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Review Article

Overview of gastric bypass surgery

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ABSTRACT

Gastric bypass surgery is indicated for several clinical reasons including benign and malignant upper gastrointestinal tract pathologies. Any gastric resection or bypass procedure interferes with gastric emptying and the aim of reconstruction is to minimize the disturbance to the upper gastrointestinal physiology. Gastric bypass procedures induce early satiety, with or without concomitant impaired absorption of nutrients, and offer the best solution for morbid obesity. The long-term health benefits of gastric bypass surgery for morbid obesity must be found to outweigh the operative risks and side-effects of gastric bypass and thus patient selection is fundamental. The aim of the study was to review the indications, complications, sequelae and outcome of gastric bypass procedures.

1. Introduction

The history of gastric bypass surgery began in 1880 when the Polish surgeon Ludwik Rydygier performed a gastroenterostomy for peptic ulcer disease [1]. In 1885, the Austrian surgeon Theodor Billroth (Fig. 1) performed a first-stage gastrojejunostomy to alleviate the symptoms of an obstructing large pyloric tumour followed by a second-stage resection of the tumour with restoration of gastroduodenal continuity [1,2]. Most modern forms of gastrectomy with gastrojejunal anastomosis (Billroth II) are modelled on this operation and described for the treatment of peptic ulcer disease in 1911 [2–4]. With the success of antral *Helicobacter pylori* eradication triple therapy for peptic ulcer disease which includes antibiotics and a reversible chemical vagotomy with H_2 receptor antagonist or proton pump inhibitor, surgery is now indicated only for the emergency complications of perforation, severe vomiting from pyloric stenosis and haemorrhage [5]. It was also well recognized that Billroth II (partial) gastrectomy is associated with weight loss and several variations of this procedure have been used effectively in the surgical treatment of morbid obesity with benefit lasting for up to 10 years [4,6–11]. The restriction of volume of ingested food together with altered absorption of nutrients, especially fat contributes to achieving the weight loss and the malabsorptive procedures alter the digestive process in different ways [8–11]. The aim of this review was to evaluate the common gastric bypass procedures with regard to their indications, sequelae and outcome.

2. Gastrojejunostomy

By diverting gastric acid away from the duodenum, anastomosis of the stomach to a loop of jejunum was once used to treat duodenal ulcer but carried a high recurrence (50%) rate [12]. Gastrojejunostomy was then used as a drainage procedure following truncal vagotomy for peptic ulcer disease but has fallen into disuse since the advent of effective medical treatment to suppress gastric acid output and antral helicobacter pylori invasion [13,14]. Laparoscopic gastrojejunostomy (LGJ) has been proposed as the technique preferred over open gastrojejunostomy for relieving gastric outlet obstruction (GOO) due to malignant and benign disease with improved outcome and an acceptable complication rate [15]. Gastrojejunostomy would also bypass congenital pre-ampullary duodenal obstruction from a duodenal web/atresia/stenosis and an annular pancreas, with no or minimal early or long term complications including malnutrition [16]. Although resection of a primary gastric tumour provides better palliation than bypass surgery provided the patient's general health will allow this, patients with unresectable distal gastric tumours may benefit from a high antecolic gastrojejunostomy [17–19]. The control of the rate of delivery of the gastric contents to the small intestine that allows adequate mixing with bile and pancreatic juices and avoids overwhelming the digestive and absorptive capacity of the small intestine requires an intact and innervated pylorus. The importance of attempting to preserve normal gastric emptying in gastric bypass procedures without compromising oncological results is seen with the more physiological post-operative digestive function of the pylorus – preserving partial pancreaticoduodenectomy for pancreatic head cancer than with the partial stomach resection of the classical Kausch–Whipple procedure [20]. The Whipple's procedure is also occasionally indicated in cases of duodenal or pancreatic head trauma. Following a

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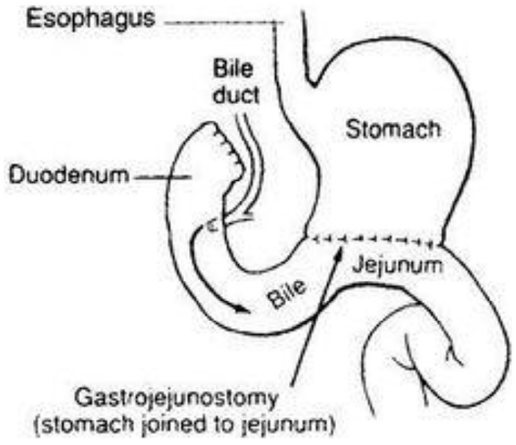

Fig. 1. Diagram of Billroth II gastrectomy.

retroperitoneal duodenal injury, options for duodenal repair may include a pyloric exclusion effected through a gastrostomy. The pyloric ring is closed with a continuous suture or stapling which breaks down after several weeks. The procedure is combined with a gastrojejunostomy and the addition of octreotide and intravenous acid suppression may improve duodenal healing and decrease stomach ulceration. Roux-en-Y loop (Roux-en-Y duodenojejunostomy) drainage of the defect from significant tissue loss in the second part of the duodenum is the procedure of choice in the stable patient [21]. Both the duodenum and the bile duct are triply bypassed with a gastroenterostomy, and a retrocolic Roux-en-Y hepatico-jejunostomy for a duodenal obstructive, locally-advanced pancreatic head carcinoma [22]. However a prophylactic gastrojejunostomy may suffice for an obstructive unresectable periampullary carcinoma [23].

