

Gastric Cancer Following Bariatric Surgery

A Review

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Background: Bariatric procedures can induce a massive weight loss that lasts for > 15 years after surgery; in addition, they achieve important metabolic effects including diabetes resolution in the majority of morbidly obese patients. However, some bariatric interventions may cause gastroesophageal reflux disease and other serious complications. The aim of our study is to evaluate the risk of cancer after bariatric surgery.

Methods: We conducted a review of the literature about the cases of gastric cancer arising after any bariatric procedure, including a case of adenocarcinoma incidentally discovered by the authors 6 months after laparoscopic adjustable gastric banding.

Results: Globally, 17 case reports describing 18 patients were retrieved, including the case study by the authors. The diagnosis of tumor was at a mean of 8.6 years after bariatric surgery, 9.3 years after RYGB, and 8.1 years after restrictive procedures. The adenocarcinoma represented most cases (15 patients, 83%). In the patients with RYGB, the adenocarcinoma was localized in the excluded stomach in 5 patients (83%) and in the pouch in 1 patient (17%). After a restrictive procedure, the cancer was localized in the pouch in 5 patients (62.5%), in the pylorus in 2 patients (25%), and in lesser curvature only in 1 patient (12.5%).

Conclusions: There is a lack of evidence about a connection between the late occurrence of gastric adenocarcinoma and the bariatric surgery. For this reason, although the preoperative upper endoscopy is still mandatory, there is no need for a regular endoscopic evaluation of patients after surgery.

Key Words: obesity, bariatric surgery, gastric cancer

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The worldwide epidemic of obesity and the global incidence of cancer are both increasing. According to the World Health Organization, obesity is rising by 30 million cases per year,¹ whereas the overall number of new cancer cases will increase by 300,000 cases per year.² Both obesity and cancer contribute to increased worldwide mortality and health care costs.

Several treatment strategies have been developed to decrease obesity; these include prevention, lifestyle, behavioral modification, and pharmacotherapy. The weight loss effects of these strategies are marginally successful and, therefore a surgical solution has been developed to provide a long-term weight loss in obese patients. Bariatric procedures can induce a massive weight loss that lasts for > 15 years after surgery; in addition, they achieve important metabolic effects including diabetes resolution in the majority of morbidly obese patients.³ Although the epidemiologic association between obesity and cancer is currently well known, there is a lot of evidence that can establish obesity as a significant risk factor for the development of cancer⁴; the risk of esophageal and gastric cancer after bariatric surgery has not been established.

We conducted a review of the literature about the cases of gastric cancer arising after any bariatric procedure, including a case of adenocarcinoma incidentally discovered by the authors 6 months after laparoscopic adjustable gastric banding (LAGB).

METHODS

The study was written according to the Preferred reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement.

Literature Search Strategy

A comprehensive search was carried out in PubMed, Ovid EMBASE, Scopus, and Cochrane Databases. The search was performed for English and French articles published from January 1, 2002 to June 30, 2013 relevant to gastric cancer after bariatric surgery. The search string used in PubMed was “gastric cancer OR gastric adenocarcinoma” AND “obesity surgery” OR “laparoscopic adjustable gastric banding” OR “gastric bypass” OR “sleeve gastrectomy” OR “duodenal switch.” The reference lists of all relevant studies were carefully examined to identify any further studies to be included (Diagram 1).

Literature Screening

Study selection was accomplished through 3 phases of study screening. In phase 1, the following types of studies were excluded: reviews, letters, editorials, and papers studying non-humans. In phase 2, abstracts were reviewed for relevance and the full-text articles were obtained. The review included all cases of obesity surgery with a diagnosis of gastric tumor after intervention. The studies had to describe ≥ 1 of the following parameters: sex, age at diagnosis, BMI at bariatric surgery and at diagnosis of tumor, previous bariatric procedure, reported symptoms, site and histologic pathways of tumor, elapsed time after bariatric surgery, and tumor treatment.

