Introduction

Obesity is a major health problem worldwide. An estimated 66% of American adults are overweight, defined as a BMI of more than 25 kg/m^2. Half of these are obese (BMI>30 kg/m2), and nearly 5% have clinically severe obesity. **[1]**

Multiple chronic diseases are associated with obesity, including type 2 diabetes mellitus, hypertension, dyslipidemia, metabolic syndrome, coronary heart disease, ischemic stroke, nonalcoholic steatohepatitis, polycystic ovarian syndrome, sleep apnea, obesity-hypoventilation syndrome, gallbladder disease, musculoskeletal disease, and certain cancers.**[2]**

Type 2 diabetes mellitus has now reached epidemic proportions affecting 246 million people worldwide, and it is expected to affect 380 million by 2025**.** Diabetes now touches nearly 24 million lives in the United States, with an increase of more than 3 million predicted to occur in approximately 2 years. According to new 2007 prevalence data, another 57 million people are estimated to have pre-diabetes. **[3]**

Bariatric surgery includes a variety of procedures performed on people who have obesity. Weight loss is achieved by reducing the size of the

stomach with a laparoscopic adjustable gastric band or through removal of a portion of the stomach by laparoscopic sleeve gastrectomy or laparoscopic biliopancreatic diversion with duodenal switch or by resecting and re-routing the small intestines to a small stomach pouch by laparoscopic gastric bypass. **[4]**

In a meta-analysis of 22 094 type 2 diabetic patients undergoing gastrointestinal bypass surgery for morbid obesity, showed a greater than 80% complete resolution of diabetes. Gastrointestinal bypass procedures such as Roux-en-Y gastric bypass and biliopancreatic diversion demonstrate 83.7 and 98.9% complete resolution of diabetes compared with restrictive procedures such as laparoscopic adjustable gastric band, which achieves 47.9% resolution. **[5]**

Glycemic control in diabetic patients improves markedly within days of bariatric surgery, which suggests that the procedures alter the hormones that control insulin secretion. **[6]**

The majority of obese patients who undergo selected types of bariatric surgery experience resolution of type 2 diabetes and enjoy normal blood glucose and glycosylated hemoglobin levels, with discontinuation of all diabetes-related medications.**[5]**

In a small study, 10 severely obese patients with uncontrolled type 1 diabetes who underwent bariatric surgery not only shed pounds, they also had improved glycemic control and a better metabolic profile 3 years later and they might require less insulin therapy after bariatric surgery. **[7]**

In non-obese diabetic patients. the bypass of duodenum and jejunum can directly control type 2 diabetes and not secondarily to the treatment of obesity, suggesting that Roux- en-Y gastric bypass and biliopancreatic diversion normalize glycemia, restore insulin sensitivity prevent the progression from impaired glucose tolerance to diabetes and also seem to reduce mortality from diabetes mellitus. **[8]**

Aim of the Work

This work aims to evaluate the effect of different bariatric procedures on obese and non-obese diabetic patients (Types 1 & 2).

Anatomy of the Stomach

I. Gross anatomy of the stomach

The stomach is the most dilated part of the gastrointestinal tract and has a J-like shape.The stomach is in the epigastric, umbilical and left hypochondrium regions of the abdomen ***(fig.1). [9]***

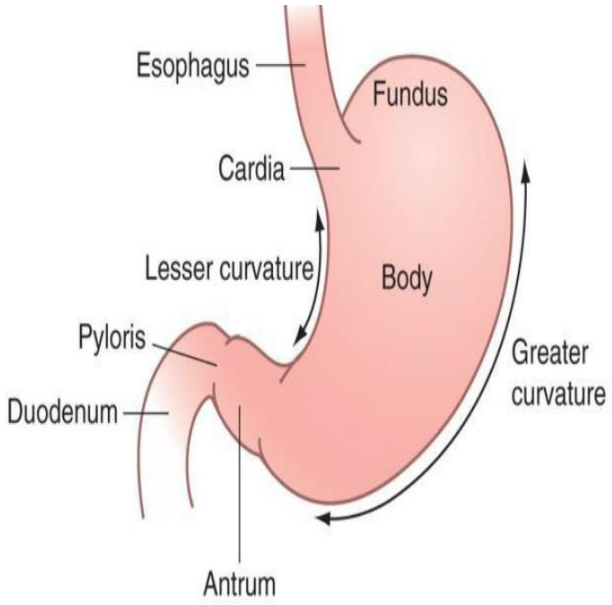

Fig. (1): The parts of the stomach. ***[9]***

The most proximal region of the stomach is called the cardia and attaches to the esophagus. Immediately proximal to the cardia is a physiologically competent lower esophageal sphincter. ***[9]***

