Anil Darbari, MD
Associate Professor of Pediatrics
Division of Pediatric Gastroenterology and Nutrition
Director, Pediatric GI Motility Center

An approach to Functional abdominal pain in children
Objectives

• To learn about the diagnostic criteria for Functional Gastrointestinal Disorders (FGIDs)
• To understand the underlying basis of abdominal pain, with special emphasis on functional abdominal pain (FAP)
• To know the clinical presentation, diagnostic evaluation and therapeutic approach to children with FAP
• To know prognostic factors
Functional GI Disorders

Definition, Diagnostic Criteria and Epidemiology
## Organic vs. Functional disorders

<table>
<thead>
<tr>
<th></th>
<th>Organic disease</th>
<th>Functional disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>History</td>
<td>Clear symptoms</td>
<td>Vague symptoms</td>
</tr>
<tr>
<td>Physical</td>
<td>Abnormal signs</td>
<td>Normal exam</td>
</tr>
<tr>
<td>Lab Tests</td>
<td>Abnormal</td>
<td>Normal</td>
</tr>
<tr>
<td>Radiology</td>
<td>Abnormal</td>
<td>Normal</td>
</tr>
<tr>
<td>Special Tests</td>
<td>Abnormal</td>
<td>Normal</td>
</tr>
<tr>
<td>Medications</td>
<td>Effective</td>
<td>Poor benefit</td>
</tr>
<tr>
<td>Family Involvement</td>
<td>Little</td>
<td>Intense</td>
</tr>
</tbody>
</table>
FGIDs: Genetic or Environmental

Genetic Susceptibility and the Role of Environment

• Some infants inherit a temperament characterized by GI reactivity to stress, which constitutes a genetic susceptibility to FGIDs
• A temperament-sensitive reactivity in infants has been suggested in association with three other biological systems: cardiovascular, neuroendocrine, and immunologic
• Conversely, environmental factors during early life clearly play a role in the development of FGIDs
• Plasticity of neonatal brain allows early life events to program physiologic responses to stress during infancy, and
• These responses may be perpetuated later into life

Science 1997;277:1659-62
FGIDs: Role of Environment

• Children learn illness-related attitudes and behaviors from their parents and caretakers (including physicians)
• Healthcare utilization by children closely resembles that of their parents\(^1\)
• Thus, not only should treatment for children include their parents, but the family should be taught about the role that psychosocial factors play in the development and perpetuation of FGIDs

Med Care 1987;25:616-26
FGIDs: Rome-III Criteria

A. Esophageal Disorders
B. Gastroduodenal Disorders
C. Bowel Disorders
D. Functional Abdominal Pain
E. Biliary Disorders
F. Anorectal Disorders
G. Childhood FGIDs: Infants and Toddlers
H. Childhood FGIDs: Children and Adolescents

Gastroenterology 2006;130:1519-1526
H. Childhood Functional GI Disorders: Child/Adolescent

Rome-III Diagnostic Categories

• **H1. Vomiting and Aerophagia**
  - H1a. Adolescent Rumination Syndrome
  - H1b. Cyclic Vomiting Syndrome
  - H1c. Aerophagia

• **H2. Abdominal Pain-related Functional GI Disorders**
  - H2a. Functional Dyspepsia
  - H2b. Irritable Bowel Syndrome
  - H2c. Abdominal Migraine
  - H2d. Childhood Functional Abdominal Pain
  - H2d1. Childhood Functional Abdominal Pain Syndrome

• **H3. Constipation and Incontinence**
  - H3a. Functional Constipation
  - H3b. Non-retentive Fecal Incontinence
Functional abdominal pain

Definition, Diagnostic Criteria and Epidemiology
FAP: Definition

• Definition of chronic/recurrent (functional) abdominal pain is derived from Apley’s pioneering study of 1000 children in late 1950s

