INTRODUCTION

The acute abdomen is a common clinical syndrome in patients admitted to the emergency department and can be related to a variety of underlying disease ***(Stoker et al., 2009)***.

Approximately 5–10% of all patients who present to the emergency department are suffering from acute abdominal pain ***(Laméris et al., 2009)***.

The acute abdomen comprises non-traumatic and traumatic emergencies, and patients come to the attention of physicians in a number of contexts: presenting themselves to the emergency department, transported by ambulance, or while already hospitalized on the ward ***(Zech and Reiser*, *2010).***

Although the intensity and the time course of the pain often correlate with disease severity, these factors may be masked in immune compromised or elderly patients, as well as in children ***(Spencer et al., 2009).***

The acute abdomen is characterized by the sudden onset of severe abdominal pain, which requires emergency medical or surgical consultation ***(Leschka et al., 2005)***.

Physical examination and laboratory tests for this condition are often non-specific, and the clinical presentations may overlap in many diseases ***(Leschka et al., 2005).***

Therefore, Cope's statement holds true, that ''all who have had much experience of the group of cases known generally as the acute abdomen will probably agree that in that condition early diagnosis is exceptionally important'' ***(Green, 2008)***.

Therefore, an interdisciplinary approach is essential to secure a prompt diagnosis for a patient admitted with an acute abdomen. There is no doubt that, prior to the widespread use of radiological imaging techniques, individuals presenting with abdominal tenderness and rigidity were candidates for surgery; however, with the present availability of diagnostic imaging for the evaluation of an acute abdomen, some of these patients will no longer undergo immediate surgery but, instead, will receive intermittent or definite medical treatment for the underlying disease ***(Stoker et al., 2009).***

According to ***the American College of Radiology (ACR) appropriateness criteria (2006)***, contrast enhanced CT of the abdomen and pelvis is the most appropriate examination for patients with fever, non-localized abdominal pain, and no recent surgery where non-enhanced CT, US, and conventional radiography are considered less appropriate initial imaging examinations for these patients.

The usefulness of CT in the diagnosis and management of acute abdominal pain is well established. In a study by the CT diagnosis correlated with the final diagnosis in 87.5% ***(Chin et al., 2012).***

AIM OF THE WORK

The aim of this objective is to provide a review of the non-traumatic emergency scenarios of the acute abdomen, with the role of MDCT as diagnostic imaging tool in the diagnosis of these scenarios.

MDCT ANATOMY OF THE ABDOMEN

There is a long list of diseases that may lead to an acute abdomen. While most of them have their origin in the abdomen, others arise from extra-abdominal regions; for example: an inferior wall myocardial infarction can lead to severe epigastric pain ***(Schein, 2005).***

A number of attempts have been made to categorize and track the major diseases that cause an acute abdomen. Frequently, these categorizations are based on the anatomic location of the abdominal pain, the decision to treat the disease surgically or non-surgically, and the different medical disciplinesinvolved in treatment.

An overview of the categorization of the major diseases according to the anatomic location of the abdominal pain is given in Table 1

Table (1): Categorization of the most common acute diseases according to the anatomic side of abdominal pain ***(Khalil, 2012)***

	Epigastrium	
	Gastritis	
Right upper quadrant	Gastroesophageal reflux	**Left upper quadrant**
Cholecystolithiasis	Peptic ulcer	Splenic trauma
Cholecystitis	Myocardial infarction	Splenic infarction
Cholangitis	Pancreatitis	Nephrolithiasis
Choledocholithiasis		Pyelonephritis
Nephrolithiasis		Pleuritis
Pyelonephritis		Pneumothorax
Pleuritis		Subphrenic abscess
Pneumothorax	**Periumbilical**	Diverticulitis
Colitis	Gastroenteritis	Large bowel ischemia
Hepatic tumors	Incisional hernia	Large bowel obstruction
Hepatic trauma	Small bowel obstruction	Large bowel perforation
Subphrenic abscess	Large bowel obstruction	
Subhepatic abscess and bilioma	Pancreatitis	
	Large bowel ischemia	
	Urinary retention	
Right lower quadrant	Intestinal pseudo-obstruction	**Left lower quadrant**
Appendicitis	Mesenterial ischemia	Diverticulitis
Urinary tract infection	Aortic aneurysm incl.	Large bowel obstruction
Renal colic	rupture/dissection	Large bowel perforation
Inguinal hernia	Abdominal hernia	Ischemic colitis
Inflamed Meckel's diverticulum	Inflammatory bowel disease	Urinary tract infection
Large bowel obstruction		Renal colic
Inflammatory bowel disease		Inguinal hernia
Colitis	**Central lower quadrant**	Inflammatory bowel disease
Cecum ischemia	Cystitis	Salpingitis
Large bowel perforation	Salpingitis	Ectopic pregnancy
Salpingitis	Urinary retention	Ovary torsion
Ectopic pregnancy	Diverticulitis	Ovary cyst rupture
Ovary torsion	Ovary cyst rupture	Volvulus
Ovary cyst rupture	Ectopic pregnancy	
Volvulus	Volvulus	
Intestinal invagination	Suprapubic herniation	