Distally, the pylorus connects the distal stomach (antrum) to the proximal duodenum. Although the stomach

is fixed at the gastroesophageal (GE) junction and the pylorus, its large mid portion is mobile. ***[9]***

The fundus represents the most superior part of the stomach and is floppy and distensible. It is bounded superiorly by the diaphragm and laterally by the spleen. The body of the stomach represents the largest portion and is also referred to as the corpus. ***[9]***

The body also contains most of the parietal cells and is bounded on the right by the relatively straight lesser curvature and on the left by the longer greater curvature. At the angularisincisura, the lesser curvature abruptly angles to the right. It is at this point that the body of the stomach ends and the antrum begins. Another important anatomic angle (angle of His) is that which the fundus forms with the left margin of the esophagus. ***[9]***

Gastric relations.

When the stomach is empty and contracted, the two surfaces tend to lie facing almost superiorly and inferiorly, but with increasing degrees of distension they come to face progressively more anteriorly and posteriorly. ***[10]***

Anterior (superior) surface:

The lateral part of the anterior surface is posterior to the left costal margin and in contact with the diaphragm, whichseparates it from the left pleura, the base of the left

lung, the pericardium and the left sixth to ninth ribs. It lies posterior to the costal attachments of the upper fibers of transversusabdominis, which separate it from the seventh to ninth costal cartilages. The upper and left part of this surface curves posterolaterally and is in contact with the gastric surface of the spleen. The right half of the anterior surface is related to the left and quadrate lobes of the liver and the anterior abdominal wall. ***[10]***

When the stomach is empty, the transverse colon may lie adjacent to the anterior surface. The entire anterior (superior) surface is covered by peritoneum. ***[10]***

Posterior (inferior) surface:

The posterior surface lies anterior to the left crus and lower fibers of the diaphragm, the left inferior phrenic vessels, the left suprarenal gland, the superior pole of the left kidney, the splenic artery, the anterior pancreatic surface, the splenic flexure of the colon and the upper layer of the transverse mesocolon.Together these form the shallow stomach bed: they are separated from the stomach by the lesser sac (over which the stomach slides as it distends). The upper left part of the surface curves anterolaterally and lies in contact with the gastric surface of the spleen. ***[10]***

The greater omentum and the transverse mesocolon separate the stomach from the duodenojejunal flexure and ileum. The posterior surface is covered by peritoneum, except near the cardiac orifice, where a small, triangular

area contacts the left diaphragmatic crus and sometimes the left suprarenal gland . ***[10]***

The left gastric vessels reach the lesser curvature at the right extremity of this bare area in the left gastropancreatic fold. The gastrophrenic ligament passes from the lateral aspect of this bare area to the inferior surface of the diaphragm . ***[10]***

VASCULAR SUPPLY

There are four main arteries :the left and right gastric arteries along the lesser curvature and the left and right gastroepiploic arteries along the greater curvature. In addition, a substantial quantity of blood may be supplied to the proximal stomach by the inferior phrenic arteries and by the short gastric arteries from the spleen. The largest artery to the stomach is the left gastric artery, and it is not uncommon (15%-20%) for an aberrant left hepatic artery to originate from it. Consequently, proximal ligation of the left gastric artery may result in acute left-sided hepatic ischemia because the aberrant left hepatic artery occasionally represents the only arterial flow to the left hepatic lobe . ***(fig.2) [9]***

The right gastric artery arises from the hepatic artery (or the gastroduodenal artery. ***[9]***

