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Change in Management After Radionuclide Gastric Emptying Studies Showing Slow Emptying

Japnit Singh and Michael M. Graham

Department of Nuclear Medicine, University of Iowa Hospitals and Clinics, Iowa City, Iowa

The radionuclide gastric emptying study is the gold standard for the diagnosis of gastroparesis. **Methods:** We performed a retrospective analysis of 510 patients to evaluate how often a diagnosis of slow gastric emptying determined by gastric emptying scintigraphy (GES) changes clinical management at our institution. **Results:** We found evidence of gastroparesis in 100 patients. A change in management was recommended for 62% within 1 mo of the GES. **Conclusion:** Our results illustrate the importance of performing GES on patients with clinically suspected gastroparesis.

Key Words: gastric emptying scintigraphy; slow gastric emptying; nutrition education counseling; prokinetics; cholinergics

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Historically, gastric emptying has been assessed using many different methods, beginning in the late 19th century with Walter B. Cannon, who pioneered the first imaging-based method, which used fluoroscopy to assess gastric function after a meal labeled with a radiopaque contrast agent (*1*). More recently, Griffith et al. (*2*) showed in 1966 that it was feasible to quantitatively assess gastric emptying with scintigraphy. The meal, "a breakfast of porridge, scrambled eggs, milk, bread and butter," was labeled with ^{51}Cr, and imaging was done with a rectilinear scanner immediately after the meal had been consumed and at half-hour intervals. Since then, the methodology has evolved, with at least 1,814 papers having been published on gastric emptying scintigraphy (GES) at the time this article was being prepared.

A major area of variability in the reported studies has been the composition of the standard meal. Several different types of standard meals have been proposed. Concern has been raised that unless all subjects eat the same meal, results could vary significantly, which would make interpretation of the results more difficult or impossible. The reality is that the emptying times for most of the proposed standard meals are very similar and minor differences are indistinguishable because of the large physiologic variation between individuals. This was illustrated in a study by Tougas et al., in which a low-fat egg-based meal was compared against a high-fat liver-based meal (*3*). Their conclusion was, "There are no data to indicate that using a meal incorporating an egg or an egg substitute is superior to using a meal incorporating liver as a screening test for delayed gastric emptying."

Although it may not matter whether eggs or chopped liver is used in the meal, the caloric content definitely makes a difference. Lobo et al. looked at gastric emptying of a meal consisting of a single pancake and 100 mL of water compared with a meal of 2 pancakes and a strawberry milkshake (*4*). The half-time for emptying was more than twice as long for the larger meal.

This difference certainly suggests that it is inappropriate to allow complete freedom in meal selection and that some degree of standardization is necessary, at least ensuring that the caloric content of all meals is similar. Standardization allows comparison of results between centers and the use of normal standards for half-time and percentage emptying.

In 2008, a true standard was proposed in "Consensus Recommendations for Gastric Emptying Scintigraphy: A Joint Report of the American Neurogastroenterology and Motility Society and the Society of Nuclear Medicine" (*5*). The meal proposed in these recommendations is that used for many of the published studies, including the one by Tougas et al. (*3*), which is the largest published study in terms of subject numbers.

The proposed standard meal consists of egg white from 2 large eggs, 2 slices of white bread, 30 g of strawberry jam, and 120 mL of water. The egg white is mixed with 18.5–37 MBq (0.5–1.0 mCi) of ^{99m}Tc-sulfur colloid and then scrambled. The scrambled eggs, along with the jam, is placed between the bread slices to form a sandwich.

Various other aspects occur in practice that introduce significant variability into the test. The most common problem is that the subject does not eat the entire meal. If that happens, it is likely that gastric emptying will be more rapid than if the entire meal had been eaten. Other common circumstances that can influence gastric emptying are medications, smoking, posture during the test, and general well-being (a mild viral illness will slow gastric emptying). Accordingly, it is important to note how much of the meal was consumed, although there is no standard method to correct for partial meal consumption. Subjects should be advised not to smoke on the day of the study, and imaging should be done in a

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For correspondence or reprints, contact Japnit Singh (japosingh@gmail.com).
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standardized manner, that is, with the subject standing or lying supine during imaging and sitting in a chair or walking around between images.