Liver

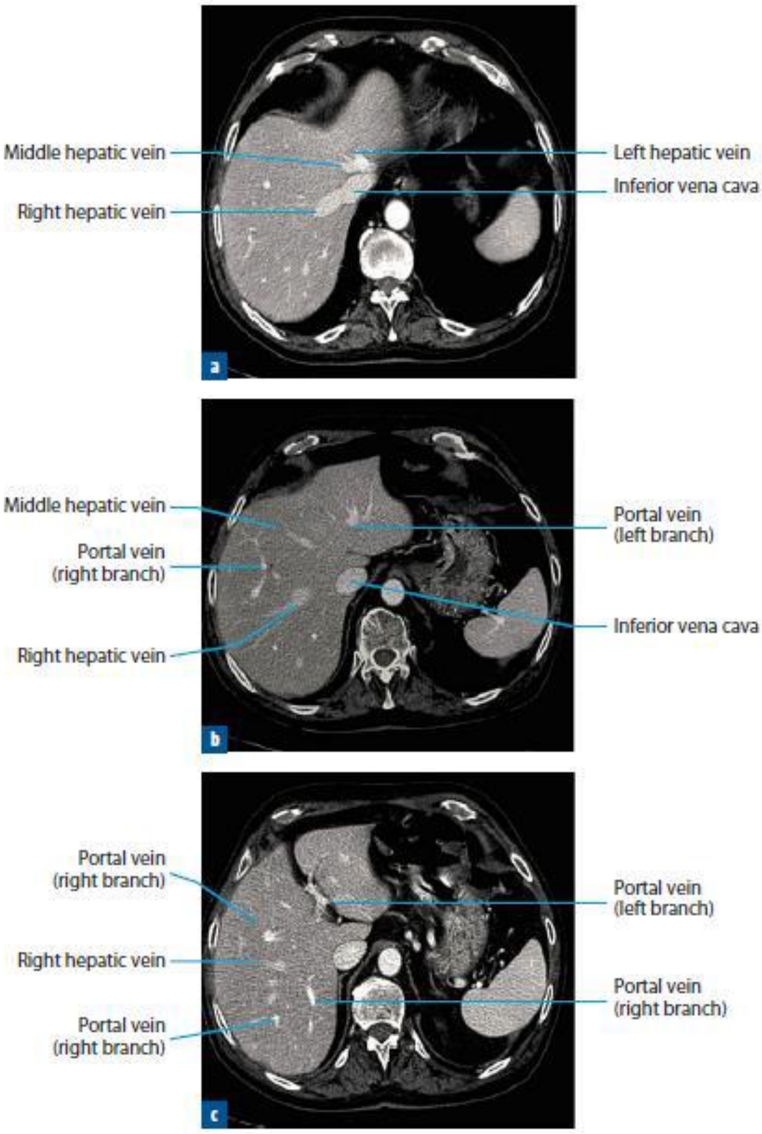

Fig. (1): a. The liver is located in the upper right quadrant of the abdominal cavity. The vascular system comprises arterial, venous, and portal systems. The hepatic artery, hepatic vein, and portal vein are contained within the hepatoduodenal ligament. Axial section of the upper liver shows the confluence between the hepatic veins and inferior vena cava, before the latter flows into the right atrium. b. In this section, the portal branches have a vertical course, bisecting the angle of the hepatic veins. The portal branches define the liver's segmental anatomy. c. The horizontal tract of the left branch of the portal vein divides the left lobe into two segments. Segment II is on the upper side, and segment III on the lower side ***(Gagliardi et al., 2011).***