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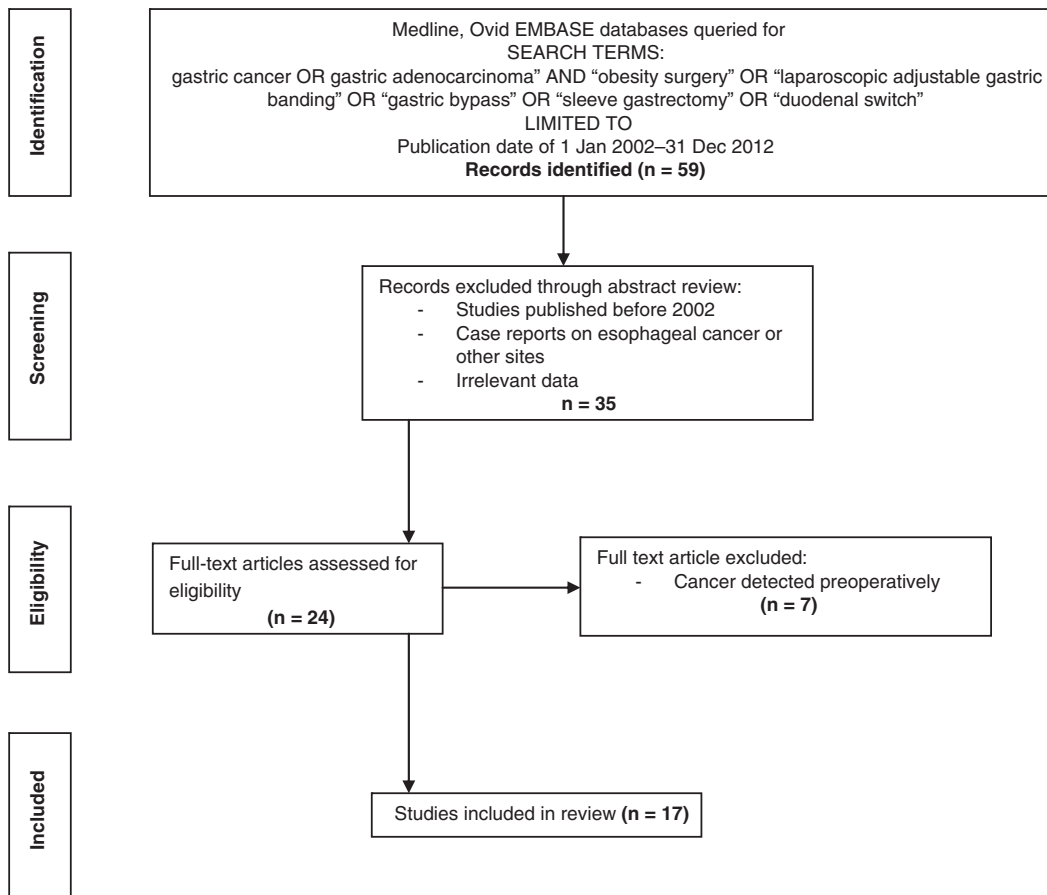


DIAGRAM 1. Flow diagram of the systematic literature search.

Case Report

L.L., a 37-year-old woman with morbid obesity (BMI 40 kg/m²) and hypertension as comorbidity, underwent LAGB in October 2010. Preoperative upper gastrointestinal endoscopy (UGE) did not reveal any pathology. At 6 months after removing infected port, a UGE was performed to identify partial band erosion and a lesion of about 8 mm in the angulus (Fig. 1). Gastric biopsies showed poorly differentiated adenocarcinoma with signet-ring cells. Open total gastrectomy was performed removing en bloc the eroded banding, followed by a Roux-en-Y reconstruction. Histopathologic examination of the specimen showed intramucosal adenocarcinoma of 2 mm, without evidence of perineural and vascular invasion (pT1sN0M0). At the last follow-up in March 2013 her condition was well.

