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Fundic accommodation assessed with gastric volume scintigraphy: comparison with the gastric barostat

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Abstract

Recently, single photon emission computed tomography (SPECT) scanning was described as a noninvasive technique to assess fundic accommodation. However, in contrast with the barostat, no intragastric distending force is applied during gastric volume scintigraphy (GVS). We hypothesized that in the absence of a barostat balloon, GVS largely detects the volume effect of the ingested meal and is a rather insensitive tool to detect fundic relaxation.

Methods. After an overnight fast, healthy volunteers underwent a barostat study and GVS on 2 separate days to assess: (1) meal induced fundic accommodation (Nutridrink, 200 mL, 300 kcal); and (2) gastric relaxation to 1 mg i.v. glucagon.

Results. Fasting fundic volumes (145 ± 8 mL vs. 280 ± 32 mL, \( P = 0.001 \)) and average postprandial volume (329 ± 10 mL vs. 571 ± 53 mL, \( P = 0.001 \)) were significantly lower measured with GVS compared to the barostat study. Meal induced fundic relaxation (183 ± 10 mL vs. 289 ± 46 mL, \( P = 0.050 \)) and the postprandial/fasting volume ratio (2.32 ± 0.10 mL vs. 2.27 ± 0.29 mL, \( P = 0.892 \)) did not differ significantly between GVS and the barostat. However, no correlation could be determined between accommodation volumes measured with both techniques. In contrast with meal-induced relaxation, glucagon induced increase in fundic volume (19 ± 5 mL vs. 406 ± 56 mL, \( P = 0.007 \)) and post/pre glucagon ratio (1.16 ± 0.03 vs. 3.02 ± 0.54, \( P = 0.046 \)) were significantly lower when measured with GVS compared to the barostat.

Conclusion. Gastric volume scintigraphy detects changes in postprandial volume but is less suitable than the gastric barostat to detect changes in gastric tone. Our study therefore questions its role as a tool to detect impaired accommodation and warrants further validation of this technique.
Introduction

Under normal conditions, the proximal stomach relaxes after ingestion of a meal, a vagally mediated motor pattern known as the meal induced accommodation. Impaired meal induced relaxation of the proximal stomach has been repeatedly demonstrated in a subgroup of patients with functional dyspepsia (FD). Symptoms such as early satiety and weight loss in particular have been reported to be associated with this phenomenon. Conversely, treatment with sumatriptan, a potent fundic relaxant, induced an increase in caloric intake in FD, suggesting that fundic relaxation may represent a new therapeutic approach for this subgroup of FD. If so, it may be of importance to determine proximal stomach function in order to select the subgroup of patients that would benefit from this fundic relaxant therapy.

At present, a gastric barostat study is generally accepted as the gold standard to investigate proximal stomach function. A balloon connected to a computerized pump is positioned in the proximal stomach to record intraballloon volume at a fixed pressure as a measure of fundic tone. This technique has provided enormous valuable information on the effect of meal ingestion and pharmacological agents on the proximal stomach. However, a major disadvantage is the invasive and stressful nature of this investigation. Furthermore, the presence of the balloon interferes with normal physiology as reported by Mundt et al. Consequently, it is an unattractive tool for routine clinical use and even for the evaluation of drug effects in clinical trials, usually requiring repeated measurements.

Recently, single photon emission computed tomography (SPECT) has been reported as a possible noninvasive alternative (gastric volume scintigraphy). Radiolabeled $^{99m}$Tc-pertechnetate is injected i.v. and accumulates in the gastric mucosa allowing visualization of the stomach. This technique was shown to record changes in postprandial volume to a similar extent as the gastric barostat. It should be emphasized that in this study the barostat balloon was positioned in the proximal stomach during gastric volume scintigraphy (GVS), providing a positive pressure to the gastric wall and thereby actively distending the stomach. Under more physiological conditions, however, the stomach will remain collapsed. Consequently, the volumes measured with GVS will reflect intragastric...
content such as gastric secretions, swallowed air and ingested foods or liquids. Based on these assumptions, we hypothesized that in the absence of a barostat balloon, GVS largely detects the volume effect of meal ingestion and will be a rather insensitive tool in detecting fundic relaxation. To test this hypothesis, the ability to detect fundic relaxation of comparable magnitude evoked by meal ingestion or glucagon was compared between the 2 techniques performed at separate days. In addition, symptoms reported during the study were evaluated as indirect measure of procedure related discomfort.
Materials and Methods

Subjects

Twenty-one healthy volunteers, recruited by public advertisement, were invited to participate (13 women, 8 men; mean age 26 yr, range 18 - 54 yr). Gastrointestinal symptoms were excluded using a questionnaire (Nepean Dyspepsia Index) and none of the subjects was taking medications known to influence gastrointestinal motility. All volunteers gave written informed consent to participate in the study, which was approved by the medical ethics committee of the Academic Medical Center of the University of Amsterdam.