2.1. Complications

Early technical complications from a gastrojejunostomy would include: (a) haemorrhage which is usually from the gastric side of the anastomosis and usually only starts when the clamps are released, by which time the lumen is not visible. It occasionally requires exploration; (b) leakage may occur as a result of tension on the anastomosis. Difficulty in bringing the stomach and jejunum together without tension may require opening the gastrocolic omentum and performing a retrocolic posterior gastroenterostomy. Otherwise, there is little advantage over the simple antecolic gastroenterostomy [24,25]; (c) an internal hernia if the mesenteric defects are not closed; (d) sepsis, either as a wound infection or an intraabdominal abscess; (e) early obstruction follows oedema around the stoma or kinking, or, later due to progression of malignancy especially if done for palliation. Late complications include stomal ulceration which can be prevented by proton pump inhibition and pancreatitis due to afferent loop obstruction [6,24].

3. Billroth II gastrectomy

The Billroth II gastrectomy is often indicated for refractory peptic ulcer disease and gastric adenocarcinoma [14,26,27]. Except in the aged, most surgeons now opt for a partial gastrectomy to treat a resistant peptic ulcer after excluding acid hypersecretion from a pancreatic islet cell gastrinoma [14,26]. Following resection of the distal stomach, reconstruction can be performed by either fashioning a new lesser curve and creating an end-to-end gastroduodenal anastomosis (Billroth I gastrectomy) described in 1881, or, by an end-to-side anastomosis of the gastric remnant to a loop of jejunum, with closure of the duodenal stump (Billroth II or Polya gastrectomy) (Fig. 1) [2–4]. The Polya gastrectomy with retrocolic end-to-side gastrojejunostomy has become a commonly performed modification of the Billroth II procedure [2]. Franz von Hofmeister described a partial gastrectomy with a retrocolic gastrojejunostomy involving the greater curvature [2,28]. Reconstruction following partial gastrectomy may be simple or difficult depending partly on the build of the patient and partly on the extent and nature of the disease process. Thus Billroth II gastrectomy is usually used for an emergency perforated large duodenal ulcer not suitable for simple omental patch closure and when a duodenal anastomosis (Billroth 1) cannot easily be made [29]. A Billroth I gastrectomy is not a bypass procedure and is suitable for a resistant benign gastric ulcer after excluding malignancy [14,27]. The Billroth II is associated with problems of bile reflux into the gastric remnant and oesophagus, and a higher risk of stomal ulceration. Thus, approximately two-thirds of stomach should be resected to avoid repeated antral exposure to bile [6,14]. For the theoretical benefits of delaying gastric emptying and preventing reflux of duodenal contents into the stomach, a Hofmeister 'valve' can often be fashioned by reducing the stoma length to around 5 cm through closing part of the opening in the gastric stump and the rest being used for the actual anastomosis [28].

3.1. Complications

Billroth II gastrectomy was favoured for many years for its relatively low peptic ulcer recurrence rate (less than 5%) [2,4,6]. However, it has a high mortality and complication rate [6,14]. Leakage may occur from either the duodenal stump or from the anastomosis. Leakage from the duodenal stump is usually due to afferent loop obstruction. This risk is reduced by the formation of a Roux-en-Y reconstruction. If there is controlled leak without sepsis or generalized peritonitis conservative treatment is indicated with parenteral nutrition. Otherwise exploration is required to drain any sepsis and to establish drainage of the afferent loop. A useful technique for the latter is to insert a T tube into the duodenum and, therefore, establish a controlled fistula, and to decompress the afferent loo obstruction [6,30,31]. It is unlikely that direct suture of a leak will be feasible. Treatment of a gastrojejunal leak is problematic. More commonly the leak is delayed, occurring 7–14 days postoperatively. If there are clinical features to indicate that this is limited and localized, then conservative treatment with nutritional support, gastrointestinal decompression and antibiotics is indicated .Otherwise, reoperation is required.

3.2. Side effects and post-prandial sequelae

3.2.1. Early satiety

Early satiety arises from the loss of reservoir function of the stomach and it is important to obtain good early dietary advice and limit meal size. The excision of 80% of the stomach leads to reduced gastric volume resulting in early satiety and hence weight loss. Gastric bypass surgery not only reduces the gut's capacity for food but also dramatically lowers ghrelin levels compared to both lean controls and those that lost weight through dieting alone [32,33]. *Ghrelin*, the "hunger hormone", is a peptide hormone produced by ghrelinergic cells in the gastrointestinal tract which functions as a neuropeptide in the central nervous system. Besides regulating appetite, ghrelin also plays a significant role in regulating the distribution and rate of use of energy [34]. It prepares the body for food intake by acting on hypothalamic brain cells to increase hunger, gastric acid secretion and gastrointestinal motility [35,36]. Ghrelin is secreted when the stomach is empty, but secretion stops when the stomach is stretched. Bariatric surgeries involving excision of the fundus as in vertical sleeve gastrectomy reduce plasma ghrelin levels by about 60% in the long term [37]. However, studies are conflicting as to whether or not ghrelin levels return to nearly normal