• He characterized abdominal pain as chronic or recurrent if at least one episode of pain occurs every month for 3 consecutive months and is severe enough to interfere with routine functioning

Arch Dis Child 1958;33:165-70
### H2d. Diagnostic Criteria* for Childhood Functional Abdominal Pain

Must include *all* of the following:

1. Episodic or continuous abdominal pain
2. Insufficient criteria for other FGIDs
3. No evidence of an inflammatory, anatomic, metabolic, or neoplastic process that explains the subject’s symptoms

*Criteria fulfilled at least once per week for at least 2 months before diagnosis*
H2d1. Diagnostic Criteria* for Childhood Functional Abdominal Pain Syndrome

Must include childhood functional abdominal pain at least 25% of the time, and 1 or more of the following:

1. Some loss of daily functioning

2. Additional somatic symptoms such as headache, limb pain or difficulty sleeping

*Criteria fulfilled at least once per week for at least 2 months before diagnosis
Epidemiology

- Initial studies indicated chronic abdominal pain affects 10-15% of school-age children\(^1\)
- More recent data suggest that approximately 20% of middle and high school students experience abdominal pain on a daily to weekly basis\(^2\)
- Early on, an organic cause for FAP in only 5-10% of patients with chronic abdominal pain
- Progressive development of endoscopic techniques, manometries and imaging have enhanced the ability to identify organic etiologies
- In the Hyams study of 227 children 33% were found to have definable causes of FAP\(^2\)

Pediatrics 1970;45:732-8
J Pediatr 1996;129:220-6
Functional abdominal pain

Neurophysiology of Abdominal Pain
Neurophysiology of Abdominal Pain

• Viscera is unique (2 sets of innervations):
  – Vagal and splanchnic nerves, or
  – Pelvic and splanchnic spinal nerves

• Both systems participate in reflex control of the gut, but their involvement in sensation differs
  – Pain and discomfort from the GI tract are conveyed to the CNS principally by the spinal afferents
  – Vagal afferent activation usually does not convey pain sensation, but may modulate spinal visceral (and somatic) pain
Pathways in Visceral Sensation

- IGLE-type endings in myenteric ganglion
- Varicose branching axons on submucous artery
- Varicose branching axons on mesenteric artery
- Enteroendocrine cells responsive to chemical and mechanical stimuli
- Luminal stimuli and changes in wall tension activate afferents
- Afferent
- Reflex modulation
- Prevertebral ganglia
- Efferent

Brain
Brainstem
Dorsal column pathway (Willis)
Neurophysiology of Abdominal Pain

• Neurons in the supraspinal sites also exhibit increases in excitability, especially in brain areas associated with descending modulation of spinal sensory transmission

• These circuits can be influenced by
  – Cognitive
  – Affective, and
  – Stressful influences
  – Also by expectation, and
  – Prior experience
Visceral Pain
Originates from the viscera

Parietal Pain
Originates from the more superficial structures

Nociceptors are present throughout the GI tract, including viscera and supporting structures. Basic understanding of the differences between the two are vital to determine the cause of patient’s complaints.
Visceral Pain

- Originates from afferent nerve fibers located within the walls or tissues of abdominal viscera
- The pain impulse is carried by small, unmyelinated, slow conducting C fibers
- The termination of these fibers within the spinal column occurs over 4-5 spinal segments
- The pain is therefore poorly localized
Location of abdominal pain

The location is determined by the level at which the afferent nerve fibers from the viscera enter the spinal cord.

