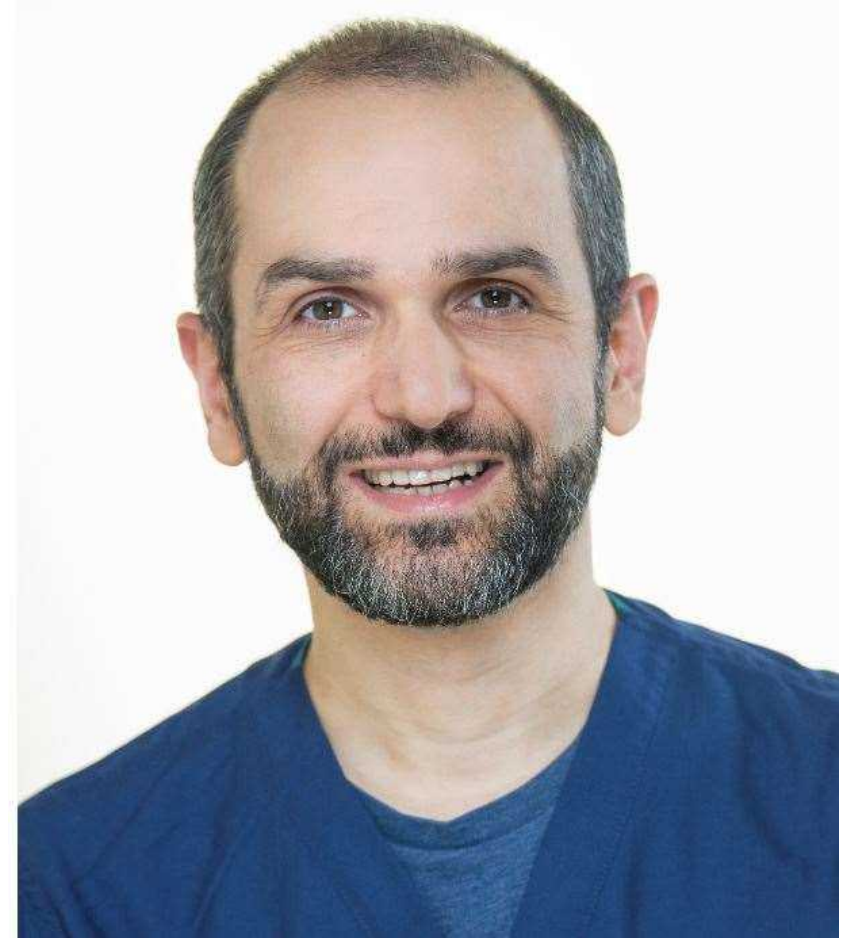


# Beyond the Basics: Decision Trees & Teaming Up with GI for Happy Tummies

Vahe Badalyan, MD, MPH, MBA  
*Medical Director, Celiac Program*  
*Gastroenterology*



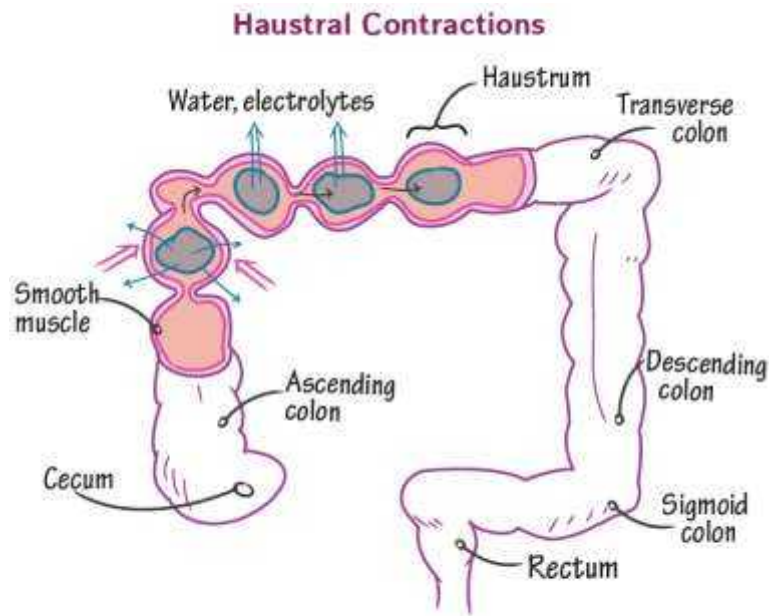
# Learning objectives

- Refresher on mechanisms of defecation and constipation
- Refresher on assessment and diagnosis
- Refresher on treatment and referral

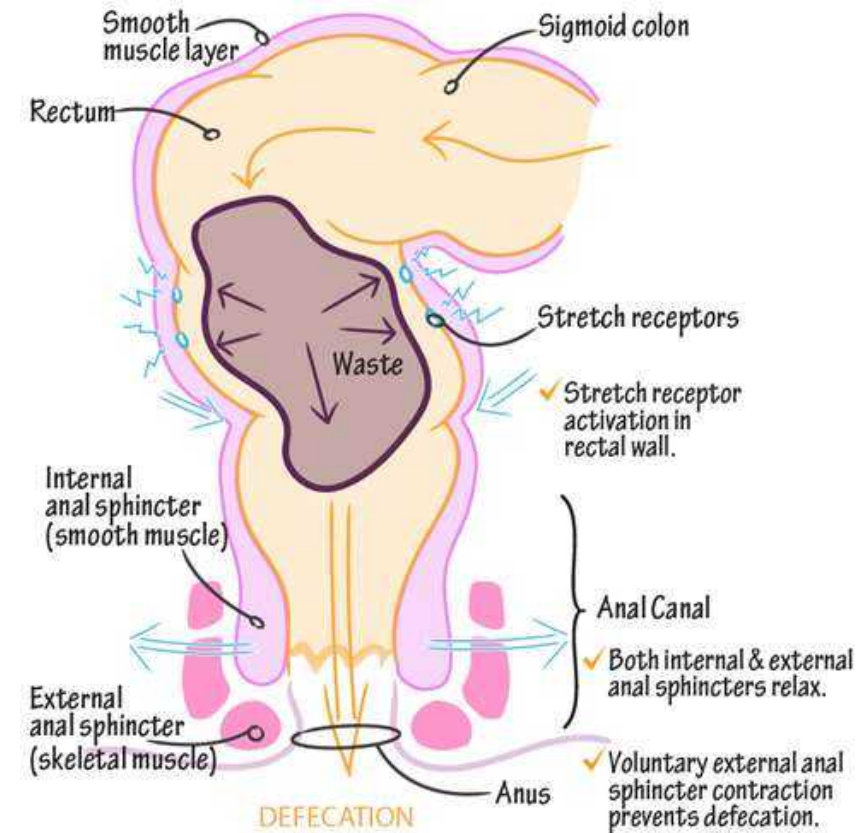
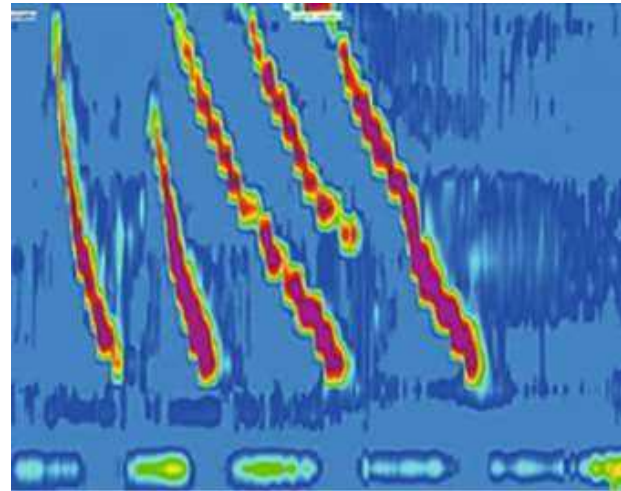
## Disclosures

- None

- Motility of the large intestine
  - 95% of motor events are segmental (mixing) pressure waves that facilitate the absorption of water and electrolytes
  - remaining 5% are propagating pressure waves (peristalsis)



✓ Also occurs in descending & sigmoid colon to further concentrate fecal waste.



<https://ditki.com/course/physiology>

*Nat Rev Gastroenterol Hepatol* 16, 559–579 (2019)

*J Acad Nutr Diet.* 2017 Feb;117(2):251-264.

- Physiology of defecation extrinsic innervation (sympathetic and parasympathetic)
- intrinsic innervation from the enteric nervous system
- key factors: GI transit, stool volume and/or consistency, and dietary intake
- coordination of neural, muscular, hormonal and cognitive systems

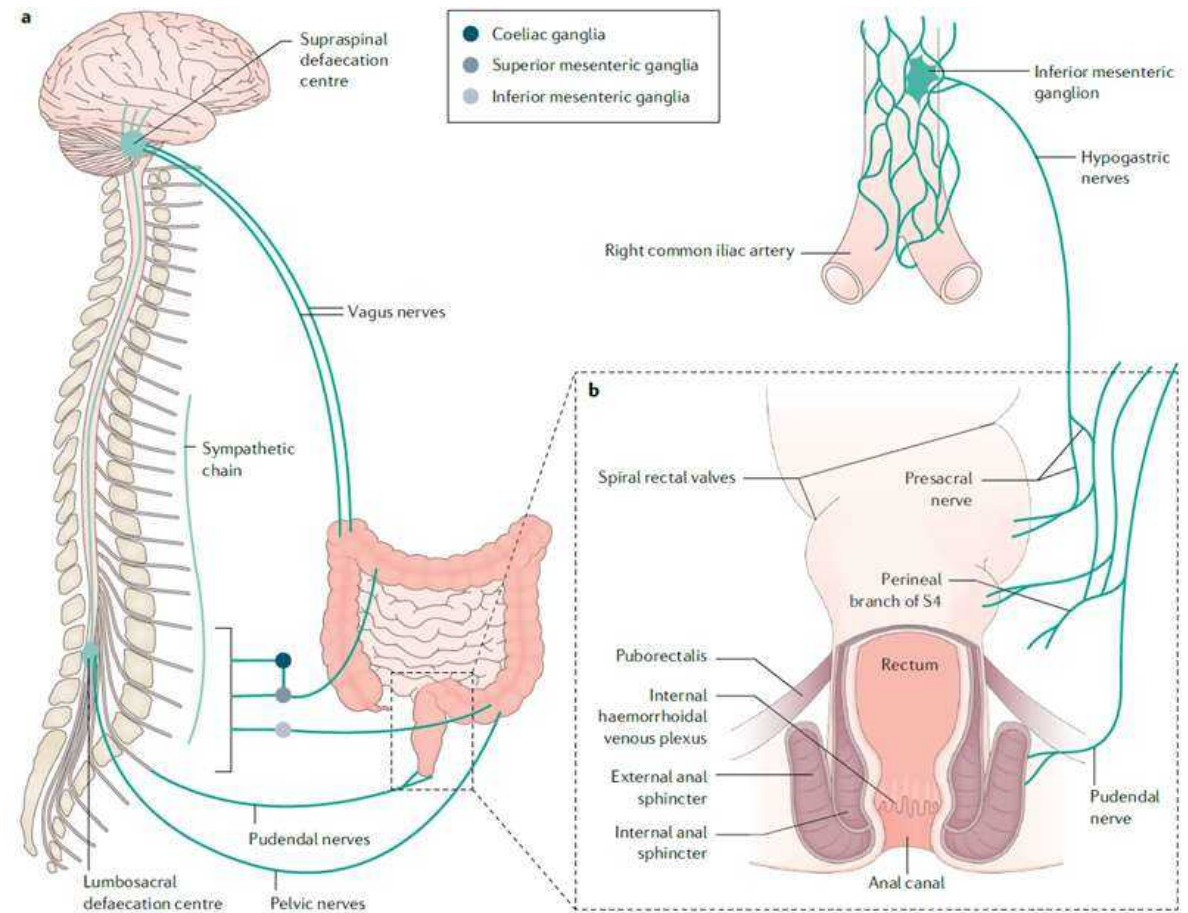
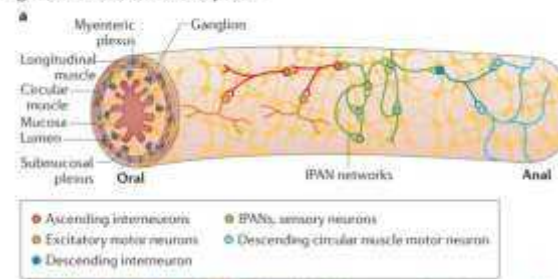


Figure 1: The enteric nervous system.



# Orchestra Concert at Strathmore



# Definitions

- **Constipation:** infrequent, and painful bowel movements, fecal incontinence, stool withholding behavior, and occasional passage of large diameter stools
- **Intractable Constipation:** constipation not responding to optimal conventional treatment for at least 3 months
- **Fecal Impaction:** a hard mass in the lower abdomen ; or a dilated rectum filled with a large amount of stool ; or excessive stool on x-ray

# Fecal incontinence

Involuntary passage of stool into the underwear; unintentional seepage of small amounts of liquid stools (generally referred to as “soiling” or “leakage”) in an older (> 4 y/o) or toilet trained child

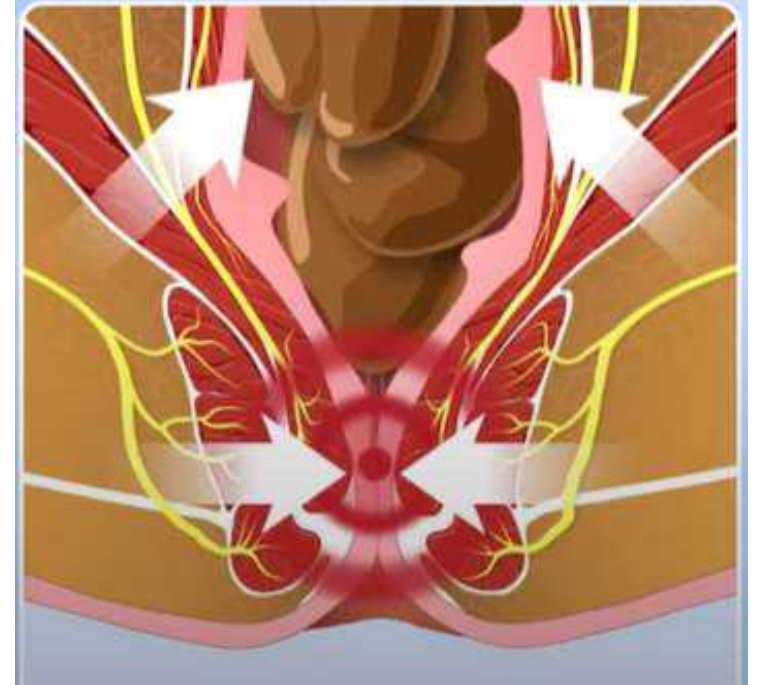
2 types:

- Retentive (constipated children with fecal impaction)
- Nonretentive (children with psychological problems)



# Dyssynergic Defecation

- Functional disorder characterized by failure of relaxation or paradoxical contraction of the anal canal and/or a failure to increase intrarectal pressure



# Rome IV criteria for diagnosing functional constipation



## Infants and toddlers<sup>1</sup>

Must have  $\geq 2$  of the following criteria for  $\geq 1$  month:

- $\leq 2$  defaecations per week
- History of painful or hard bowel movements
- History of excessive stool retention
- History of large diameter stools
- Presence of a large faecal mass in the rectum
- $\geq 1$  episode of faecal incontinence per week<sup>a</sup>
- History of large diameter stools that can obstruct the toilet<sup>a</sup>

## Children and adolescents<sup>2</sup>

Must have  $\geq 2$  the following criteria for  $\geq 1$  month:

- $\leq 2$  defaecations in the toilet per week
- History of painful or hard bowel movements
- History of retentive posturing or excessive volitional stool retention
- History of large diameter stools that can obstruct the toilet
- Presence of a large faecal mass in the rectum
- $\geq 1$  episode of faecal incontinence per week

Practice Guideline

➤ [J Pediatr Gastroenterol Nutr. 2014 Feb;58\(2\):258-74.](#)

doi: [10.1097/MPG.0000000000000266.](#)

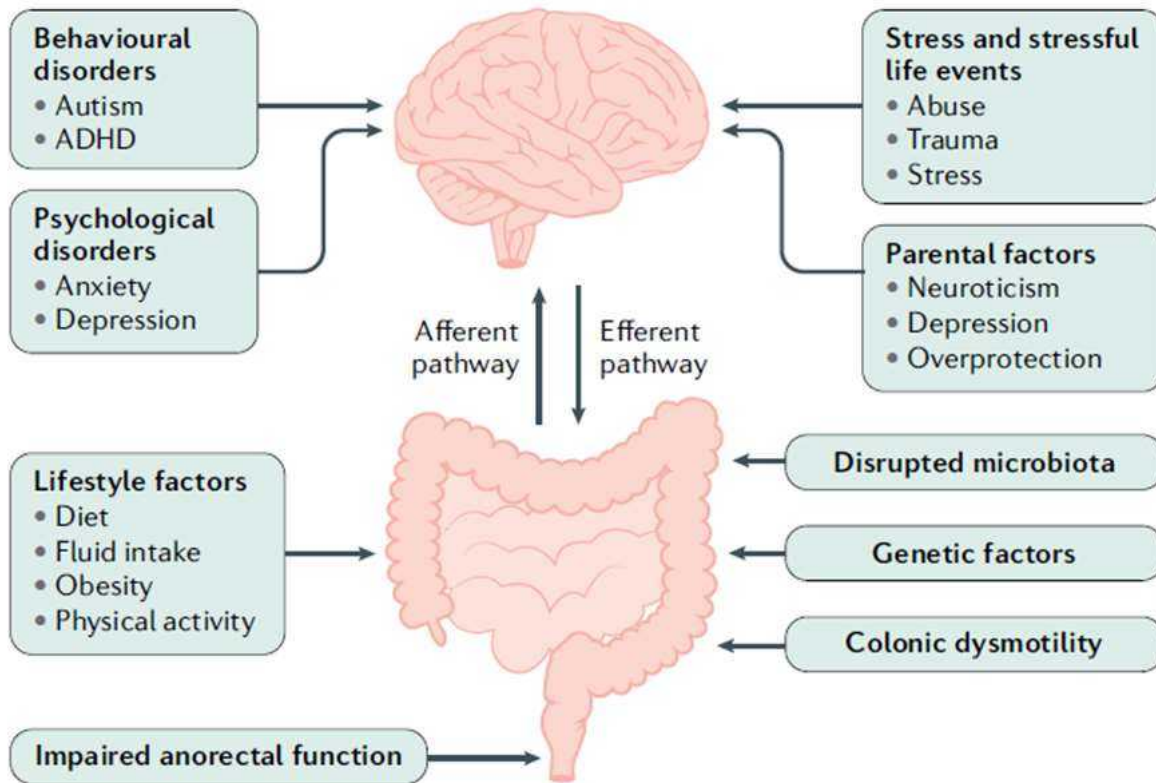
# **Evaluation and treatment of functional constipation in infants and children: evidence-based recommendations from ESPGHAN and NASPGHAN**

M M Tabbers <sup>1</sup>, C DiLorenzo, M Y Berger, C Faure, M W Langendam, S Nurko, A Staiano, Y Vandenplas, M A Benninga;

European Society for Pediatric Gastroenterology, Hepatology, and Nutrition;

North American Society for Pediatric Gastroenterology

# Functional (95%) and Organic Causes (5%)



- Hirschsprung disease: 1 out of 5,000 newborns
- Anorectal Malformations: 1 out of 5,000 newborns
- Spina Bifida: 1 in 2,500 newborns
- Tethered cord: 1 in 4,000 children
- Cystic fibrosis: 1 in 2,500 white newborns; 1 in 17,000 black newborns, 1 in 31,000 Asian newborns
- Hypothyroidism: 1 in 4,000 to 5,000 newborns








# Key aspects of history

- What was the age when constipation first started?
- What were the circumstances/ events around the initial constipation event?
- Bowel habits
- Incontinence
- Urinary symptoms

## Common Associations with Constipation

Type of Risk Factor	Example
Dietary	Transition from breast-milk to formula or to cow's milk Starting rice cereal Lack of fiber
Psychosocial	Toilet training Birth of sibling Starting school Parental strife/divorce Toilet phobia Sexual abuse Depression/anxiety
Medications	Antidepressants ADD/ADHD medications

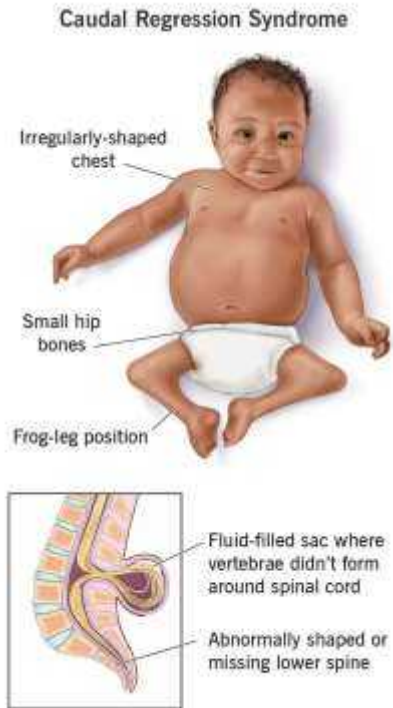
# Bristol stool

Type 1		Separate hard lumps, like nuts (hard to pass)
Type 2		Sausage-shaped but lumpy
Type 3		Like a sausage but with cracks on its surface
Type 4		Like a sausage or snake, smooth and soft
Type 5		Soft blobs with clear-cut edges (passed easily)
Type 6		Fluffy pieces with ragged edges, a mushy stool
Type 7		Watery, no solid pieces, <b>Entirely liquid</b>

# Some “Red flags” on history and physical

- Symptoms that commence from birth or in the first few weeks
  - Failure or delay (>first 48 hours at term) in passing meconium
  - Ribbon stools, leg weakness or locomotor delay
  - Abdominal distension with vomiting
  - Abnormal examination findings including:
    - Abnormal appearance of anus
    - Gross abdominal distension
    - Abnormal gluteal muscles, scoliosis, sacral agenesis, discoloured skin, naevi or sinus, hairy patch, or central pit
    - Lower limb deformity including talipes
    - Abnormal lower limb reflexes or neuromuscular signs unexplained by existing conditions
  - Other symptoms that cause concern
- 99% of healthy term neonates pass their first meconium before 48 hours
  - ~30% of neonates with Hirschsprung’s disease (HD) can pass meconium within 48 hours
  - only about 50% of children with HD are diagnosed by 1 year of age, and 80% are diagnosed by 7 years

# Some aspects of physical exam



Cleveland Clinic ©2022



1 - 2.5 per 100,000 newborns



Gluteal deviation



Cleveland Clinic ©2021



Tuft of hair

- Include inspection of perianal area for appearance, position and patency;
- Abdominal examination, inspection of spine/lumbosacral and gluteal regions;
- Lower limb neuromuscular examination including tone and strength.
- If any red flags in history or examination suggest new onset neurological impairment check lower limb reflexes.