Study protocols

Gastric relaxation was evoked by 2 different protocols: (1) meal intake and (2) i.v. injection of glucagon. For each protocol, subjects were invited to undergo a gastric barostat study and a $^{99m}$Tc-pertechnetate SPECT on 2 separate days. To determine the gastric-emptying time after meal ingestion, a $^{13}$C breath test was performed.

Protocol I: Meal induced relaxation

Barostat. After an overnight fast, 17 healthy volunteers (13 women, 4 men; mean age 25 yr, range 18 – 54 yr) underwent a gastric barostat study at 09:00 AM. The barostat bag was introduced, unfolded, and positioned into the proximal stomach. After an equilibration period of approximately 30 min, the mean distending pressure (MDP) was determined and baseline operating pressure was set at MDP + 2 mm Hg. After a 30 min baseline period, a liquid test meal with a caloric load of 300 kcal and a volume of 200 mL (Nutridrink; Nutricia) was consumed with the aid of a straw. Intrabag volume was recorded during the following 60 min and symptoms of bloating, nausea, pain, satiety, fullness, hunger and burning were assessed every 5 min with a Visual Analogue Scale (VAS), whereby 0 mm represents “no sensation” and 100 mm represents “worst imaginable”. The $^{13}$C breath test was performed before the test meal and every 10 min during the first h, and thereafter every 15 min the next 3 h.
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*Gastric volume scintigraphy.* On a separate day, after an overnight fast, the same subjects underwent SPECT scanning at 9:00 AM. Thirty min after i.v. injection of 200 MBq $^{99m}$Tc-pertechnetate, a baseline scan was performed. The test meal (Nutridrink, 200 mL, 300 kcal) was given and scans were made every 10 min up to 1 h postprandially. Before every scan, breath samples were taken and symptoms of bloating, nausea, pain, satiety, fullness, hunger and burning were scored with the VAS. After the first h, breath samples were collected every 15 min for the next 3 h.

**Protocol 2: Glucagon induced fundic relaxation**

*Barostat.* After an overnight fast, 4 healthy volunteers (4 men; mean age 29 yr, range 22 – 38 yr) underwent a gastric barostat study at 09:00 AM. The barostat bag was introduced, unfolded and positioned into the proximal stomach. After an equilibration period of approximately 30 min, MDP was determined and baseline operating pressure was set at MDP + 2 mm Hg. Intrabag volume was recorded for 30 min, followed by i.v. injection of 1 mg glucagon (Glucagen; Novo Nordisk Farma) dissolved in 1 mL saline water for i.v. injection and was injected slowly during 1 min. Intrabag volume was recorded during the following 15 min.

*Gastric volume scintigraphy.* On a separate day, after an overnight fast, the same subjects underwent SPECT scanning at 9:00 AM. Thirty min after intravenous injection of 200 MBq $^{99m}$Tc-pertechnetate, a baseline scan was performed. Glucagon (1 mg) was administered intravenously and 7-min scans were started after 1 min and 8 min.

**Methods**

*Gastric Barostat.* Following anesthesia of the throat (Xylocaine 10 % spray; AstraZeneca), subjects swallowed a 1,200 mL polyethylene bag, tightly wrapped on the distal end of a double lumen polyvinyl tube (4 mm outer diameter Salem Sump tube; Sherwood Medical). The balloon was unfolded by inflation of 500 mL of air and was positioned in the proximal stomach by gently withdrawing the catheter. The catheter was connected to the barostat and fixed to the cheek, and subjects were positioned upright. The barostat device (Medtronic Functional Diagnostics) automatically corrected for the compressibility of air. Intraballoon pressure and volume were recorded continuously.
Gastric volume scintigraphy versus barostat

during the protocol, and data were stored on a personal computer using commercially available software (Polygram for Windows; Medtronic Functional Diagnostics, Synectics Medical). MDP was determined as the minimum pressure at which intrabag volume was > 30 mL. For measuring fasting volume, meal induced fundic relaxation and glucagon induced fundic relaxation, baseline operating pressure was set at MDP + 2 mm Hg.