T5 – T9  Foregut Structures
Distal Esophagus
Stomach
Duodenum
Liver, Biliary Tree, Pancreas

T8 – L1  Midgut Structures
Most of small intestine
Appendix
Cecum/Ascending
Proximal 2/3rds of Transverse colon

T11-L1  Hindgut Structures
Distal 1/3rds of Transverse colon
Descending
Rectosigmoid
Parietal pain

• Conducted by both C-fibers as well as large, thinly myelinated, rapid conducting A-delta fibers

• The A-delta fibers respond to tactile, thermal and chemical stimulation

• They convey discriminatory information, including the location and intensity of the stimuli

• Most parietal nociceptors are located in the peritoneum and supporting tissues; pain is therefore often aggravated by movement.
Functional Abdominal Pain

Three Main mechanisms:

1. Autonomic Nervous System (ANS) Function
2. Gastrointestinal motility
3. Altered intestinal permeability
Functional Abdominal Pain

Pathophysiology

Autonomic Nervous System Abnormalities:

- ANS is considered to be a biological anlage for internal emotional responses
- 13 children with FAP were studied, using pupillary responses as a measure of ANS responsivity
  - At rest or under stress, no difference between healthy children and children with RAP
  - Following stress, a significant difference was noted, as a small initial decrement in the pupillary children with FAP
  - The mechanism of drive reduction in children with FAP is aberrant.

Psychosom Med 1967;29:111-20
Functional Abdominal Pain

Pathophysiology

**Autonomic Nervous System Abnormalities:**

- Children with FAP were more likely to have unstable ANS recovery from stress\(^1\)
- Increased rectosigmoid activity was noted after sub-Q injection of prostigmine in children with FAP compared to controls
- Patients with FAP have increased sensitivity to parasympathetic stimulation, indicating a generalized autonomic imbalance\(^2\)

Arch Dis Child 1971;46:337-40
Pediatrics 1967;39:539-45
Functional Abdominal Pain

Pathophysiology

**Effect of GI Motility:**

- Major function of motility
  - Accomplish propulsion
  - Mix gut contents with digestive juices
  - Expose the fluids to the absorptive surface
  - Facilitate temporary storage in certain regions
  - Prevent retrograde movement of contents
  - Dispose off residues
- Motility is controlled by (central and peripheral) reflexes, and descending modulation from the brain-gut axis
- Communication between regions is achieved by neurogenic and myogenic signals longitudinally along the gut

Astroenterology 2006;130:1412-1420
Effect of GI Motility:

- Patients with FAP had more frequent MMCs (Migrating Motor Complexes), with slower propagation velocities compared to healthy controls.
- They also had high amplitude duodenal contractions associated with events of abdominal pain.

*J Pediatr 1988;113(5):820-5*
Functional Abdominal Pain

Pathophysiology

Effect of GI Motility:

Abnormalities of antroduodenal motility were found in 39/44 (89%) children with RAP

Tonic, non propagated duodenal contractions

Non propagated burst of phasic duodenal contractions

Retrograde propagation

Pediatr 1990;86:39-44
Functional Abdominal Pain

Pathophysiology

Altered Intestinal Permeability:

- Small bowel permeability by measuring 24-hour urinary excretion of oral 51-Cr EDTA showed significantly higher excretion in children with FAP.
- Indicating increased intestinal permeability.
- Also correlated with histologic evidence of abnormalities in a subsequent study.

Conceptual model

Psychological Factors
- Psychosocial Distress
  - Anxiety
  - Depression
  - Somatization
- Psychiatric Disorders
- Health Beliefs/Coping
  - Catastrophizing
  - Health Anxiety
  - Selective Attention
  - GI Specific Anxiety
  - Self-efficacy

GENETICS

Environmental Factors
- Early Life Experiences
- Stressors
- Social Support
- Social Learning

Central Nervous System
Enteric Nervous System

Outcomes
- Symptoms
- Quality of Life
- Health Care Use

Physiology
- Motility
- Nociception
- Permeability?
Functional abdominal pain

Clinical Presentation, Evaluation, and Differential Diagnosis
Functional Abdominal Pain

- Patient age: >6 years
- Paroxysmal abdominal pain
- Pain location: epigastric, periumbilical or infraumbilical
- Pain characterization: dull, sharp or cramping, non-radiating
- Symptom duration: 3 or more episodes in 3 months
- Symptom free intervals
- No temporal correlation of pain with activity, meals or bowel patterns
- Pain interferes with normal activity
- Normal PE and laboratory studies
Organic Abdominal Pain