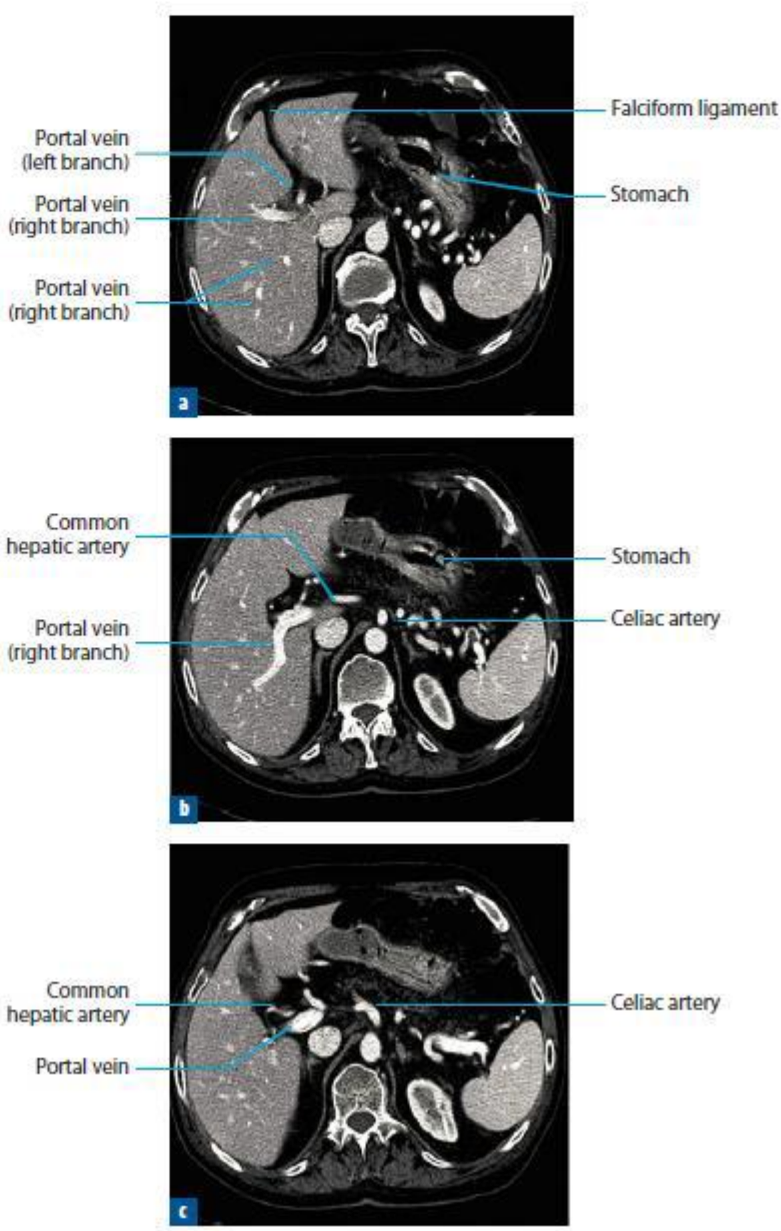

Fig. (2): a. The horizontal tract of the right portal vein separates the upper segments of the right lobe (VII and VIII) from its lower segments (V and VI). The falciform ligament separates segment IV, of the right lobe, from the left lobe. b. The common hepatic artery has a horizontal course, on the same plane as the celiac artery. c. The horizontal course of the portal vein is towards the confluence of the splenic vein ***(Gagliardi et al., 2011).***