RESULTS

Globally, 16 articles and all case reports describing 17 patients were retrieved; the patients’ characteristics are summarized in Table 1. The last patient is L.L, mentioned in the table. Twelve patients were female (67%) and 6 were male (33%); the mean age at diagnosis was 54.8 years. The previous bariatric operation was a Roux-en-Y gastric bypass (RYGB) in 7 patients and a restrictive procedure (vertical banded gastroplasty, gastric band, silastic ring

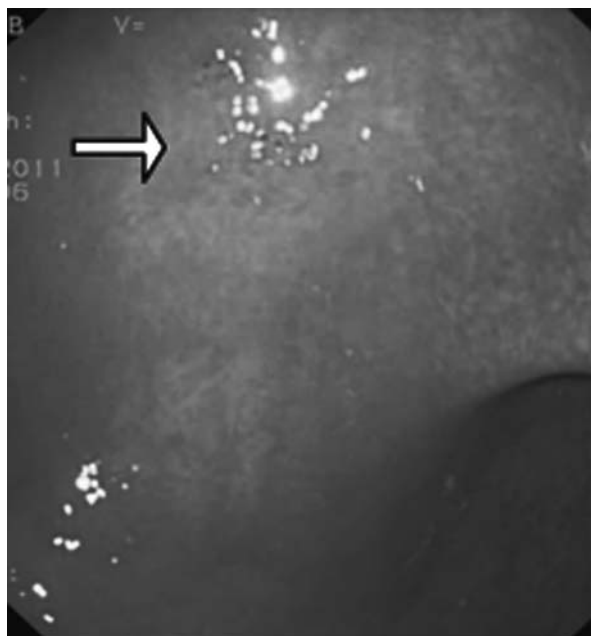


FIGURE 1. Poorly differentiated adenocarcinoma with signet-ring cells in the angulus.

TABLE 1. Literature-reported Data on the Gastric Cancer After Bariatric Procedures

References	Age (y)	Sex	BMI Before Surgery	BMI at Diagnosis of Tumor	Bariatric Procedure	Reported Symptoms	Tumor Site	Time After Bariatric Surgery (y)	Treatment
Zirak et al ⁵	52	F	—	—	SRVGB	Epigastralgia and anorexia; nausea and vomiting	Pouch	2	Total gastrectomy plus splenectomy and lymphadenectomy
Papakonstantinou et al ⁶	46	M	49	23.6	VBG	Vomiting, weakness, and weight loss	Pylorus	6	Whipple pancreaticoduodenectomy
Khitin et al ⁷	57	F	—	—	GBP	Epigastric pain and distention	Excluded stomach	22	Resection of gastric remnant and loop gastrojejunostomy with proximal gastric remnant
Jain et al ⁸	67	F	56.8	—	VBG	Anemia and weight loss	Pouch	15	Total gastrectomy
Hackert et al ⁹	62	F	47.2	29.2	LB	Epigastric pain	Pouch	10	Near-total gastrectomy
Escalona et al ¹⁰	51	F	42	27	GBP	Epigastric pain, nausea	Excluded stomach	8	Total gastrectomy
Trincado et al ¹¹	52	F	45	—	LB and GBP	Epigastric pain	Pouch	5	Esophagopouchectomy
De Roover et al ¹²	66	M	44	—	GBP	Fever and left shoulder pain with anemia	B-cell lymphoma	3	Distal gastrectomy
	47	F	—	—	VBG	Dysphagia and vomiting	GIST	12	Total gastrectomy
Corsini et al ¹³	57	M	—	—	GBP	Abdominal pain and excessive weight loss	Excluded stomach	4	Palliative therapy
Babor and Booth ¹⁴	61	F	—	—	Loop gastric bypass	Dysphagia, nausea, and vomiting	Pouch	29	Roux-en-Y esophagojejunostomy
Harper et al ¹⁵	45	F	48	—	GBP	Abdominal pain, distention, and constipation with weight loss	Excluded stomach	1	Palliative therapy (liver and omental metastases)
Chebib et al ¹⁶	60	M	35.5	55	VBG	Massive upper GI bleeding and weight loss	Pouch	15	Total gastrectomy
Watkins et al ¹⁷	44	M	50.6	23	GBP	Upper abdominal pain	Excluded stomach	16	Remnant gastrectomy
Sun et al ¹⁸	65	M	—	—	GBP	Dysphagia	Pouch	5	Palliative therapy (hepatic metastases)
Stroh et al ¹⁹	65	F	46	36	LB	Hematemesis	Pouch	2.5	Exploratory laparotomy
Belhaj et al ²⁰	54	F	—	—	SRVGB	Vomiting, poor appetite, dysphagia, and weight loss	Juxta-pyloric	10	Neoadjuvant chemotherapy, a subtotal gastrectomy
This study	37	F	40	37	LB	None	Lesser curvature	0.5	Total gastrectomy

F indicates female; GBP, gastric bypass; LB, laparoscopic gastric banding; M, male; SRVGB, silastic ring vertical gastroplasty; VGB, vertical gastroplasty.

vertical banded gastroplasty) in 9 patients. Only 1 patient underwent a loop gastric bypass, and another patient was operated on by a LAGB procedure removed 9 months later because of total intragastric migration and followed by RYGB. No case of cancer after sleeve gastrectomy was reported.