Gastric volume scintigraphy. Gastric volume was assessed by means of SPECT scanning using \(^{99m}\)Tc-pertechnetate i.v. A dual-head gamma camera in SPECT mode allowed 3-dimensional data acquisition. Tomographic studies were acquired on a large-field-of-view dual-head gamma camera system (Varicam; General Electric Medical Systems) equipped with low-energy high-resolution collimators. Volunteers were positioned supine on the imaging table with the gastric region in the middle of the field-of-view. Thirty min after i.v. injection of 200 MBq \(^{99m}\)Tc-pertechnetate, a baseline acquisition was performed (360\(^\circ\) orbit, 5\(^\circ\) step, 72 views, 10 sec/view, 7 min total acquisition time including gantry movement). Subsequently, after intervention (test meal, glucagon) multiple acquisitions were made up to 1 h and up to 15 min, respectively. After completion of the acquisition, every acquisition was reconstructed on a Hermes processing station (Nuclear Diagnostics) using filtered back-projection (Ramp-Butterworth filter, order 10, cut-off 0.45 Nyquist) to produce transverse, sagittal and coronal images of the stomach. After reconstruction, stomach volume measurements were performed using the volume tool software on the Hermes processing station. A threshold of 20\% of the maximal voxel count value was applied, after filling the interior stomach with a default 50\% voxel count value. Total and regional (proximal – distal) gastric volumes were calculated. The stomach was divided into proximal and distal stomach by drawing a horizontal line across the incisura. To allow repetitive studies, a limited dose of 200 MBq \(^{99m}\)Tc-pertechnetate was administered, limiting the radiation burden to 2.4 mSv per study. We have previously determined that this dose is capable of delivering good quality images for at least 2.5 h after i.v. injection. Total radiation exposure was within permissible ranges for research and clinical studies.

\(^{13}\)C breath test. Gastric emptying was measured with the \(^{13}\)C breath test. Acetic acid-1-\(^{13}\)C sodium salt was added to the caloric liquid meal (Nutridrink). Breath was collected by breathing into a tube through a straw. Breath samples were taken before the test meal
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and every 10 min during the first h thereafter, followed by every 15 min for the next 3 h. All breath samples were obtained in duplicate. Analysis of the breath samples was performed with the BreathMAT Plus TM (ThermoQuest Finnigan MAT).

Data analysis

Barostat. Fasting volume was calculated as the mean volume of 15 min before meal intake or glucagon injection using commercially available software (Polygram for Windows). Postprandial volumes were measured as the mean volume of 5-min periods. Average postprandial volume was defined as the mean volume over the 60-min postprandial period. Maximal volume was measured as the highest volume recorded during the 60 min postprandial. Fundic relaxation after ingestion of a liquid meal was expressed as the difference in volume between the average postprandial volume and the fasting volume. Relaxation induced by glucagon was measured as the difference in volume between the average of 15 min after injection and the fasting volume. The postprandial ratio and post glucagon ratio were calculated as the postprandial volume or the post glucagon volume divided by the fasting volume, respectively.

Gastric volume scintigraphy. SPECT fasting and postprandial volumes were measured as the mean volume of 7-min periods using the volume tool software on the Hermes processing station (Nuclear Diagnostics). Similar to the barostat, gastric relaxation after liquid meal ingestion was defined the difference in volume between the average postprandial volume and the 7-min fasting period before the meal. For relaxation after glucagon injection, the difference in volume between the average of 15 min postinjection and the 7 min before injection of glucagon fasting volume was calculated. The postprandial ratio and post glucagon ratio were defined as the average postprandial volume or post glucagon volume divided by the fasting volume, respectively.

Symptoms. Symptoms reported before the meal and during the postprandial period were expressed as mean values for every 5-min time point during the barostat study and every 10-min time point during SPECT scanning. Individual sensation scores for bloating, nausea, pain, satiety, fullness, hunger and burning were assessed on a VAS, from which an individual score, a total postprandial symptom score for each time point and the total symptom score of each individual symptom were calculated.
Gastric volume scintigraphy versus barostat