Biliary System

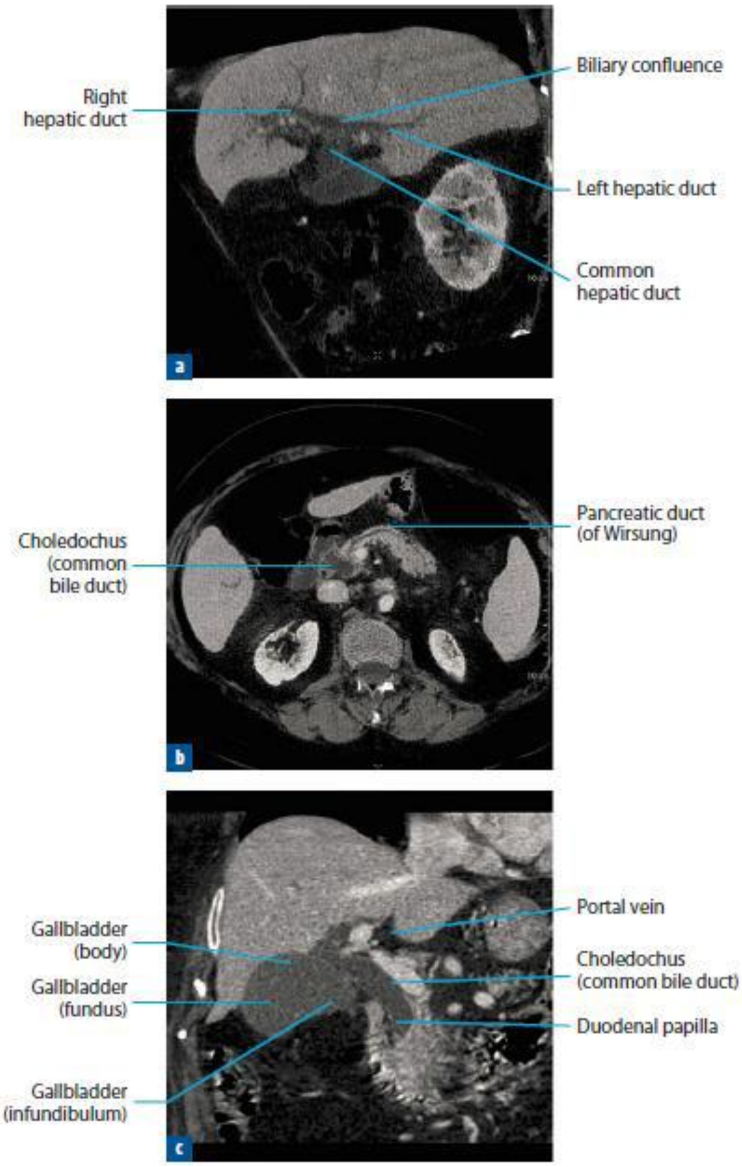

Fig. (3): a. The image shows moderate dilation of the intra- and extra-hepatic biliary ducts, with the right and left hepatic duct merging to yield the biliary confluence. b. The middle and distal portions of the choledochus (common bile duct) are located behind the head of the pancreas. Within the pancreatic gland, the moderately dilated pancreatic duct (of Wirsung) merges with the duodenum together with the choledochus. c. The latter runs along the portal vein and drains into the duodenal papilla (ampulla of Vater). The gallbladder, located at the anterior-inferior edge of the liver, is divided into three parts: fundus, body, and infundibulum ***(Di Pietto et al., 2011).***