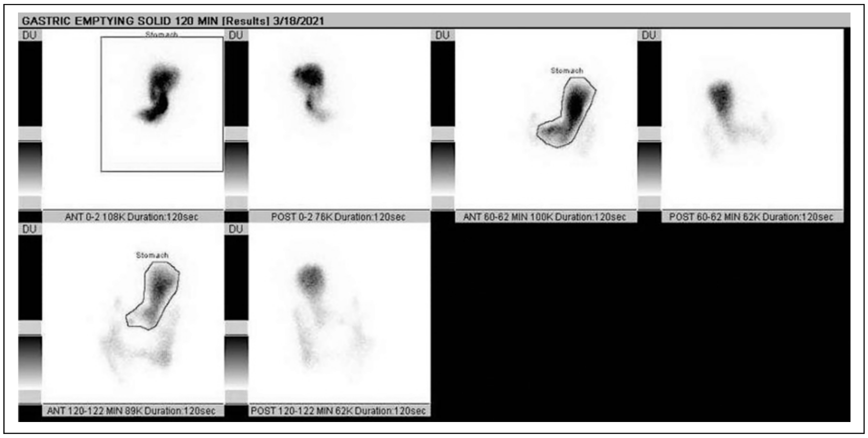

FIGURE 1. γ-camera images and regions of interest of gastric emptying study. At top left are anterior and posterior images of stomach just after intake of radiolabeled meal. Large region of interest is always used on first image to contain all activity ingested. Subsequent regions of interest are drawn to conform to stomach. Images at top right were obtained 1 h after meal intake. Images at bottom show retention of meal after 2 h. Regions of interest are mirrored and applied to posterior images. Anterior and posterior counts are averaged using geometric mean, and count is decay-corrected to beginning of emptying.

Although there has been agreement on a standardized approach for gastric emptying, in actual practice there continues to be moderate variability in many of the technical details because of continuation of past practices and following of preferences at many sites. In general, as long as there is local standardization and interpretation of results, it is likely that the results will be clinically useful. For instance, at the University of Iowa, we omit the jam from the standard meal and image patients supine. Patients are allowed to walk or sit between images. Both anterior and posterior images are acquired, and counts over the stomach are combined using geometric averaging. The locally generated normal emptying curves almost exactly match the published curves.

Although we have been conducting 2–3 gastric emptying studies per day for decades at the University of Iowa, we have been unaware of the impact of these studies on patient management. The study reported here was a determination of changes in management that have occurred in response to our reports of abnormally slow gastric emptying.

MATERIALS AND METHODS

This retrospective study was performed at a single institution, the University of Iowa Hospitals and Clinics, and was approved by the Institutional Review Board, which waived the need for informed consent. Electronic medical records were accessed for 510 patients (age range, 17–84 y; median age, 52 y). The exclusion criteria were normal or rapid gastric emptying results on GES. The only inclusion criterion was the diagnosis of slow gastric emptying (half-time > 2 h, <40% emptying at 2 h, or <90% emptying after 4 h). Parameters that were recorded and included in the data analysis included sex, age, symptoms, body mass index, presence of diabetes, and the date and type of any change in management.

All patients received the same meal: 2 scrambled eggs mixed with 37 MBq (1 mCi) of ^{99m}Tc-sulfur colloid before cooking, along with a slice of toast and 120 mL of water. Anterior and posterior γ-camera imaging was done immediately after the meal had been eaten and at 1 and 2 h later (Fig. 1). The patients lay supine during the imaging and sat in a chair between images. Geometric means of the anterior and posterior counts were calculated and corrected for radionuclide decay. The results were assessed by comparison to standard curves for solid gastric emptying, similar to plots shown by Hansrod et al. (*6*)

RESULTS

Of the 510 patients analyzed, 100 (19.6%) had slow gastric emptying (Fig. 2). Their mean age was 56 y (range, 17–84 y).

