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ORIGINAL ARTICLE

Analysis of weight changes after left gastric artery embolization in a cancer-naive population

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PURPOSE
We aimed to evaluate weight changes after left gastric artery (LGA) embolization in a retrospective cancer-naive cohort.

METHODS
A retrospective study was conducted to identify patients who underwent LGA embolization for gastrointestinal bleeding (GI). Patients with known cancer diagnoses at the time of LGA embolization were excluded. Pre- and postprocedure weights were assessed. Statistical analysis was performed using paired t-test and Wilcoxon signed-rank test.

RESULTS
A total of 39 patients were identified. In 21 patients who had documented pre- and postprocedural weights, a median of 16.3 kg weight loss ($P = 0.045$) was observed over a median time of 12 months (range, 2–72). In patients who had pre- and postprocedure endoscopies (n=6), 2 had worsening ulcers following LGA embolization and 4 had stable or no abnormal findings.

CONCLUSION
Our preliminary observation suggests that LGA embolization is well tolerated and results in unintended weight loss. Larger studies are needed to confirm these preliminary findings.

Obesity is an epidemic that affects more than a third of adults in the United States (1, 2). Despite advances in medical research and surgical techniques, obesity remains one of the largest drivers of chronic disease and healthcare costs in the United States (2, 3). In response to the growing obesity epidemic, left gastric artery (LGA) embolization has evolved as a promising procedure for weight loss therapy (4, 5). LGA embolization, also termed bariatric embolization when used for weight loss, decreases blood supply to the gastric fundus, which has the highest concentration of cells responsible for releasing ghrelin, a potent appetite-stimulating hormone (6). LGA embolization has been shown to suppress serum ghrelin levels and modulate weight in animal models (4, 5, 7). Promising results in animal models prompted investigators to retrospectively evaluate patients who underwent LGA embolization, an established procedure in interventional radiology for treatment of gastrointestinal (GI) bleeding. Early retrospective studies, though limited by small sample sizes and potential confounding factors, demonstrated significant weight loss as a nonintended side effect of LGA embolization and showed promise for reproducibility in humans. Results from clinical trials investigating the utility of LGA embolization to modulate weight have demonstrated promising results (4–6, 8–15). However, studies have been limited to small sample sizes and long-term data are lacking.

This retrospective cohort affords us a unique opportunity to assess a potential treatment population where weight loss is not intended and also to evaluate adverse events such as mucosal ulcers in the absence of strict standardized GI prophylaxis regimens implemented by current ongoing clinical trials. Drawing from the current literature on this topic, our hypothesis is that LGA embolization for GI bleeding will result in weight loss as an unintended side effect.

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Methods

Patient selection

This single institution retrospective study was approved by the Institutional Review Board. Patients who underwent LGA embolization for treatment of acute gastrointestinal (GI) bleeding from 2001 to 2016 were identified through a search of the institutional database. Patients had to be at least 18 years of age and have no known cancer diagnoses at the time of procedure. All of the patients reviewed underwent LGA embolization in the inpatient or emergency setting. Twenty-one patients had documented pre- and postprocedure weights in their electronic medical record.

LGA embolization technique

While variations in technique existed depending on user preference, a generalized institutional approach to LGA embolization demonstrated the following technique: After sterile preparation of the right groin, the right common femoral artery was accessed with an 18-gauge needle. A Bentson wire was advanced into the aorta. The needle was exchanged for a 6 French (F) sheath and connected to a heparinized saline drip. A 5 F SOS catheter was advanced into the celiac artery. Selective catheterization was performed using a Progreat catheter and GT wire. The choice of embolic used depended on the type and location of the vascular lesion as well as user preference. The most common embolic agents used included gelfoam slurry followed by coil embolization and polyvinyl alcohol (PVA) particle embolization.

Outcome measures

Patients were assessed for any treatment-related adverse events. Primary adverse events were defined as the presence of gastric mucosal abnormalities ranging from superficial mucosal abnormalities to bleeding gastric ulcers on esophagogastroduodenoscopy. Medical records were evaluated for postprocedure complications, rebleeding events, or complaints of worsening abdominal pain within 30 days following the procedure. Height (m) and weight (kg) data were obtained through electronic medical records. Postprocedure weights were obtained based on availability in subsequent clinic notes. Changes in weight as well as changes in body mass index (BMI) as measured by weight in kilograms (kg) per height in meters squared (m^2) were calculated.

Main points

- Left gastric artery embolization was evaluated retrospectively for unintended weight loss.
- Left gastric artery embolization results in unintended weight loss.
- Left gastric artery embolization appears to be well tolerated in patients.

Statistical analysis

Continuous variables were summarized using means (±SD) or median (25%, 75%) and categorical variables using frequencies (percent). Pre and post BMI and weight were compared using a paired t-test. All tests were two-sided and conducted in SAS v9.4. A *P* value of 0.05 was considered statistically significant.

Results

Patients ranged from 33–92 years of age. The median preprocedure weight and BMI of the patients evaluated in this study were 93.4 kg and 29.9 kg/m^2, respectively. Additional demographics and clinical characteristics of all patients are displayed in Table 1.

The method of arterial embolization included coils (n=6), gelfoam slurry (n=19), PVA particles ranging from 100–300 µm, 300–500 µm, and 500–700 µm (n=5), and combination embolics (n=9). Additional data regarding embolization techniques are displayed in Table 2.

Following LGA embolization, median weight decreased from 93.4 kg to 77.1 kg and BMI decreased from 29.9 kg/m^2 to 27.1 kg/m^2 (n=21; $P = 0.045$) over a median time of 12 months (range, 2–72 months).