How is growth/nutrition?

<https://my.clevelandclinic.org/> <https://www.orthobullets.com/> <https://neupsykey.com/> <https://pediatricneurosurgery.org>

UK NHS: National Primary Care Clinical Pathway for Constipation in Children



# Rectal exam

## Pediatric Rectal Exam: Why, When, and How

Susan R. Orenstein<sup>1</sup> · Arnold Wald<sup>2</sup>



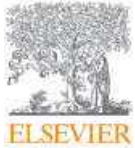
- May not be necessary for routine screening
- Can help to identify anal stenosis or anorectal malformations ; fecal mass in the rectum or rectal dilatation
- Lack of anal tone - > ? spinal cord lesion
- Forceful stool expulsion upon finger removal -> ? Hirschsprung disease
- Extreme fear - > ? trauma, abuse

<https://www.open-medis.com/>

*Curr Probl Pediatr Adolesc Health Care* 2020;50:100802

*Curr Gastroenterol Rep.* 2016 Jan;18(1):4. doi: 10.1007

# Role of imaging - radiography





The Journal of Pediatrics  
Volume 161, Issue 1, July 2012, Pages 44-50.e2



Original Article

## Value of Abdominal Radiography, Colonic Transit Time, and Rectal Ultrasound Scanning in the Diagnosis of Idiopathic Constipation in Children: A Systematic Review

[Marjolein Y. Berger PhD, MD<sup>1</sup>](#)  , [Merit M. Tabbers MD<sup>2</sup>](#), [Miranda J. Kurver MD<sup>3</sup>](#),  
[Nicole Boluyt PhD, MD<sup>4</sup>](#), [Marc A. Benninga PhD, MD<sup>2</sup>](#)

- 6 studies (700 children of all ages)
- Comparison of fecal loading on X-rays vs. Rome criteria or clinical assessment
- Sensitivity of abdominal x-ray ranged from 60 to 80%
- Specificity ranged from 43 to 99%

# Appropriateness and caveats of radiography



The Journal of Pediatrics  
Volume 191, December 2017, Pages 179-183

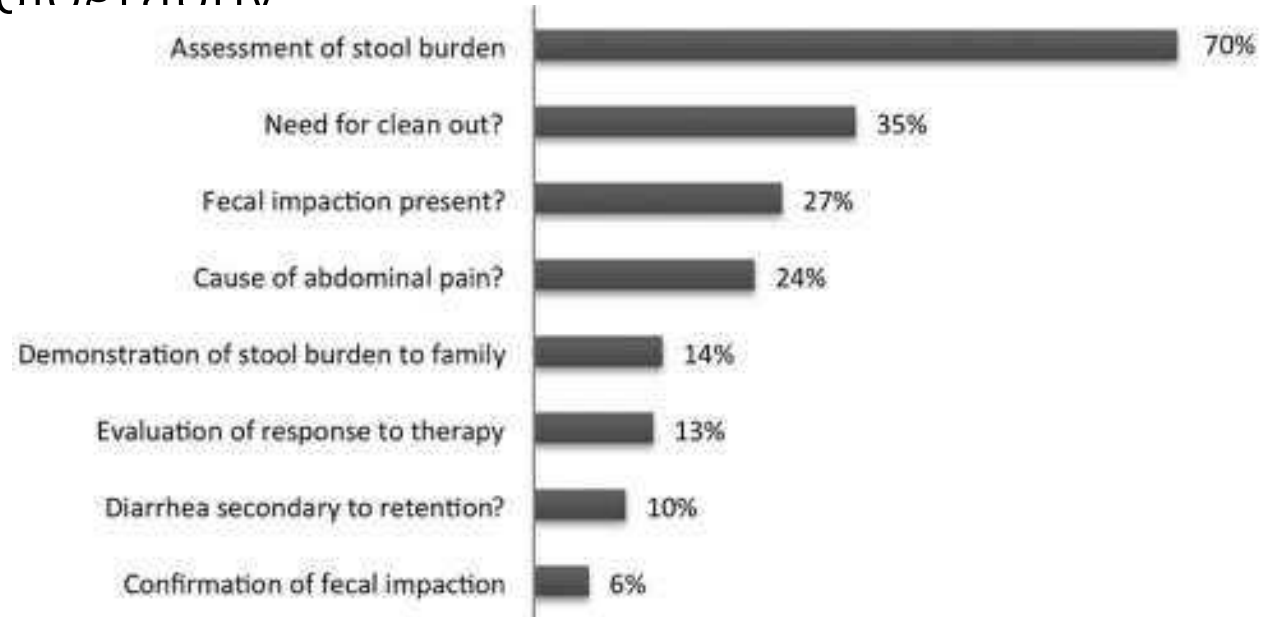


Original Articles

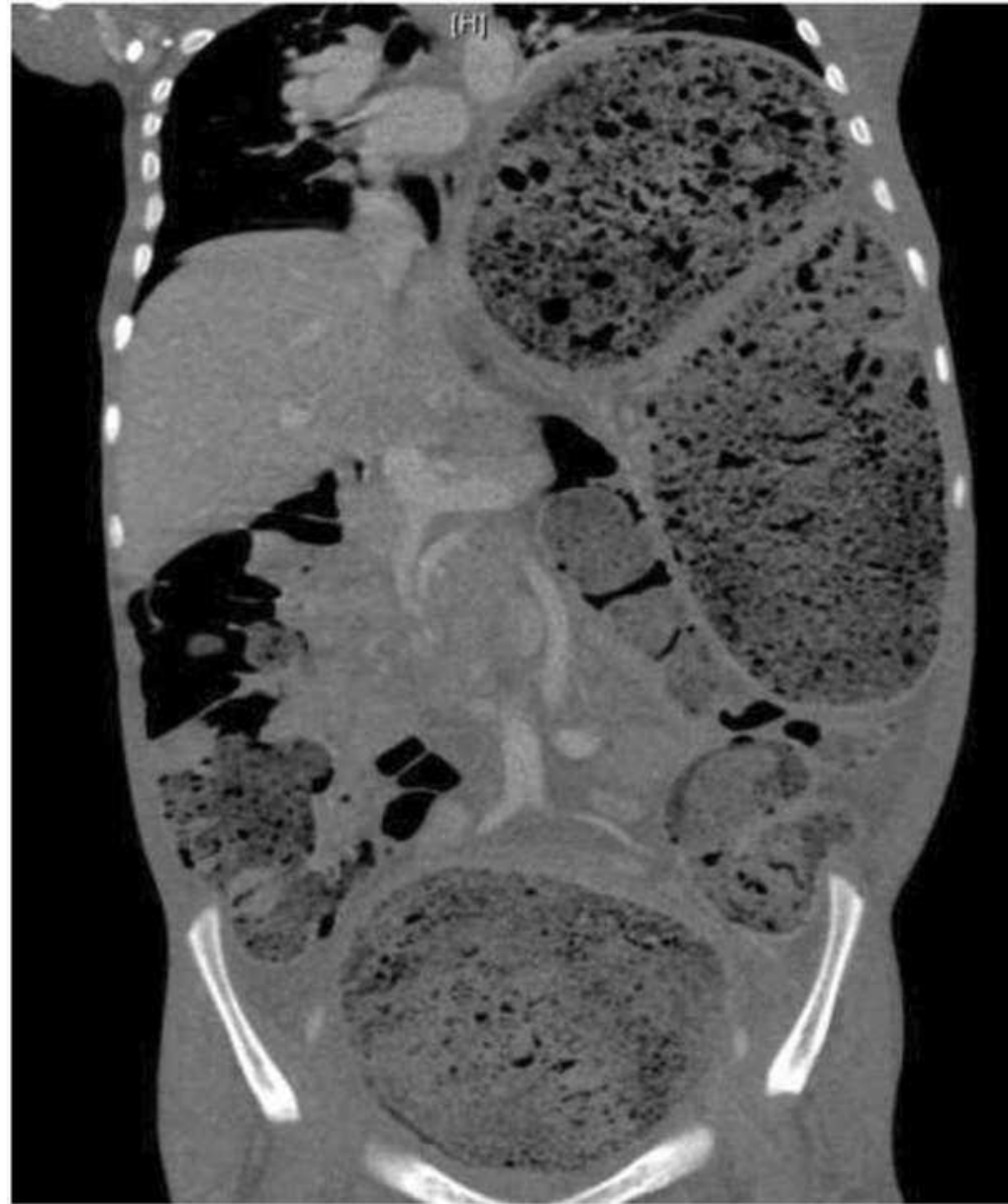
## Are We Using Abdominal Radiographs Appropriately in the Management of Pediatric Constipation?

Beate Beinvogl MD,<sup>1,2</sup> Sabina Sabharwal MD, MPH,<sup>2</sup> Maireade McSweeney MD, MPH,<sup>2</sup> Samuel Nurko MD, MPH,<sup>1,2</sup>

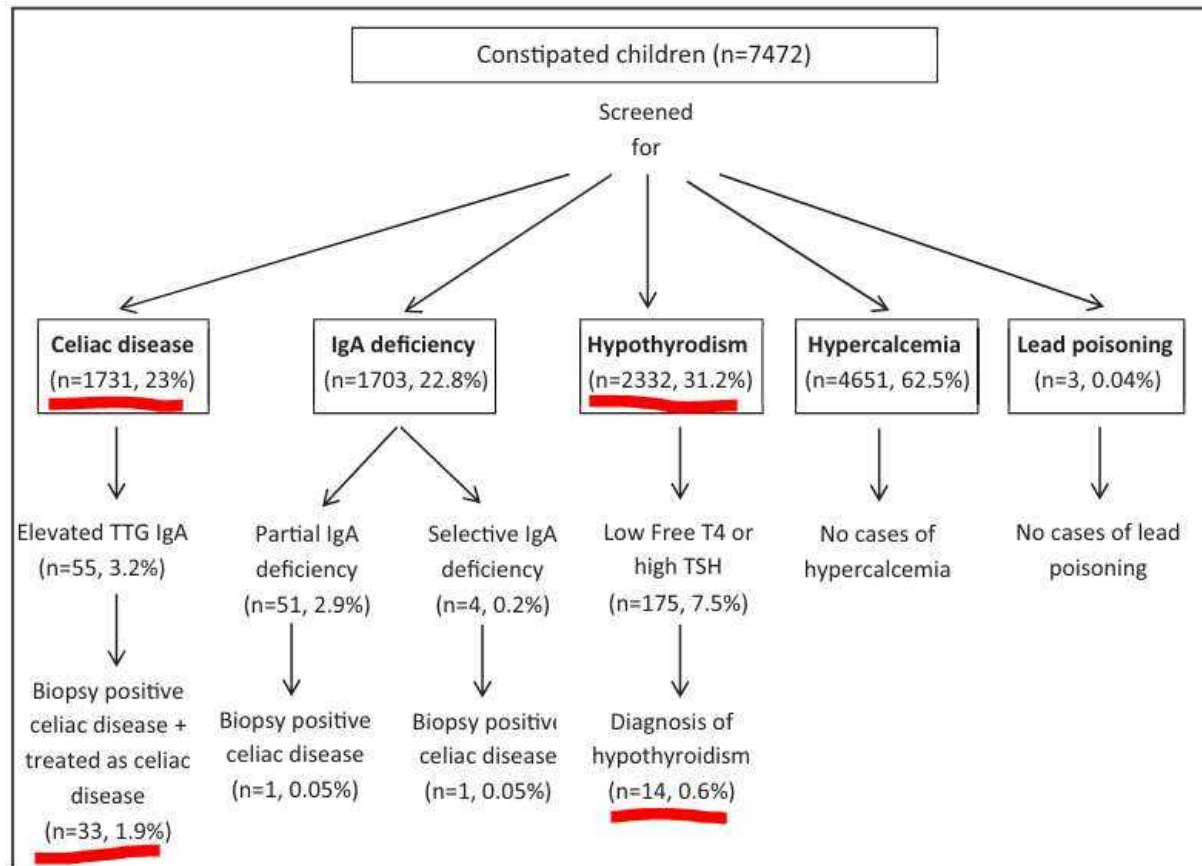
Prospective survey of 24 pediatric gastroenterology providers (18 attendings, 4 NPs, 1 fellow) who ordered x-rays on 72 patients



- X-ray poorly correlates with clinical symptoms or severity of fecal retention, and the interrater reliability of their interpretation is poor
- Diagnosis of constipation by x-ray may overlook medical/surgical conditions. University of Toronto study: 20/3685 (0.5%) ED patients had appendicitis, intussusception, obstruction

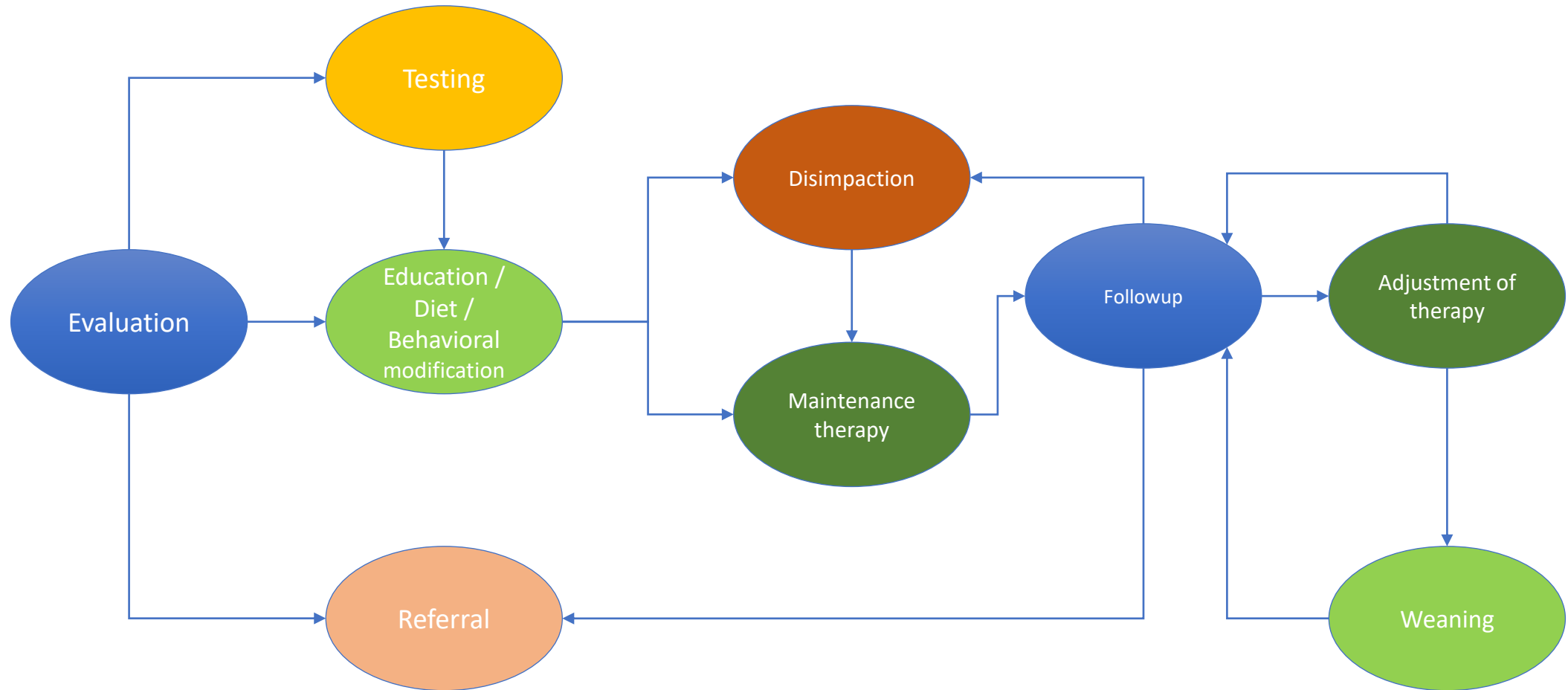


# Role of labs



- Lack of evidence to support obtaining thyroid function tests, celiac screening, serum electrolytes, including calcium, in the absence of red flags
- Rare to find organic diseases in children presenting only with constipation

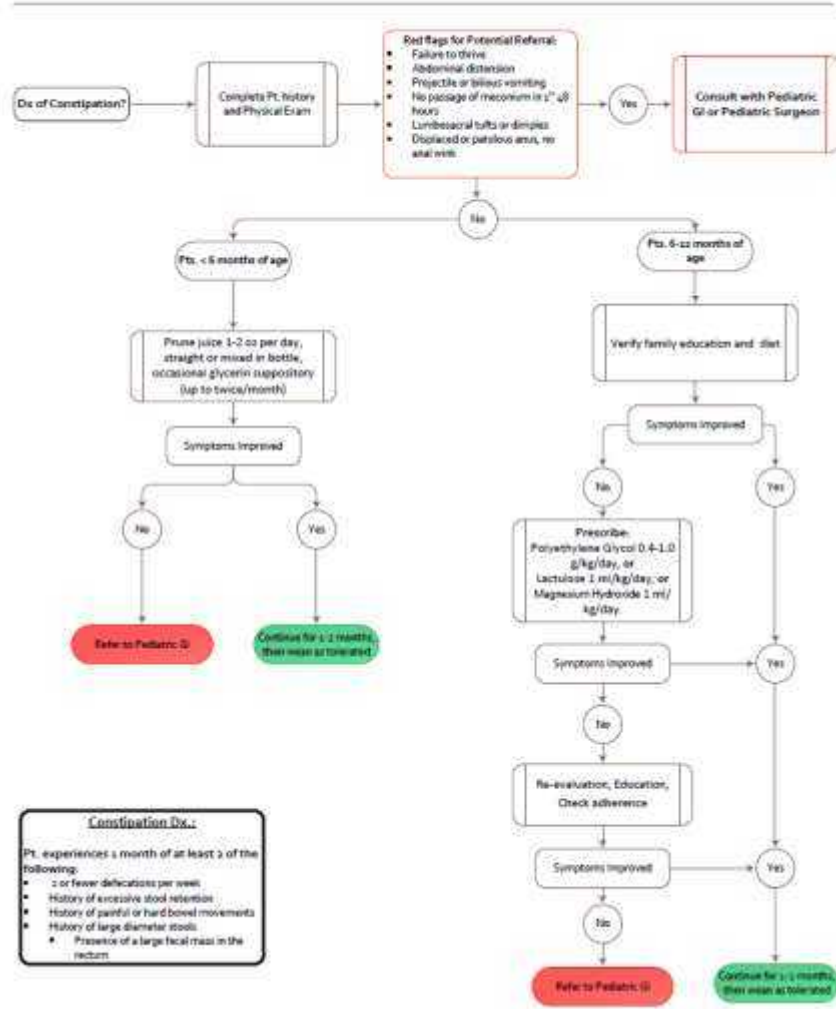
# Principles of management



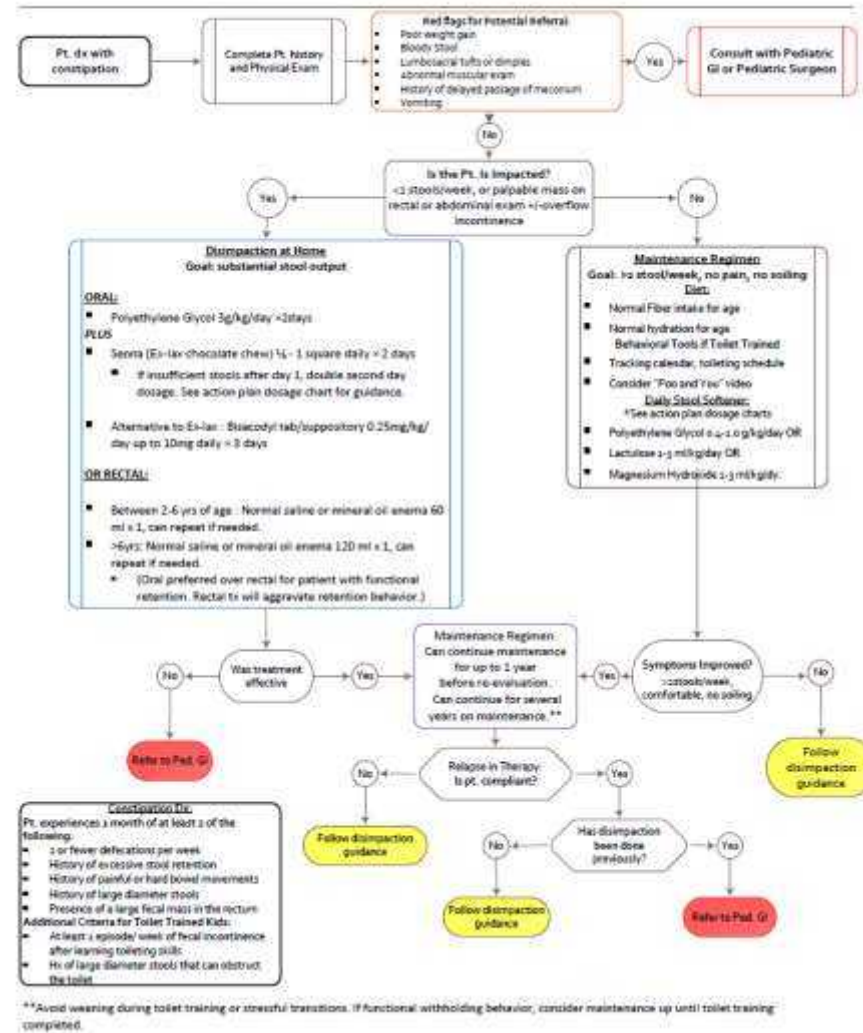


Ad

Constipation Algorithm Patients < 1 Years Old



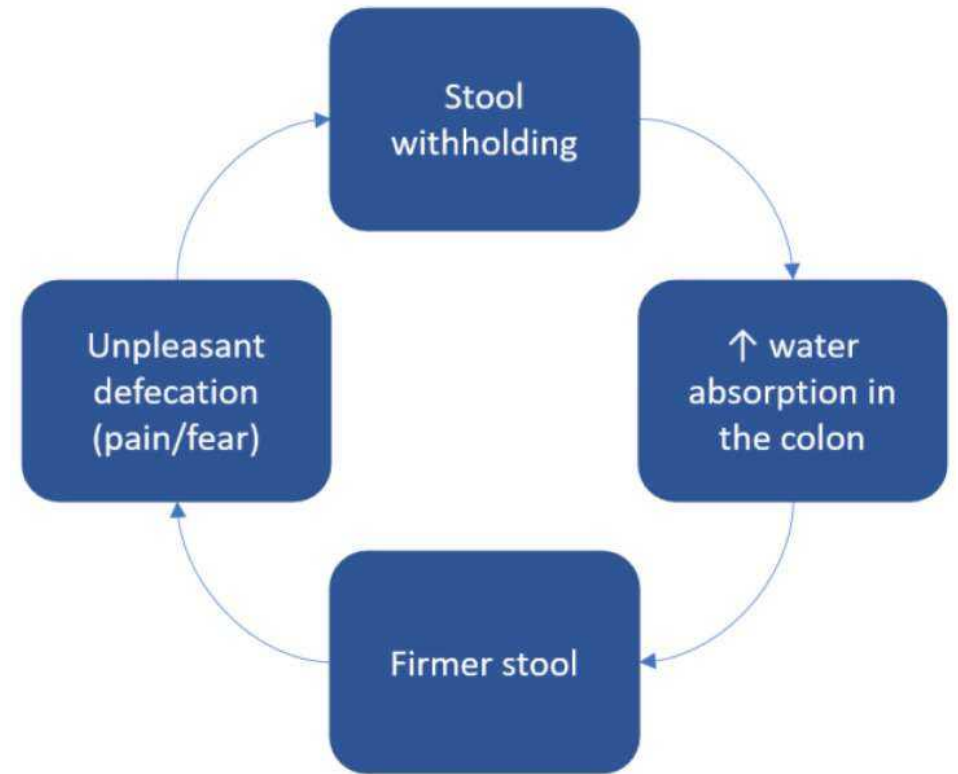
Constipation Algorithm Patients > 1 Years Old