Table 1. Patient data

<table>
<thead>
<tr>
<th></th>
<th>Baro (mL)</th>
<th>GVS Fundus (mL)</th>
<th>$P$ value</th>
<th>Correlation</th>
<th>GVS total stomach (mL)</th>
<th>$P$ value</th>
<th>Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast</td>
<td>280±32</td>
<td>145±8</td>
<td>0.001</td>
<td>-0.19</td>
<td>18 ±11</td>
<td>0.011</td>
<td>-0.20</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(P = 0.49)</td>
<td></td>
<td></td>
<td>(P = 0.45)</td>
</tr>
<tr>
<td>PP</td>
<td>571±53</td>
<td>329±10</td>
<td>0.001</td>
<td>-0.26</td>
<td>38 ±13</td>
<td>0.004</td>
<td>-0.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(P= 0.34)</td>
<td></td>
<td></td>
<td>(P = 0.69)</td>
</tr>
<tr>
<td>Diff</td>
<td>289±46</td>
<td>183±10</td>
<td>0.050</td>
<td>-0.08</td>
<td>200±13</td>
<td>0.111</td>
<td>-0.31</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(P = 0.77)</td>
<td></td>
<td></td>
<td>(P = 0.25)</td>
</tr>
<tr>
<td>Ratio</td>
<td>2.3±0.3</td>
<td>2.3±0.1</td>
<td>0.892</td>
<td>-0.12</td>
<td>2.2 ± 0.1</td>
<td>0.816</td>
<td>-0.29</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(P = 0.67)</td>
<td></td>
<td></td>
<td>(P = 0.30)</td>
</tr>
</tbody>
</table>

GVS = gastric volume scintigraphy; Baro = barostat

Fast = fasting state; PP = postprandial; Diff = difference; Ratio = postprandial ratio

$^{13}$C breath test. The breath samples collected over 4 h after the ingestion of the meal were analyzed with the BreathMAT Plus TM (ThermoQuest Finnigan MAT). After analysis, the obtained $\delta^{13}$ values were used in curve-fitting modules in Excel (Microsoft) to calculate gastric half-emptying time.$^{10}$

Statistical analysis

All group data are expressed as means ± SEM. Descriptive statistics were used for pre and postprandial stomach volumes and symptom scores in time. To compare the barostat and SPECT scanning volumes, statistical analysis was performed using a Student's $t$ test and a Spearman's rho test. All statistical tests were 2-tailed and were evaluated at the 5% level of significance.
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Figure 1. Gradient shading volume rendered SPECT images of the stomach

Reconstructed 3D single photon emission computed tomography (SPECT) images of a fasting (A) and postprandial (B) stomach of a healthy volunteer.

Figure 2. Gastric volumes determined with barostat and GVS vs time

Dynamics of meal induced relaxation represented by fundic volumes plotted in time as assessed with barostat and GVS (SPECT).
Gastric volume scintigraphy versus barostat

Figure 3. Gastric volumes determined with barostat and GVS

Fundic accommodation induced by meal intake as measured with barostat and GVS (SPECT). Meal induced fundic accommodation measured with barostat and GVS is not significantly different. Note that the meal induced fundic accommodation as measured with GVS approaches the volume of the ingested meal (200 mL).

Results

Protocol I: Meal induced fundic relaxation

Volume: Comparison of GVS and Barostat

While the dose of $^{99m}$Tc-pertechnetate used by Kuiken et al. was halved to reduce the radiation burden, the quality of the images was high, allowing volume calculations up to 2 h postprandially. Within 2 h, postprandial volumes returned to their initial fastening volume (data not shown).

Fasting volume. Before meal ingestion, there was a great variation in fasting fundic volumes measured with the gastric barostat, ranging from 142 mL to 562 mL.
In contrast, both fundic and total gastric volumes obtained with GVS varied much less ranging from 105 mL to 205 mL and 113 mL to 268 mL, respectively. Fasting fundic and total gastric volumes were significantly lower during GVS compared to those obtained with the barostat (Table 1).

**Postprandial volume.** Meal intake resulted in a significant increase in gastric volume for both barostat \( (P < 0.001) \) and GVS (Fig. 1). As shown in Figure 2, fundic volume increased rapidly after meal intake reaching a plateau within 10 min. In both the barostat and the GVS studies, volumes slowly declined at a comparable rate. Average postprandial fundic and total gastric volumes were both significantly lower with GVS compared to the gastric barostat (Table 1). The maximal fundic volume \( (407 \pm 16 \text{ mL}) \) and total gastric volume \( (479 \pm 22 \text{ mL}) \) reached during GVS was significantly lower compared with the barostat values \( (677 \pm 49 \text{ mL}, \; P = 0.001 \) and \( P < 0.001 \), respectively).