The diagnosis of tumor was at a mean of 8.6 years (SD 6.4y) after bariatric surgery, 9.3 years (SD 8y) after RYGB, and 8.1 years (SD 5.6y) after restrictive procedures. Pathologic findings were always reported, except for a patient who underwent LAGB. The adenocarcinoma represented most cases (15 patients, 83%), whereas a single case of diffuse large B-cell lymphoma of the gastric fundus and 1 case of intramural gastrointestinal stromal tumor

were reported.¹² Four patients (22%) underwent palliative therapy, whereas in the other cases (88%) surgery was performed. In the patients who had undergone RYGB, the adenocarcinoma was localized in the excluded stomach in 5 patients (83%) and in the pouch in 1 patient (17%). After a restrictive procedure, the cancer was localized in the pouch in 5 patients (62.5%), in the pylorus in 2 patients (25%), and in lesser curvature in only 1 patient (12.5%) (Fig. 2).

In all case reports, the patients showed aspecific symptoms of tumor, whereas our patient was asymptomatic because of the early endoscopic diagnosis during follow-up (pT1sN0M0). The most frequently reported symptoms were epigastric/abdominal pain and dysphagia, nausea, vomiting, and weight loss. It is notable that abdominal or

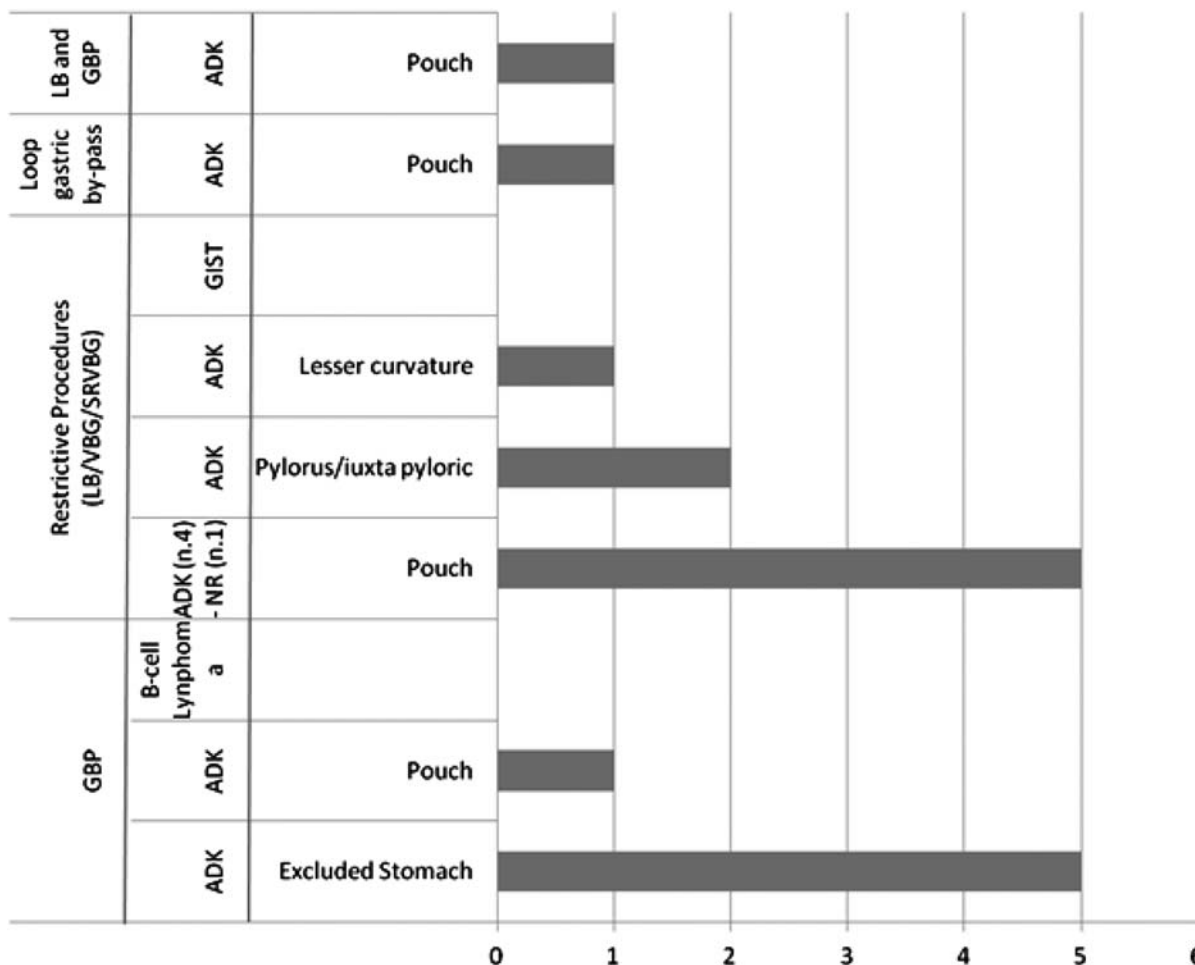


FIGURE 2. Localization of gastric tumor after bariatric procedures.

epigastric pain was always reported in the patients with cancer of excluded stomach, whereas only 5 of the 8 patients with cancer in the pouch complained of pain or dysphagia. Furthermore, the weight loss and the distension were the most common symptoms after pain in patients with cancer of remnant stomach, whereas the weight loss with nausea or vomiting and upper GI bleeding were the second most common symptoms in patients with cancer of the pouch (Fig. 3).

DISCUSSION