# Therapeutic aspects to discuss with family

- Healthy diet, adequate fiber intake
- Toilet training / education on stool withholding
- Oral laxatives – doses should be individualized
- Rectal enemas / suppositories - essential for disimpaction. Can be used as-needed
- Parent/child input on choosing medications
- Need to give medications regularly and for a long time
- Unfounded concern for developing “dependence”





## Understanding the Physics of Functional Fibers in the Gastrointestinal Tract: An Evidence-Based Approach to Resolving Enduring Misconceptions about Insoluble and Soluble Fiber

Johnson W. McRorie, Jr, PhD; Nicola M. McKeown, PhD

liquid stool is  $\approx 90\%$  water content; soft stool is  $\approx 77\%$  water; formed stool is  $\approx 75\%$  water, and hard stool is  $\leq 72\%$  water

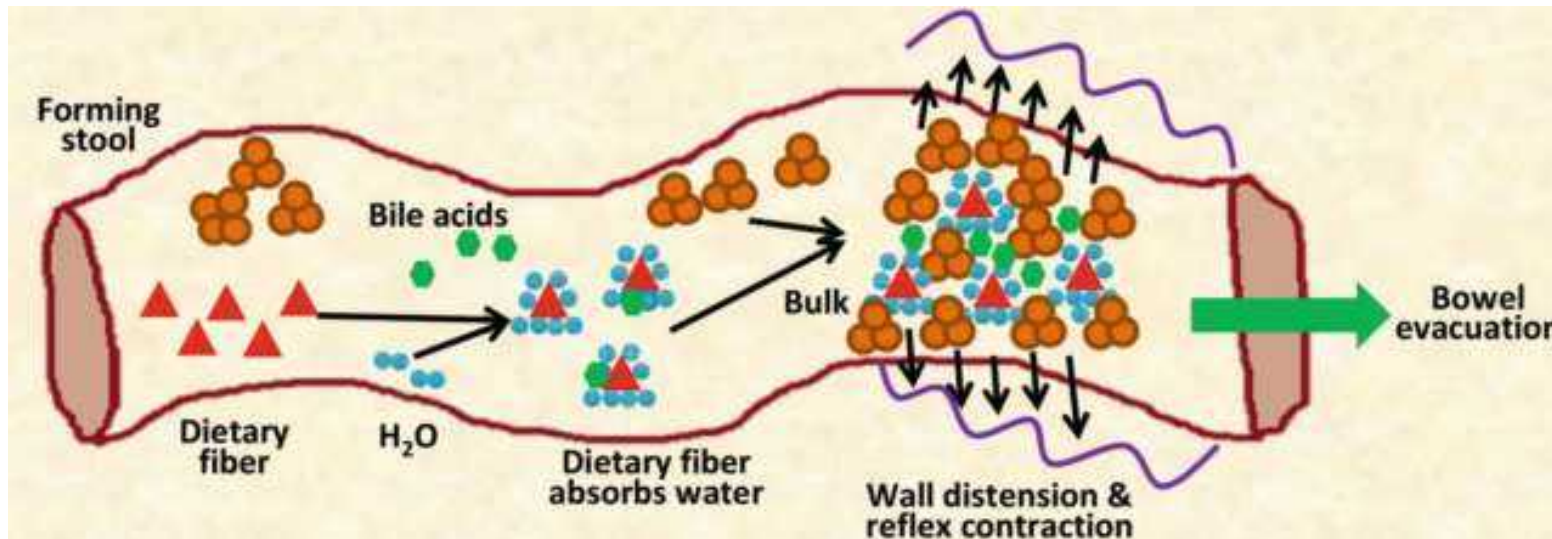
200 x difference in viscosity

*J Acad Nutr Diet. 2017 Feb;117(2):251-264.*

- large/coarse **insoluble** fiber particles (eg, wheat bran) have a mechanically irritating effect on colonic mucosa, stimulating secretion of water and mucus
- small/smooth insoluble fiber particles may be constipating
- **soluble** gel-forming fiber (eg, psyllium) has a high water-holding capacity
- **fermentable fibers** would not work

# Psyllium

- gel-forming psyllium is not fermented in the gut
- retains its high water-holding capacity
- provides bulky/soft stools that are easy to pass



*Aliment Pharmacol Ther.* 1998 May;12(5):491-7

*J Acad Nutr Diet.* 2017 Feb;117(2):251-264.

- **Fibers**
- Dietary fiber intake of “age plus 5 g” is usually recommended
- Evidence does not support the use of extra fiber supplements

Characteristic	No Water-Holding Capacity			Water-Holding Capacity			
	Insoluble Wheat bran	Soluble No Viscosity		Viscous Methylcellulose	Viscous/Gel-Forming		
		Wheat dextrin	Inulin		Partially hydrolyzed guar gum	b-glucan	Psyllium
Example	All Bran <sup>a</sup>	Benefiber <sup>b</sup>	Fiber Choice <sup>c</sup>	MiraFiber Citrucel <sup>d</sup>	Generic	Quaker Oats <sup>e</sup>	Metamucil <sup>f</sup>
Source	Wheat	Chemically altered wheat starch	Chicory root	Chemically altered wood pulp	Guar beans	Oats, barley	Blonde psyllium seed husk
Natural?	Natural	Semisynthetic	Natural	Semisynthetic	Processed (↓ viscosity)	Natural	Natural
Degree of fermentation	<u>Poorly fermented</u>	Readily fermented	Readily fermented	<u>Nonfermented</u>	Readily fermented	Readily fermented	<u>Nonfermented</u>
Cholesterol lowering					± <sup>g</sup>	+ <sup>h</sup>	+
Improved glycemic control					± <sup>g</sup>	+ <sup>h</sup>	+
Constipation/stool softener	+ <sup>i</sup>			± <sup>j</sup>			+
Diarrhea/stool normalizer							+

Comr

TABLE 6. Dosages of most frequently used oral and rectal laxatives

Oral laxatives	Dosages
Osmotic laxatives	
Lactulose	1–2 g/kg, once or twice/day
PEG 3350	Maintenance: 0.2–0.8 g · kg <sup>-1</sup> · day <sup>-1</sup>
PEG 4000	Fecal disimpaction: 1–1.5 g · kg <sup>-1</sup> · day <sup>-1</sup> (with a maximum of 6 consecutive days)
Milk of magnesia (magnesium hydroxide)	2–5 y: 0.4–1.2 g/day, once or divided
	6–11 y: 1.2–2.4 g/day, once or divided
	12–18 y: 2.4–4.8 g/day, once or divided
Fecal softeners	
Mineral oil	1–18 y: 1–3 mL · kg <sup>-1</sup> · day <sup>-1</sup> , once or divided, max 90 mL/day
Stimulant laxatives	
Bisacodyl	3–10 y: 5 mg/day
	>10 y: 5–10 mg/day
Senna	2–6 y: 2.5–5 mg once or twice/day
	6–12 y: 7.5–10 mg/day
	>12 y: 15–20 mg/day
Sodium picosulfate	1 mo–4 y: 2.5–10 mg once/day
	4–18 y: 2.5–20 mg once/day
Rectal laxatives/enemas	
Bisacodyl	2–10 y: 5 mg once/day
	>10 y: 5–10 mg once/day
Sodium docusate	<6 y: 60 mL
	>6 y: 120 mL
Sodium phosphate	1–18 y: 2.5 mL/kg, max 133 mL/dose
NaCl	Neonate <1 kg: 5 mL, >1 kg: 10 mL
	>1 y: 6 mL/kg once or twice/day
Mineral oil	2–11 y: 30–60 mL once/day
	>11 y: 60–150 mL once/day

# Disimpaction

- Indicated when a hard fecal mass is identified in the rectum
- Improves the response to maintenance treatment
- RCT: high-dose (1–1.5 g/kg/day) oral polyethylene glycol (PEG) and sodium docusate enema for 6 consecutive days - no difference in efficacy between both treatments
- High-dose PEG is associated with a higher frequency of fecal incontinence during treatment
- ESPGHAN/NASPGHAN guideline recommends the use of PEG as a first choice

# PHN Algorithm: disimpaction for patients > 1 years old

## Disimpaction at Home

Goal: substantial stool output

### ORAL:

- Polyethylene Glycol 3g/kg/day x 2 days

### PLUS

- Senna (Ex-lax chocolate chew)  $\frac{1}{4}$  - 1 square daily x 2 days
  - If insufficient stools after day 1, double second day dosage. See action plan dosage chart for guidance.
- Alternative to Ex-lax : Bisacodyl tab/suppository 0.25mg/kg/day up to 10mg daily x 3 days

### OR RECTAL:

- Between 2-6 yrs of age : Normal saline or mineral oil enema 60 ml x 1, can repeat if needed.
- >6yrs: Normal saline or mineral oil enema 120 ml x 1, can repeat if needed.
  - (Oral preferred over rectal for patient with functional retention. Rectal tx will aggravate retention behavior.)

## PHN Algorithm: maintenance for patients > 1 years old

### Long-term maintenance therapy

- ESPGHAN/NASPGHAN: use PEG as a first choice
- If PEG is not available, use lactulose as an alternative osmotic laxative
- continue for at least 2 months and until toilet training is accomplished

#### Maintenance Regimen

**Goal: >2 stool/week, no pain, no soiling**

#### Diet:

- Normal Fiber intake for age
- Normal hydration for age
- Behavioral Tools if Toilet Trained
- Tracking calendar, toileting schedule
- Consider "Poo and You" video

#### Daily Stool Softener:

\*See action plan dosage charts

- Polyethylene Glycol 0.4-1.0 g/kg/day OR
- Lactulose 1-3 ml/kg/day OR
- Magnesium Hydroxide 1-3 ml/kg/dy.



## Weaning

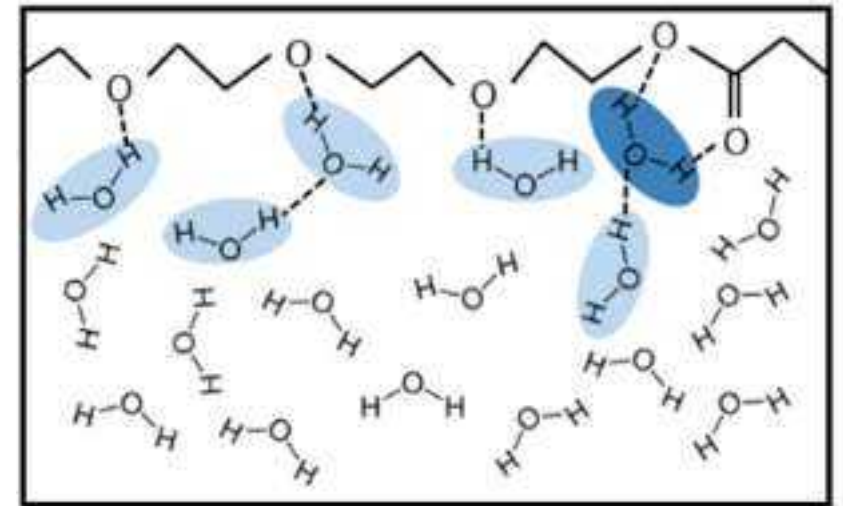
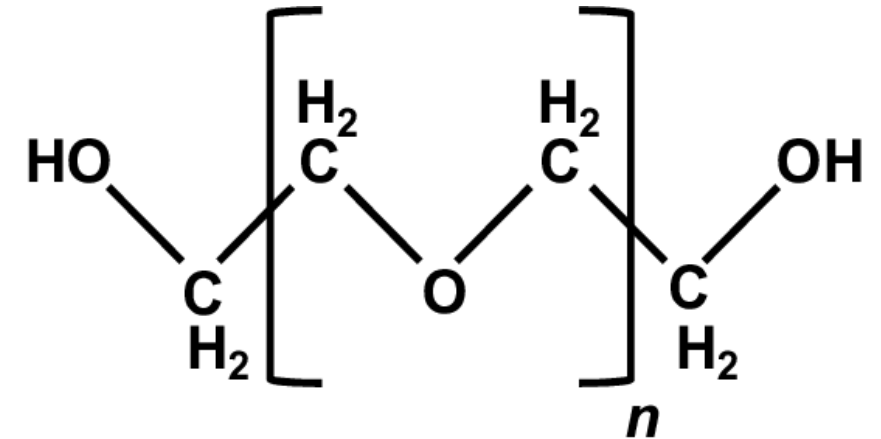
- approximately 50 % on maintenance treatment can be weaned within 6–12 months
- symptoms should be resolved for > 1 month before weaning is initiated
- should be gradually reduced, rather than abruptly discontinued
- symptoms should be evaluated 2 months after cessation of treatment, to prevent or detect relapses

PHN Algorithm: long-term therapy for patients > 1 years old

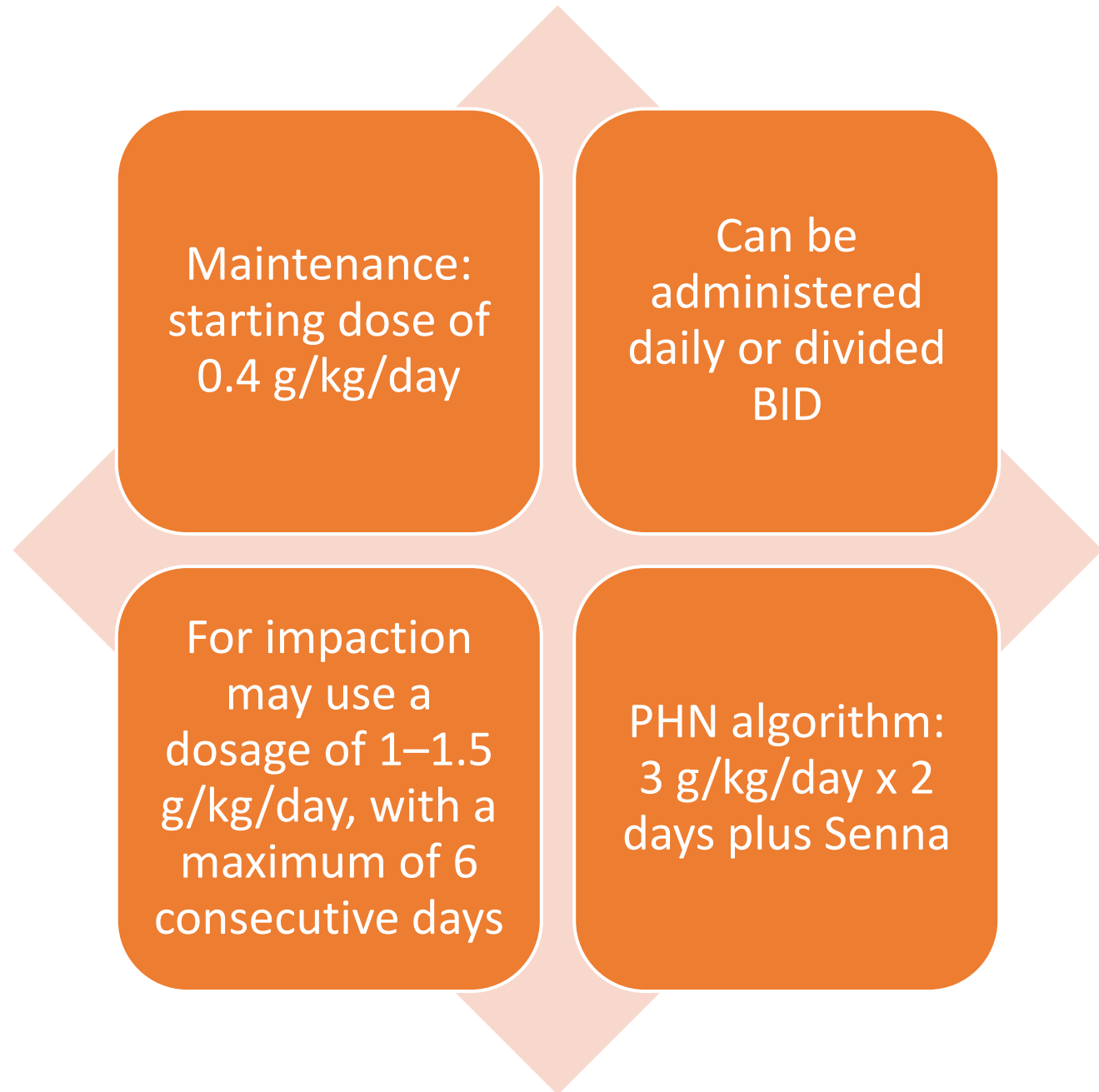
Maintenance Regimen.  
Can continue maintenance for up to 1 year before re-evaluation.  
Can continue for several years on maintenance.\*\*

# Polyethylene glycol (PEG)

- Not metabolized and is minimally (<1%) absorbed in the intestine
- More effective in increasing stool frequency than placebo, lactulose, and magnesium hydroxide
- Effect seen within 1–2 days; in fecal impaction, this effect might be delayed
- Dosages and frequency should be individualized




# PEG dosing



# Safety of PEG

The New York Times

## *Drug for Adults Is Popular as Children's Remedy*

 Share full article



 192

By [Catherine Saint Louis](#)

May 25, 2012

- Empire State Consumer Project, a New York consumer group, sent a citizen petition to the F.D.A.
- Reports of tremors, tics, and obsessive-compulsive behavior
- To date, evidence on any relationship between PEG and neuropsychiatric events remains limited to anecdotal reports

## **Role of Polyethylene Glycol in the Treatment of Functional Constipation in Children**

Ilan J N Koppen<sup>1</sup>, Ilse J Broekaert, Michael Wilschanski, Alexandra Papadopoulou, Carmen Ribes-Koninckx, Nikhil Thapar, Frederic Gottrand, Rok Orel, Paolo Lionetti, Marc A Benninga

### Concerns about laxative addiction

- *“physical or psychological dependence have never been reported for the use of PEG, nor are they expected to occur based on its mechanism of action.”*
- *“abrupt cessation of treatment with PEG can cause a relapse related to the underlying constipation”*
- *“no published adult or pediatric evidence that the effect of PEG will wear off over time”*

# Other concerns about PEG



“lazy bowel” or “lazy bowel syndrome” : nonmedical terms referring to a decrease in colonic function as a result of laxative usage



has not been described in the medical literature for patients using PEG



may have been seen in patients with severe functional constipation who have an underlying motility disorder



## PEG 3350 Administration Is Not Associated with Sustained Elevation of Glycol Levels

Kent C. Williams, MD > [J Pediatr Gastroenterol Nutr.](#) 2020 Aug;71(2):171-175. doi: 10.1097/MPG.0000000000002786.

## Polyethylene Glycol Dosing for Constipation in Children Younger Than 24 Months: A Systematic Review

Helisa Rachel<sup>1 2</sup>, Andrew F Griffith<sup>1 2</sup>, Warwick J Teague<sup>1 2 3</sup>, John M Hutson<sup>1 3 4</sup>,  
Susan Gibb<sup>1 3 5</sup>, Sharon Goldfeld<sup>1 3 6</sup>, Misel Trajanovska<sup>1 3 6</sup>, Sebastian K King<sup>1 2 3 7</sup> 40.

## Polyethylene glycol: a game-changer laxative for children

Arik Alper<sup>1</sup>, Dinesh S Pashankar

# 25<sup>th</sup> anniversary of “Miracle-LAX”

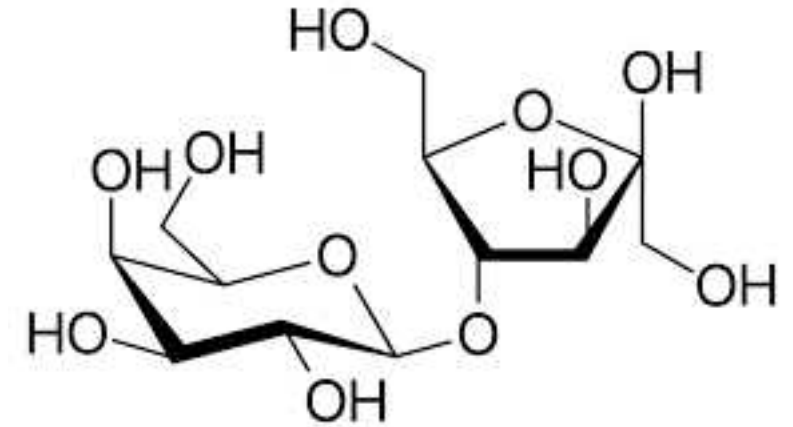


*Michelangelo (1508-1512); Vatican Museums*



# Lactulose

- disaccharide of lactose (C<sub>12</sub>H<sub>22</sub>O<sub>11</sub>)
- fermented into low-molecular-weight acids in the colon by bacteria
- acids cause an osmotic effect, increase of intraluminal fluids
- lower fecal pH stimulates peristalsis
- safe and effective for pts >6 months
- may cause abdominal gas, bloating, and cramping



Dosing: 1-3 ml/kg/day

Magnesium hydroxide (also known as milk of magnesia, MOM)

- hyperosmolar agent causing an osmotic gradient
- Cochrane review : PEG is superior to MOM
- RCT from Mexico (41 vs. 42 children): no difference between PEG and MOM
- Side effects: diarrhea, abdominal pain, and bloating
- **Dosing per NASPGHAN**
  - 2–5 y: 0.4–1.2 g/day, once or divided
  - 6–11 y: 1.2–2.4 g/day, once or divided
  - 12–18 y: 2.4–4.8 g/day, once or divided

# Lactulose vs. Milk of Magnesia

Review > Cochrane Database Syst Rev. 2016 Aug 17;2016(8):CD009118.

doi: 10.1002/14651858.CD009118.pub3.