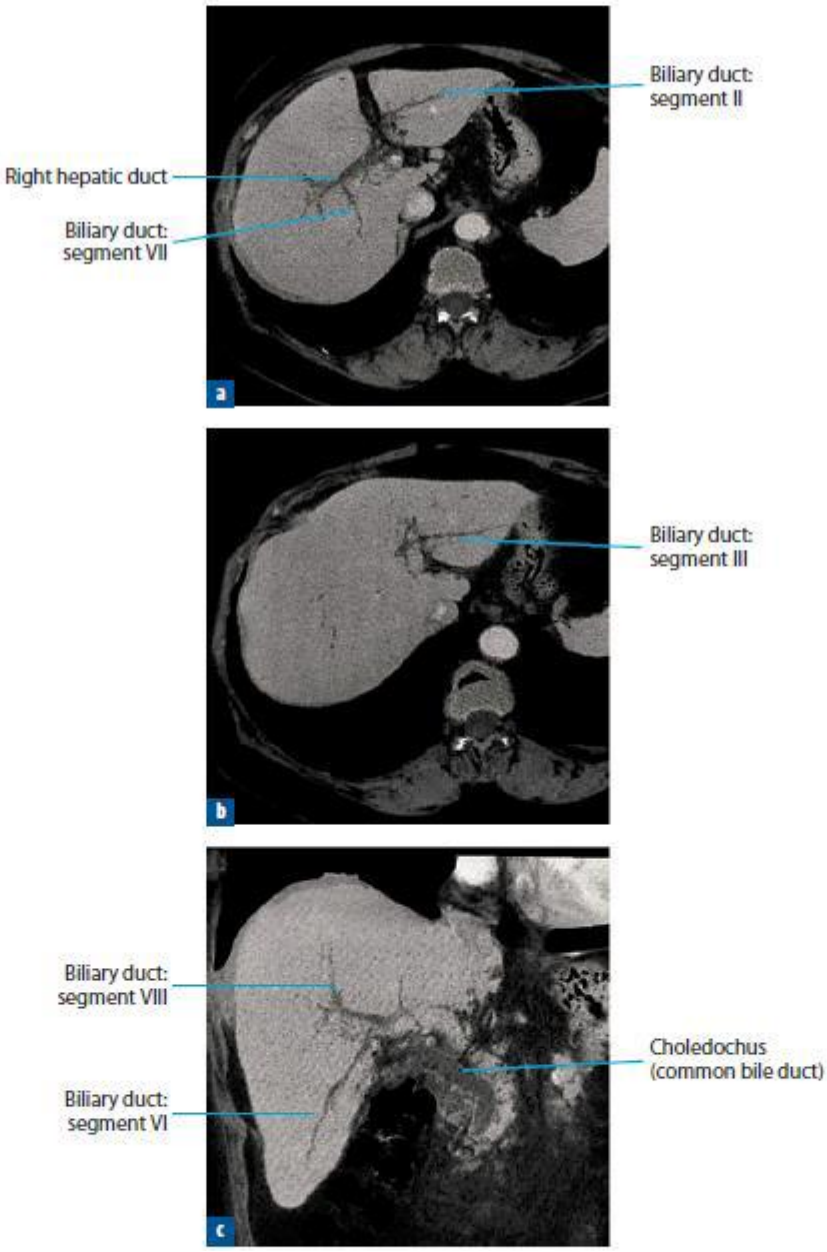

Fig. (4): a. Segment VII of the biliary duct originates from the right hepatic duct, while segment II of is located in the left hepatic lobe. b. Segment III of the biliary duct is located within the left hepatic lobe. c. The right hepatic duct is the origin of segment VIII, which runs upwards, and segment VI, which runs downwards ***(Di Pietto et al., 2011).***