The number of reported cases of gastric cancer after different bariatric operations is very small with anecdotal evidence, arising at least 10 years postoperatively. In contrast, surgery for morbid obesity is increasing in all industrialized countries and is becoming one of the most common types of surgery. The global total number of procedures in 2003 was 146,301, whereas in 2011 it was 340,768. The most commonly performed procedures were RYGB 46.6%; sleeve gastrectomy 27.8%; adjustable gastric banding 17.8%; and biliopancreatic diversion/duodenal switch 2.2%.²¹

From the general surgery literature, the only available data for a comparison, at least for RYGB, are about the cancer risk in the gastric stump after gastrectomy for

benign disease (peptic ulcer surgery). The risk has been recognized in the gastric stump with a 3-fold to 5-fold increase compared with the general population. Carcinoma classically develops 15 to 25 years postoperatively, most often near the anastomotic site.^{22,23} In the case reports of gastric cancer after RYGB, leaving out the B-cell lymphoma, 5 of the 6 lesions developed in the excluded stomach.

Current surgical procedures for weight loss have been otherwise shown to be effective in achieving a significant and long-term weight loss with improvement or resolution of obesity-related diseases.³ Furthermore, cancer incidence is clearly increased in obese individuals⁴ and bariatric surgery was associated with a significant reduction in cancer incidence.²⁴ It is interesting to note the prevalence of cancer in the excluded stomach for the RYGB and in the pouch for the restrictive procedures. This finding leads to a possible pathophysiological mechanism, despite anatomic and functional modification after the intervention. For adenocarcinoma of the pouch after restrictive procedures (ie, gastric banding, VBG), the main pathophysiological explanations are chronic GERD, chronic mucosal irritation for the stasis of food and gastric acid, and finally the presence of the gastric band. For cancer of the excluded stomach in RYGB, it is notable that intestinal metaplasia and carcinogenesis are experimentally promoted by

