

Henry P. Parkman, M.D., Series Editor

Importance of Gastrointestinal Motility Disorders



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Gastrointestinal (GI) motility and functional GI disorders are common reasons for patients to see physicians, especially gastroenterologists. Knowledge of GI motility disorders, including the evaluation and treatment of these disorders, is important for gastroenterologists, clinicians and health care providers to appropriately care for these many patients. This manuscript will discuss several aspects on the importance of gastrointestinal motility disorders for clinicians, clinical investigators, and basic scientists.

INTRODUCTION

Gastrointestinal motility can be defined as motor activity in the digestive tract which mixes ingested food with digestive juices and moves luminal contents of the gastrointestinal tract in an aboral direction from the mouth towards the anus. Gastrointestinal (GI) motility and functional GI disorders are common reasons for patients to see physicians, especially gastroenterologists. Knowledge of GI motility disorders, including the evaluation and treatment of these disorders, is important for gastroenterologists, clinicians and health care providers to appropriately

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care for these frequently seen patients. Disorders of GI motility and function may comprise a larger percentage of GI practice in the future stemming from the changes in the patient population in the United States and changes in the types of procedures gastroenterologists will be performing in the future (1).

This manuscript and the entire series on GI motility disorders to appear in *Practical Gastroenterology* will expound on the importance of gastrointestinal motility disorders for clinicians, clinical investigators, and basic scientists.

PREVALENCE OF GI SYMPTOMS AND GI MOTILITY DISORDERS

Gastrointestinal motility disorders encompass a wide array of symptoms that can occur from dysfunction throughout the luminal gastrointestinal tract (2).

Importance of Gastrointestinal Motility Disorders

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Table 1
Symptoms of Gastrointestinal Dysmotility

<i>Esophagus</i>	<i>Stomach/Small Intestine</i>	<i>Colon</i>	<i>Biliary Tract</i>
Dysphagia	Nausea	Constipation	RUQ abdominal pain
Heartburn	Vomiting	Diarrhea	Nausea/vomiting
Odynophagia	Early satiety	Lower abdominal pain	
Chest pain	Abdominal fullness	Anismus	
Regurgitation	Abdominal distension	Tenesmus	
Coughing	Abdominal pain	Fecal soiling	
Choking	Gas		
Wheezing			
Hoarseness			
Sore throat			

Symptoms of gastrointestinal disorders are common in the general population (Table 1). For instance, a recent telephone survey of 21,128 adults representative of the US population characterized the prevalence of upper gastrointestinal symptoms (3). The most common

upper GI symptoms reported in this general US population were heartburn, dysphagia, early satiety, bloating, and postprandial fullness (Table 2). Notably, women reported proportionately more symptoms than men. This particular study used factor analysis to look at symptoms that often occur together in individual patients. Four combinations of symptoms that were prominent: heartburn/regurgitation; nausea/vomiting; abdominal pain/discomfort and bloating; and early satiety/fullness. These symptom combinations may be due to different processes and correspond to the GI motility disorders of gastroesophageal reflux, gastroparesis, functional dyspepsia—epigastric pain syndrome, and functional dyspepsia—postprandial distress syndrome (Table 3).

Lower GI symptoms are also common. Estimates of the prevalence of constipation in North America ranges from 12%–19%. Prevalence estimates by gender support that constipation and related symptoms of bloating and abdominal discomfort are more common in females with a female to male ratio of 2.2:1 (4).