Pancreas

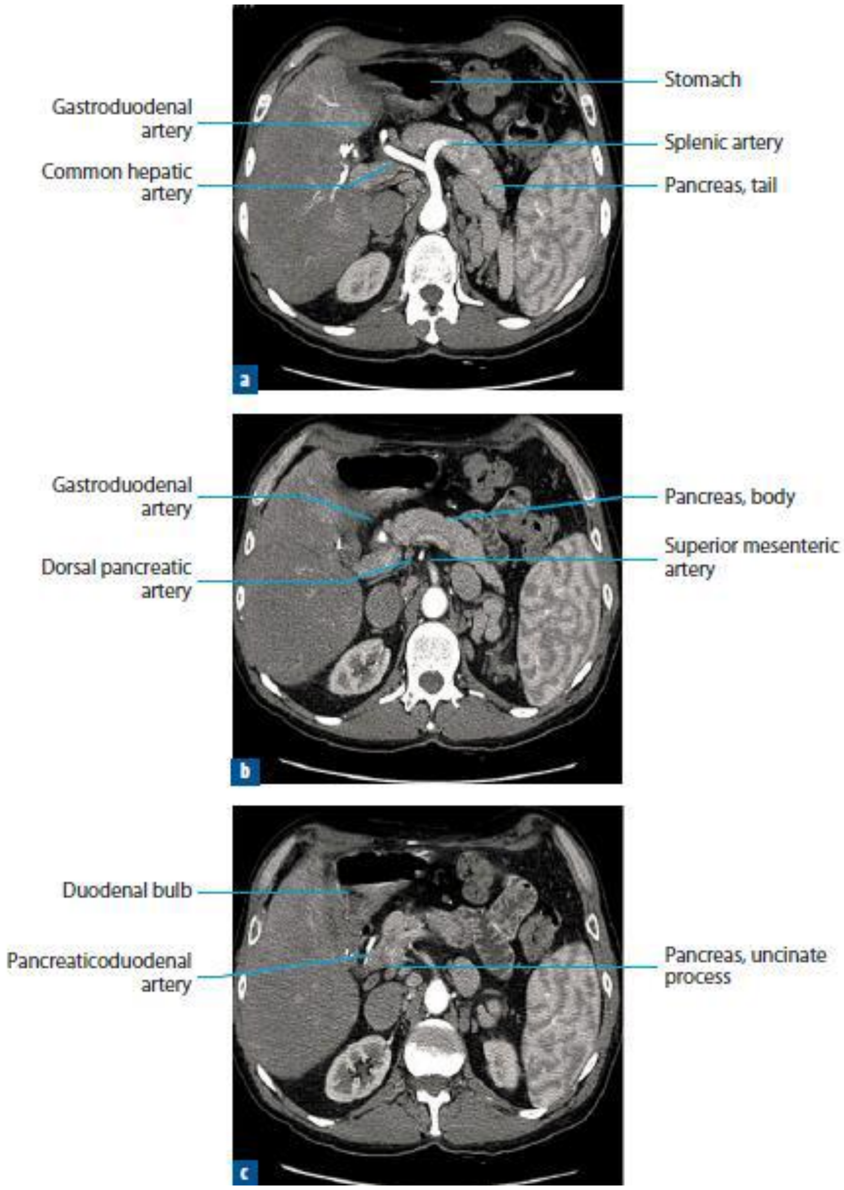

Fig. (5): a. The pancreas is located in the anterior retroperitoneal space and is slanted, with the head lower than the tail. The pancreatic head and uncinate process are embedded in the duodenal Cloop, while the tail is often located between the stomach and spleen. Superior mesenteric vessels and the celiac trunk are pancreatic landmarks. The upper body of the pancreas is visible on the same plane as the hepatic and splenic arteries. b. The body of the pancreas is on the same plane as the superior mesenteric artery. Flow in the gastroduodenal and dorsal pancreatic arteries is vertical. c. The uncinated process is visible at the level of the pancreaticoduodenal artery ***(Ponticiello and Perrotta, 2011).***

