved, creates immune response
- IgG and IgA ('intolerance/sensitivity') body's response and info:
    - Delayed reaction (hours to days)
    - GI upset, fatigue, irritability, behavior impact, headaches, congestion, skin issues
- Autoimmune most common reactions:
    - self-antigens drive the immune response,
    - T-Cell mediated destruction of specific cells
- Autoimmune body's response and info:
    - Various symptoms, tissue damage, gut damage, ex: celiac
    - Often genetic

Allergies

- Non-IgE = delayed, hard to Dx
- 50% kids with allergies, ages 0-2, = non-IgE-mediated reactions
- Why didn't baby react early on?
    - Sensitization can take time.
    - Non-IgE symptoms often viewed as 'normal': eczema, green poop, excessive spit up, colic…
- Factors in sensitization process during Pg/Bf:
    - Parental diet, GI flora during pg/bf
    - Exposure to smoke, alcohol, meds (Abx, antacids)
    - Environmental triggers
    - Vit D levels
    - Early introduction of solid foods
    - Mode of birth, feeding
- (Jyonouchi, 2008; Lucarelli et al., 2011; National Institute for Health and Clinical Excellence (NIHCE), 2011; Pali-Scholl, 2009; Rautuava, 2012; Sanz, 2011)

How do babies develop allergies anyway?

- GI tract = largest immunologic organ
- Is a food safe or a 'foreign invader'
- 'Safe' = immune tolerance
- Tolerance 'fail' = possible allergy, inflammatory attack
- First years = critical expansion of gut associated lymphoid tissue (GALT)

How do human milk-fed babies develop allergies?

- Food components can pass through parental gut gap junctions into the blood
- Milk is made from blood
- Food components, proteins, meds can pass from blood to milk, placenta
- Infant's immune system may mount inflammatory response, becoming sensitized to the proteins, components in question.
- (Jarvinen, 1999; Suomalainen, 1997)

Possible Signs: Sensitivity, Allergy, GI Discomfort

- Skin: wheals, redness around eyes, peri-anal redness, hives, eczema
- GI: 'colic', excessive gas, stooling issues, reflux
- Feeds: Pain, arching, short, on/off, aversion, dream feeds
- Sleep: disturbed, waking w/ pain, gas, open mouth, noisy/congested
- Growth: Poor intake, absorption
- Severe: Wheezing, chronic congestion, anaphylaxis

Facial features of allergy

- Allergic shiners: Blood vessel congestion, swelling
- Dennie-Morgan lines: Crease-like wrinkles under eyes, double folds
- Increased redness: around eyes, often worsening with feeds, itching
- Mouth breathing: congestion
- Wheals: Small, red, raised 'bumps', indicating reaction.
- Eczema: Atopic dermatitis, inflammatory reaction

What about testing?

- Skin prick, patch and blood tests = IgE only
- Infant results = harder to interpret, high rate false negative/positives
- Elimination diet: Standard of care, noninvasive, replace nutrients
- ABM says: "Lab tests can be considered but aren't very reliable… fecal smears don't always show detectable leukocytes/eosinophils... Total/antigen-specific serum IgE values are similar to those of non-affected infants"
- Holistic options: Little published evidence. Vega, EAV, NAET, ALCAT, muscle testing, etc. Consult CAM provider.
- (Meardo et all, 1985; Isolauri et al, 1996)

Management of Infant Food Sensitivities

- Perinatal ideas
    - Mixed evidence: avoid or expose to allergens
    - Severe familial allergy Hx, consult allergist
    - Consider probiotics. Little risk, may help
    - (WHO, Cuello-Carcia et al, 2015)
- Suspected Infant Sensitivity:
    - Food/reaction journal
    - Eliminate suspected food(s) min 1 week (2-4 ideal)
    - Challenge food back into parental diet
    - Balance nutrients for parent, teamwork, refer
    - Consider parental use of a pancreatic/digestive enzyme (ABM)
    - Consider allergy testing if reactions are severe
    - GI support: probiotics, CAM, question hypoallergenic formula
    - Optimize vitamin D
    - (Baek, 2014)

Infant Reflux 101

- 45-80% physiologic reflux (GER), 0-6mos
- 8-10+% pathologic reflux (GERD)
- Symptoms:
    - Develop months 1-2
    - Peak months 4-6
    - Usually decline months 8-18
    - Symptoms persisting past 12-24 months more concerning
- Diagnosis
    - Family narrative
    - Observation
    - Dx tools: intraesophageal pH monitoring/impedance probe, VFSS, upper GI barium study
- (Dranove, 2008; Leung, 2019; Oeso, 2015; Rosen, 2014: Sinjendonk, 2019))

Factors in Infant Reflux

- LES hypotonia
- Transient relaxation of LES
- Increased intragastric pressure, delayed emptying
- Esophagus: length, impaired motility
- Food allergies (16-56%)
- Hiatal hernia, congenital GI disorders
- Angle of His (angle between esophagus + stomach fundus)

- Vagal dysfunction
- (Caselli, 2017; Heine, 2006; Machaud, 1997; Milovanovic, 2015; Rybak, 2017; Yukselen, 2016)