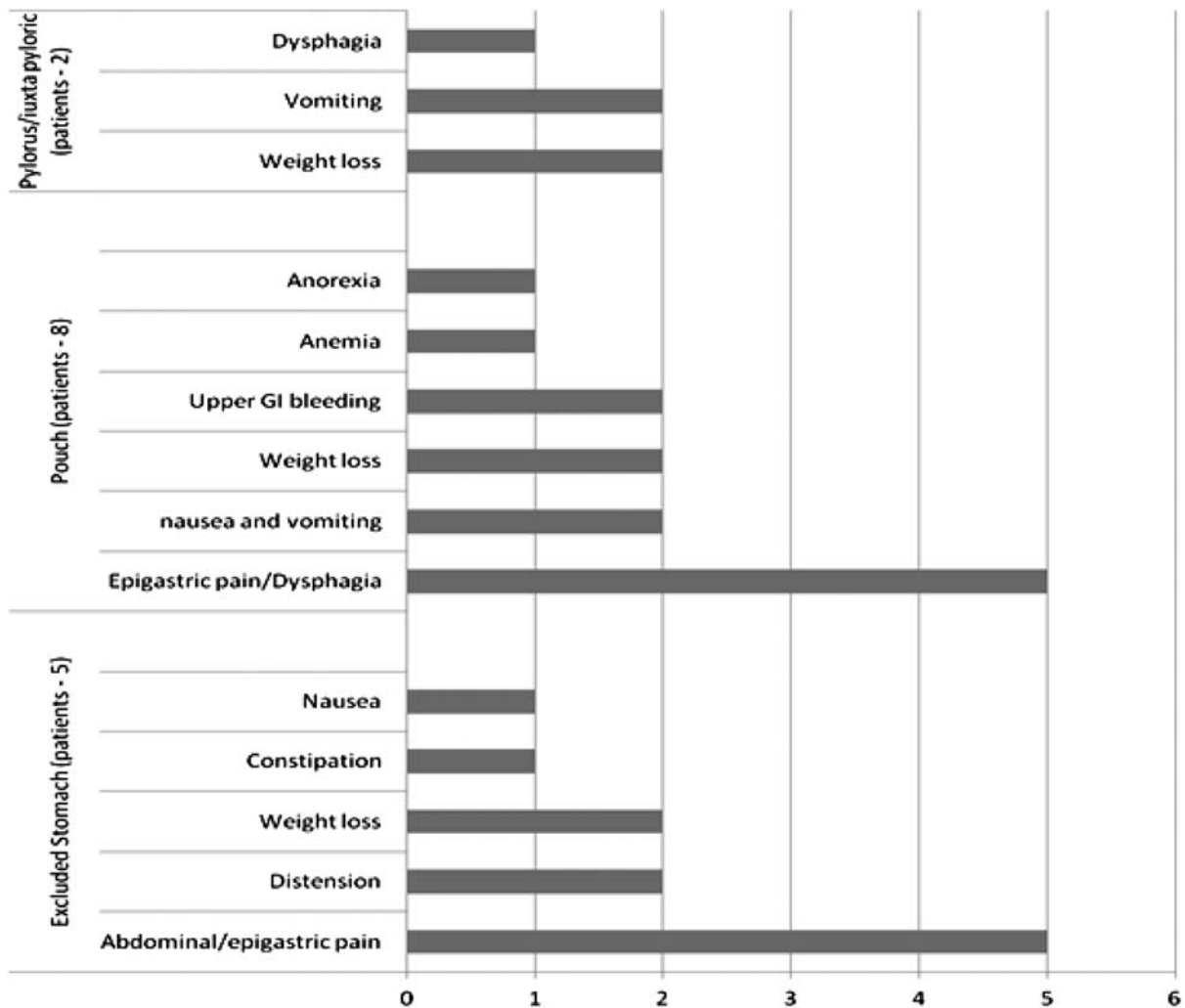


FIGURE 3. Most frequently reported symptoms in the gastric cancer after bariatric procedures.

pancreaticobiliary reflux.²⁵ In contrast, the presence of bile in the excluded stomach is well described.²⁶

Malignancy of the stomach after bariatric surgery may be initially overlooked. In all case reports of gastric cancer after bariatric procedures, the delay in diagnosis was reported because the aspecific symptoms may be attributed by the patient or by the surgeon to the effects of surgery. After restrictive procedures, the symptoms may also be attributed to dietary indiscretion.

The early diagnosis of our case was incidental, because after the infected port was removed we decided to perform a UGE to evaluate the band.²⁷ This revealed partial band erosion and the early lesion in the lesser curvature.