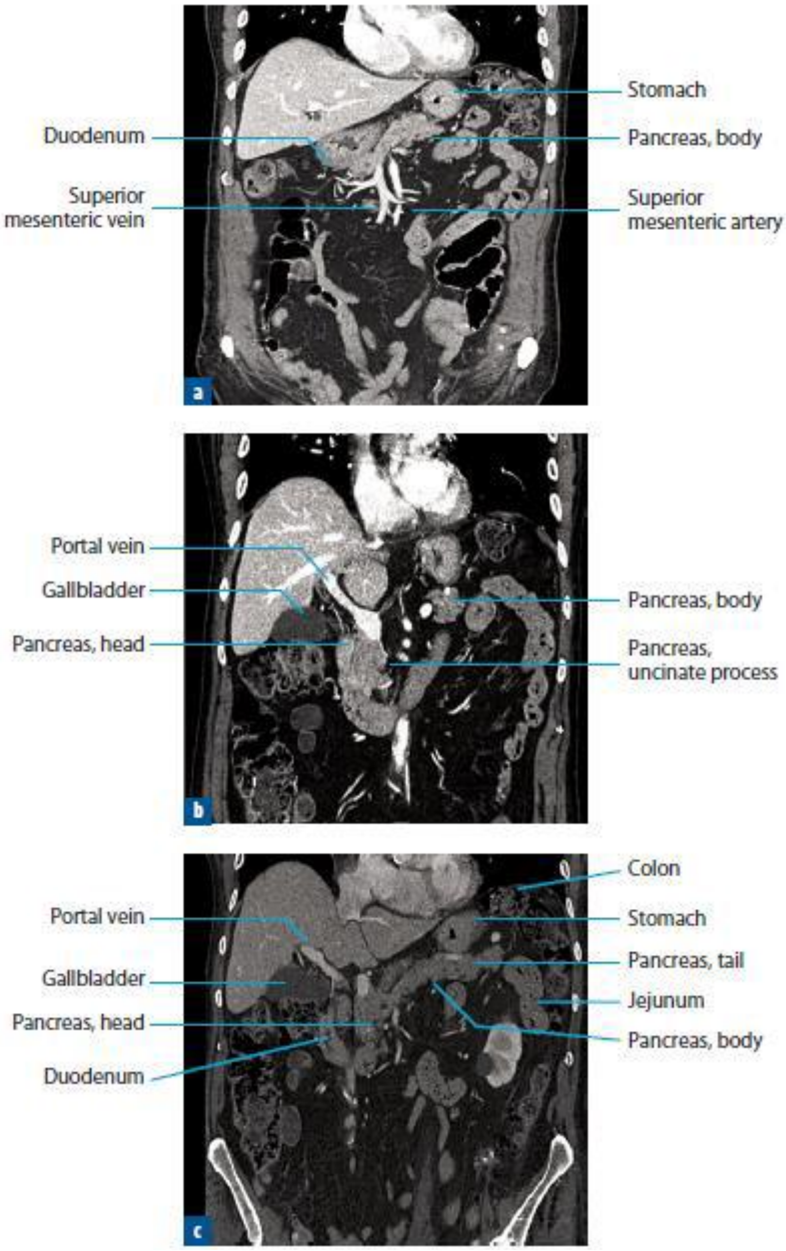

Fig. (6): a. Coronal reformatted image shows vertical flow in the superior mesenteric artery and vein. The body of the pancreas is visible. b. The head of the pancreas, the portal vein, and the gallbladder are shown in this section. c. Only a multiplanar reconstruction (MPR) curved reformatted image is able to visualize the pancreas in a single section and, at the same time, the adjacent organs (portal vein, gallbladder, stomach, duodenum, colon, and jejunum) ***(Ponticiello and Perrotta, 2011).***

Spleen

Fig. (7): a. The spleen is located subdiaphragmatically, in the left hypochondriac region. It is an intraperitoneal organ, except for the hilar region, which gives rise to two peritoneal folds: posteriorly, the splenorenal ligament, containing the splenic vessels and pancreatic tail; and anteriorly, the gastrolienal ligament, which extends to the greater curvature of the stomach. b. Relationships between the spleen and posterior wall of the stomach, retroperitoneal fat (containing the adrenal gland), left kidney, splenic flexure of the colon, and pancreatic tail can be appreciated. c. Splenic lobulation is a frequent anatomical variant ***(Ponticiello and Perrotta, 2011).***

