INTRODUCTION

The prevalence of obesity is increasing worldwide at an alarming rate. In 2009, the number of overweight and obese people in the world overtook the number of Malnourished ***(Anand, 2009).***

Man has become sedentary with computers, remote controls, taking elevators for even one floor, increased cars and high-calorie convenience food ***(Buchwald, 2008).*** The obesity epidemic (globesity) is affecting developing countries ***(Schauer et al., 2010).***

Overweight and obesity are associated with increased rate of type II diabetes mellitus, hypertension, cardiovascular diseases, dyslipidemia, arthritis, non-alcoholic steatohepatitis, gall bladder disease, sleep-apnea syndrome and several cancers. Mortality increases with increasing body mass index (BMI). Mortality rate is twelve times than that in young normal-weight men ***(Olshansky et al., 2009).***

Although medical management of morbid obesity patients made some progress, however, a persistent weight reduction can hardly be achieved in these patients. For extreme cases of obesity, only surgical intervention can produce substantial weight loss ***(Weber, 2008).***

In response to the failure of conservative weight loss measures, several different bariatric surgical interventions have been developed. Bariatric surgery is considered major surgery in which a surgeon alters the patients' digestive tract in an attempt to induce weight loss. The goals of bariatric surgery are to maintain a significant weight loss over time and to ameliorate co-morbid conditions. (***Chapman A. et al., 2002)***

Bariatric surgery is classified into three broad categories: gastric restrictive, mal-absorptive, or a combination of the two. Restrictive procedures attempt to reduce the caloric intake by reducing gastric volume, slowing gastric emptying, and creating early satiety. Mal-absorptive procedures attempt to reduce the caloric uptake by bypassing various lengths of small intestine. (***Chapman A. et al., 2002)***

Laparoscopic Adjustable Gastric Banding is a purely restrictive procedure, in which the surgeon places a silicone band around the entire upper portion of the stomach. Because of the tiny pouch and the narrow channel through the band, patients feel satiated after only a small amount of food is eaten. (***Chapman A. et al., 2002)***

Laparoscopic Adjustable Gastric Banding (LAGB) is an effective weight loss procedure, with the majority of patients losing between 44% and 55% of their excess body weight ***(Brethauer SA and Chand B, 2006).***

While gastric bypass surgery has been at the forefront of weight loss surgery since the 1960s, adjustable gastric banding (AGB) is quickly becoming the most popular procedure performed in the US and Canada. Of the 220, 000 bariatric operations performed in the US and Canada that year, 42.3% were an AGB operation, which is an increase from the 24.4% five years ago, while the percentage of gastric bypasses decreased from 65.1% to 49.0% over the same time period. ***(Buchwald H et al., 2009)***

Laparoscopic adjustable gastric banding has proved to be a safe and effective bariatric procedure. Advantages of LAGB over other bariatric procedures include the ability to adjust the stoma, safe laparoscopic placement and reversibility. Important changes in the placement technique have improved outcomes and reduced late complication, such as band slippage. (***O'Brien P. et al., 1999)***

Since its approval by the FDA in June 2001, reports have been published from a number of centers throughout the United States demonstrating successful weight loss with LAGB and an evolving understanding of the importance of the appropriate patient management. ***(O'Brien P. et al., 2003)***

These methods may have the added advantage of reduced invasiveness, reversibility, cost-effectiveness, and applicability to a larger segment of the population with moderate obesity ***(Abu Dayyeh and Thompson, 2011).***

LAGB, being minimally invasive with a very short hospital stay, would be cost effective per unit care. It could help to address the problem of increasing numbers of morbidly obese people on waiting lists and the demands of their obesity-related co-morbidities on the provincial health care system. ***(Guo B., Harstall C., 2005)***

From the currently available evidence, guidelines, and position statements, all bariatric surgeries are effective in the treatment of morbid obesity but differ in the degree of weight loss and range of early or late postoperative complications. Defining the appropriate patient population for each of the bariatric surgical procedures remains a challenge. ***(Guo B., Harstall C., 2005)***

Aim of the Work

The aim of this work is to discuss the advantages and disadvantages of laparoscopic adjustable gastric banding in management of metabolic derangement of morbid obesity.