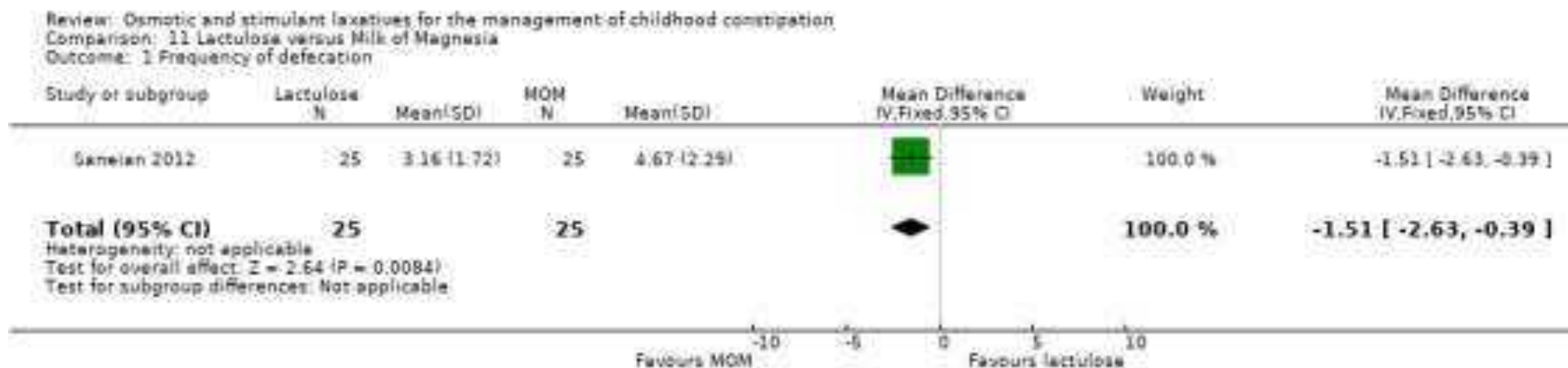
## Osmotic and stimulant laxatives for the management of childhood constipation

Morris Gordon<sup>1</sup>, John K MacDonald, Claire E Parker, Anthony K Akobeng, Adrian G Thomas

FULL TEXT LINKS



ACTIONS:



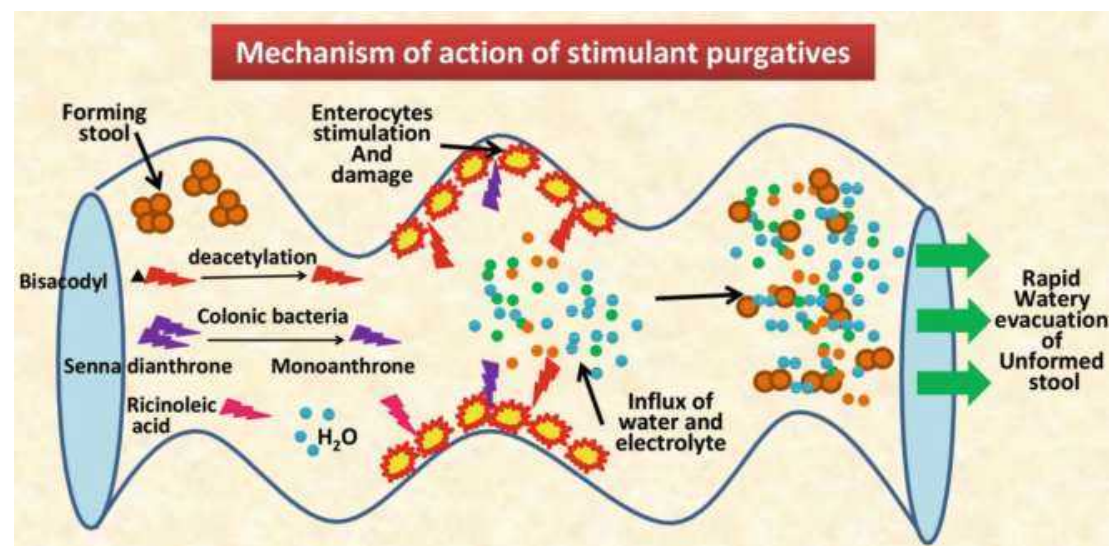
# Other magnesium products

- Oral magnesium citrate - used for bowel cleanout prior to colonoscopy
- In one study, 12% of the children were unable to drink the entire dose of magnesium citrate
- little evidence to use as maintenance therapy



# Stimulant Laxatives

- enhance colonic peristalsis and secretion by stimulation of the enteric nervous system
  - diphenylmethanes (e.g., bisacodyl and sodium picosulfate)
  - anthraquinones (e.g., senna)  
phenolic compounds, metabolized by bacteria
- abdominal cramping is a common side effect



# Bisacodyl

- Maintenance therapy (can not be crushed)
  - 3–10 y: 5 mg/day
  - >10 y: 5–10 mg/day
- PHN algorithm: does not include for maintenance.
- retrospective study in 164 children with refractory constipation: bowel movements increased from 2 to 4 per week
- do not administer rectally if proctitis or anal fissures



# Senna

- Tablet (8.6, 15, 25 mg) > syrup (8.6 mg/5 ml) > ExLax 15 mg/square
- Dosing:
  - 2–6 y: 2.5–5 mg once or twice/day
  - 6–12 y: 7.5–10 mg/day
  - >12 y: 15–20 mg/day
- Side effects: diarrhea, abdominal pain, nausea, and flatulence and young children are at risk of diaper rash, blisters



# Safety of Senna



Are *Senna* based laxatives safe when used as long term treatment for constipation in children?



Alejandra Vilanova-Sanchez\*, Alessandra C. Gasior, Nicole Toocheck, Laura Weaver, Richard J Wood, Carlos A. Reck, Andrea Wagner, Erin Hoover, Renae Gagnon, Jordan Jagers, Tassiana Maloof, Onnalisa Nash, Charae Williams, Marc A Levitt

- Review of literature and single center data (640 patients)
- 83 (13%) minor side effects (cramping, vomiting, diarrhea)
- 17 (2%) had blisters
- Advised to reduce stool exposure by changing diapers often
- Adults on long-term senna – melanosis coli, decreased apoptosis
- Retrospective study in adults – higher adenoma rates, no increased cancer



# Enemas

- predominantly used for fecal impaction
- different formulations: Sodium docusate, Sodium lauryl sulfoacetate, Sodium phosphate (hyperosmolar phosphate solution), Bisacodyl, Glycerin
- Japanese study: olive oil enemas in combination with glycerin was effective in 80% of children
- Adverse events are mostly minor and include abdominal pain, emesis, and diarrhea

# Doses of rectal laxatives

---

## Rectal Laxatives/Enemas

---

Bisacodyl

2–10 y: 5 mg once per day  
>10 y: 5–10 mg once per day

---

Sodium docusate

<6 y: 60 mL  
>6 y: 120 mL

---

Sodium phosphate

1–18 y: 2.5 mL/kg, maximum 133 mL/dose

---

Sodium chloride

Neonate <1 kg: 5 mL  
Neonate >1 kg: 10 mL  
>1 y: 6 mL/kg once or twice per day  
2–11 y: 30–60 mL once per day  
>11 y: 60–150 mL once per day

---

Mineral oil

2–11 y: 30–60 mL once per day  
>11 y: 60–150 mL once per day

---

# Newer agents

Prosecretory agents		
Lubiprostone	Limited evidence in children; improvement of stool frequency and consistency, and reduced straining and bloating in adults	Nausea
Linacotide	Limited evidence in children; improvement of stool frequency and consistency in adults	Diarrhoea
Plecanatide	Limited evidence in children; improvement of symptoms in adults	Diarrhoea
Serotonergic agents		
Prucalopride	Limited evidence in children; improvement of stool frequency, consistency and straining in adults	Headache, nausea, diarrhoea and abdominal pain

prostaglandin E1 derivative, promotes intestinal fluid secretion by acting on the type 2 chloride channel and promoting intestinal motility

guanylate cyclase C receptor agonist, promoting intestinal fluid secretion

guanylate cyclase C receptor agonist

selective 5-hydroxytryptamine receptor 4 serotonergic agent that increases acetylcholine release and intestinal motility

# Biofeedback

Pediatr Drugs 17, 349–360 (2015).

Approximately 50 % of children with FC have abnormal defecation dynamics

Reinforcing stimuli and aims to achieve a recognizable sensation with an appropriate response

long-term goal is to teach children to recognize the sensation by themselves

current evidence does not support the use of biofeedback training for the treatment of childhood constipation

# Pelvic physiotherapy

- Pelvic physiotherapy + standard care vs. standard care
- multicenter randomized controlled trial of 53 children
- 92.3% success rate with PPT vs. 63.0% with standard care

## CLINICAL—ALIMENTARY TRACT

### Effectiveness of Pelvic Physiotherapy in Children With Functional Constipation Compared With Standard Medical Care



Marieke L. van Engelenburg-van Lonkhuyzen,<sup>1</sup> Esther M. J. Bols,<sup>1</sup> Marc A. Benninga,<sup>2</sup> Wim A. Verwijs,<sup>3</sup> and Rob A. de Bie<sup>1</sup>

Intervention	Therapeutic process (EPI and SPI) per planned session <sup>c</sup>		
1	EPI	Focus: information	Information and demystification Normalize behavior Improve TR Advice on PEG, MDD, and diet
	SPI	Focus: start TT, posture	Core stability and balance training Relaxation and breathing exercises PEG, MDD, TR/TT
2	EPI	Focus: information	Core stability and balance training Relaxation and breathing exercises Sensory processing techniques PFMT <sup>d</sup>
	SPI	Focus: TT, posture, body awareness (urge to defecate), straining to defecate	PEG, MDD, TR/TT
3-5	EPI	Focus: information	Core stability and balance training Relaxation and breathing exercises Sensory processing techniques PFMT <sup>d</sup>
	SPI	Focus: TT, posture, body awareness, straining to defecate, relaxation, and breathing	PEG, MDD, TR/TT
6	EPI	Focus: information	Core stability and balance Relaxation and breathing
	SPI	Focus: TT, posture, straining to defecate, relaxation, and breathing	PEG, MDD, TR

# Prognosis

## **Functional constipation in children: a systematic review on prognosis and predictive factors**

M A M Pijpers <sup>1</sup>, M E J Bongers, M A Benninga, M Y Berger

- 14 studies with a total of 1752 children
- 50% resolved and taken off laxatives after 6–12 months
- additional 10% were symptom free but still on laxatives
- recovery rate of 58% and 56% after 1–2 years and 5–10 years
- *“.. a sizable group remains symptomatic regardless of treatment and can remain symptomatic into adolescence or adulthood”*

# Referrals / consultations

Red flags

Refractory constipation

Need for frequent cleanouts

Prolonged use of stimulants

Recurrent relapse after weaning off



# Conclusions

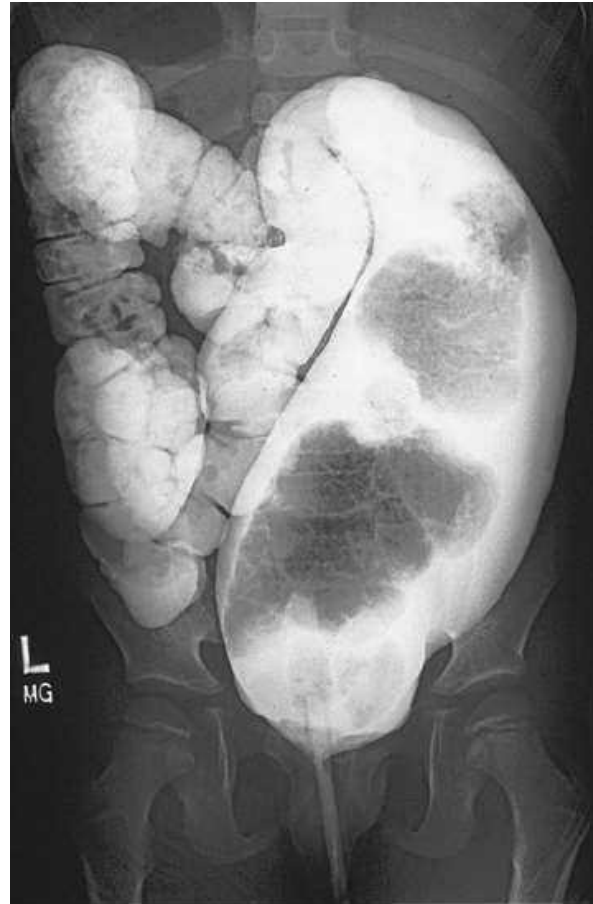
- Diagnosis is based on the Rome IV criteria after a thorough H&P
- Withholding behavior plays a major role
- Additional testing when an organic cause is suspected or if there is a lack of response
- Education, demystification, lifestyle advice, and toilet training (for age  $\geq 4$  years)
- Pharmacological treatment: disimpaction and long-term maintenance
- Polyethylene glycol (PEG) is the first choice
- Long-term stimulants can be used as alternative or additional options
- A large proportion of children remains symptomatic after 6–12 months



Additional slides

# Contrast enema

- Look for megacolon, megarectum,
- Look for transition zone suspicious for Hirschsprung's disease



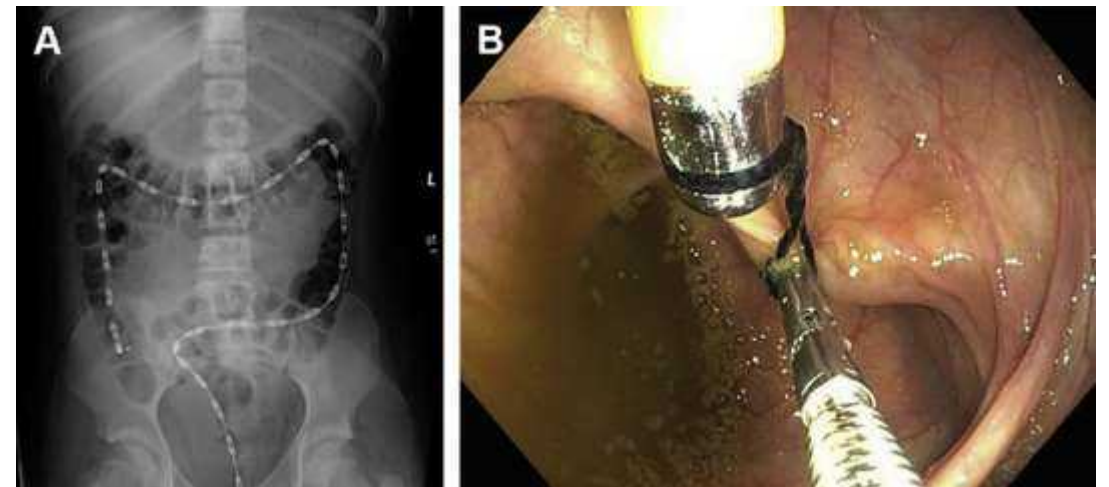
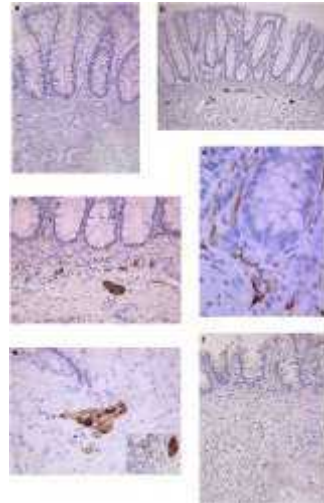
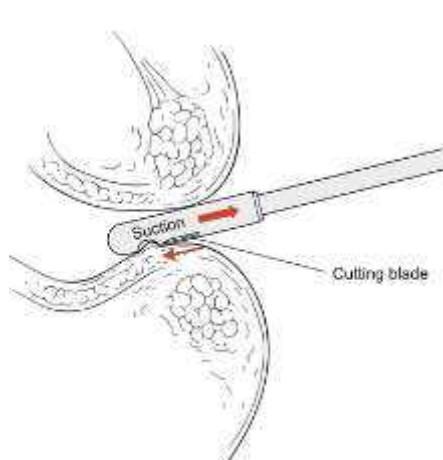
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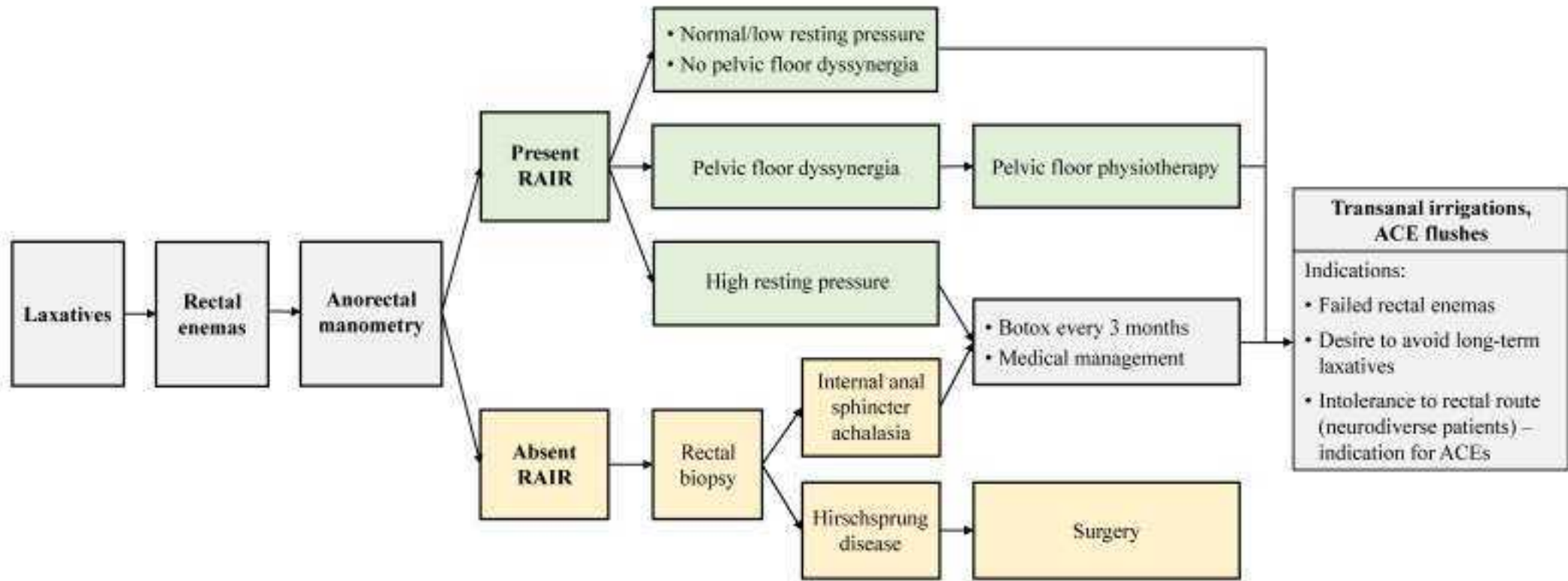


Peña A, Levitt M. 2002

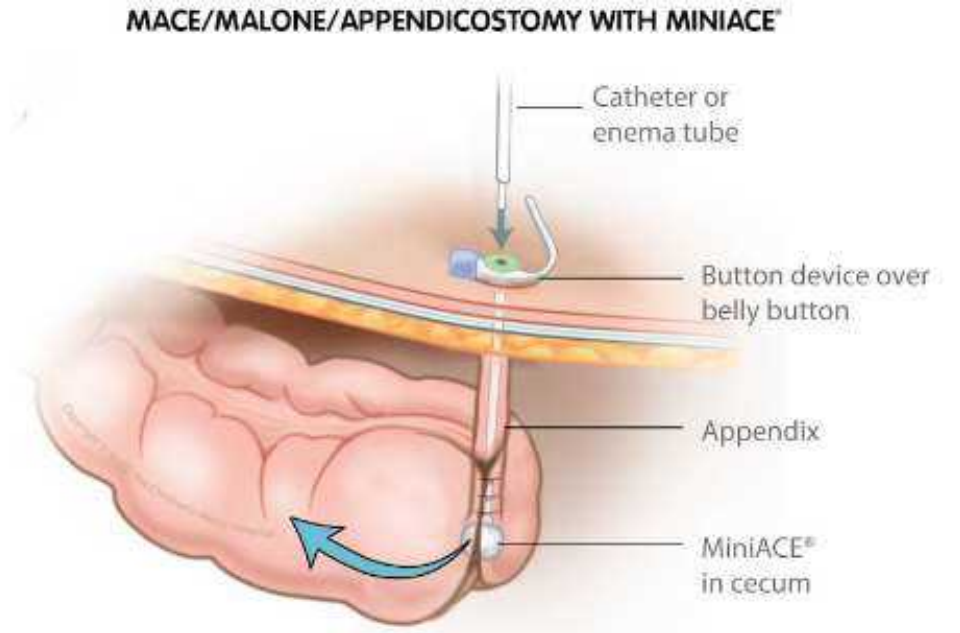
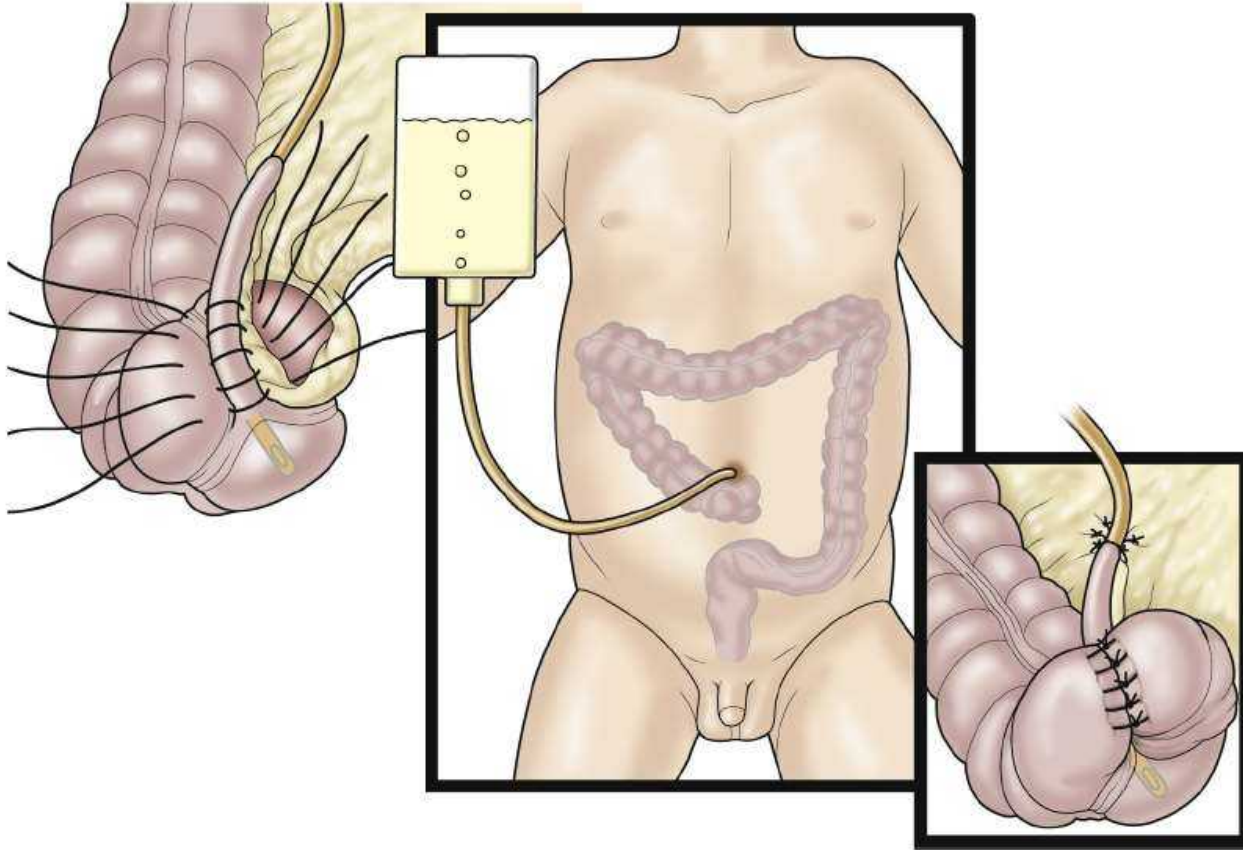
# More advanced testing