- Age < 5 years
- Constitutional symptoms:
  - fever, wt. Loss, growth retardation, joint symptoms
- Emesis: esp. bile or blood stained
- Pain awakens the child from sleep
- Well localized, away from the umbilicus
- Referred pain to back, shoulders or extremities
- Dysuria, hematuria or flank pain
- Family h/o IBD, PUD, etc.
- Perianal disease: tag, fissure or fistula
- Occult or gross blood in stool
- Abnormal screening laboratory studies: ↑ WBC/ESR, ↓ protein/albumin, anemia
### Symptom-Related Behaviors Often Seen in Patients with FAPS

<table>
<thead>
<tr>
<th>Expression of Pain</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Expressing pain of varying intensity through verbal and non verbal methods</strong>, may diminish when the patient is engaged in distracting activities, but increase when discussing in a psychologically distressing issue or during examination.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Urgent Reporting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Urgent reporting of intense symptoms</strong> disproportionate to available clinical and laboratory data (e.g., always rating the pain as “10” on a scale from 1 to 10)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Minimizing or Denying</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Minimizing or denying a role for psychosocial contributors</strong>, or of evident anxiety or depression, or attributing them to the presence of the pain rather than to understandable life circumstances</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Requesting Diagnostics</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Requesting diagnostic studies</strong> or even exploratory surgery to validate the condition as “organic”</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Focusing Attention</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Focusing attention on complete relief of symptoms</strong> rather than adaptation to a chronic disorder</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Seeking Health Care</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Seeking health care frequently</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Taking Responsibility</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Taking limited personal responsibility for self-management</strong>, while placing high expectations on the physician to achieve symptom relief</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Making Requests</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Making requests for narcotic analgesics</strong> when other treatment options have been implemented</td>
<td></td>
</tr>
</tbody>
</table>

*Gastroenterology 2006;130:1492-1497*
Clinical evaluation

• A comprehensive interview with the child and parents, a thorough PE, and specific laboratory studies
• Convey genuine concerns
• Establish a trusting and supportive environment
• Ensure adequate time is allotted for this process
History

• Important to hear from patient, minimizing parental influence
• Pain: quality, intensity, duration, timing,
• Sleep quality and duration
• Temporal connection of pain with other symptoms: nausea, emesis, diarrhea, constipation, fever
• Relationship of pain to food consumption and kind, activity or posture
History

• Medications: prescriptions, OTCs
• Effects of prior medications
• Effects of prior therapies

**Abdominal pain diaries**: detailing time, location, intensity and character of pain, time and content of meals, daily activities and stooling pattern
Physical Examination

• Begin during history gathering
• Carefully note patient’s expressions, respiratory pattern, body positioning, and movements, or how he gets up or down from the examination table
• Note interactions of the child with family
• Meticulous PE cannot be overemphasized
• All clothing should be removed (gown)
Physical Examination

• Perform PE with parents in the room
• Ask the patient about their preference in case of older adolescents
• Careful review of growth parameters

**Abdominal examination:** inspection, character of bowel sounds, detailed palpation of entire abdomen, flanks, perianal region, digital rectal examination
Laboratory and Imaging Studies

- Initial screening: CBC/Diff, UA and culture, serum transaminases, ESR, serum proteins, fecal leukocytes and O&Ps
- These may R/O 95% organic etiologies¹
- Non invasive studies: Lactose breath H₂
- Abdominal ultrasound: ?Utility, ?Detrimental value
- Endoscopy/Specialized tests