Symptoms of GI motility and functional GI disorders are a frequent complaint of patients seeking health care in both primary care settings and in gastroenterology practices. The leading GI symptoms prompting outpatient physician visits were recently reported (5). The most frequent were abdominal pain, diarrhea, nausea, vomiting, heartburn and dyspepsia, followed by constipation (Table 4). The most common physician

(continued on page 29)

Table 2
Prevalence of Upper GI Symptoms in the General Population

	<i>Presence of Symptom (≥1 episode per month)</i>	<i>Clinically Relevant Symptoms (>1–2 episodes per month)</i>
Heartburn	21.6%	6.3%
Regurgitation	16.4%	2.9%
Dysphagia	7.8%	4.6%
Bloating	10.7%	4.5%
Postprandial fullness	20.9%	3.6%
Early satiety	23.0%	5.3%
Nausea	9.5%	2.2%
Vomiting	2.7%	0.4%
Belching/burping	6.3%	3.0%
Abdominal pain	0.8%	
Abdominal discomfort	4.3%	

Results expressed as percent of the population.
From: Camilleri, Dubois, et al. *Clinical Gastroenterology Hepatology*, 2005;3:543-552.

(continued from page 24)

Table 3
Groupings of Upper GI Symptoms in the Community—Relation to Possible GI Motility Disorders

Symptoms	Possible Pathophysiology
Heartburn and regurgitation	GERD
Nausea and vomiting	Delayed gastric emptying
Bloating and abdominal pain/discomfort	Visceral hypersensitivity
Early satiety, postprandial fullness, loss of appetite	Impaired fundic accommodation

Table 4
Leading Gastrointestinal Symptoms Prompting Outpatient Physician Visits

1. Abdominal pain
2. Diarrhea
3. Nausea
4. Vomiting
5. Heartburn and indigestion
6. Constipation
7. Anal/rectal bleeding
8. Blood in stool (melena)
9. Other, unspecified GI symptoms
10. Decreased appetite
11. Difficulty swallowing

From: Russo, Wei, Thiny, et al. *Gastroenterology*, 2004;126: 1448-1453.

Table 5
Leading Physician Diagnoses of Outpatient Doctor Visits for GI Symptoms

1. Abdominal Pain
2. GERD
3. Gastroenteritis
4. Gastritis
5. Hemorrhoids
6. Irritable bowel syndrome
7. Hernias
8. Colonic polyps
9. Colorectal cancer
10. Inguinal hernia
11. Diverticulosis of colon
12. Dyspepsia
13. Constipation

From: Russo, Wei, Thiny, et al. *Gastroenterology*, 2004;126: 1448-1453.

diagnoses were abdominal pain and gastroesophageal reflux disease (Table 5).

GI motility and functional bowel disorders affect up to 25% of the US population. These disorders comprise about 40% of GI problems for which patients seek health care. Frequent GERD can affect 7%–10% of the general population. Irritable bowel syndrome is the most common functional bowel disorder with a prevalence in the range of 5%–25% and accounts for 36% of all visits to gastroenterologists (6) (Table 6). GI motility disorders include: achalasia, gastroesophageal reflux, gastroparesis, functional dyspepsia, irritable bowel syndrome, colonic inertia, pelvic floor dyssynergia, and fecal incontinence. Functional GI disorders are also common (Table 6): the prevalence of dyspepsia is approximately 20%–25%, irritable bowel syndrome 10%–25%, and chronic constipation

12%–19%.

IMPACT OF GI MOTILITY DISORDERS ON THE QUALITY OF LIFE

Motility disorders are often chronic in nature and can cause a tremendous burden to the individual patient from both the symptoms and an overall decreased quality of life (Table 7). Days of missed work is especially high among individuals reporting nausea, vomiting, and abdominal pain/discomfort syndromes (3) (Table 8). A societal burden is due to the decreased work productivity compounded by the high prevalence of these disorders. A number of studies have demonstrated reductions in health related quality of life mea-

Importance of Gastrointestinal Motility Disorders

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Table 6
Prevalence of GI Functional/Motility Disorders
Compared to Chronic Non-GI Disorders

GI	
Dyspepsia	20%–25%
Irritable bowel syndrome	10%–25%
Functional heartburn (GERD)	15.5%
Chronic constipation	12%–19%
Non GI	
Hypertension	28%
Migraine headache	6%–18%
Asthma	8%
Diabetes	8%

IBS and chronic constipation, but not dyspepsia, are more common in females than males.

From Chang L. *Aliment Pharm Ther*, 2004;20 (Suppl 7): 31-39.