SURGICAL ANATOMY OF THE STOMACH

The stomach is readily recognizable as the asymmetrical, pear-shaped, most proximal abdominal organ of the digestive tract. The part of the stomach attached to the esophagus is called the cardia. Just proximal to the cardia at the gastroesophageal (GE) junction is the anatomically indistinct but physiologically demonstrable lower esophageal sphincter. At the distal end, the pyloric sphincter connects the stomach to the proximal duodenum. The stomach is relatively fixed at these points, but the large midportion is quite mobile ***(Mercer et al., 2002).***

The superior-most part of the stomach is the distensible floppy fundus, bounded superiorly by the diaphragm and laterally by the spleen. The angle of His is where the fundus meets the left side of the GE junction. Generally, the inferior extent of the fundus is considered to be the horizontal plane of the GE junction, where the body (corpus) of the stomach begins. The body of the stomach contains most of the parietal (oxyntic) cell. The body is bounded on the right by the relatively straight lesser curvature and on the left by the more curved greater curvature. At the angularis incisura, the lesser curvature turns rather abruptly to the right, marking the anatomic beginning of the antrum, which comprises the distal 25 to 30% of the stomach ***(Ashley et al., 1999).***

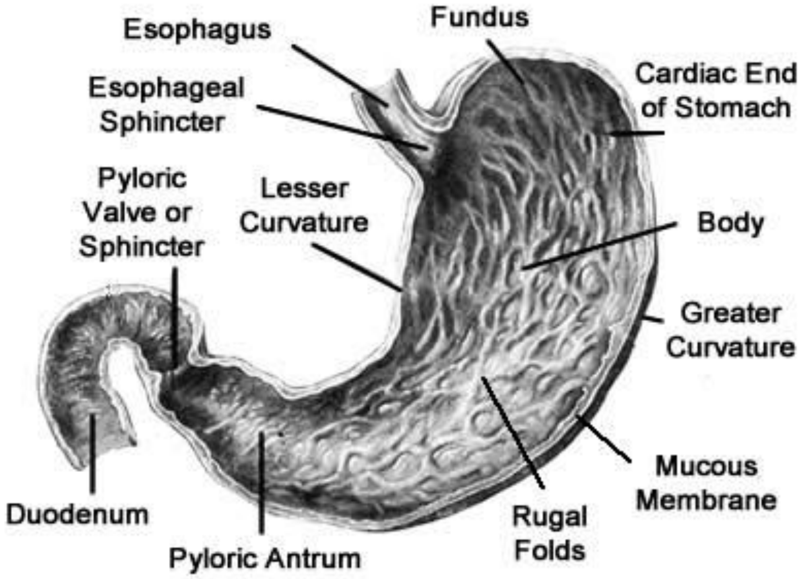

Fig. (1): Parts of the stomach ***(Mercer et al., 2002).***

The organs that commonly surround the stomach are the liver, colon, spleen, pancreas, and occasionally the kidney. The left lateral segment of the liver usually covers a large part of the anterior stomach. Inferiorly, the stomach is attached to the transverse colon by the gastrocolic omentum. The lesser curvature is tethered to the liver by the hepatogastric ligament, also referred to as the lesser omentum or pars flaccida. Posterior to the stomach is the lesser omental bursa and the pancreas ***(Mercer et al., 2002).***

Blood supply of the stomach:

The stomach is the most richly vascularized portion of the alimentary tube. The large majority of the gastric blood supply is from the celiac axis via four named arteries. The left and right gastric arteries form an anastomotic arcade along the lesser curvature, and the right and left gastroepiploic arteries form an arcade along the greater gastric curvature. The consistently largest artery to the stomach is the left gastric artery, which usually arises directly from the celiac trunk and divides into an ascending and descending branch along the lesser gastric curvature ***(Orringer et al., 2007).***