- Anorectal manometry
- Colonic manometry
- Rectal suction biopsy

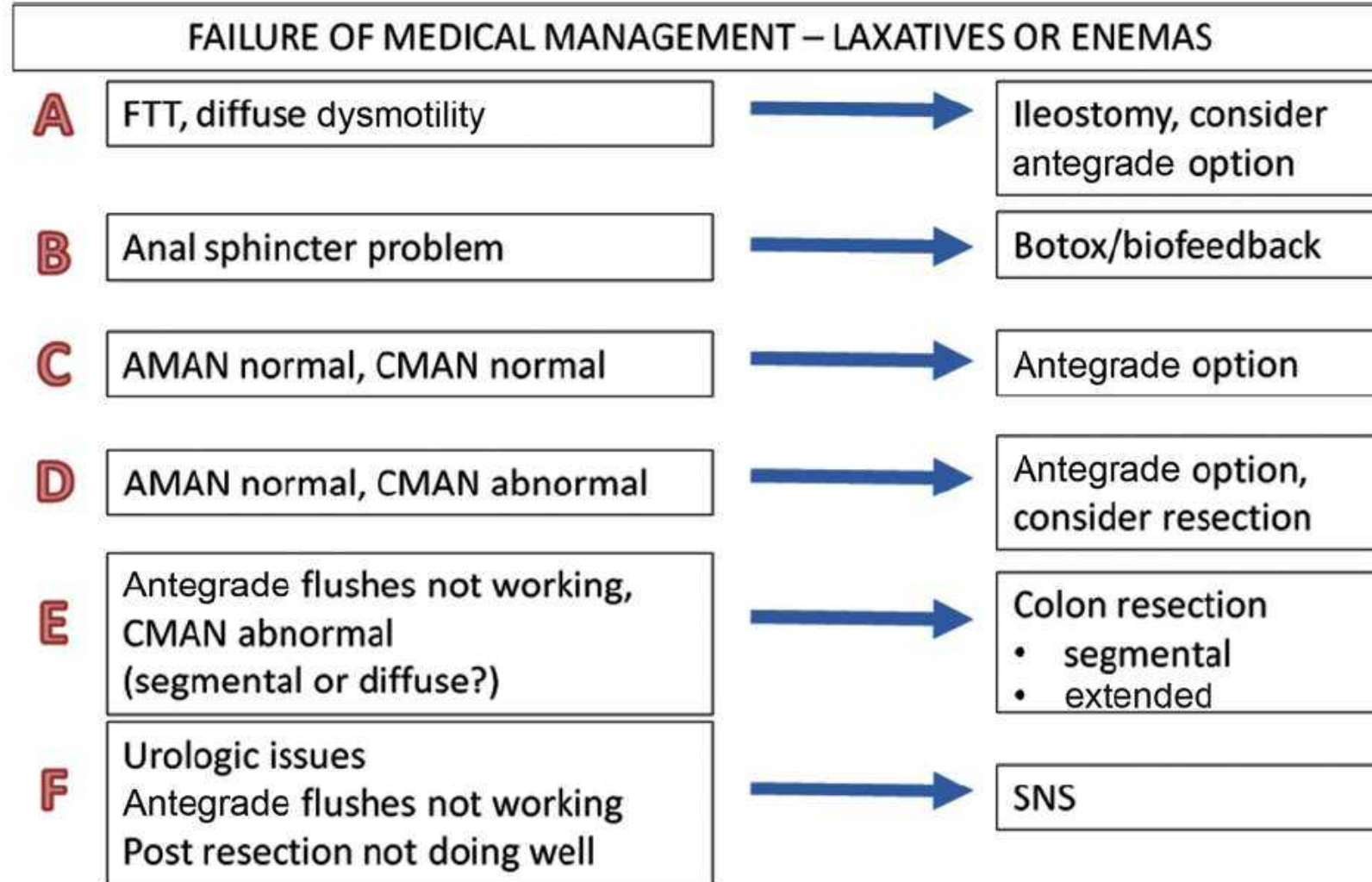




# Antegrade enemas



# Summary of surgical options



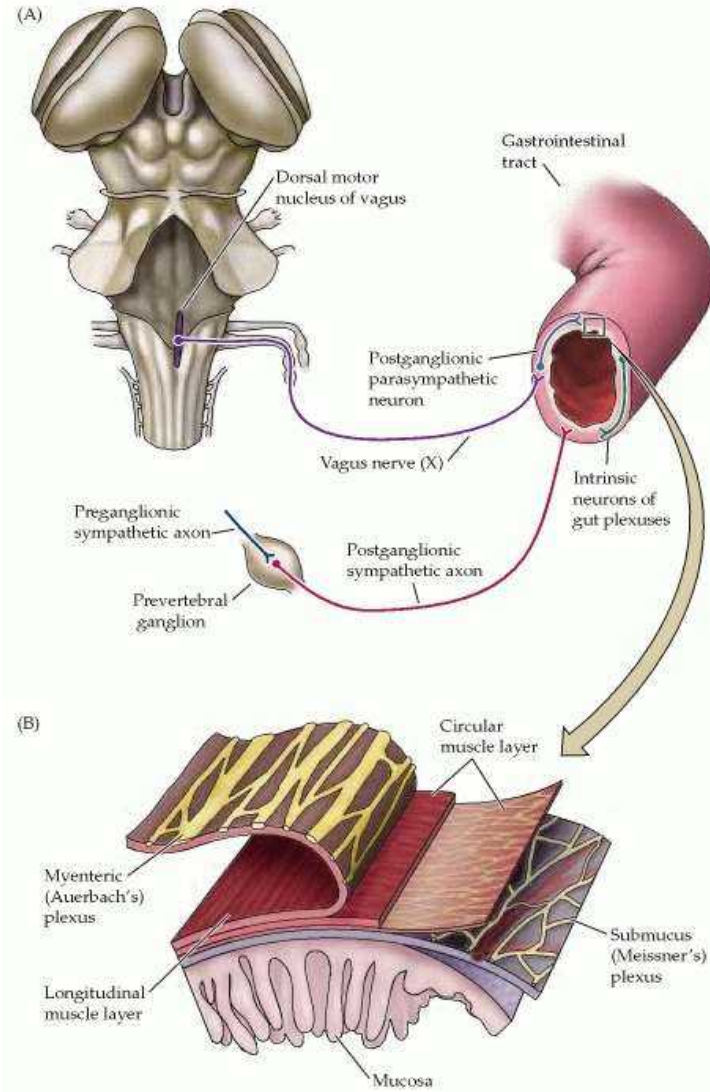
## Anorectal manometry

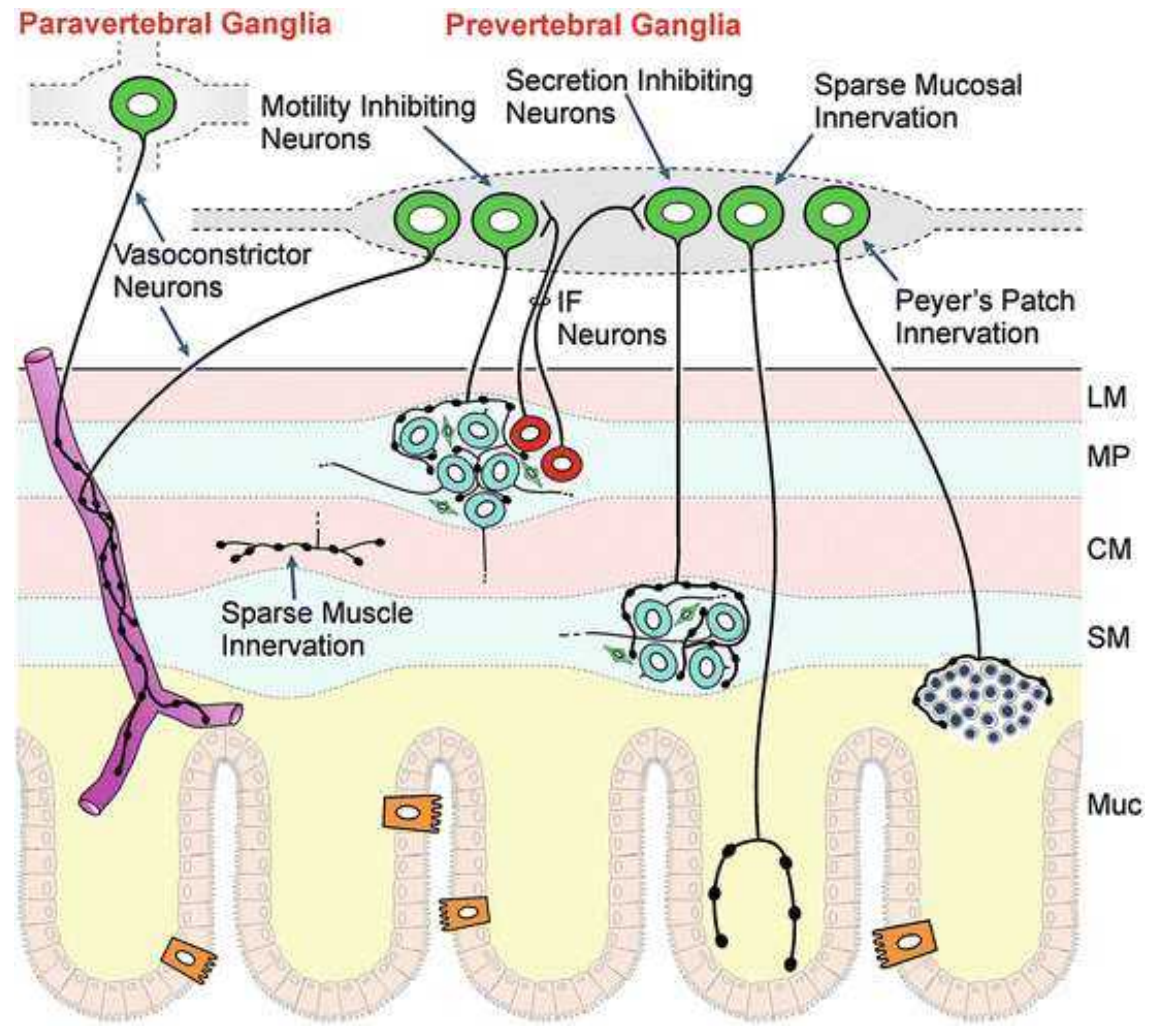
- assesses anal sphincter function, rectal sensation, anorectal reflexes, and pelvic floor function
- balloon inflation with air and determine the presence or absence of the recto-anal inhibitory reflex (RAIR)
- In awake and cooperative patient - patient is asked to simulate defecation and push out an inflated balloon from the rectum

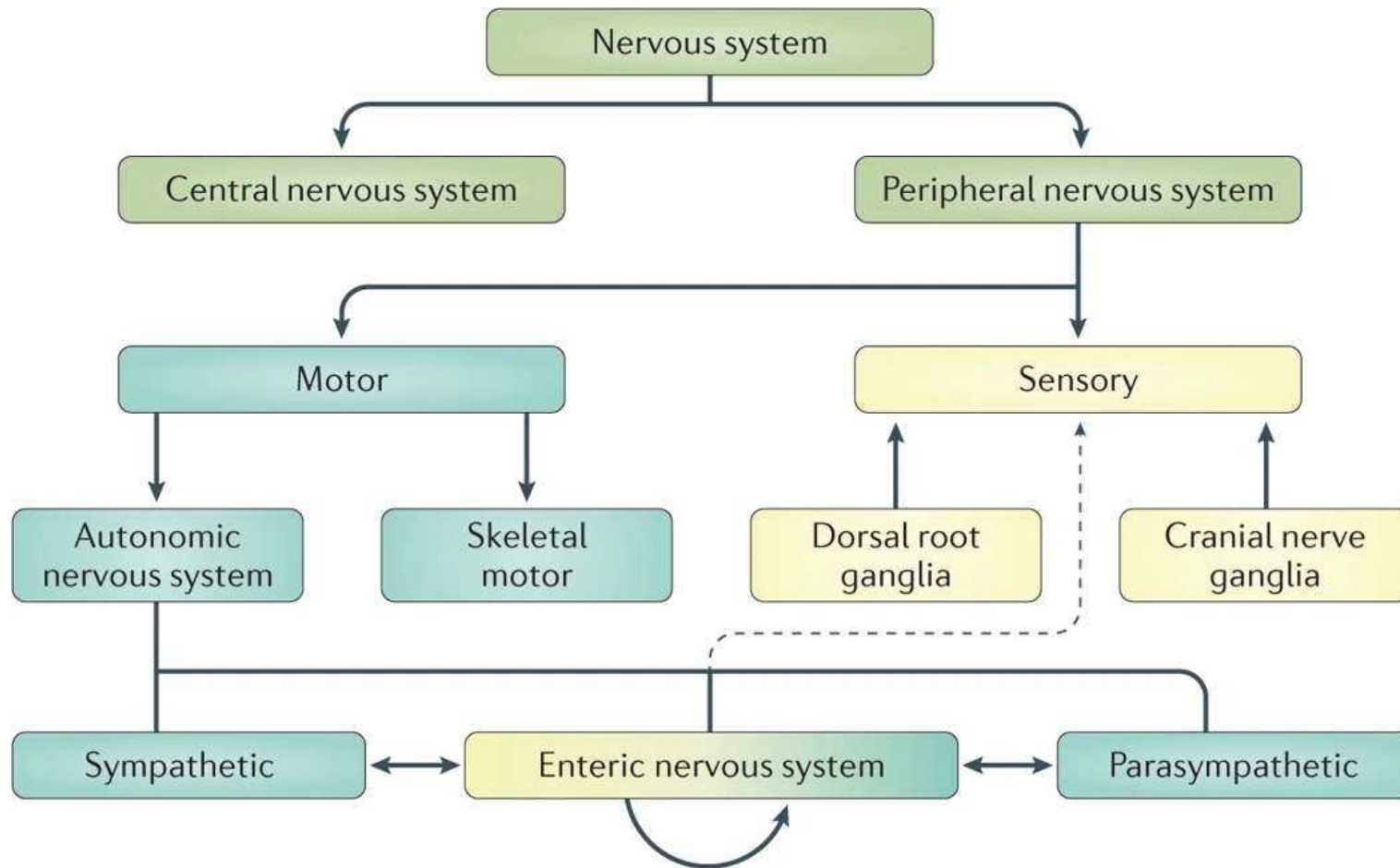
## Colonic Manometry

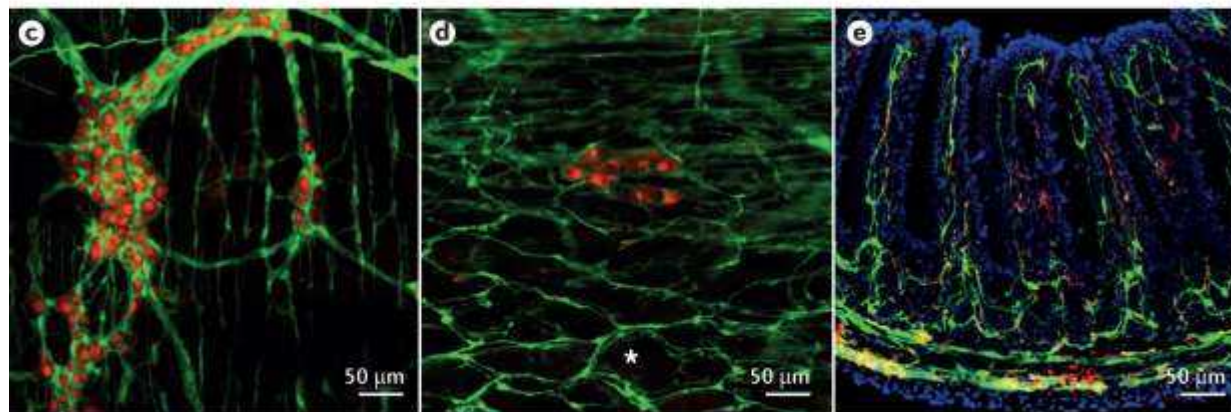
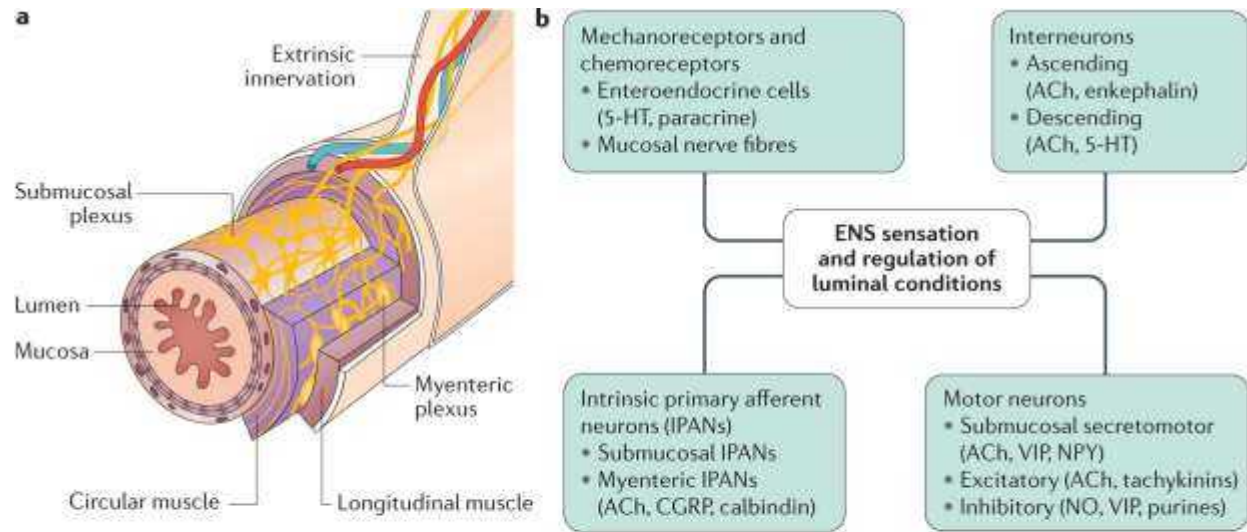
- Determine if severe constipation that is unresponsive to adequate medical therapy is due to intrinsic colonic dysmotility or has functional etiology.
- Act as a guide to plan surgical interventions—including creation of diverting stoma, segmental colonic resection or formation of a conduit for administration of antegrade continence enemas.
- Evaluate a diverted colon before possible takedown of an ostomy












## Title

- the enteric nervous system, the paravertebral ganglia of the autonomic nervous system, and the cerebrospinal axis.
- support of local muscle tone

*Source:*

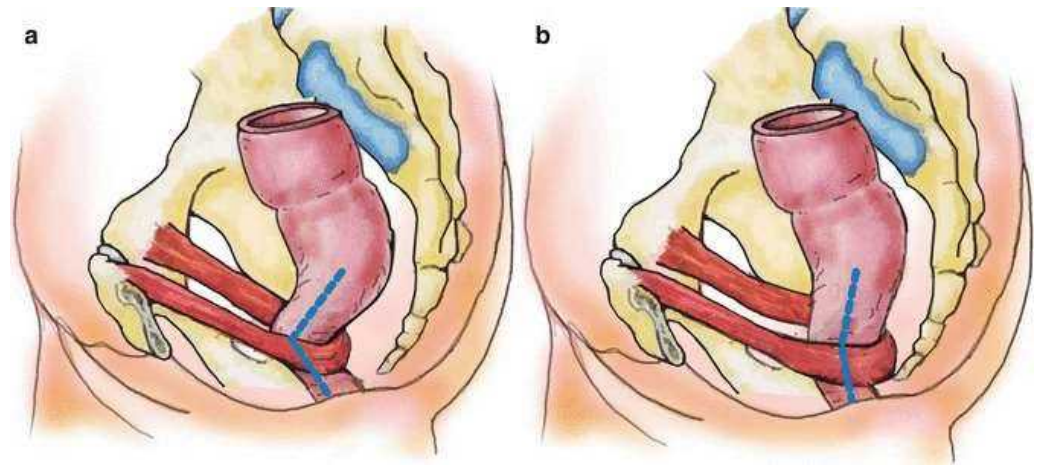
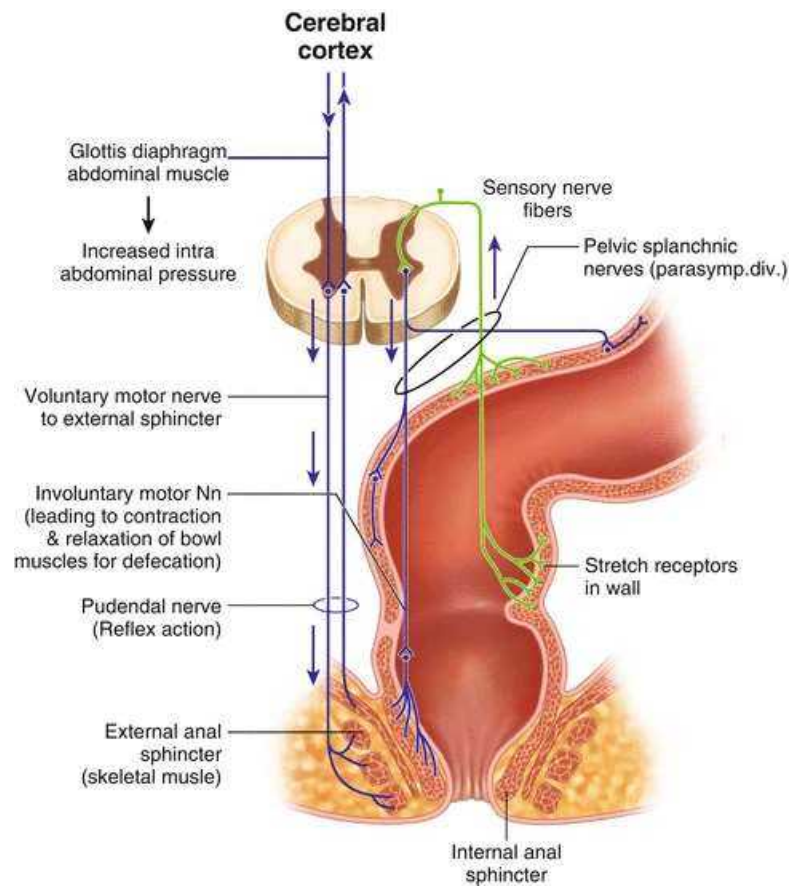
 **MECHANISMS**

Slow-transit constipation is attributed to a reduced frequency or absence of contractions that normally induce propulsive mass movements in the colon

 Rectal evacuation disorders are caused by the inability to coordinate the abdominal muscles, pelvic floor muscles and the anal sphincter to evacuate stools owing to structural or functional defects. Dyssynergic defecation is the most common evacuation disorder and is caused by functional defects; it is the consequence of, for example, faulty toilet habits, painful defecation and dysfunction of the gut-brain axis.