**Fundic accommodation.** To evaluate whether GVS is a noninvasive alternative for the barostat to assess gastric accommodation, the accommodation responses were compared between the 2 techniques. The calculated meal induced fundic and total gastric accommodation, expressed as the difference between the average pre and postprandial volume, were not significantly different for both techniques (Fig. 3). Similarly, no difference in the ratio of postprandial over fasting volume was observed. (Table 1). However, after applying Spearman's rho test to determine a correlation between GVS and the barostat, no significant linear relationship could be detected between barostat and GVS accommodation volumes or ratios (Table 1). Furthermore, when individual accommodation volumes obtained with barostat are plotted against those obtained with GVS, a wide variation in measured barostat volumes in contrast to SPECT fundic volumes is observed (Fig. 4). Moreover, the individual accommodation volumes, as measured with GVS, do not significantly differ from the 200 mL volume of the ingested meal \( (P = 0.1, \) one sample Student's \( t \)-test, Fig. 4). In contrast, meal induced accommodation measured with the barostat significantly differed from 200 mL \( (P = 0.04, \) one sample Student's \( t \)-test).
Gastric volume scintigraphy versus barostat

Figure 4. Correlation plot

Correlation plot between meal induced accommodation assessed with GVS (SPECT) and barostat. Note that GVS volumes are not significantly different from 200 mL ($P = 0.1$), which equals the amount of the ingested meal.

Symptoms: comparison of GVS and Barostat.

Symptoms reported by the healthy volunteers were compared for both techniques. Healthy subjects reported significantly more postprandial symptoms of bloating, nausea, satiety and fullness during the barostat study compared to GVS (Fig. 5). Pain, hunger and burning sensation were not significantly different.

Gastric emptying: comparison of GVS and Barostat.

To evaluate possible differences in gastric emptying evoked by the presence of the barostat balloon, gastric half-emptying times were measured in 8 healthy volunteers (6 women, 2 men, mean age 27 yr (range 18 – 54 yr). The gastric half-emptying time for the barostat was $33 \pm 4$ min. This was significantly faster compared to the gastric half-emptying time ($70 \pm 12$ min; $P = 0.021$) during GVS.
Figure 5. Total postprandial VAS score

Total postprandial VAS score measured during barostat and GVS for each individual symptom. (*p < 0.05, Students t-test).

Protocol 2: Glucagon induced fundic relaxation

Volume: comparison of pre and post glucagon.

To eliminate possible interference of meal volume, the capacity of GVS to assess a pharmacologically induced relaxation was compared with that of the gastric barostat. During the barostat study, glucagon induced a rapid onset relaxation of the gastric fundus comparable to that obtained after meal ingestion. In contrast, GVS only detected a small increase in volume after glucagon injection, reaching a mean volume significantly smaller compared to that measured with the barostat (Fig. 6, 7 and Table 2). When data are expressed as the ratio of post glucagon volume over fasting volume, the post glucagon ratio was significantly lower for GVS compared to the barostat (Table 2).
### Table 2. Gastric volumes measured with GVS and barostat

<table>
<thead>
<tr>
<th></th>
<th>Barostat (mL)</th>
<th>GVS fundus (mL)</th>
<th>$P$ value Baro vs GVS fundus</th>
<th>GVS total stomach (mL)</th>
<th>$P$ value Baro vs. GVS total stomach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline volume</td>
<td>226 ± 39</td>
<td>119 ± 15</td>
<td>0.084</td>
<td>182 ± 18</td>
<td>0.407</td>
</tr>
<tr>
<td>Post-glucagon volume</td>
<td>632 ± 51</td>
<td>139 ± 18</td>
<td>0.002</td>
<td>194 ± 25</td>
<td>0.003</td>
</tr>
<tr>
<td>Difference</td>
<td>406 ± 56</td>
<td>19 ± 5</td>
<td>0.007</td>
<td>12 ± 10</td>
<td>0.007</td>
</tr>
<tr>
<td>Post-glucagon ratio</td>
<td>3.0 ± 0.5</td>
<td>1.16 ± 0.03</td>
<td>0.046</td>
<td>1.06 ± 0.05</td>
<td>0.039</td>
</tr>
</tbody>
</table>

GVS = gastric volume scintigraphy; Baro = barostat

### Figure 6. Barostat and GVS with glucagon

Volumes measured before (scan 1) and after (scan 2 and 3) glucagon i.v. injection, as assessed with barostat and GVS (SPECT). Scan 1 was performed from 1 up to 8 min, followed by scan 2 from 8 to 15 min after glucagon injection.
Figure 7. Glucagon induced fundic accommodation

Glucagon induced fundic accommodation measured with barostat and GVS (SPECT) is significantly different. ($P < 0.05$, Students t test).
Gastric volume scintigraphy versus barostat