CONCLUSIONS

The association between a gastric adenocarcinoma and a bariatric procedure is difficult to assess without a case-control or a cross-sectional study, and on the basis of the few reported anecdotal cases evidence-based data are lacking for a link between the late occurrence of gastric adenocarcinoma and the bariatric surgery.

Therefore, the institution of a surveillance program started immediately after surgery is not validated. Nevertheless, when new upper digestive tract complaints occur in any patient with an otherwise unremarkable bariatric surgery follow-up, the diagnosis of gastric cancer should be borne in mind. The UGE could be considered the best choice in the diagnostic assessment of a patient with symptoms suggestive of esophagogastric neoplasms, except for exploring excluded stomach after RYGB. In this case, the postoperative anatomy makes the distal stomach difficult to access by conventional endoscopy. Some authors described different techniques allowing the bypassed stomach to be studied, that is, virtual gastroscopy, CT, double-balloon endoscopy, percutaneous endoscopy through a gastrostomy, but up to date there are no evidence-based data on diagnostic accuracy.^{17,28-30}

The development of gastric malignancies is influenced by many factors, not only by geographical, racial, and socioeconomic differences in addition to lifestyle choices. The multidimensional nature of these risk factors requires a complete understanding of their influence in the development of malignancy. As more bariatric operations are performed each year, it is important that surgeons be aware

of potential malignancies involved with obesity. For this reason, a preoperative upper endoscopy is mandatory before bariatric surgery^{31,32} but it is still not necessary to perform periodically an endoscopic exam after the intervention.³³ According to our findings, postoperative UGE must be performed when some complications, such as vomiting, port infection, or stop weight loss, occur.

Although the risk of the gastric cancer after bariatric procedures seems to be extremely low, prospective epidemiologic studies are required to evaluate patient-related or procedure-related risk. In contrast, it is evident that bariatric surgery affects not only obesity-related cancers, but with a broad effect also reduces the incidence of a variety of cancer types.