Most patients with chronic constipation do not have evidence of slow colonic transit or rectal evacuation disorders; this type of constipation is called functional constipation

 **QUALITY OF LIFE**



Key aspects of

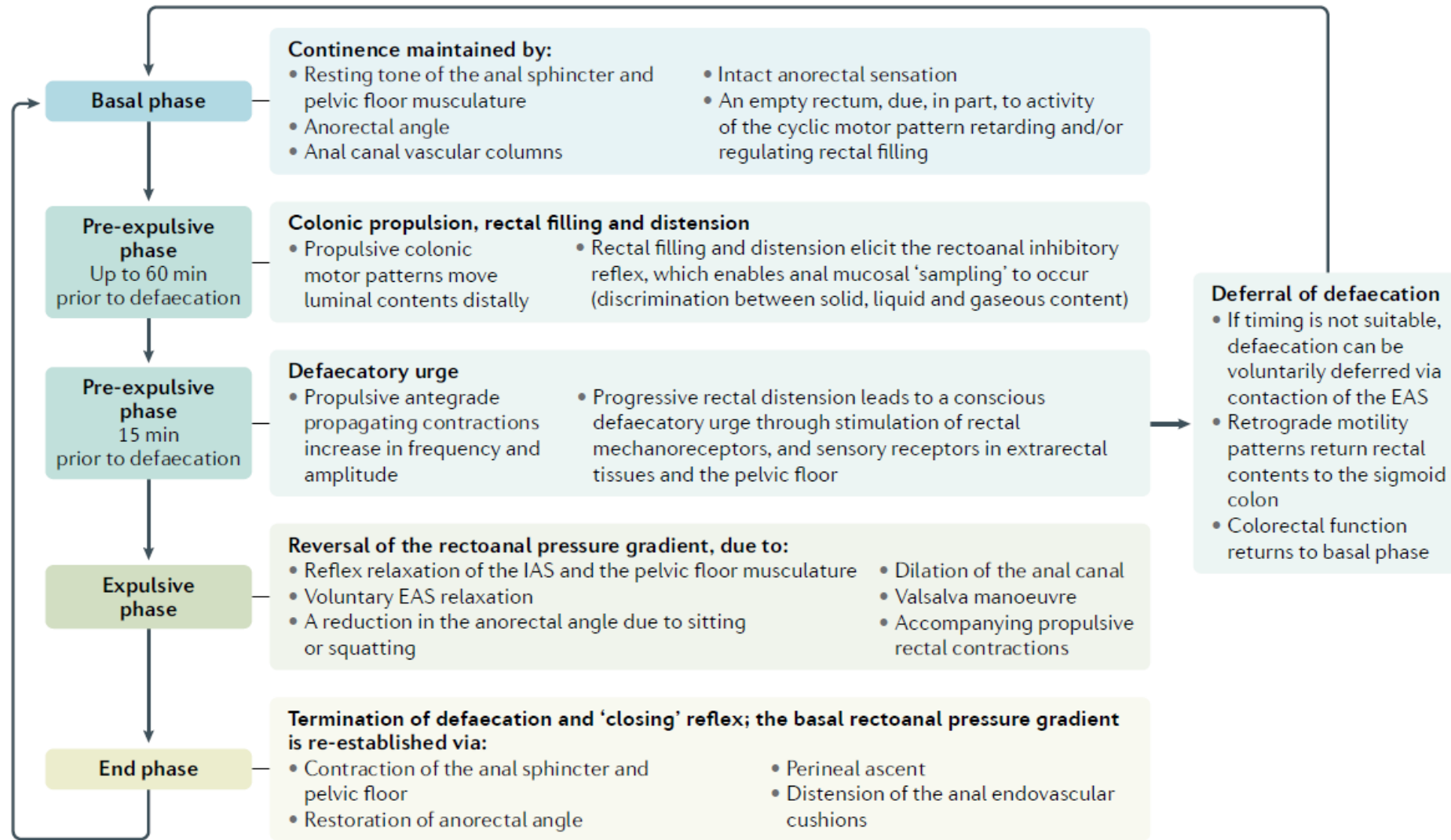
- Distention
- Abnormal neu
- pilonidal dimple
- tuft
- abnormal pigm
- lower spine
- perianal skin t

## **RED FLAGS – for immediate referral to paediatrician**

- Symptoms that commence from birth or in the first few weeks
- Failure or delay (>first 48 hours at term) in passing meconium
- Ribbon stools, leg weakness or locomotor delay
- Abdominal distension with vomiting
- Abnormal examination findings including:
  - Abnormal appearance of anus
  - Gross abdominal distension
  - Abnormal gluteal muscles, scoliosis, sacral agenesis, discoloured skin, naevi or sinus, hairy patch, or central pit
  - Lower limb deformity including talipes
  - Abnormal lower limb reflexes or neuromuscular signs unexplained by existing conditions
- Other symptoms that cause concern



Tit'



Source:



## Title

- 'gastrocolonic
- reflex'<sup>243</sup>. More recently, the colonic meal response was
- hypothesized to be a neurohormonal response to gastric
- distension in humans, causing the release of neuropeptides
- including cholecystokinin, serotonin, neurotensin
- and gastrin<sup>244</sup>.

Source:

## Title

- The colon receives approximately
- 1,500 ml of liquid enteric content (chyme) per day
- Mean colonic transit time
- is ~24 h, ranging between ~4 and 50 h
- 'to- and- fro' motions.
- regional
- transit time in the colon is not evenly distributed<sup>74,75</sup>
- (Supplementary Fig. 1)

Source:

## Title

- The motor patterns responsible for these
- movements might include low- amplitude propagating
- contractions, high- amplitude propagating contractions
- (HAPCs), the cyclic motor pattern and colonic
- pressurizations<sup>69</sup>.

Source:

## Title

- both propagating and non-propagating activity begins to increase up to 1 h prior to defaecation
- Importantly, these changes are not associated with any conscious awareness or urge. A series of antegrade propagating contractions sequentially originate at a more distal location
- distal transit of the capsule from the descending colon to the sigmoid colon 30–60 min prior to defaecation

Source:

## Title

- The compliance of the rectal wall allows passive distension, but also adaptive reductions in rectal tone in response to distension, permitting storage of increasing volumes of content with minimal alteration in intraluminal pressure
- Rectal distension is detected by mechanoreceptors or rectal intraganglionic laminar endings<sup>110</sup>, which transmit this information along S2–S4 parasympathetic neurons in the pelvic splanchnic nerves to the spinal cord

## Title

- Sensory receptors are also present in the extrarectal tissues and pelvic floor, as the defaecatory urge can still be perceived in patients following rectal excision with coloanal or ileoanal anastomoses
- rectal contractions are required to generate a conscious defaecatory urge
- Distension of the rectum beyond a threshold initiates the rectoanal inhibitory reflex (RAIR)<sup>116</sup>, that causes reflex relaxation of the IAS and contraction of the EAS.

Source:



## Title

- The RAIR is an intramural reflex mediated by the myenteric plexus and is characteristically absent in Hirschsprung disease, in which the affected segment of rectum and/or colon lacks myenteric ganglia
- preservation of the RAIR in patients following spinal cord injury or following extrinsic denervation of the rectum

Source:

## Title

- luminal content to be ‘sampled’ by the mucosa of the anal canal
- Sampling of content allows sensory discrimination between solid, liquid and/or gas
- The sensory information gathered from anal canal sampling is relayed to the lumbosacral defaecation centre in the spinal cord via parasympathetic neurons within the pelvic splanchnic nerves (S2–S4)
- A spinal cord reflex arc can mediate contraction of the EAS<sup>56</sup>, while sensory information is additionally relayed to the brainstem and cerebral cortex via the spinothalamic tracts

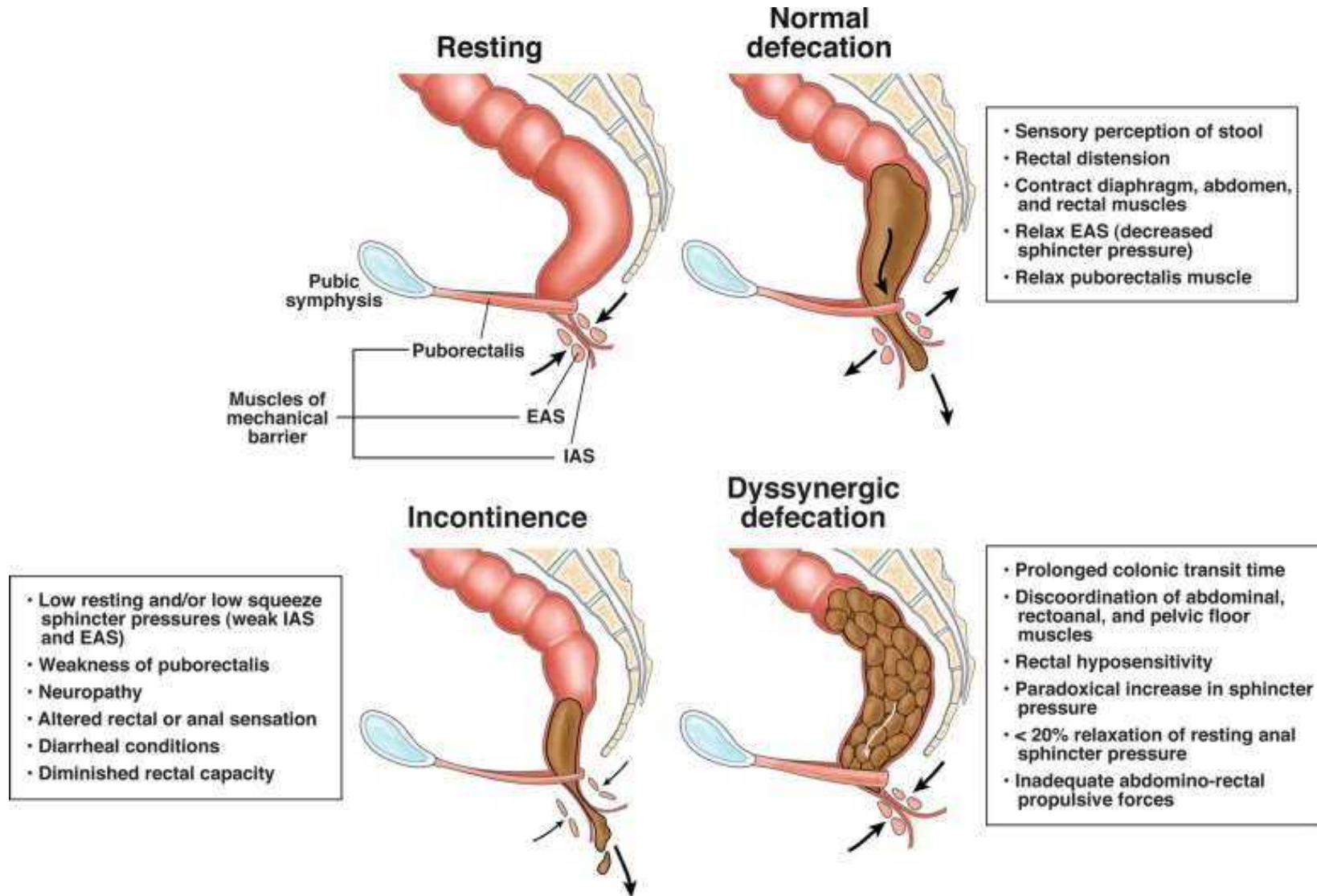
Source:

## Title

- The conscious perception of rectal distension involves multiple cortical areas
- Cortical input is critical to both voluntary inhibition or initiation of defaecation; notably, patients with spinal cord injury who lack cortical input require stimulation via manual digitation to initiate defaecation

*Source:*

Title



Source:

## Factors affecting defecation process

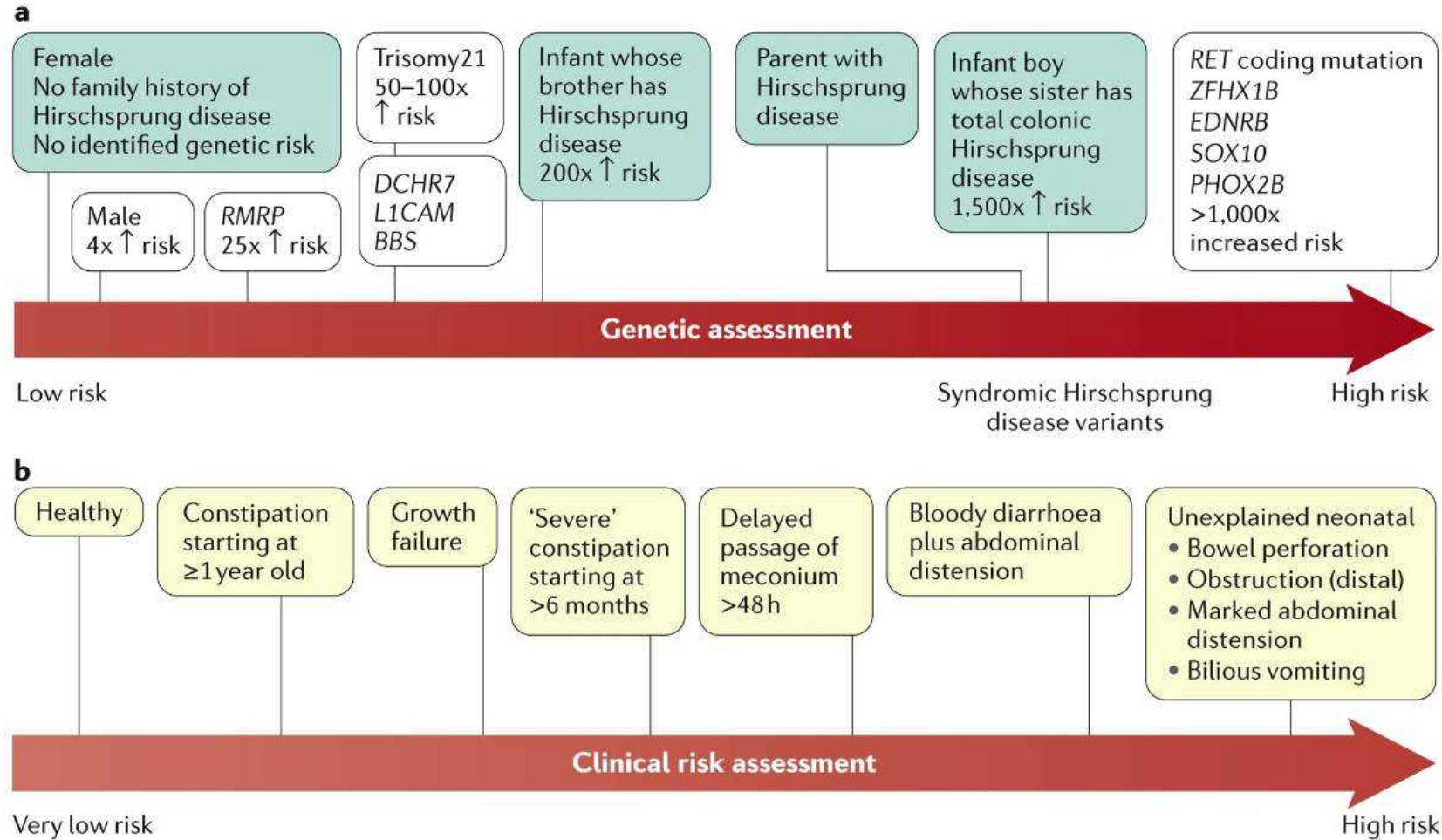
- Voluntary suppression or stool withholding
  - associated with painful or unpleasant defaecation
  - can result in faecal retention, constipation and overflow incontinence
- Stress, psychologic disorders, abuse
  - alterations in autonomic function, gastrointestinal motility, visceral afferent signalling
  - Symptoms can be compounded by hypervigilance, somatization and maladaptive illness behaviours
- Posture
  - Squatting increases hip flexion and posterior pelvic tilt, facilitating straightening of the anorectal angle
- Colonic transit, stool volume and consistency

## Title

- whole- gut transit time was most strongly correlated with stool consistency, followed by stool volume
- Colonic transit and stool consistency are interrelated with colonic microbiota composition, diversity and metabolism
- colonic
- microbiota profile has a 94% accuracy for discriminating
- between healthy adults and patients with constipation
- (25 women in each group)228

Source:

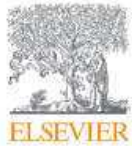
# Hirschsprung disease risk assessment







## Role of labs - celiac





The Journal of Pediatrics  
Volume 227, December 2020, Pages 77-80



Original Article

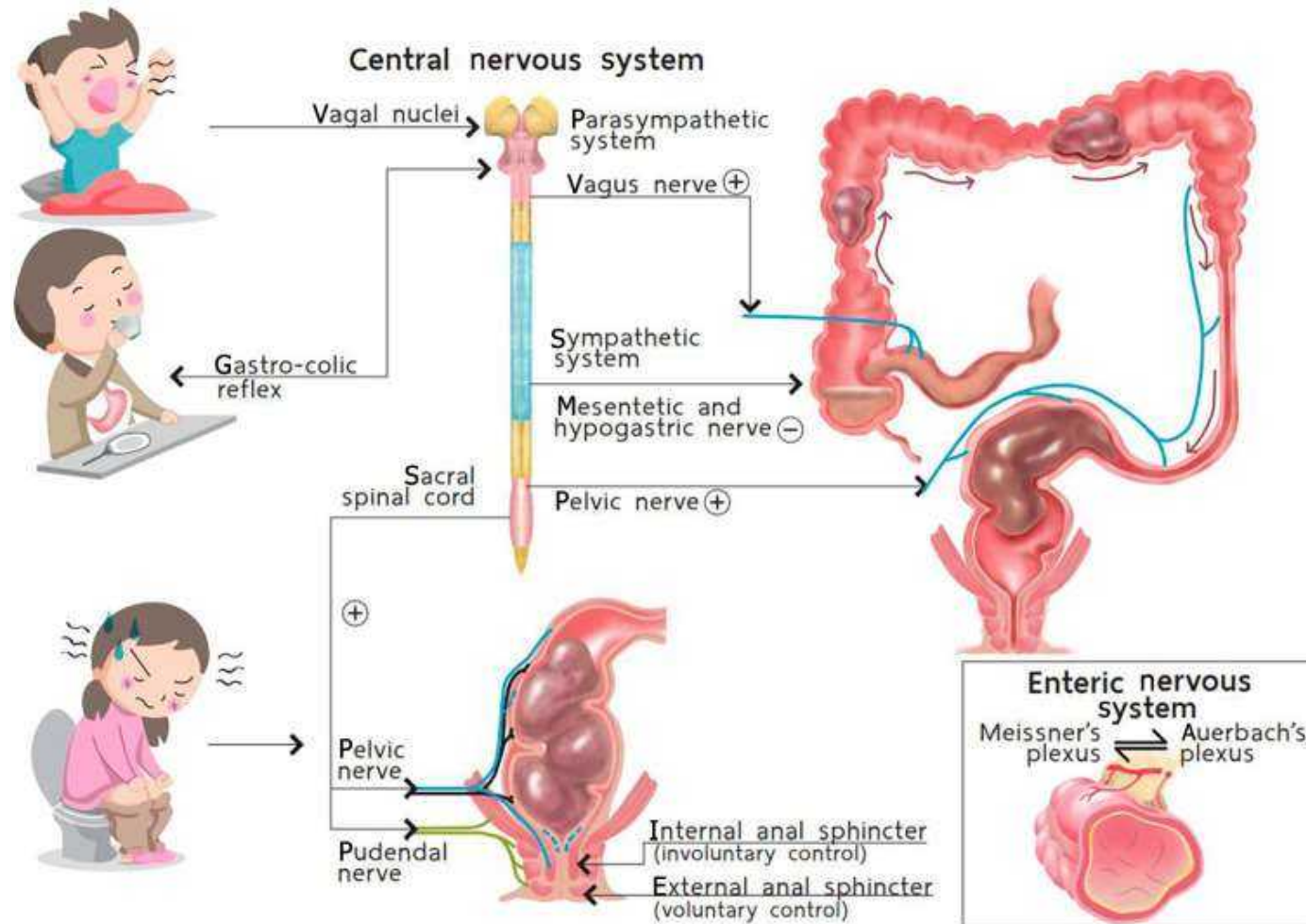
### Celiac Disease in Children with Functional Constipation: A School-Based Multicity Study