Discussion

In the present study, we investigated whether GVS is a noninvasive alternative to the barostat to evaluate gastric relaxation. GVS detected lower volumes before and after meal intake compared to the barostat, most likely due to the absence of a distending pressure. Although the dynamics of the meal-induced relaxation were comparable to that detected with the barostat, the increase in volume detected with GVS was not different from the ingested volume. Furthermore, in comparison with the meal induced volume increase, GVS failed to detect the profound gastric relaxation following glucagon infusion. These findings suggest that GVS rather detects the volume of the intragastric contents after meal intake and is less sensitive to detect changes in gastric tone in the absence of a distending force. Our results therefore question the role of GVS as a tool to detect impaired accommodation and warrants further validation of this technique.

Currently, the gastric barostat is considered the gold standard to assess fundic accommodation. However, as this technique is invasive, 99mTc-pertechnetate SPECT scanning has been proposed as a noninvasive alternative to evaluate this gastric motor reflex. Indeed, Bouras et al. reported a good correlation between both techniques. These authors concluded that GVS accurately measures volume in vitro and can identify changes in gastric volume in response to a meal and gastric distension. In our study, we confirmed the ability of GVS to detect changes in gastric volume with comparable postprandial/fasting ratios as obtained with the barostat. However, we found no correlation of the accommodation volumes measured with the 2 different techniques. Most likely, this discrepancy can be explained by a difference in methodology. In the study reported by Bouras et al., GVS was performed with the gastric barostat balloon in situ. As GVS measures intragastric volume based on the imaging of the gastric wall, comparable volumes will be detected under these circumstances. In our study, however, the 2 techniques were performed separately and thus GVS occurred in the absence of a distending pressure. Under these conditions the stomach will be collapsed and gastric volume detected with GVS will be determined by other factors such as ingested meal, swallowed air and gastric secretion (estimated at 40-200 mL/h). These methodological differences explain the lower postprandial volume detected with GVS and the lack in
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correlation between the increase in postprandial volumes detected with the two different techniques. Our findings that the meal-induced accommodation assessed with GVS did not differ from the meal volume, further corroborates this hypothesis and suggests that GVS mainly detects meal volume rather than gastric relaxation. Preliminary data confirm this assumption, showing a good correlation ($r = 0.66$, $P = 0.034$; $n = 10$) between ingested volume and volume measured with GVS (unpublished results). Finally, when assessed with the barostat, glucagon induced a pronounced gastric relaxation (202%) of comparable magnitude as meal ingestion. GVS, however, only detected a marginal increase in fundic volume of 16%, suggesting that GVS is less sensitive to detect gastric relaxation per se. Similar findings were reported by previous studies evaluating the relaxant effect of GLP-112 and sublingual nitroglycerine.13 In these studies, only minor increases in gastric volume were reported whereas from barostat studies these agents are known to induce pronounced relaxation of the stomach.1415

Considering our hypothesis that GVS rather detects intragastric volume, the detected increase in postprandial volume also depends on gastric emptying and gastric secretion. In contrast to Liao et al., who state that up to 50% of a small liquid meal will be emptied during the 20-min period they measured,15 we measured an average gastric half-emptying time of 70 min. Therefore, more than half of the ingested meal is still present after 60 min postprandially and is likely to contribute to the measured gastric volume. This implies that patients with fast gastric emptying may be incorrectly identified as having impaired accommodation. Consequently, further studies investigating the specificity and sensitivity of GVS to detect impaired accommodation are warranted.

After meal intake, subjects reported significantly more symptoms during the barostat study than during GVS. Most likely, this results from the gastric distension induced by the positive pressure applied by the intragastric balloon. As the barostat balloon may also interfere with gastric function,6 GVS still remains an attractive tool to study the stomach in a noninvasive manner. For example, it may be useful to study the relationship between symptoms and antral or fundic volume under more physiological circumstances. As such, it may contribute to a better understanding of the factors involved in the increased perception of postprandial symptoms in patients with functional dyspepsia.
Gastric volume scintigraphy versus barostat

Conclusion

In summary, we conclude that GVS is able to detect changes in gastric volume in a noninvasive manner. However, our data suggest that GVS, in the absence of a distending force, is less suitable than the gastric barostat to detect gastric relaxation and rather detects the volume of the intragastric contents after meal intake. These findings question the role of GVS as a tool to detect gastric relaxation or impaired accommodation and imply that further validation is required.

References