Table 7
Societal Burden of GI Symptoms from
Decreased Work Productivity

	<i>Days of Missed Work During the Past 3 months</i>
Asymptomatic	0.4
Heartburn	1.0
Regurgitation	1.3
Dysphagia	1.3
Postprandial fullness	0.9
Early satiety	1.1
Nausea	2.2
Vomiting	4.4
Belching	1.4
Bloating	1.4
Abdominal pain	1.9

From: Camilleri, Dubois, et al. *Clin Gastroenterol Hepatol*, 2005; 3:543-552.

sure as well as a general well-being in patients with functional GI disorders and gastrointestinal motility disorders (6). This has been shown in a multitude of studies for irritable bowel syndrome and several studies for functional dyspepsia which also has a large clinical and economic burden (7,8). Other studies show this for the GI motility disorder gastroparesis (9). There is evidence to support that treatment of GI motility and functional GI disorders may correlate with an improvement in symptomatic response and in the quality of life.

GI DYSMOTILITY ASSOCIATED WITH OTHER DISORDERS

Gastrointestinal dysmotility also impacts on the quality of life of patients with other disorders. For example, a significant percentage of patients with diabetes have gastrointestinal dysmotility. Gastrointestinal complications of diabetes can affect one or more parts of the gut and produce nausea, vomiting, abdominal pain, constipation and/or diarrhea. Abnormal gastric emptying, or gastroparesis, may lead to poor glucose control.

Likewise, esophageal and GI motor dysfunction is often present in neurologic disorders such as Parkinson's disease, amyotrophic lateral sclerosis, and

strokes which may lead to trouble swallowing or evacuating the bowels. Other systemic disorders such as scleroderma and amyloidosis can lead to esophageal, gastric, and small intestinal dysfunction.

GI motility also plays an important role in issues outside of what is traditionally considered gastroenterology. Examples of this include nutrition, obesity, and drug delivery. Nutrition depends on the controlled delivery of food for optimal assimilation from the gastrointestinal tract. There is coordination between motility and secretion to help expose nutrients to digestive surfaces. Signaling of satiety is dependent on proper control of GI motility and release of GI hormones; obesity can result when satiety and GI motility are altered (10). Bioavailability of orally administered drugs is controlled in large part by GI motility.

Functional bowel disorders can occur in patients with organic bowel diseases especially inflammatory disease of the gastrointestinal tract. In these patients, when organic disease is in remission, persistent symptoms may be due to a functional motility component. In one study 96% of 228 consecutive patients with inflammatory bowel disease had one or more functional gastrointestinal disorder (11). Eighty-one percent of patients with inactive disease had one or more functional disorder with slightly higher prevalence of

lower gastrointestinal functional disorders. In another study, 20% of celiac disease patients were found to have IBS type symptoms compared with 5% of normal subjects (12). High prevalence of irritable bowel syndromes is also reported after infective enterocolitis suggesting the possibility IBS may be a postinfectious syndrome in some patients (13).

EVALUATION OF GI MOTILITY DISORDERS

Understanding GI motility dysfunction often underpins the appropriate management of patients. Unfortunately, these disorders are often ignored or sidelined due to a lack of understanding of mechanisms and appropriate therapy. In some cases, motility disorders can be complex and difficult to treat. Significant progress has been made over the last decade in understanding the etiology and pathophysiology of GI motility disorders allowing for better treatments of these disorders. GI motility has entered into the mainstay of gastroenterology and medicine (1).

For patients with possible GI motility problems, there has been a pendulum swaying between the decision to treat first versus an evaluation first—one that is often decided by the availability of treatments with few side effects versus the ease of the test—both in terms of availability and patient comfort. For instance, although esophageal manometry, esophageal pH monitoring, and other esophageal function tests are available, patient evaluation for gastroesophageal reflux disease (GERD) and esophageal motility disorders is generally performed after a therapeutic trial with a proton pump inhibitor (PPI) and is often reserved for patients that do not fully respond to treatment.