## Differential Diagnosis

<table>
<thead>
<tr>
<th>Malabsorptive Conditions</th>
<th>Inflammatory Bowel Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post surgery gastrectomy</td>
<td>Crohn’s Disease</td>
</tr>
<tr>
<td>Intestinal disease sprue</td>
<td>Ulcerative Colitis</td>
</tr>
<tr>
<td>Pancreatic insufficiency</td>
<td>Other microscopic colitis</td>
</tr>
<tr>
<td></td>
<td>Collagenous colitis</td>
</tr>
<tr>
<td></td>
<td>Mast Cell Disease</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dietary Factors</th>
<th>Psychiatric Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lactose intolerance</td>
<td>Panic Disorder</td>
</tr>
<tr>
<td>Caffeine</td>
<td>Depression</td>
</tr>
<tr>
<td>Alcohol</td>
<td>Somatization Disorders</td>
</tr>
<tr>
<td>Fat containing, gas producing foods cruciferous vegetables</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Infections</th>
<th>Miscellaneous Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacteria</td>
<td>Endometriosis</td>
</tr>
<tr>
<td>Campylobacter, Salmonella, Yersinia</td>
<td>Endocrine Tumors</td>
</tr>
<tr>
<td>Parasites</td>
<td>Carcinoid</td>
</tr>
<tr>
<td>Giardia lamblia</td>
<td>Zollinger-Ellison Syndrome</td>
</tr>
<tr>
<td></td>
<td>VIPoma</td>
</tr>
<tr>
<td></td>
<td>HIV Disease</td>
</tr>
</tbody>
</table>

---

---
Functional abdominal pain

Therapeutic Approach and Prognosis
FAP: Therapy

- Directed to the family as a unit
- Education, reassurance and ongoing support for patient and family members
- Important to clearly review with the child and parents how the diagnosis was reached often going through history, exams, and tests
- Stress to the family it is a common condition affecting 20% of school aged children
Therapy

- Goal of therapy is to decrease stress for child, while promoting normal school attendance and activities
- Pain is GENUINE and not imagined
- Express this is similar to headache
- Stress: research clearly indicates that abnormal GI motility and autonomic activity is related to stress
Factors contributing to an effective patient-physician relationship include

<table>
<thead>
<tr>
<th>Empathy towards the patient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient education</td>
</tr>
<tr>
<td>Validation of the illness</td>
</tr>
<tr>
<td>Reassurance</td>
</tr>
<tr>
<td>Treatment negotiation</td>
</tr>
<tr>
<td>Establishment of reasonable limits in time and effort</td>
</tr>
</tbody>
</table>

General aspects of care to consider:
(before implementing specific therapy such as antidepressants, or anticonvulsants)

<table>
<thead>
<tr>
<th>Setting of treatment goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Helping the patient take responsibility</td>
</tr>
<tr>
<td>Basing treatment on symptom severity and degree of disability</td>
</tr>
<tr>
<td>Referral to mental health professional</td>
</tr>
<tr>
<td>Referral to multidisciplinary pain treatment center, if available</td>
</tr>
</tbody>
</table>
Therapy

• Rapid return to school
• Acknowledgment of pain without encouraging it should be emphasized to the parents
• Secondary gains should be discussed clearly
• Specific rules should be set (negative feedback)
• No/harmful role of sedative/analgesic use
## Pharmacological Therapies

<table>
<thead>
<tr>
<th>Agents</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCAs</td>
<td>Low daily doses</td>
</tr>
<tr>
<td></td>
<td>No evidence of efficacy in RCTs</td>
</tr>
<tr>
<td></td>
<td>Less effective than SNRIs in other chronic pain conditions</td>
</tr>
<tr>
<td>SSRI+SNRI combined agents</td>
<td>Venlafaxine, duloxetine</td>
</tr>
<tr>
<td>SSRIs</td>
<td>Useful when anxiety or depression co-exist</td>
</tr>
<tr>
<td>Analgesics</td>
<td>Offer limited benefit</td>
</tr>
<tr>
<td>Narcotic analgesics</td>
<td>Should be avoided</td>
</tr>
<tr>
<td>Anticonvulsants</td>
<td>Gabapentin, carbamazepine and lamotrigine</td>
</tr>
<tr>
<td></td>
<td>Not specifically studied in FAPS</td>
</tr>
<tr>
<td></td>
<td>Relatively safe and non-habituating</td>
</tr>
<tr>
<td></td>
<td>May interrupt the cycle between pain and depression</td>
</tr>
</tbody>
</table>