REFERENCES

- World Health Organization. Obesity and overweight fact sheet N311. Available at: <http://www.who.int/mediacentre/factsheets/fs311/en/>. Accessed January 15, 2013.
- World Health Organization. Cancer-fact sheet N 297. Available at: <http://www.who.int/mediacentre/factsheets/fs297/en/>. Accessed January 15, 2013.
- Mingrone G, Panunzi S, De Gaetano A, et al. Bariatric surgery versus conventional medical therapy for type 2 diabetes. *N Engl J Med*. 2012;366:1577–1585.
- Rehnan AG, Tyson M, Egger M, et al. Body-mass index and incidence of cancer: a systematic review and meta-analysis of prospective observational studies. *Lancet*. 2008;371:569–578.
- Zirak C, Lemaitre J, Lebrun E, et al. Adenocarcinoma of the pouch after silastic ring vertical gastroplasty. *Obes Surg*. 2002;12:693–694.
- Papakonstantinou A, Moustafellos P, Terzis I, et al. Gastric cancer occurring after vertical banded gastroplasty. *Obes Surg*. 2002;12:118–120.
- Khitin L, Roses RE, Birkett DH. Cancer in the gastric remnant after gastric bypass: a case report. *Curr Surg*. 2003;60:521–523.
- Jain PK, Ray B, Royston CM. Carcinoma in the gastric pouch years after vertical banded gastroplasty. *Obes Surg*. 2003;13:136–137.
- Hackert T, Dietz M, Tjaden C, et al. Band erosion with gastric cancer. *Obes Surg*. 2004;14:559–561.
- Escalona A, Guzmán S, Ibáñez L, et al. Gastric cancer after Roux-en-Y gastric bypass. *Obes Surg*. 2005;15:423–427.
- Trincado MT, del Olmo JC, García Castaño J, et al. Gastric pouch carcinoma after gastric bypass for morbid obesity. *Obes Surg*. 2005;15:1215–1217.
- De Roover A, Detry O, de Leval L, et al. Report of two cases of gastric cancer after bariatric surgery: lymphoma of the bypassed stomach after Roux-en-Y gastric bypass and gastrointestinal stromal tumor (GIST) after vertical banded gastroplasty. *Obes Surg*. 2006;16:928–931.
- Corsini DA, Simoneti CA, Moreira G, et al. Cancer in the excluded stomach 4 years after gastric bypass. *Obes Surg*. 2006;16:932–934.
- Babor R, Booth M. Adenocarcinoma of the gastric pouch 26 years after loop gastric bypass. *Obes Surg*. 2006;16:935–938.
- Harper JL, Beech D, Tichansky DS, et al. Cancer in the bypassed stomach presenting early after gastric bypass. *Obes Surg*. 2007;17:1268–1271.
- Chebib I, Beck PL, Church NG, et al. Gastric pouch adenocarcinoma and tubular adenoma of the pylorus: a field effect of dysplasia following bariatric surgery. *Obes Surg*. 2007;17:843–846.
- Watkins BJ, Blackmun S, Kuehner ME. Gastric adenocarcinoma after Roux-en-Y gastric bypass: access and evaluation of excluded stomach. *Surg Obes Relat Dis*. 2007;3:644–647.
- Sun C, Jackson CS, Reeves M, et al. Metastatic adenocarcinoma of the gastric pouch 5 years after Roux-en-Y gastric bypass. *Obes Surg*. 2008;18:345–348.
- Stroh C, Hohmann U, Urban H, et al. Gastric cancer after laparoscopic adjustable gastric banding. *Obes Surg*. 2008;18:1200–1202.
- Belhaj A, Memmo L, Mehdi A, et al. Gastric adenocarcinoma following “silastic vertical ring gastroplasty”: case report. *Rev Med Brux*. 2010;31:459–462.
- Buchwald H, Oien DM. Metabolic/bariatric surgery worldwide 2011. *Obes Surg*. 2013;23:427–436.
- Safatle-Ribeiro AV, Ribeiro U Jr, Reynolds JC. Gastric stump cancer: what is the risk? *Dig Dis*. 1998;16:159–168.
- MacDonald WC, Owen DA. Gastric carcinoma after surgical treatment of peptic ulcer: an analysis of morphologic features and a comparison with cancer in the nonoperated stomach. *Cancer*. 2001;91:1732–1738.
- Sjöström L, Gummesson A, Sjöström CD, et al. Swedish Obese Subjects Study. Effects of bariatric surgery on cancer incidence in obese patients in Sweden (Swedish Obese Subjects Study): a prospective, controlled intervention trial. *Lancet Oncol*. 2009;10:653–662.
- Miwa K, Fujimura T, Hasegawa H, et al. Is bile or are pancreaticoduodenal secretions related to gastric carcinogenesis in rats with reflux through the pylorus? *J Cancer Res Clin Oncol*. 1992;118:570–574.
- Kuga R, Safatle-Ribeiro AV, Faintuch J, et al. Endoscopic findings in the excluded stomach after Roux-en-Y gastric bypass surgery. *Arch Surg*. 2007;142:942–946.
- Silecchia G, Restuccia A, Elmore U, et al. Laparoscopic adjustable silicone gastric banding: prospective evaluation of intragastric migration of the lap-band. *Surg Laparosc Endosc Percutan Tech*. 2001;11:229–234.
- Silecchia G, Catalano C, Gentileschi P, et al. Virtual gastro-duodenoscopy: a new look at the bypassed stomach and duodenum after laparoscopic Roux-en-Y gastric bypass for morbid obesity. *Obes Surg*. 2002;12:39–48.
- Gill KR, McKinney JM, Stark ME, et al. Investigation of the excluded stomach after Roux-en-Y gastric bypass: the role of percutaneous endoscopy. *World J Gastroenterol*. 2008;14:1946–1948.
- Yamamoto H, Sekine Y, Sato Y, et al. Total enteroscopy with a nonsurgical steerable double-balloon method. *Gastrointest Endosc*. 2001;53:216–220.
- Muñoz R, Ibáñez L, Salinas J, et al. Importance of routine preoperative upper GI endoscopy: why all patients should be evaluated? *Obes Surg*. 2009;19:427–431.
- Sharaf RN, Weinshel EH, Bini EJ, et al. Endoscopy plays an important preoperative role in bariatric surgery. *Obes Surg*. 2004;14:1367–1372.
- Scozzari G, Trapani R, Toppino M, et al. Esophagogastric cancer after bariatric surgery: systematic review of the literature. *Surg Obes Relat Dis*. 2013;9:133–142.