GI motility testing has several functions: 1) allow for the assessment of GI physiology and identification of abnormal physiology and patterns; 2) provide the correct diagnosis of GI motility disorders; 3) guide treatment of patients; and 4) provide prognostic information for patients (Table 8). Some examples of the importance of motility testing in the diagnosis and guiding treatment are readily apparent in clinical practice. For example, esophageal manometry can specifically diagnose achalasia and provide the rationale for effective, yet invasive, treatments. Anal manometry can determine if the cause of constipation is pelvic

Table 8
Goals of GI Motility Testing

- Allow assessment of GI physiology
- Identify abnormal physiology and patterns
- Diagnose GI motility disorders
- Guide treatment of patients
- Provide prognostic information for patients
- Evaluate pharmacologic and surgical therapy

floor dyssynergia for which biofeedback may be recommended. Anal manometry biofeedback is also helpful for evaluation of fecal incontinence to determine if there is a sensory and/or motility dysfunction.

GI motility specialists can fully evaluate and care for the patients with GI motility disorders. Often, the GI motility specialist is considered the physician that can take care of the complex GI motility patient that no one else can. Care of patients is becoming more advanced with the increasing number of treatments and increasing number of tests for evaluation. For instance, there has been an increase in the laparoscopic surgical and endoscopic antireflux procedures for GERD. Proper selection of patients is needed to help decide on medical treatment, surgical treatment, endoscopic treatment, or no treatment at all. This selection of patients can be performed with esophageal manometry and esophageal pH monitoring—the two main procedures performed in a GI motility laboratory.

REGISTRY OF GI MOTILITY LABORATORIES

Proper evaluation of patients with a possible GI motility disorder is important in order to provide optimal care for these patients in clinical practice. The Clinical Practice Committee of the American Motility Society (AMS) has developed a registry of GI motility laboratories that have experience in performing high quality GI motility procedures commonly used for the evaluation of patients. The registry serves several purposes: 1) identify GI motility laboratories that perform procedures using appropriate standard methodology; 2) raise awareness of these centers for health care providers who do not have direct access to a GI motility laboratory; 3)

(continued on page 34)

Importance of Gastrointestinal Motility Disorders

GI MOTILITY, A SERIES FROM THE AMS, SERIES #1

(continued from page 31)

Table 9
An Anatomic Classification of Neurogastroenterology Disorders (GI Motility and Functional GI Disorders)

<i>Organ</i>	<i>GI Motility Disorders</i>	<i>Functional GI</i>
Esophagus	Achalasia Diffuse esophageal spasm Gastroesophageal reflux disease	Functional dysphagia Functional chest pain Functional heartburn
Stomach	Gastroparesis Dumping syndrome	Functional dyspepsia
Small Intestine	Chronic intestinal pseudoobstruction	Irritable bowel syndrome
Colon	Colonic inertia Functional rectosigmoid obstruction Hirschsprung's disease	Irritable bowel syndrome Functional constipation Functional incontinence

raise awareness to patients who are either seeking such centers or wish to be evaluated for their condition. The procedures tracked in the registry are the standard motility procedures such as esophageal manometry, esophageal pH monitoring, and anorectal manometry. Other procedures tracked also include more specialized procedures such as electrogastrography and antroduodenal manometry. This registry is available at the AMS website at www.motilitysociety.org. Some of these laboratories provide mentorship programs allowing GI fellows, practicing gastroenterologists, and/or nurses/technicians to visit their motility laboratory to see the procedures performed.

CLASSIFICATION OF NEUROGASTROENTEROLOGY AND GI MOTILITY DISORDERS

The field of gastrointestinal motility, possibly more appropriately described as neurogastroenterology, concerns itself with a vast spectrum of clinical disorders of varying pathophysiology, presentation and management. The most common GI motility disorders include achalasia, esophageal motility disorders, dyspepsia, gastroparesis, chronic intestinal pseudoobstruction, irritable bowel syndrome and chronic constipation (2).