[Amanda C. Fifi MD<sup>1</sup>](#)  , [Carlos Velasco-Benitez MD<sup>2,3</sup>](#), [Miguel Saps MD<sup>1</sup>](#)

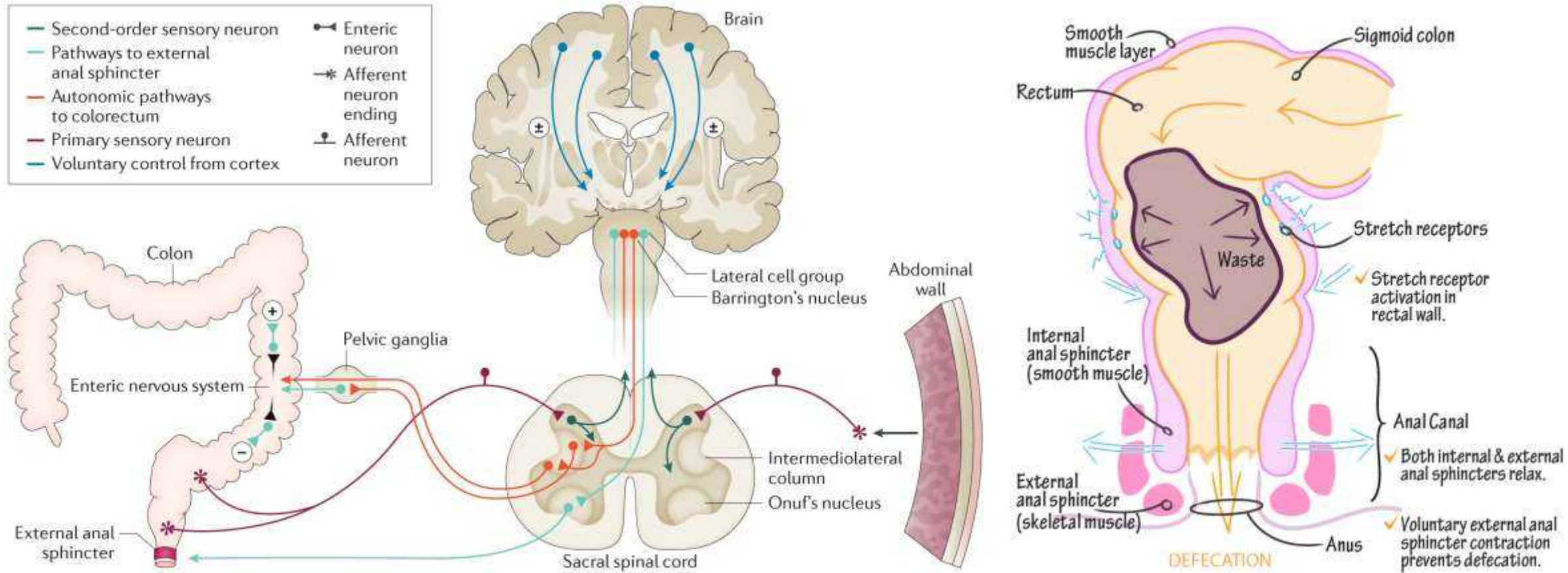
- 1809 schoolchildren in Colombia
- Rome questionnaire
- 203 with functional constipation and 419 controls screened for celiac disease
- 1 (0.5%) in constipation group and 3 (0.7%) in control group diagnose with celiac disease

## Physiology of defecation

- dependent on the coordination of neural, muscular, hormonal and cognitive systems.
- factors influence including gastrointestinal transit, stool volume and/or consistency, and dietary intake
- intrinsic neural innervation from the enteric nervous system
- extrinsic innervation (sympathetic and parasympathetic) from the lumbar nerves, and extrinsic innervation from the vagus nerve (proximal colon) and pelvic splanchnic nerves

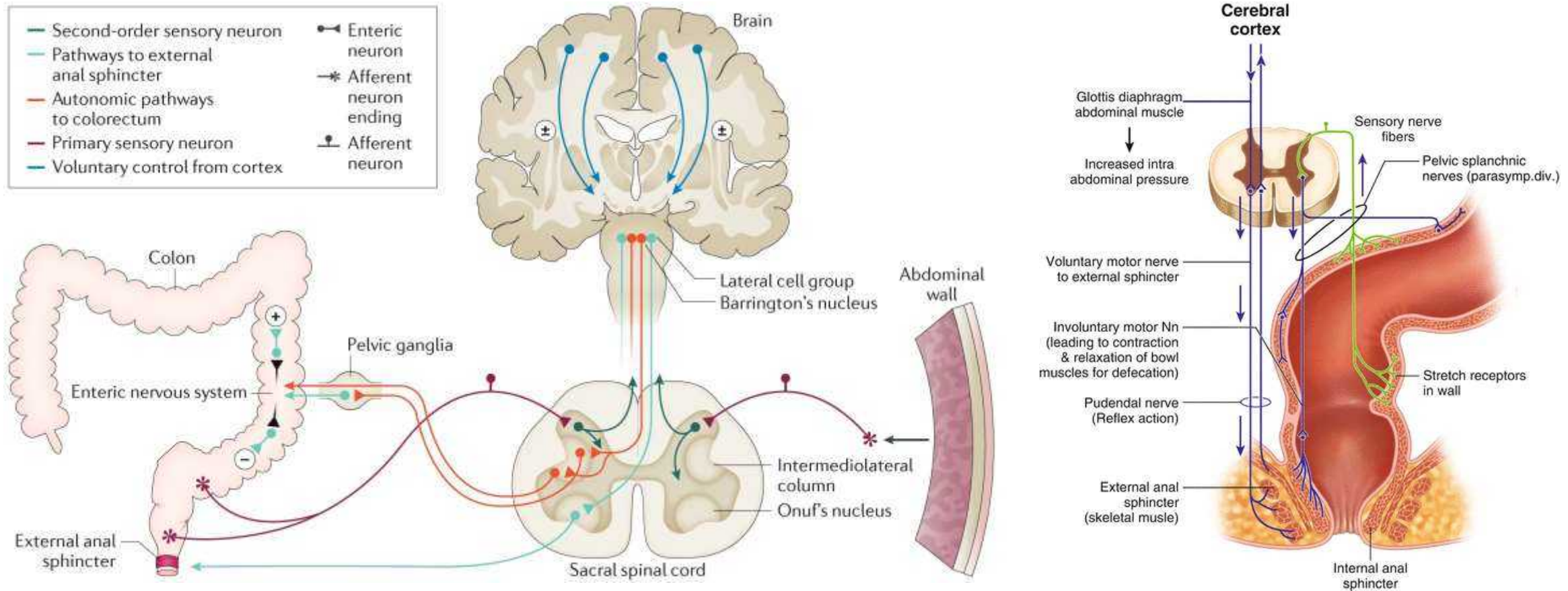


DOI: 10.3748/wjg.v29.i8.1261 Copyright ©The Author(s) 2023.



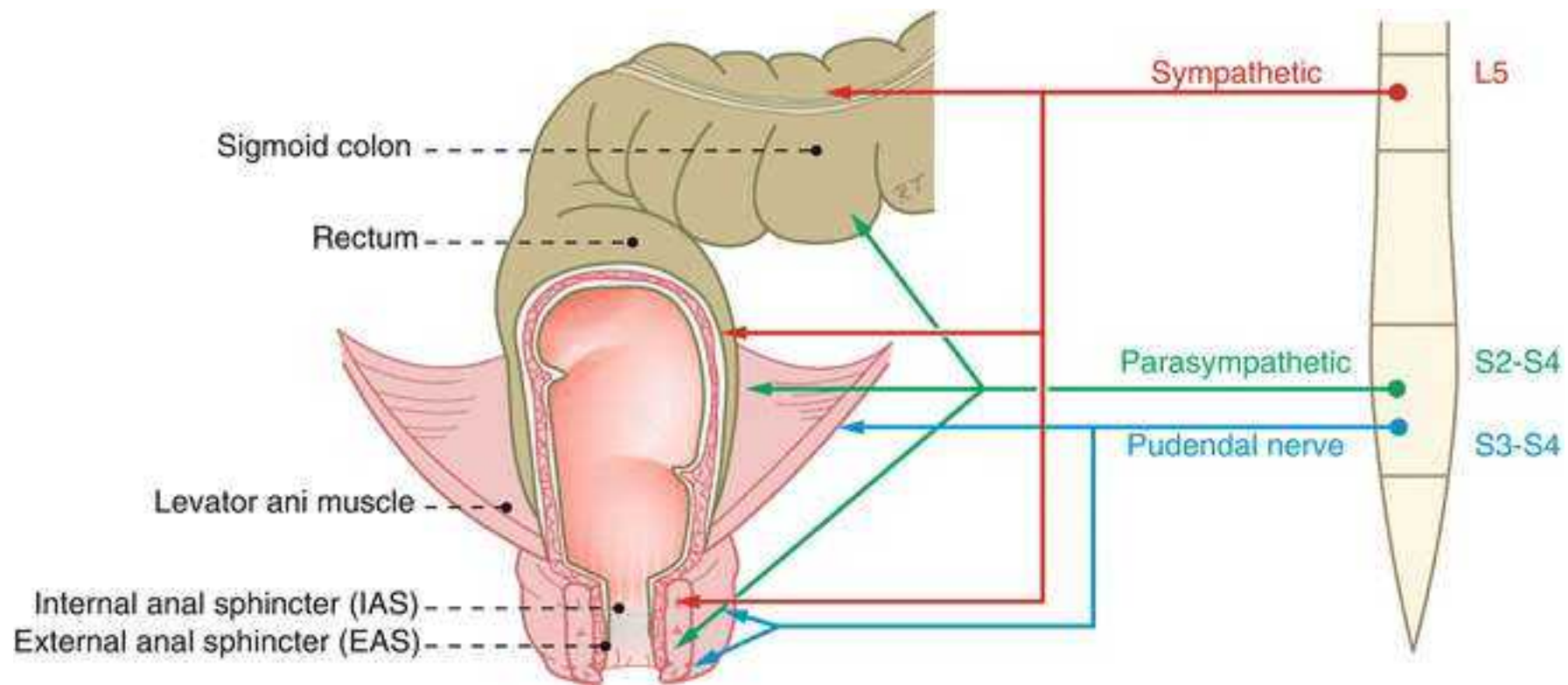
*Understanding the physiology of human defaecation and disorders of continence and evacuation*





*Understanding the physiology of human defaecation and disorders of continence and evacuation*

- A spinal cord reflex arc can mediate contraction of the EAS
- sensory information is additionally relayed to cortex
- Cortical input is critical to both voluntary inhibition or initiation of defaecation
- patients with spinal cord injury who lack cortical input require stimulation via manual digitation to initiate defaecation

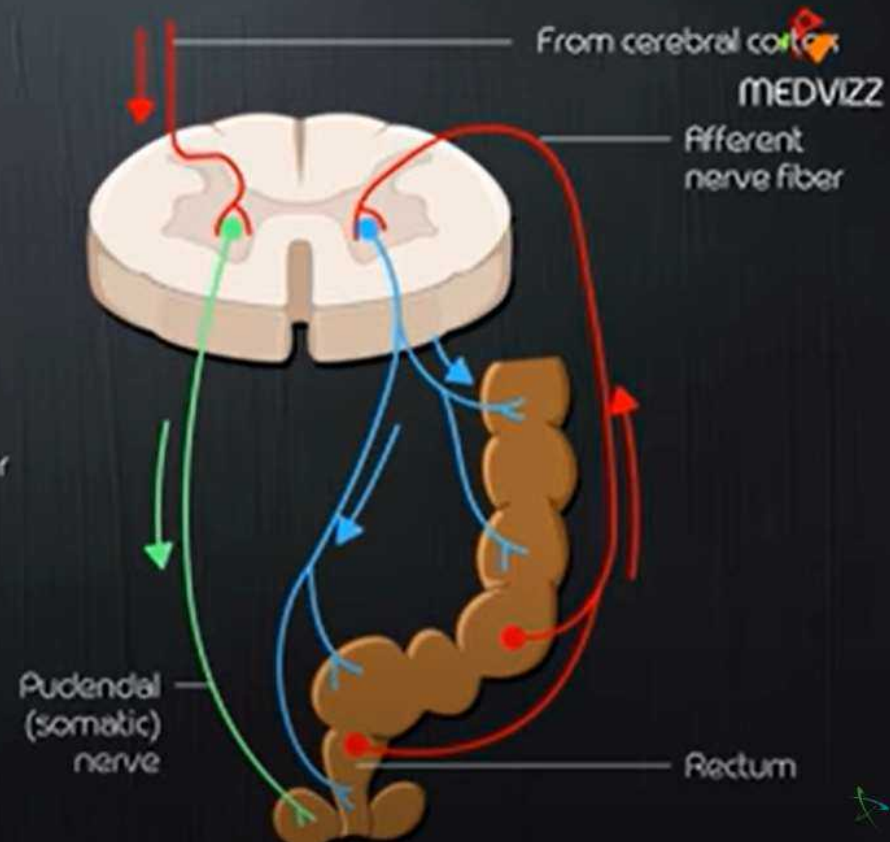


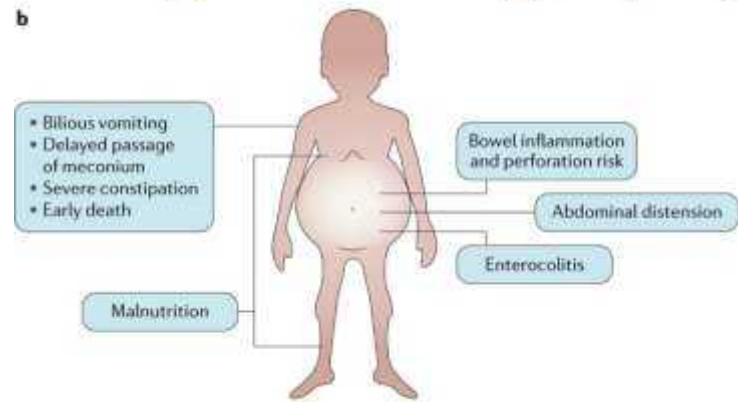
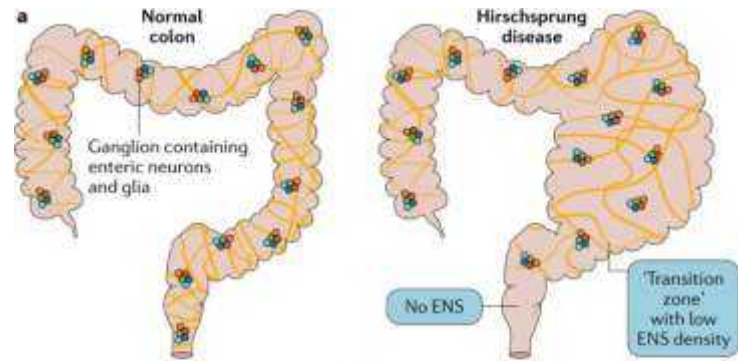


## DEFECATION

### II. Pathway for defecation reflex

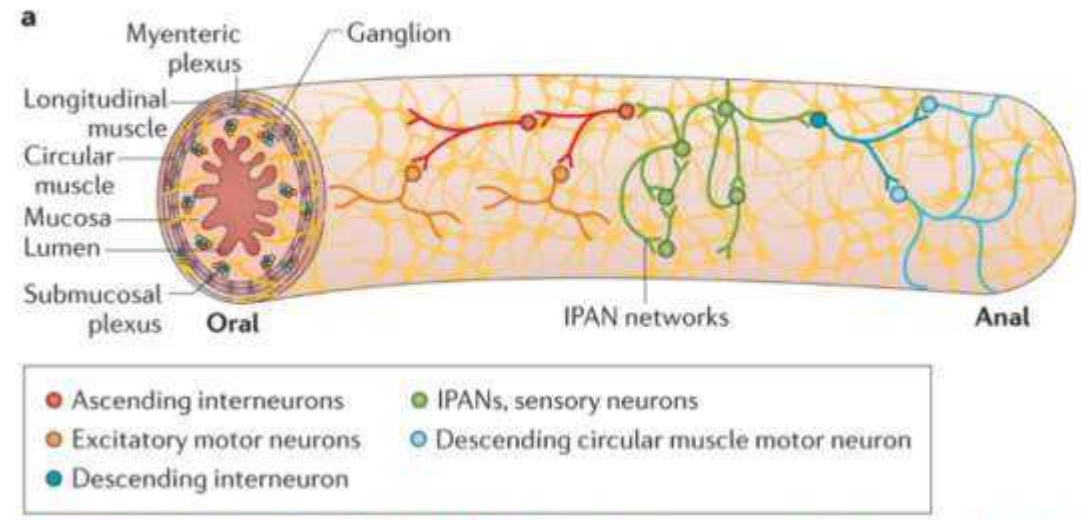
- Entry of feces by mass movement
- Rectum is distended
- Sensory nerve endings are stimulated
- Impulses are transmitted via afferent fibers of pelvic nerve to defecation center
- Center sends motor impulses to the descending colon, sigmoid, & rectum via efferent nerve fibers of pelvic nerve





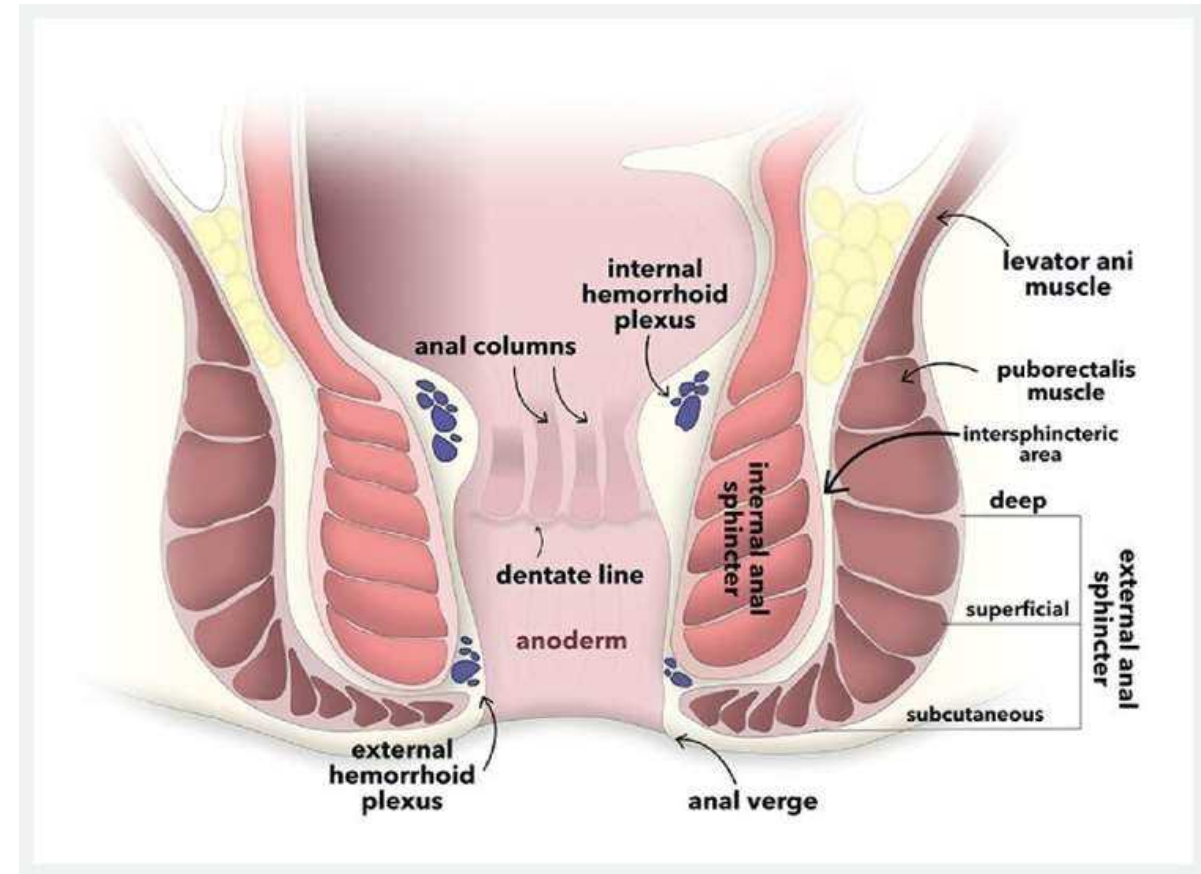
- Distension of the rectum beyond a threshold initiates the rectoanal inhibitory reflex (RAIR)
- intramural reflex mediated by the myenteric plexus and is characteristically absent in Hirschsprung disease
- preservation of the RAIR in patients following spinal cord injury

Figure 1: The enteric nervous system.