The left gastroepiploic artery originates from the splenic artery, and the right gastroepiploic originates from the gastroduodenal artery. The extensive anastomotic

connection between these major vessels assures that, in most cases, the stomach will survive if three out of four arteries are ligated, provided that the arcades along the greater and lesser curvatures are not disturbed. In general, the veins of the stomach parallel the arteries. The left gastric (coronary) and right gastric veins usually drain into the portal vein. The right gastroepiploic vein drains into the superior mesenteric vein, and the left gastroepiploic vein drains into the splenic vein ***(fig.2) .[9]***

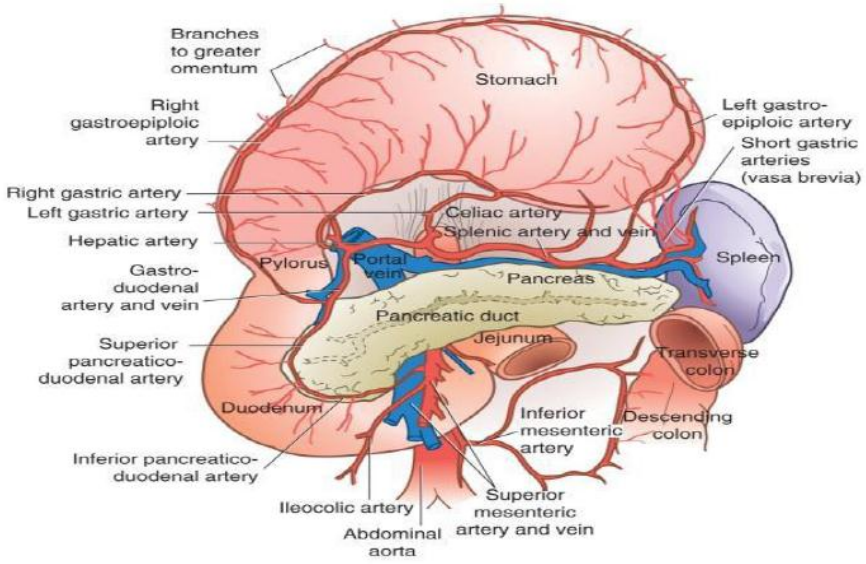

Fig. (2): Blood supply to the stomach and duodenum with anatomic relationships to the spleen and pancreas ***.[9]***

Surgical anatomy of the stomach

From the viewpoint of a surgeon, the stomach is part of two almost separate organ systems, each with its special pathology and surgical approach. The first can be called the ―proximal gastric unit, ‖ and

contains the proximal stomach, distal esophagus, and esophageal hiatus of the diaphragm**.**The second is the distal gastric unit, and includes the gastric antrum, pylorus and the first part of the duodenum**.** ***[12]***

Proximal Gastric Surgical Unit

The length of the abdominal esophagus ranges from 0.5 to 2.5 cm. Its relations with surrounding structures are:

Anterior: Posterior surface of left lobe of liver

Posterior: Right crus of diaphragm, and aorta .

Right: Caudate (spigelian) lobe of liver.

Left: Fundus of stomach.

The cardiac orifice is the gastroesophageal junction. The fundus, for all practical purposes, is the upper part of the body, which in the supine position augments upward. The body is the part of the stomach between the antrum and the fundus **.*[12]***

Distal Gastric Surgical Unit

The gastric antrum, pylorus, and first portion of the duodenum form a unit from an embryologic, physiologic and certainly, surgical view point **.*[12]***

Gastric Antrum

In the opened stomach, the antrum is easily distinguished from the body of the stomach by its mucosa, which is flatter and without rugae. It is histologically distinct, being without chief or parietal (acid-producing) cells. The margin of the antrum is irregular, but definite. Externally the antrum is difficult to demarcate ***.[12]***

The boundary on the lesser curvature usually lies at the incisuraangularis; it is usually found in textbook drawings, but inconstant and often absent in the operating room ***.[12]***

Surgeons not planning a gastrotomy to locate the antral margin can use the crow‘s foot of the anterior descending vagal trunk as a landmark. The antrum can be expected to begin 3–4 cm cranial to the crow‘s foot, about 8-10 cm proximal to the pylorus. On the greater curvature, there is no good landmark.[***12]***

In most cases the boundary extends from a point on the lesser curvature 2/5 of the way from the pylorus to the esophagus to a point on the greater curvature 1/8 of the distance from the pylorus to the esophagus ***.[12]***

Pylorus

The pylorus is a region of the stomach variously called the pyloric canal, pyloric ring, and pyloric valve. Proximally, it merges into the gastric antrum without a definite external boundary; distally, it ends abruptly at the thin-walled duodenum ***.[12]***.