Gastric motility disorders illustrate several points about the relation between motility disorders and functional GI disorders. Gastroparesis is the most common

disorder of gastric motility. It is however, frequently overlooked in clinical practice because the symptoms of gastroparesis are nonspecific and the relationship of delayed gastric emptying to symptoms is difficult to define (1).

Gastroparesis may also be part of a larger problem with generalized dysmotility syndromes of the entire GI tract such as chronic intestinal pseudoobstruction. In addition, there is some overlap between gastroparesis and functional dyspepsia as both symptoms and gastric emptying test results may meet definitions for both in a subset of patients. As a consequence, some patients with mild abdominal pain, nausea, vomiting, and evidence of delayed emptying are considered to have functional dyspepsia by some clinicians and gastroparesis by others.

Importantly, new methods for diagnosis are being developed with breath testing and the use of the Smart-Pill. New treatment options for gastroparesis are being developed including gastric electric stimulation (14). Rapid gastric emptying (dumping), which has been recognized for generations in post-gastrectomy patients, is now being found to play a role in many other situations including diabetes, post-Nissen fundoplication, and even functional dyspepsia. Interestingly, patients may have dysfunction of both the proximal and distal regions of the stomach. Loss of gastric accommodation from proximal dysfunction may lead

(continued on page 36)

Importance of Gastrointestinal Motility Disorders

GI MOTILITY, A SERIES FROM THE AMS, SERIES #1

(continued from page 34)

(continued on page 39)

Table 10
A Classification of Neurogastroenterology Disorders (GI Motility and Functional GI Disorders)
Based on Location and Pathophysiology (Motility and/or Sensory Dysfunction)

<i>Location</i>	<i>Pathophysiology</i>		
	<i>Primarily GI Dysmotility</i>	<i>Both Motility and Sensory Dysfunction</i>	<i>Primarily Sensory Dysfunction</i>
Esophagus	Achalasia	Diffuse esophageal spasm Nutcracker esophagus Unexplained chest pain Gastroesophageal reflux disease	
	Scleroderma	Non-erosive reflux disorder	Functional heartburn Functional dysphagia Globus
		Belching disorders	
Stomach	Gastroparesis Dumping syndrome	Functional dyspepsia Cyclic vomiting syndrome Rumination syndrome Chronic idiopathic nausea Functional vomiting	
Biliary Tract	Sphincter of oddi dysfunction		Gallbladder hypomotility
Intestine	Chronic intestinal pseudo-obstruction (dilated) Chronic intestinal dysmotility (non-dilated CIIP) Small intestinal bacterial overgrowth	Irritable bowel syndrome	
	Slow transit constipation		Functional constipation
	Colonic inertia Rapid transit diarrhea		Functional diarrhea
Anorectal	Hirschsprung's disease Functional rectosigmoid obstruction: dyssynergia	Functional fecal incontinence	
Miscellaneous		Functional abdominal pain	

(continued from page 36)

to rapid gastric emptying of liquids and some symptoms of dumping. This may coexist with distal gastric dysfunction of the antrum with delayed emptying of solids. This may be a reason why there is often a poor relation between symptoms of gastroparesis and measurement of emptying of solids.

There are many ways of classifying GI motility disorders. As is apparent, there is an overlap between GI motility disorders defined by objective motility abnormalities and functional GI disorders which are primarily defined by symptoms. Classifying the GI motility disorders can be helpful. Table 9 presents a working classification of GI motility and functional GI disorders based on the region of the GI tract affected. Other ways to classify disorders include classifying motility and functional GI disorders not only according to the region involved, but also classifying the disorder as to the pathophysiology. The example shown in Table 10 attempts to classify disorders into the predominant abnormality: motility abnormalities; sensory abnormalities; or a combination. This type of classification might be helpful to the clinician caring for patients, as it may also be used therapeutically, helping the clinician determine what type of therapeutic agent to use.