The second largest artery to the stomach is the right gastroepiploic artery, which arises consistently from the gastroduodenal artery behind the first portion of the duodenum. The left gastroepiploic artery arises from the splenic artery, and, together with the right gastroepiploic artery, forms the rich gastroepiploic arcade along the greater curvature ***(Leung, 2003).***

The right gastric artery usually arises from the hepatic artery near the pylorus and hepatoduodenal ligament, and runs proximally along the distal stomach. In the fundus along the proximal greater curvature, the short gastric arteries and veins arise from the splenic circulation ***(Orringer et al., 2007).***

The veins draining the stomach generally parallel the arteries. The left gastric (coronary vein) and right gastric veins usually drain into the portal vein, though occasionally the coronary vein drains into the splenic vein. The right gastroepiploic vein drains into the superior mesenteric vein near the inferior border of the pancreatic neck, and the left gastroepiploic vein drains into the splenic vein ***(Leung, 2003).***

Generally speaking, the gastric lymphatics parallel the blood vessels. The cardia and medial half of the corpus commonly drain to nodes along the left gastric and celiac axis. The lesser curvature side of the antrum usually drains to the right gastric and pyloric nodes, while the greater curvature half of the distal stomach drains to the nodes along the right gastroepiploic chain. The proximal greater curvature side of the stomach usually drains into nodes along the left gastroepiploic or splenic hilum. The nodes along both the greater and lesser curvature commonly drain into the celiac nodal basin ***(Orringer et al., 2007).***

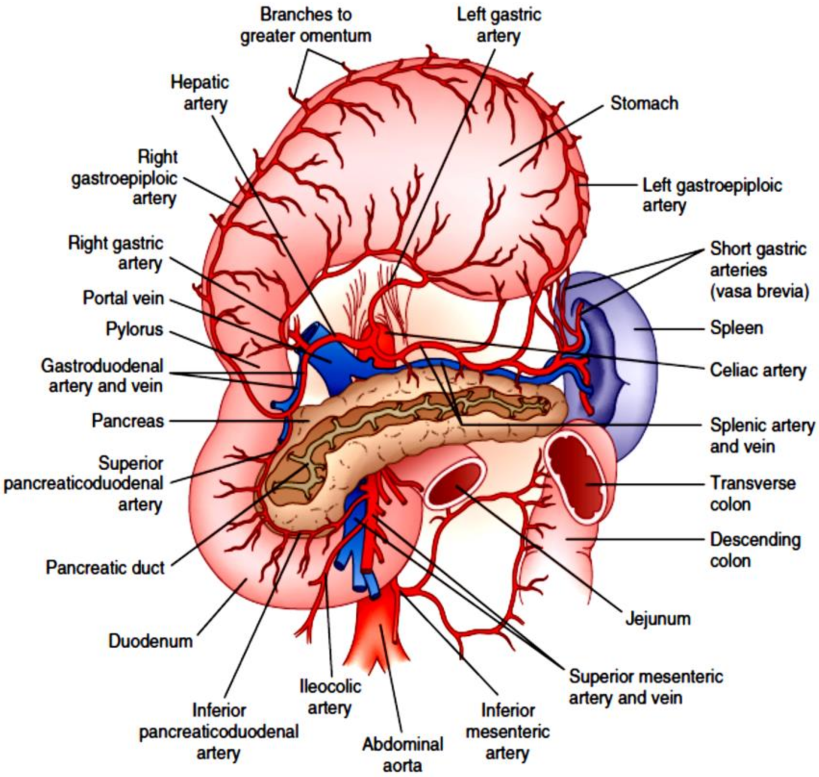

Fig. (2): Blood supply to the stomach and duodenum showing anatomic relationships to the spleen and pancreas. The stomach is reflected cephalad **(David, Emily, 2007).**

Innervations:

As shown in Figure (3), the extrinsic innervation of the stomach is parasympathetic (via the vagus) and sympathetic (via the celiac plexus). The vagus nerve originates in the vagal nucleus in the floor of the fourth ventricle and traverses the neck in the carotid sheath to enter the mediastinum, where it divides into several branches around the oesophagus. These branches coalesce above the oesophageal hiatus to form the left and right vagus nerves. It is not uncommon to find more than two vagal trunks at the distal oesophagus. At the GE junction, the left vagus is anterior, and the right vagus is posterior (LARP)

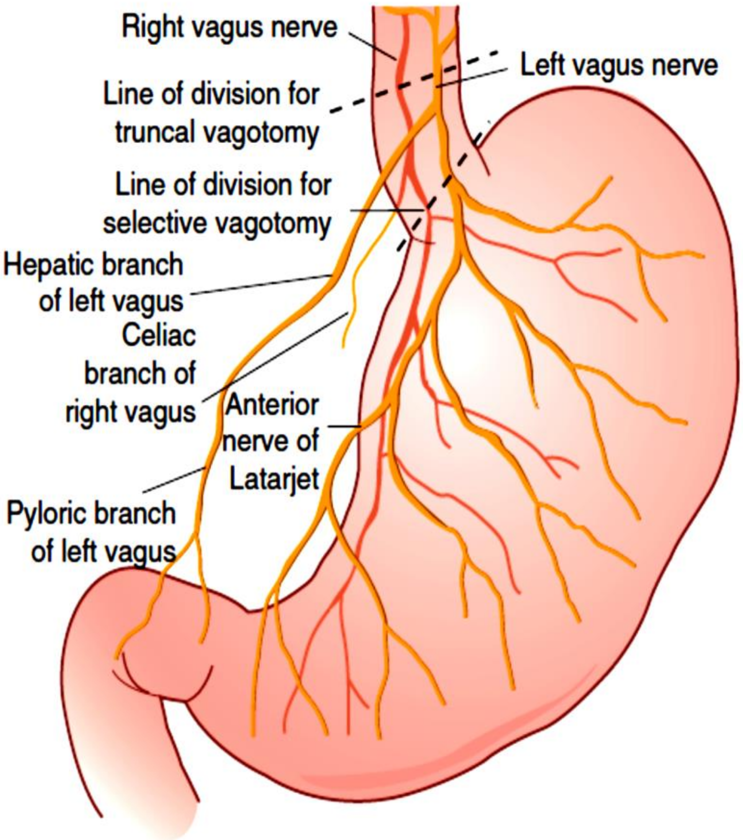

Fig. (3): Innervation of the stomach **(David, Emily, 2007).**

The left vagus gives off the hepatic branch to the liver and then continues along the lesser curvature as the anterior nerve of Latarjet. Although not shown, the so-called criminal nerve of Grassi is the first branch of the right or posterior vagus nerve; it is recognized as a potential cause of recurrent ulcers when left undivided. The right nerve gives a branch off to the celiac plexus and then continues posteriorly along the lesser curvature. Most (90%) of the vagal fibers are afferent, carrying stimuli from the gut to the brain. Efferent vagal fibers originate in the dorsal nucleus of the medulla and synapse with neurons in the myenteric and submucosal plexuses. These neurons use acetylcholine as their neurotransmitter and influence gastric motor function and gastric secretion. In contrast, the sympathetic nerve supply comes from T5 to T10, travelling in the splanchnic nerve to the celiac ganglion. Postganglionic fibers then travel with the arterial system to innervate the stomach **(David, Emily, 2007).**

Histology of the stomach:

There are four distinct layers of the gastric wall: mucosa, submucosa, muscularis propria, and serosa. The inner layer of the stomach is the mucosa, which is lined with columnar epithelial cells of various types. Beneath the basement membrane of the epithelial cells is the lamina propria, which contains connective tissue, blood vessels, nerve fibers, and inflammatory cells ***(Mercer et al., 2002).***