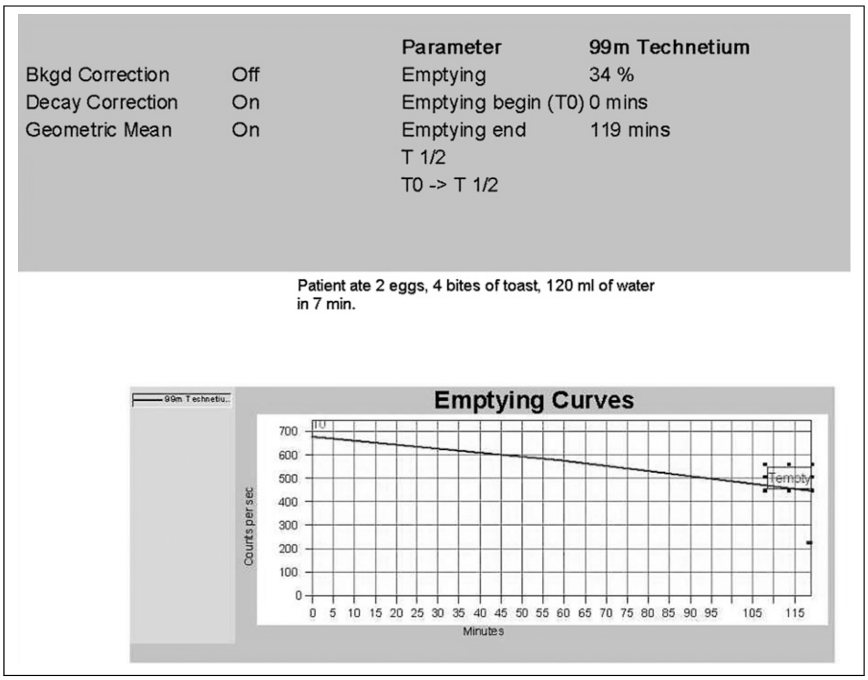

FIGURE 2. Typical slow gastric emptying curve (time points at 0, 60, and 120 min). Analysis was done using esoft software (Siemens). T 1/2 = half-time.

TABLE 1
Change in Management in Patients with Slow Gastric Emptying

Recommendation given for …	Patients (*n*)
Any change in management	62 (62%)
Nutrition education only	41 (41%)
Medication only	10 (10%)
Medication and nutrition education	6 (6%)
Intervention	4 (4%)
Imaging	1 (1%)

There were 22 male patients and 78 female patients; 88% had 2 or more symptoms of gastroparesis (nausea/vomiting, fullness/early satiety, bloating/distension, and upper abdominal discomfort/pain) for over 2 mo. A change in clinical management was recommended for 62% of the patients within 1 mo of diagnosis (Table 1). Nutritional counseling (41%) and medication changes (10%) were the 2 most common recommendations, with prokinetics (e.g., metoclopramide) and cholinergics (e.g., bethanechol) being the medications added most often. Weight loss, gastric pacemakers, endoscopic or surgical procedures, and psychologic interventions were some of the other recommendations for these patients. Change in clinical management did not significantly differ between diabetic (64%) and nondiabetic (60%) patients or between obese (65%) and nonobese (59%) patients (Table 2).

DISCUSSION

Disorders of gastrointestinal transit and motility are common, causing either slow or rapid transit through the stomach, small intestine, or colon and affecting one or more regions of the gastrointestinal system. Although current knowledge of the mechanisms responsible for slow gastric emptying is limited, it is clear that gastroparesis arises from a spectrum of motor dysfunctions. Clinical symptoms are insufficient to make a diagnosis; therefore, objective measurement is required for the diagnosis of gastroparesis. Scintigraphic measurement of gastric emptying is at present the gold standard for establishing the diagnosis, although other techniques, such as radioisotopic breath tests and ultrasound, show considerable promise (*7*). Assessment of regional or whole-gut transit times can also provide direct measurements and diagnostic information to explain the etiology of symptoms and plan therapy (*8*).

TABLE 2
Patient Distribution by Body Mass Index

Body mass index	Patients (*n*)	Change recommended (*n*)
<18.5 (underweight)	4	1 (25%)
18.5–24.9 (normal weight)	29	17 (37%)
25–30 (overweight)	20	13 (39%)
>30 (obese)	47	31 (40%)

Gastroparesis can be idiopathic or diabetic in origin, with little difference seen in their presentations. Patients with suspected gastroparesis often report symptoms referable to other sources of motility impairment in the stomach and extragastric regions. Gastroparesis is a heterogeneous disorder; its etiology affects symptoms and severity. Long-term studies are needed to determine whether the differences in symptoms and gastric emptying affect progression and treatment response. Symptoms attributed to the gastroduodenal region represent one of the main subgroups among functional gastrointestinal disorders.