Nonpharmacological Reflux Management

- Parent education, support
- Watch cues, avoid overfeeding
- Positioning
- Therapeutic non-nutritive suck
- Address oral restrictions, function
    - 45% reported reflux symptoms pre-Tx, significant improvement 1 week, 1 mos post Tx
    - (Ghaheri, Cole et al, 2016)
- Thickening feeds (controversial)
- Parental food elimination trial (dairy, eggs, etc)
- Holistic care options (manual therapy, TTM!, vagal support, herbal options, Lactobacillus reuteri DSM 17938)

Pharmacological Reflux Management

- Severe GERD, not responding to basics
- Recent recalls, changes in attitudes, provider preference
- Proton pump inhibitors (PPIs) favored over Histamine2-receptor antagonists (H2RAs), superior efficacy
    - H2RAs: ranitidine, famotidine, etc
    - PPIs: omeprazole, lansoprazole, etc
- Benefit: decreases acid causing pain, tissue damage
- Risks: increased allergies, can loose effectiveness, bacterial overgrowth (SIBO, C.diff), long term – suboptimal bone density, GI/respiratory infections, eczema, quells CCK
- Prokintetics
- Antireflux surgery

What about thickeners?

- Starch-based thickener (SBT): Thick It, rice cereal, cornstarch, etc
- Gum-based thickener (GBT): xanthan gum, Simply Thick, Thicken Up, carob gum, GelMix, etc
- Thickened formulas: Similac Spit Up, Enfamil AR, etc
- Benefits: May reduce regurgitation, reflux symptoms (formula feeds, avg reduction 2x/day)
- Cons: Viscosity is highly variable, may pose safety issue, warnings (2011 Simply Thick) about NEC concerns, product can be unstable (refrigeration and formula can increase thickness, etc), no info on long-term impact of high carb/low protein feed
- Considerations: May not apply to Bf/Cf, human milk challenging to thicken, clinical efficacy highly variable
- (Koo, et al., 2019; Kwok et al., 2017; Ng et al., 2022; Salvatore et al., 2018)

Teamwork!

- Document assessment, observations, family narrative
- No big red flags?
    - Consider general digestive support ideas
- Red flags, clinical issues? TEAMWORK, REFER
    - suspected allergy, significant reflux, malabsorption, suboptimal growth…
- PCP, allergist, nutritionist, gastroenterologist

General Digestive Support Ideas

Nourishing Vagus!

- Connects ENS to CNS
- Longest cranial nerve
- Brain- throat-heart/lungs- gut-kidneys/uterus.
- Impacts: gut-brain axis, swallowing, gut motility, mood, appetite…
- Research shows vagal stim, therapies can help IBS/IBD
- Nourishing activities:
    - Sing, hum, chant
    - Brief exposure to cool air, go outside
    - Movement, massage, acupressure
    - Skin to Skin, Face to Face
    - TummyTime! Method
- (Feldman, 2003; Field, 2008; Moore, 2009; Porges, 2001)

Holistic Care Options

- Manual therapy, therapeutic touch
    - Studies show chiropractic, manual therapies reduce colic and crying. (Dobson, 2012; Miller, 2012)
    - Sensory stim aids in the release of GI hormones, non-nutritive sucking, tactile stimulation vital to growth, GI function. (Uvnas-Moberg, 1987)
    - Baby massage significantly reduces colic (Mansouri, 2018; Nahidi, 2017; Sheidaei, 2016)
- Herbs, Supplements
    - RCT, herbal tea eliminated colic in 57%, placebo only 8% (Weizman, 1993)
    - 'gripe water': chamomile, fennel, licorice, ginger, peppermint, dill, etc (Valussi, 2012)
    - Zinc, vit D, L-glutamine, homeopathics, marshmallow, slippery elm, magnesium
    - Seek professional CAM support

Probiotics

- Bifidobacteria: Most prevalent healthy bacteria in Bf babies (B. longum, infantis, anamalis, bifidum, breve, adolescentis…)
- Lactobacillus Reuteri: Shown reduced crying compared to simethicone, E.coli reduction in stool
- L. GG (or L. rhamnosus GG): Published evidence around gut and skin health
- Sacchromyces Boulardii: A yeast, not bacteria. Useful for GI health, anti-candida
- (Basim, 2020; Celik, 2019; Kelesidis, 2012: Xu, 2019; Quin, 2018; O'Callaghan, 2016)

Probiotics

- Parental consumption of traditional, fermented foods has been shown to reduce infantile atopic dermatitis, lactational mastitis, etc
- What about probiotic supplement safety?
    - Majority of evidence shows little risk
    - Some NICUs use
    - Some researchers urge caution with very ill or immunocompromised babies
    - Some suggest very specific strain selection
- *Changes in fecal pH 1926-2017 (5-6.5), increase in pathogenic bacteria and antibiotic resistant bacteria (*Funding source disclosure)
- (Basim, 2020; Casaburi, 20201; Celik, 2019; Cuello-Garica, 2015; Henrick, 2018; Kelesidis, 2012: Xu, 2019; Quin, 2018; O'Callaghan, 2016)

Summary

- Be a good detective. Feeding issues can be digestive issues in disguise
- Coping with a fussy infant can be stressful for parents. Provide care plan ideas that are sustainable, supportive.
- Infant and parental gut health are interwoven and complex
- It takes a team! Refer appropriately and work together!
- Healthcare providers should strive to keep learning about digestive health and care. Future generations depend on it.

Thank you!