Beneath the lamina propria is a thin muscle layer called the *muscularis mucosa*, the deep boundary of the mucosal layer of the gut. The epithelium, lamina propria, and muscularis mucosa constitute the mucosa ***(Ashley et al., 1999).***

The epithelium of the gastric mucosa is columnar glandular. The gastric glands are lined with different types of epithelial cells, depending upon their location in the stomach. There are also endocrine cells present in the gastric glands. Progenitor cells at the base of the glands differentiate and replenish sloughed cells on a regular basis. Throughout the stomach, the carpet consists primarily of mucus-secreting surface epithelial cells (SECs) that extend down into the gland pits for variable distances. These cells also secrete bicarbonate and play an important role in protecting the stomach from injury due to acid, pepsin, and/or ingested irritants. In fact, all epithelial cells of the stomach (except the endocrine cells) contain carbonic anhydrase and are capable of producing bicarbonate *(Antonioli & Madara, 1998).*

In the fundus and body, the glands are more tubular and the pits are deep. Parietal and chief cells are common in these glands. Histamine-secreting enterochromaffin-like (ECL) cells and somatostatin-secreting D cells are also found. Parietal cells secrete acid and intrinsic factor into the gastric lumen, and bicarbonate into the intercellular space. Chief cells secrete pepsinogen I, which is maximally activated at a pH of 2.5. They tend to be clustered toward the base of the gastric glands. When stimulated, the chief cells produce two immunologically distinct proenzyme forms of pepsinogen: predominantly pepsinogen I and some pepsinogen II, most of which is produced by SECs (Surface epithelial cells) ***(Ashley et al., 1999).***

In the antrum, gastrin-secreting G cells and somatostatin-secreting D cells are present. A variety of hormone-secreting cells are present in various proportions throughout the gastric mucosa. Histologic analysis suggests that in the normal stomach, 13% of the epithelial cells are oxyntic (parietal) cells, 44% are chief (zymogenic) cells, 40% are mucous cells, and 3% are endocrine cells ***(Feldman, 2002).***

Deep to the muscularis mucosa is the submucosa, which is rich in branching blood vessels, lymphatics, collagen, various inflammatory cells, autonomic nerve fibers, and ganglion cells of Meissner's autonomic submucosal plexus. The collagen-rich submucosa gives strength to GI anastomoses. The mucosa and submucosa are folded into the grossly visible gastric rugae, which tend to flatten out as the stomach becomes distended ***(Ashley et al., 1999).***

Below the submucosa is the thick muscularis propria (also referred to as the muscularis externa), which consists of an incomplete inner oblique layer, a complete middle circular layer (continuous with the esophageal circular muscle and the circular muscle of the pylorus), and a complete outer longitudinal layer (continuous with the longitudinal layer of the esophagus and duodenum). Within the muscularis propria is the rich network of autonomic ganglia and nerves that make up Auerbach's myenteric plexus. The outer layer of the stomach is the serosa, also known as the visceral peritoneum. This layer provides significant tensile strength to gastric anastamoses ***(Feldman, 2002).***

Table 1: Gastric Cell Types, Location and Function, ***(David, Emily, 2007).***

CELL TYPE	LOCATION	FUNCTION
Parietal	Body	Secretion of acid and intrinsic factor
Mucus	Body, antrum	Mucus
Chief	Body	Pepsin
Surface epithelial	Diffuse	Mucus, bicarbonate, prostaglandins (?)
Enterochromaffin-like	Body	Histamine
G	Antrum	Gastrin
D	Body, antrum	Somatostatin
Gastric mucosal interneurons	Body, antrum	Gastrin-releasing peptide
Enteric neurons	Diffuse	Calcitonin gene–related peptide, others
Endocrine	Fundus	Ghrelin

Physiology of the stomach:

The stomach stores food and facilitates digestion through a variety of secretory and motor functions. Important secretory functions include the production of acid, pepsin, intrinsic factor,