ADDRESSING THE UNMET CLINICAL NEED FOR GI MOTILITY

GI motility and its disorders are important areas for the health of the United States. Important progress has been made in understanding these GI motility disorders and improving the treatment of patients affected with these disorders. However, much more needs to be done as this field is one with continued unmet clinical and research needs. These patients represent a large number of patients seeking healthcare. Table 11 lists several suggestions to address the unmet clinical need for caring for patients with GI motility and functional GI disorders. There are three main areas: 1) increasing awareness of GI motility; 2) training/mentoring in GI motility; and 3) promoting GI motility.

Increasing awareness of the importance of GI motility disorders occurs at both the training level for GI fellows and to clinicians. This will help GI fellows understand that this training is needed for their clinical practice (15). Clinical courses in GI motility and

functional GI disorders are given by the American Motility Society and other organizations. In addition to their teaching value, these meetings provide interaction between trainees, clinicians, and established investigators. For didactic teaching, updated teaching modules for the instruction of GI motility and its disorders have been developed (16,17). The International Foundation of Functional GI Disorders (IFFGD), an organization promoting recognition of GI motility and functional GI disorders, has recently opened a web site, www.aboutmotility.org, to help advance the awareness and importance of GI motility disorders. The American Motility Society has recently started a mentorship program for individuals wanting to enter the field of GI motility, either in research or clinical care.

There is a critical need to communicate with other specialty societies, the NIH, and the pharmacologic industry to convince them of the importance of education, funding of research, developing new treatments and educating the general public about these matters. Increasing the funding for research in GI functional and/or motility disorders is important to improve the health care of our citizens.

Awareness is needed about the variety of GI motility tests available for patient evaluation which allow diagnosis of the patients' condition and help point to the correct treatment. New technologies have recently increased the excitement in evaluation of patients for GI motility disorders since these provide more information and/or increase patient acceptance. Recent examples of using new technology in clinical evaluation include wireless esophageal pH monitoring with Bravo capsule, impedance monitoring to complement esophageal manometry and esophageal pH monitoring, high resolution contour mapping for esophageal manometry, and capsule technology to measure gastric emptying and total GI transit.

Exciting research in neurogastroenterology is advancing this field, not only in the basic science laboratory but also in the clinical setting. For example, in the basic sciences, ongoing research is helping understand the role of interstitial cells of Cajal as the pacemaker cells of the GI tract. Studying neural-immune interactions is allowing better understanding of the effects of inflammation on GI motility and sensation. Novel methods of imaging and recording techniques are being used

Table 11
Addressing the Unmet Clinical Need for GI Motility

Increasing Awareness of GI Motility

- Education of practicing physicians on importance of GI motility disorders
- GI motility tests using novel technology
- New treatments available

Training/Mentoring in GI Motility

- Reach out to trainees early in their training
- Increase the number of mentors in GI motility
- Develop centers of excellence in GI motility
 - Patient evaluation
 - GI motility training
- Clinical courses in GI motility disorders

Promoting GI Motility

- Highlight new concepts in GI motility
- Promote research in GI motility
- Increase attractiveness of career opportunities in GI motility
 - Research funding
 - Reimbursement for GI motility tests

in the clinical evaluation of patients to measure GI motility including SPECT imaging, MRI, capsule telemetry, and endoluminal ultrasonography. These new techniques have the ability to provide clearer diagnostic measures that will hopefully allow better understanding of the patient's cause of their symptoms.

New concepts have emerged over the last decade in both GI motility and functional GI disorders allowing improved treatment. Electrical stimulation is being used to treat gastroparesis and is being applied to other areas of the luminal GI tract. Neurotoxins are being used locally to abolish excitatory nerve function and treat spastic disorders of the GI tract including achalasia and gastroparesis. As in many areas, our understanding of the physiology has surpassed our current ability to treat many of the pathophysiologic disorders. Current and future clinical research will continue to enhance our armamentarium for treating patients with GI motility disorders. For example, research is ongoing in neural stem cell therapy to replenish the enteric nervous system and treat GI motility disorders (18). ■

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