At the pyloroduodenal junction, the continuity of the circular musculature is interrupted by an annular septum that arises from the connective tissue of the submucosa. Proximal to this ring, the circular muscle layer is thickened to form the pyloric sphincter. Distal to the ring, the circular muscle coat at the duodenum is thinner ***.[12]***

First Part of the Duodenum

The distal gastric surgical unit includes only the first 2.5 cm of the duodenum.

GASTRIC WALL

The gastric wall consists of the serosa, the muscular layer, submucosal layer, and mucosal layer. The distal esophagus is lined by stratified squamous epithelium, with mucous cells in the abdominal esophagus. Simple columnar cells compose the mucosal layer of the cardia. The mucosal layer of the fundus and body consists of two types of cells:

Parietal (oxyntic) acid-secreting cells and chief pepsin-secreting cells***.[12]***

LIGAMENTS

Hepatogastric Ligament (Lesser Omentum)

The hepatogastric ligament is the proximal part of the lesser omentum. It extends from the portahepatis to the lesser curvature of the stomach and upward as the ventral mesentery of the abdominal esophagus. The ligament contains:

Regularly: Left gastric artery and vein; hepatic division of the anterior vagal trunk; anterior and posterior gastric divisions of the vagal trunks (nerves of Latarjet); lymph nodes and vessels.

Occasionally: An aberrant left hepatic artery (23 percent of individuals) in proximal part of hepatogastric ligament; distally and to the right, branches of the right gastric artery and vein. In this region also are the common hepatic artery and portal vein; here they rise ventrally to gain their positions in the hepatoduodenal segment of the lesser omentum***.[12]***

Hepatoduodenal Ligament

The hepatoduodenal ligament is the dextral part of the lesser omentum, extending from the liver to the first 2.5 cm of the duodenum. The free edge envelops the hepatic triad, whichincludes the proper hepatic artery, portal vein, and extrahepatic biliary ducts, as well as the hepatic plexus and lymph nodes***.[12]***

Gastrocolic Ligament

The gastrocolic ligament is a portion of the greater omentum passing from the greater curvature of the stomach and the first part of the duodenum to the transverse colon***.[12]***

Gastrosplenic Ligament

The hepatogastric ligament encloses the abdominal esophagus on the right; its leaves rejoin on the left of the esophagus to form the gastrosplenic ligament. The lesser sac lies behind these ligaments***.[12]***

Gastrophrenic Ligament

The gastrophrenic ligament is continuous with the hepatogastric ligament to the left of or, perhaps, opposite the esophagus. It has an avascular area

through which the surgeon‘s finger can safely pass and through which a Penrose drain can be inserted around the cardia to pull down the esophagus. This is a useful maneuver in vagotomy. The upper part of the ligament is avascular, and the lower part contains short gastric arteries and veins, and lymph nodes***.[12]***

Anatomy of The Duodenum

The duodenum has received its name from being about equal in length to the breadth of twelve fingers (25 cm.). It is the shortest, the widest, and the most fixed part of the small intestine, and has no mesentery, being only partially covered by peritoneum. Its course presents a remarkable curve, somewhat of the shape of an imperfect circle, so that its termination is not far removed from its starting-point**.[13]**

Arterial Supply of The Duodenum

The superior pancreaticoduodenal artery arises from the gastroduodenal artery; the inferior pacreaticoduodenal artery originates as the first branch of the superior mesenteric artery . These vessels both lie in the curve between the duodenum and the head of the pancreas, supplying both structures .Interestingly, their anastomosis represents the site of junction of the fore-gut (supplied by the coeliac artery), and the mid-gut (supplied by the