Pre- and postprocedure endoscopies were performed in 6 of the 39 patients. Of these patients, 2 had worsening ulcers following LGA embolization and 4 had stable or no abnormal findings. The majority of patients who did not have endoscopies were lost to follow-up or had no documentation of GI associated complications. One patient with a complex medical history requiring lifelong anticoagulation for multiple prosthetic heart valves was found to have complications with ischemic segment of jejunum requiring surgical intervention two days postprocedure. Given the site of ischemia, these findings are favored to represent thrombus related to holding anticoagulation rather than being related to LGA embolization. Another patient died within

Table 1. Patient characteristics

	All LGA embolization patients (n=39)	LGA embolization patients with pre- and postprocedure weights (n=21)
Age (years), median (range)	57 (41–92)	57 (33–92)
Age (years), mean (SD)	60.5 (14.7)	56.3 (15.6)
Gender, n (%)		
Male	27 (69.2)	12 (57.1)
Female	12 (30.8)	9 (42.9)
Race, n (%)		
Caucasian	30 (76.9)	17 (81.0)
African American	9 (23.1)	4 (18.2)
Follow-up time intervals, n (%)		
1–3 months		4 (19.1)
4–6 months		3 (14.3)
7–12 months		4 (19.1)
12–24 months		5 (23.8)
24+ months		5 (23.8)

LGA, left gastric artery; SD, standard deviation.

Table 2. Embolization techniques

	All LGA embolization patients (n=39)	LGA embolization patients with pre- and postprocedure weights (n=21)
Embolic used, n (%)		
Coil	6 (15.4)	4 (19.1)
Gelfoam	19 (48.7)	11 (52.4)
PVA	5 (12.8)	0 (0.0)
PVA + coils	3 (7.7)	2 (9.5)
Gelfoam + coils	6 (15.4)	4 (19.5)
Embolic status, n (%)		
Permanent	19 (48.7)	10 (47.6)
Temporary	20 (51.3)	11 (52.4)
Vessels embolized, n (%)		
LGA	34 (87.1)	18 (85.7)
LGA + splenic artery	3 (7.7)	2 (9.5)
LGA + right gastroepiploic artery	1 (2.6)	1 (4.8)
LGA + phrenic artery	1 (2.6)	0 (0.0)

LGA, left gastric artery; PVA, polyvinyl alcohol.

60 days following the procedure from preexisting complex medical complications related to heart failure, again not directly related to LGA embolization.

Discussion

Studying a retrospective cohort of patients for weight loss provides an opportunity to assess patients without confounding factors such as intrinsic motivation, diet modification or other weight loss strategies. Gunn et al. (16) reported on a small retrospective cohort (n=22) where they compared patients with LGA embolization for GI bleeding against those that had embolization elsewhere (extra-gastric) for GI bleeding. The group that received LGA embolization demonstrated significant nonintended weight loss (7.3% at 3 months) compared with the control group; however, this study was limited due to the inclusion of patients with a cancer diagnosis which introduces a significant confounding variable. A subsequent retrospective study was performed by Anton et al. (17), where they investigated patients with LGA embolization for GI bleeding in patients without cancer diagnoses (n=10). Their study also demonstrated significant weight loss (9.8% at one month and 11.7% at 4 months) compared with baseline weight.

Our study involves a retrospective cohort that does not include patients with a cancer diagnosis at the time of procedure. The patients in the study experienced a median 16.3 kg (17.4%) of unintended weight loss following LGA embolization for GI bleeding, over a median time interval of 12 months. Our cohort had an average BMI of 29.9 kg/m^2 which classifies them as overweight, whereas current clinical trials have been performed on morbidly obese individuals. This finding may provide insight into the effectiveness of LGA embolization on individuals who are not morbidly obese; however, clinical trials are needed to validate this claim.

Current clinical trials implement GI prophylaxis regimens both pre and post LGA embolization. While many of the patients received proton pump inhibitors on admission for GI bleeding, there was no rigorous standardized GI prophylaxis regimen before or after the procedure, as defined in clinical trials. Current clinical trials administer protracted dosing of sucralfate and proton-pump inhibitors to reduce the rate of gastric ulceration after LGA embolization (5). Our findings suggest that even in the absence of standardized preprocedure GI prophylaxis, the majority of patients appear to tolerate the procedure with minimal complications following LGA embolization. Of note, the authors do not advocate eliminating GI prophylaxis from clinical trials as the embolization techniques are quite different.

Our study has several limitations. Most notably, without a large sample size and low statistical power, our findings regarding association between weight change related to LGA embolization and various endpoints such as embolic type and follow-up time interval serve as observations, and true efficacy of this procedure cannot be inferred from this observation. Furthermore, the retrospective nature of this study introduces inevitable selection bias. Second, is an inability to determine whether the mechanism of weight loss was due to appetite suppression or other confounding factors such as weight loss due to illness, as is usually present in a hospitalized patient. Third, is lack of a control group which will make it difficult to assess the net effect of this LGA embolization. Fourth, is the nonstandardized embolization technique with no consistent embolic endpoint.

In conclusion, our findings suggest that LGA embolization for GI bleeding results in weight loss as an unexpected side effect. This procedure appears to be well tolerated and may be a promising technique for modulating weight in obese adults. However, further larger and prospective studies are needed to confirm these preliminary findings.

Conflict of interest disclosure

Dr Akinwande is supported by an institutional (Washington University School of Medicine) and departmental (Mallinckrodt Institute of Radiology) grant. Siemens Healthcare, Merit Medical, BTG, Clear Guide Medical, and NIH NIH/NIBIB R01EB017615 provide grant support for Dr. Weiss. Other authors have nothing to disclose.

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