A slightly modified classification into 4 categories has been proposed (*9*). The first, functional dyspepsia, is characterized by one or more of the following symptoms if unexplainable after a routine clinical evaluation: postprandial fullness, early satiation, epigastric pain, and epigastric burning. This category includes 2 subgroups: postprandial distress syndrome, which is characterized by meal-induced dyspeptic symptoms, and epigastric pain syndrome, which does not occur exclusively postprandially; these subgroups can overlap. The second category, belching disorders, defined as audible escapes of air from the esophagus or stomach, is classified into 2 subgroups—gastric belch and supragastric (or esophageal) belch—depending on the origin of the refluxed air as detected by intraluminal impedance measurement. The third category, nausea and vomiting disorders, includes 3 subgroups: chronic nausea and vomiting syndrome, cyclic vomiting syndrome, and cannabinoid hyperemesis syndrome (caused by long-term cannabis use). The fourth category, rumination syndrome, is characterized by effortless regurgitation of most meals after consumption.

Symptoms due to rapid gastric emptying are often indistinguishable from those of gastroparesis; hence, it is important to differentiate the two to correctly identify the etiology and treat the patient appropriately. A range of treatments has been used for gastroparesis, including dietary modifications, nutritional supplements, medications to stimulate gastric motility, antiemetic drugs, endoscopic or surgical procedures, and psychologic interventions. Most treatments have not been subjected to controlled testing in patients with gastroparesis. Active ongoing research is providing important insights into the pathogenesis, diagnosis, treatment, and outcomes of this disease (*10*).

Patients with gastroparesis often have other comorbidities, including obesity and diabetes. Most patients with slow gastric emptying were recommended to receive nutrition education, which primarily included the recommendation to eat 4–6 small meals, decrease fiber and fat in the diet, and increase protein intake. These patients were encouraged to increase consumption of vitamins and other nutrients in a smoothie-consistency meal. Patients with a high body mass index were encouraged to lose weight. Some patients who were already on a gastroparesis diet were started on metoclopramide (which speeds gastric emptying), taken 15–20 min before meals at least 3 times a day. Patients for whom gastroparesis treatment was not recommended were often those found to have serious comorbidities, including cardiac failure, a severe eating disorder, and diabetic neuropathy. All of these needed urgent treatment.

In this retrospective study, we used the electronic medical records to analyze and track management of each patient who was reported to have slow gastric emptying on GES testing. Information obtained from medical records can be variable, but generally the case notes showed the clinician's reason for referring a patient and gave reliable clues to any changes in management. We are aware, however, that the results derived from this study alone may not form a basis to draw firm conclusions about any specific management recommendations for patients with gastroparesis on GES testing. A more structured characterization of management recommendations is provided by previous studies that prospectively compared how GES and wireless motility capsule testing inform recommendations for treatments and additional diagnostic evaluations (*11*).

CONCLUSION

Gastroparesis is a disorder that is heterogeneous not only in symptoms but also in severity. Clinical symptoms such as nausea, vomiting, fullness, early satiety, bloating, distension, or upper abdominal pain are not reliable for the diagnosis of gastroparesis, as some of these symptoms can also be due to rapid gastric emptying. GES is the gold standard for diagnosis of gastroparesis. A diagnosis of gastroparesis by GES resulted in a change in clinical management in 62% of such patients in our study, thus illustrating the importance of performing GES on patients with clinically suspected gastroparesis.

DISCLOSURE

No potential conflict of interest relevant to this article was reported.

KEY POINTS

QUESTION: Does a slow gastric emptying on GES study change clinical managment?

PERTINENT FINDINGS: Symptoms of rapid gastric emptying and gastroparesis are similar; therefore, differentiating the two is important for proper treatment determination.

IMPLICATIONS FOR PATIENT CARE: Depending on the clinical diagnosis, patients with gastroparesis can be managed by surgery, medication, or conservatively with alterations in diet.

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