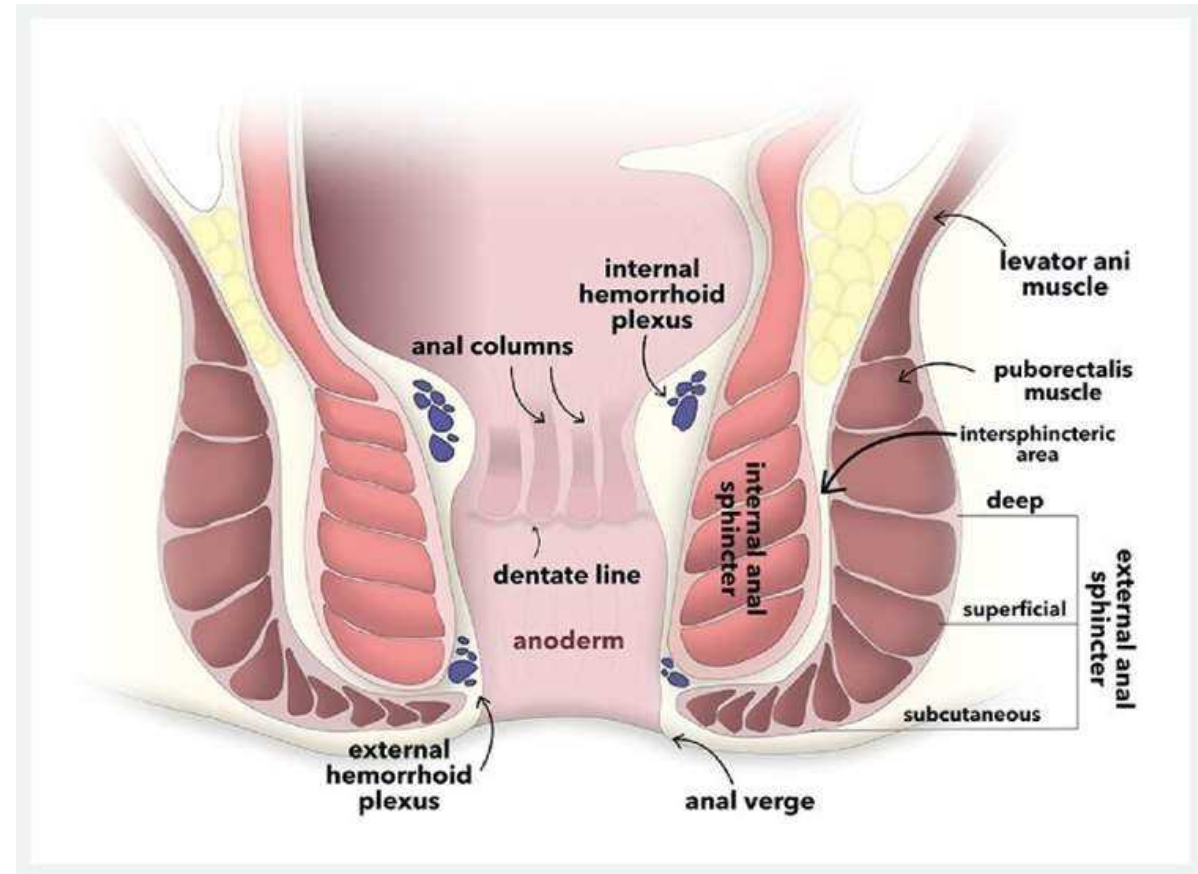
## internal anal sphincter (IAS)

- Smooth muscle
- Not under voluntary control
- Relaxes via release of nitric oxide
- Resting tone is responsible for the majority (70–85%) of anal canal resting pressure

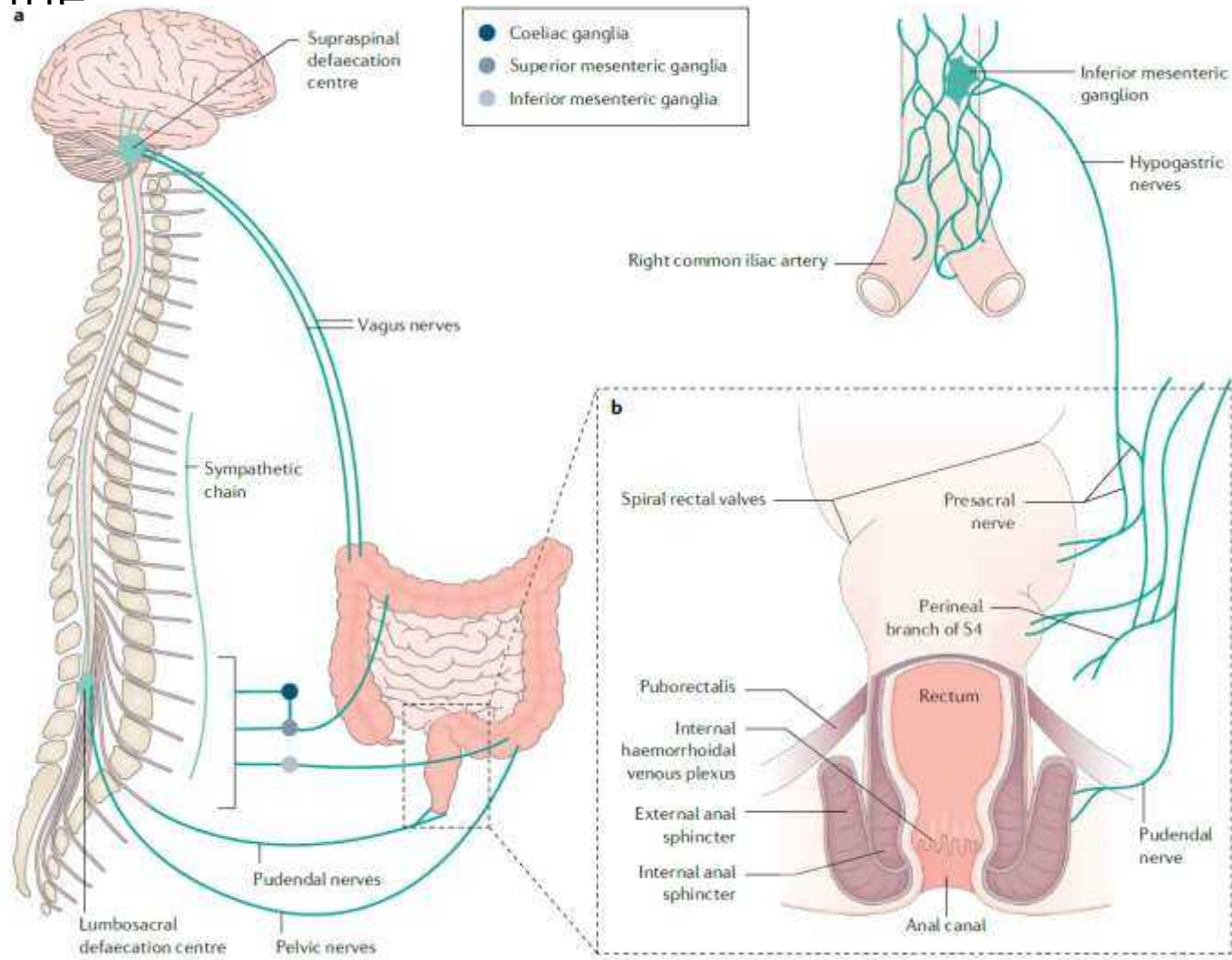


## external anal sphincter (IAS)

- skeletal muscle
- under spinal and cortical control
- Generates maximal squeeze pressure and the acute voluntary control of continence
- Some of control also supported by musculature of pelvic floor



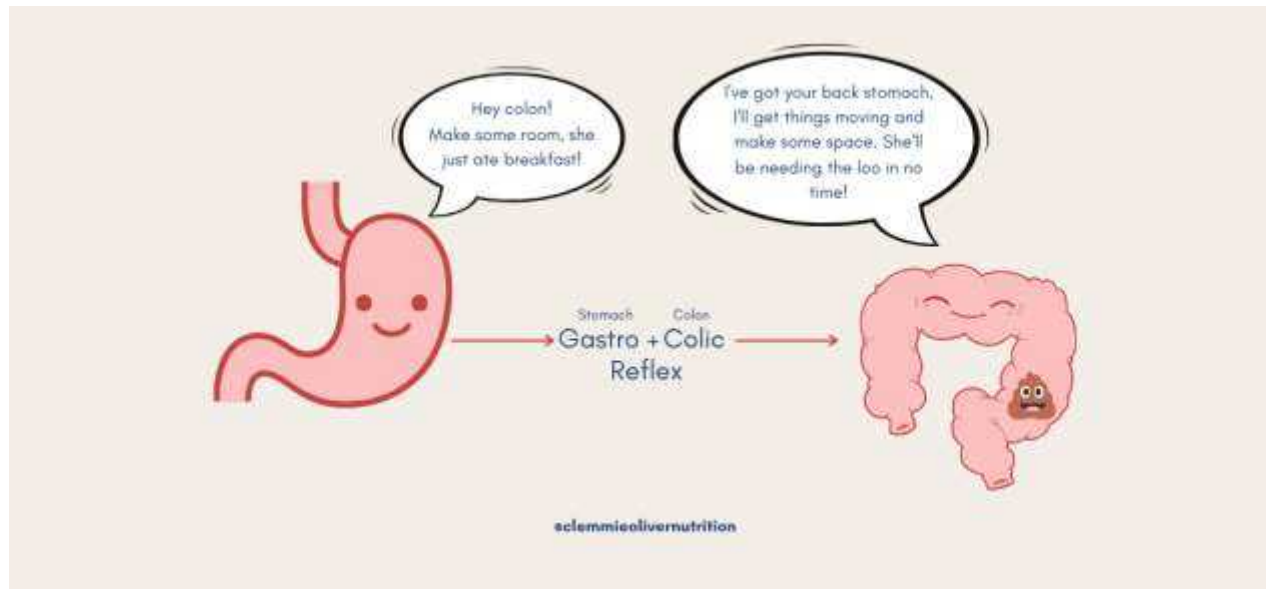
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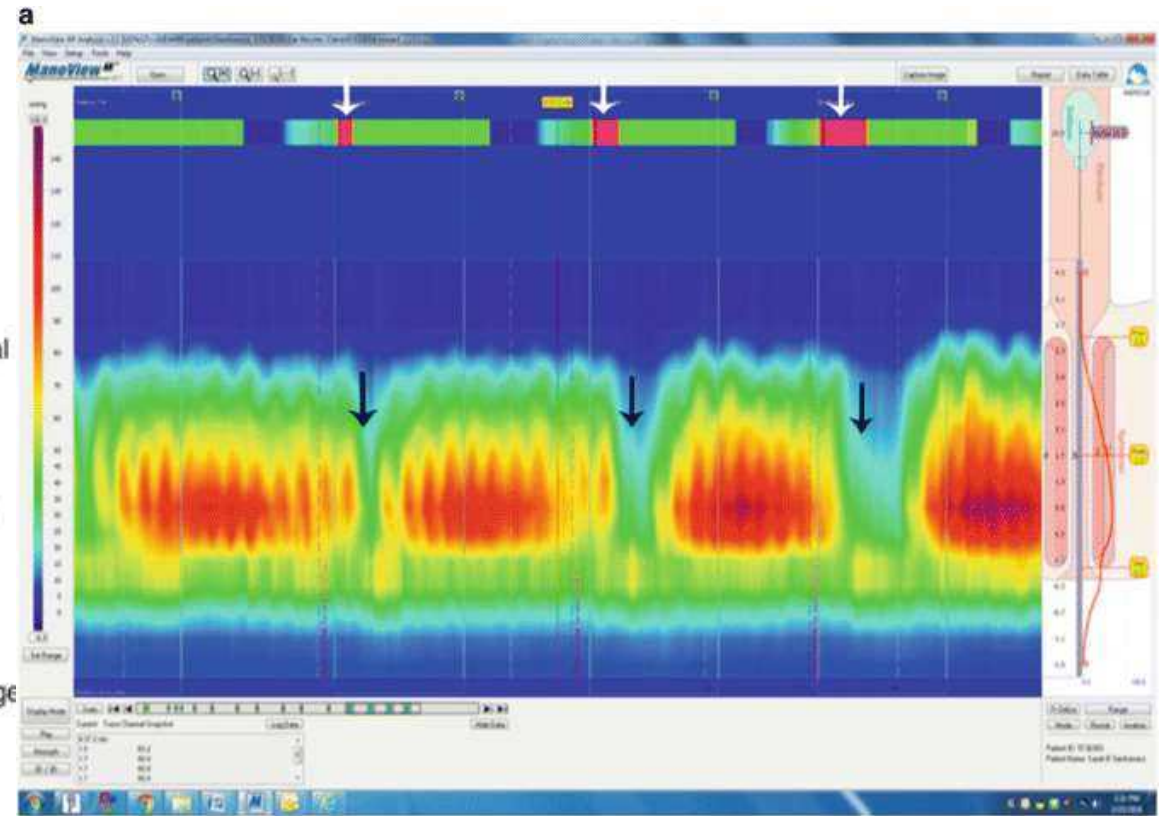
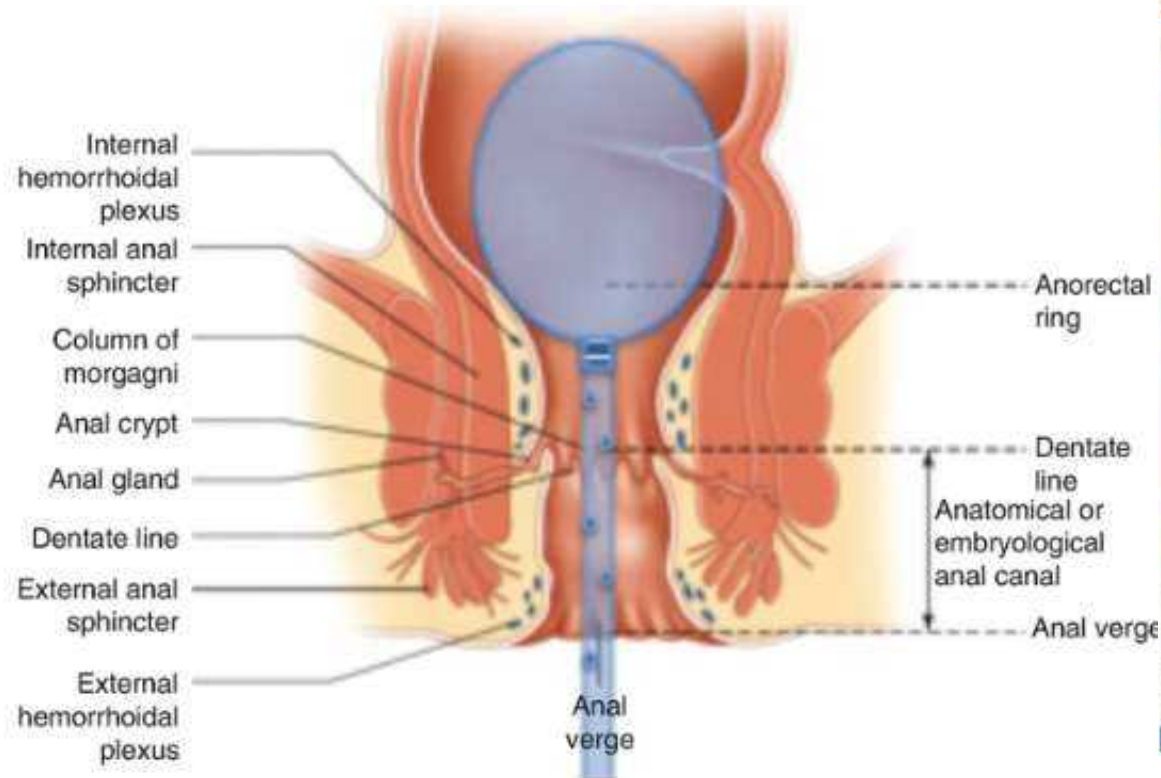
Source:

# Gastrocolic reflex

- Frequency of propulsive HAPCs increases after a meal



# Recto-anal inhibitory reflex (RAIR)





## Fiber

- must resist fermentation to remain relatively intact throughout the length of the large bowel
- must significantly increase the percent water content of stool
- liquid stool is  $\approx 90\%$  water content; soft stool is  $\approx 77\%$  water; formed stool is  $\approx 75\%$  water, and hard stool is  $\leq 72\%$  water
- this 18-percentage point difference in water content represents a 240-fold increase in stool viscosity

## Fiber

- effective fiber therapy will keep stools soft/formed, and significantly increase stool bulk
- ineffective fiber might add to the dry mass of stool, which would decrease the percentage of stool water content and result in harder stools



## Other Definitions

- *“difficulty with defecation for at least 2 weeks, which causes significant distress to the patient”*
- **Intractable Constipation:** Constipation not responding to optimal conventional treatment for at least 3 months.
- **Fecal Impaction:** A hard mass in the lower abdomen ; or a dilated rectum filled with a large amount of stool ; or excessive stool on x-ray.
- **Infant dyschezia:** 10+ minutes of straining and crying before successful passage of soft stools, in the absence of other health problems

# Enemas

## Enemas

- Sodium phosphate
- Sodium docusate
- Mineral Oil
- Bisacodyl
- Glycerin
  - PediaLax – 2.8 g (4mL)
  - Fleet – 5.4 g (7.5 mL)



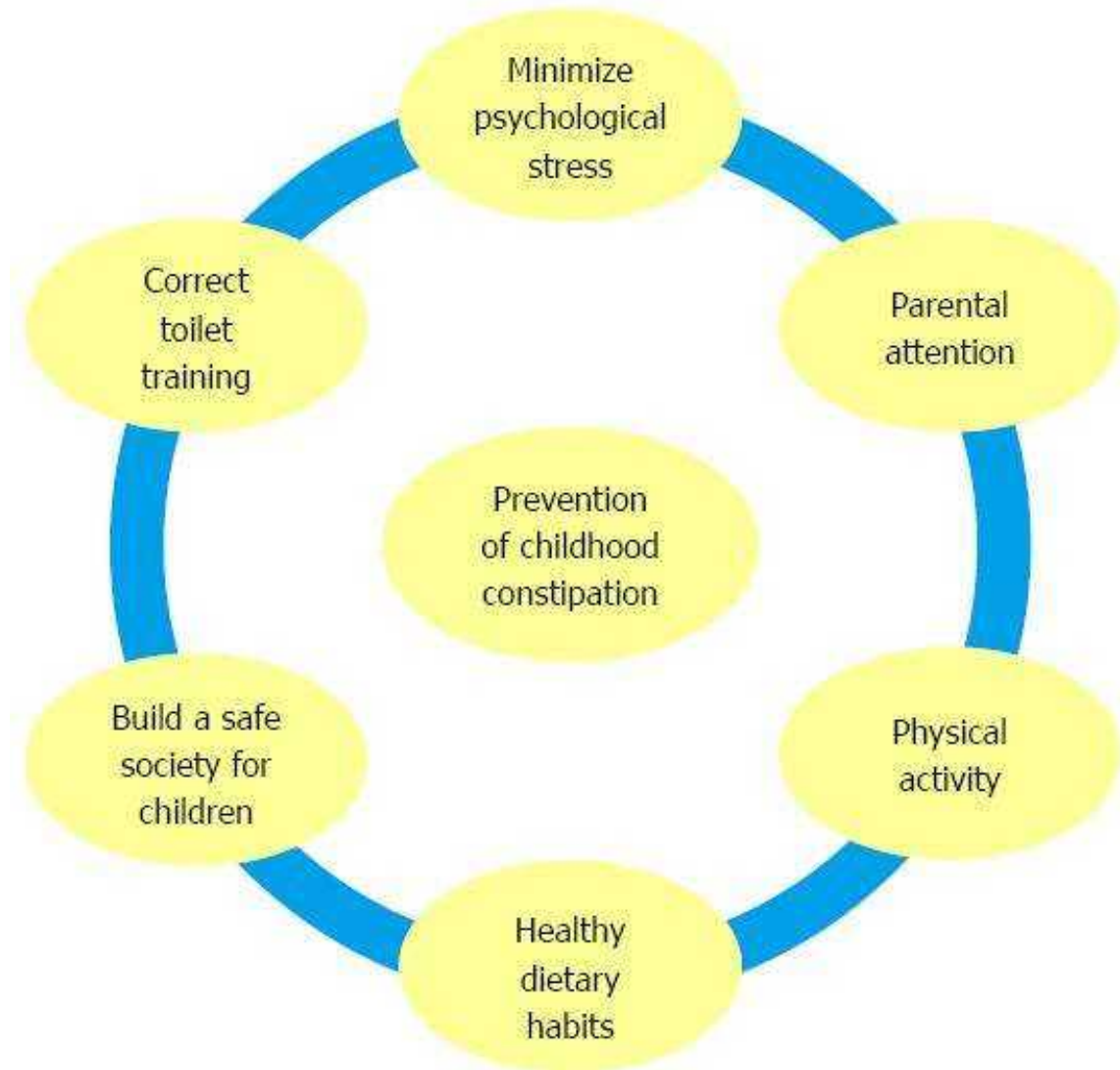
## Suppositories

- Bisacodyl (10mg)
- Glycerin
  - Pediatric – 1g
  - Adult – 2g

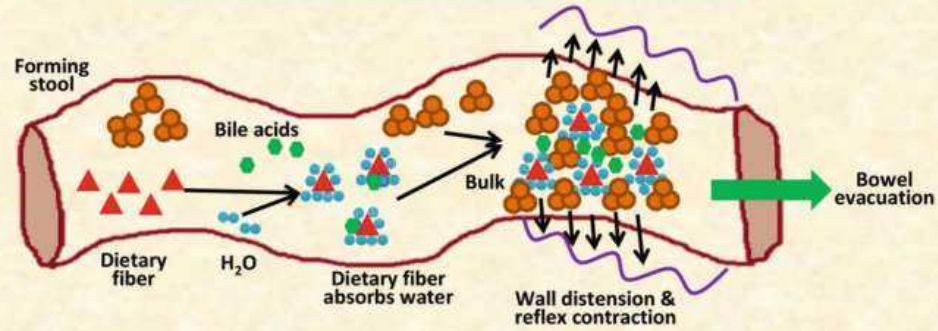


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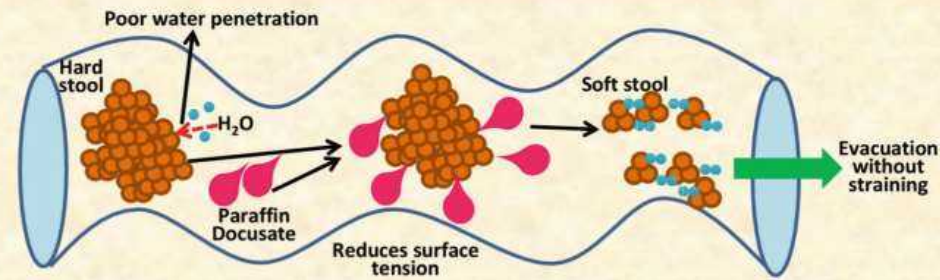
- Dietary fiber
  - Soluble and insoluble
- Fluid intake
- Behavioral therapy



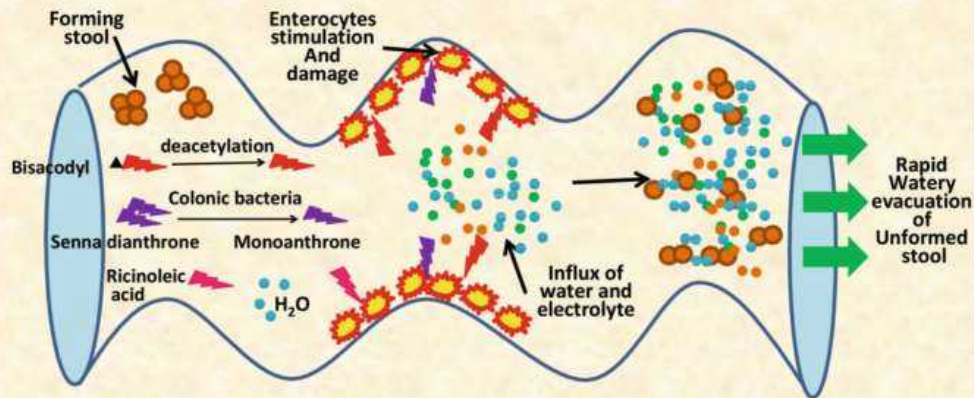
### Mechanism of action of Bulk forming agents



### Mechanism of action of stool softeners



### Mechanism of action of stimulant purgatives



Minimize psychological stress

Parental attention

Prevention of childhood constipation

Physical activity

Healthy dietary habits