Gastroenterology 2006;130:1492-97
Psychological Therapy

- Potentially beneficial interventions include:
  - CBT
  - Dynamic or interpersonal behavioral therapy
  - Hypnotherapy
  - Stress management therapy
- Treatments have shown to improve
  - Mood
  - Coping
  - QOL
  - Healthcare costs
- Less demonstrable impact on specific visceral or somatic symptoms

Gastroenterology 2006;130:1492-97
Complementary Therapies

Commonly used therapies include:

- Spinal manipulation
- Massage therapy
- Accupuncture
- Data supporting their use is limited

TENS (Transcutaneous Electrical Nerve Stimulation)

- Few reports
- Uncontrolled results are indeterminant

Laparascopy +/- adhesion lysis

- Uncontrolled studies suggest benefit
- Outcome may be placebo related
- Unsuspected diagnoses are rare
- Laparascopic adhesiolysis or diagnostic laparascopy alone have similar outcomes suggesting no additional advantage of the adhesiolysis
- Spontaneous improvement in 6 months?

Gastroenterology 2006;130:1492-97
Dietary Therapy

- Food allergies and intolerances
  - Milk
  - Gluten
  - FODMAPs
  - Other allergies and intolerances
- Functional foods for FAP
  - Fiber
  - Peppermint Oil
  - Probiotics
- Diet content vs. dietary habits
Prognosis

**Worse Prognosis**
- Male
- < 6 years
- Family “painful”
- Duration > 6 months
- Education < HS
- SES: Lower
- Operations: frequent (Appendix, Tonsils)

**Better Prognosis**
- Female
- > 6 years
- Family normal
- Duration < 6 months
- Education ≥ HS
- SES: middle upper
- Operations: infrequent
Summary

• Functional GI Disorders are common and varied
• Abdominal Pain is very common in childhood and can be functional and organic
• It is important to understand the differences in the underlying mechanisms
• Clinical markers may indicate functional vs. organic abdominal pain
• A detailed and careful evaluation is necessary to diagnose FAP
• Specific laboratory and imaging studies are indicated for the diagnosis
Summary

• Differential diagnosis of FAP should be carefully considered
• Goal of therapy is reduction of stress and anxiety in the child and the family
• Multidisciplinary approach is needed in therapy of FAP
• Good rapport with the patient and the family is useful in FAP therapy
• Prognosis of FAP may be identifiable based on the presenting features
Thank you

Contact: 202-476-3032
adarbari@childrensnational.org
FGIDs: Definition

- (Non organic) Functional GI disorders refer to those GI disorders where the clinical features cannot be explained on the basis of structural or biochemical abnormalities.
- FGID is not synonymous with Psychogenic or imaginary disorders
- Diagnostic Criteria-
  - Manning Criteria 1978
  - Rome Criteria 1989
  - Rome-II Criteria 1999
  - Rome-III Criteria 2006
FGIDs: Definition

- Childhood FGIDs include a variable combination of often age-dependent, chronic, or recurrent symptoms not explained by structural or biochemical abnormalities.
- They accompany normal development, or may be triggered by age-appropriate but maladaptive behavioral responses to internal or external stimuli.
FGIDs: Definition

• The diagnosis of some FGIDs depends on the child’s ability to report symptoms.

• Some diagnoses are therefore not seen in children below a certain age, this does not mean that it is not present in that age group.

• Therefore childhood FGIDs are classified based on main complaints reported by children or their parents.