Small Intestine

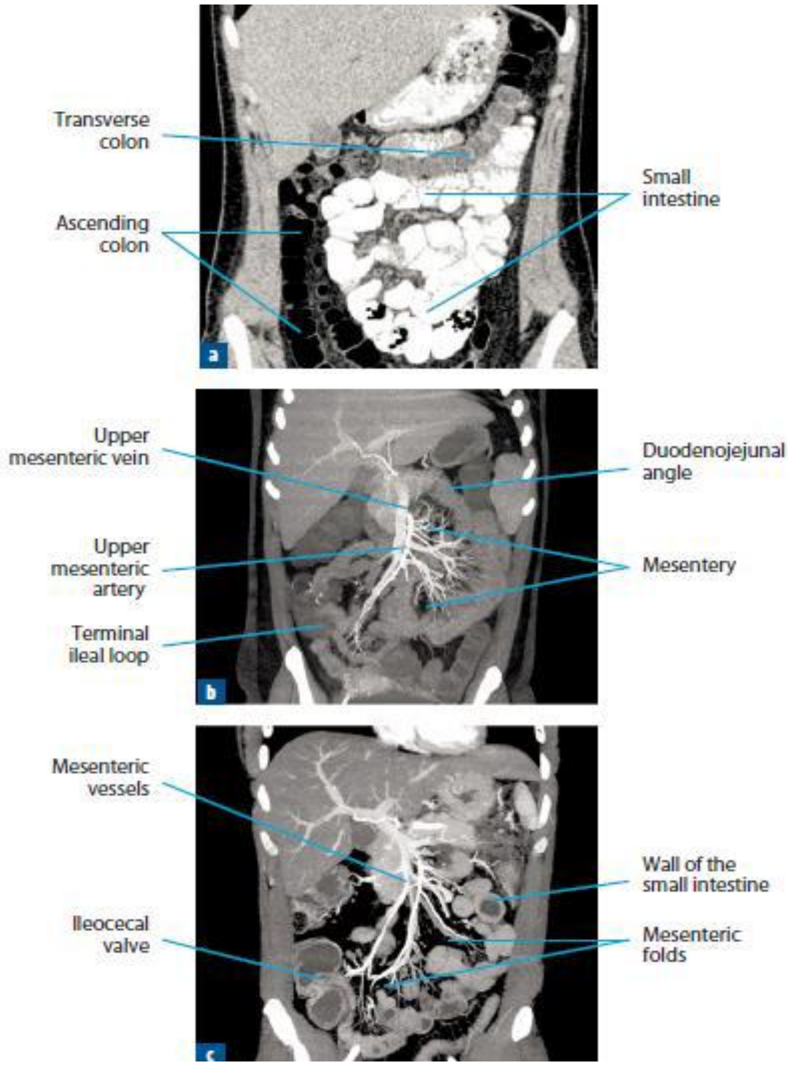

Fig. (8): a. The mesenteric small intestine is the most mobile and longest (8–9 m) segment of the gastrointestinal tract. It is surrounded by the colon and enveloped by a fan-shaped mesentery that suspends it from the posterior abdominal wall. b. The mesentery contains arterial, venous, and lymphatic vessels. Of these, the superior mesenteric artery supplies the entire small intestine. The small intestine begins at the duodenojejunal angle and ends at the ileocecal valve. The jejunum represents the proximal 40% of the small intestine and is 2-3 m in length. It begins after the fourth portion and suspensory ligament of the duodenum and lies in the left upper abdominal quadrant. It is less mobile than the ileal tract due to its shorter mesentery. c. Wall thickness varies according to the degree of lumen distention. The small intestine is characterized by mucosal and circular folds, the valvulae conniventes and plicae circulares, respectively ***(Romano et al., 2011).***

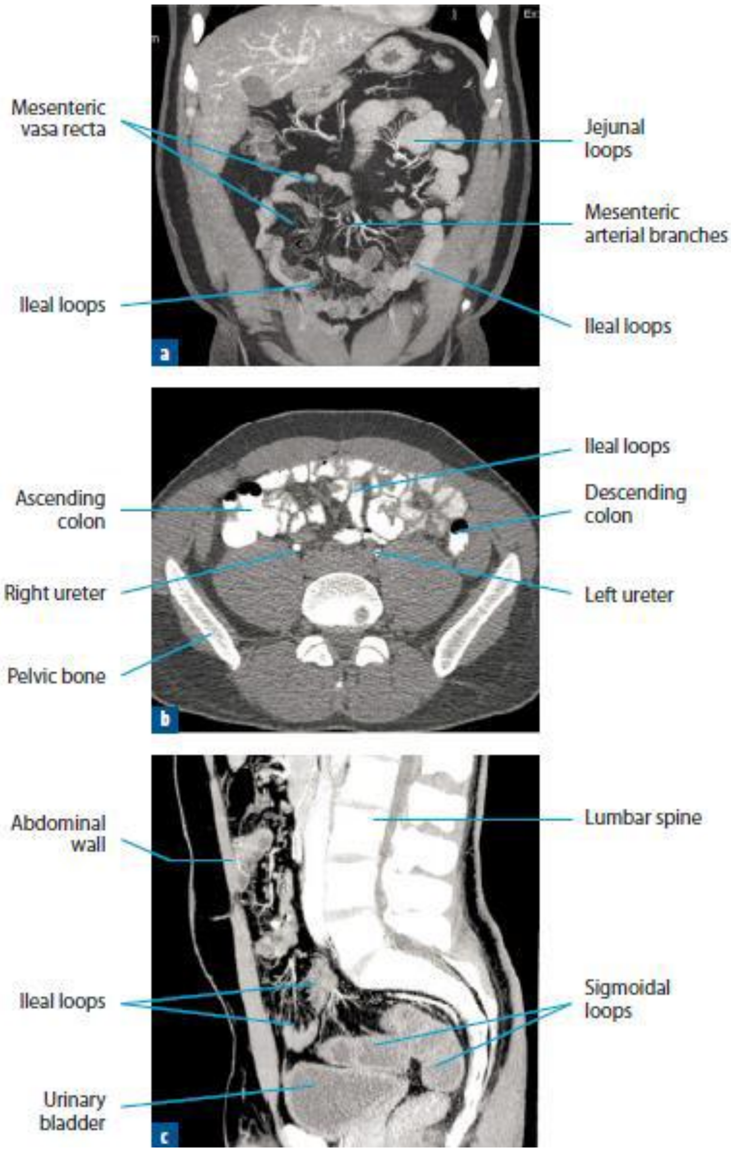

Fig. (9): a. Ileal loops follow the jejunal loops, with no clear anatomical point of distinction between these two intestinal tracts. The ileal loops represent 60% (4 m) of the small intestine by length. They are more mobile than the jejunal loops because of their longer mesentery. The ileal wall is thinner than the jejunal wall, with a less prominent pattern of folds and wider valvulae conniventes. The superior mesenteric artery sends 15-18 branches to the small intestine. These form arterial arcades and the vasa recta, which penetrate the intestinal wall. b. The ileal intestine lies in the lower abdominal quadrants and pelvic space, where it is surrounded by the ascending and descending colon. Both ureters lie behind the ileal loops. c. In the pelvic space, the ileal loops are surrounded by sigmoid intestine, urinary bladder, and, in females, the uterus and ovaries ***(Romano et al., 2011).***

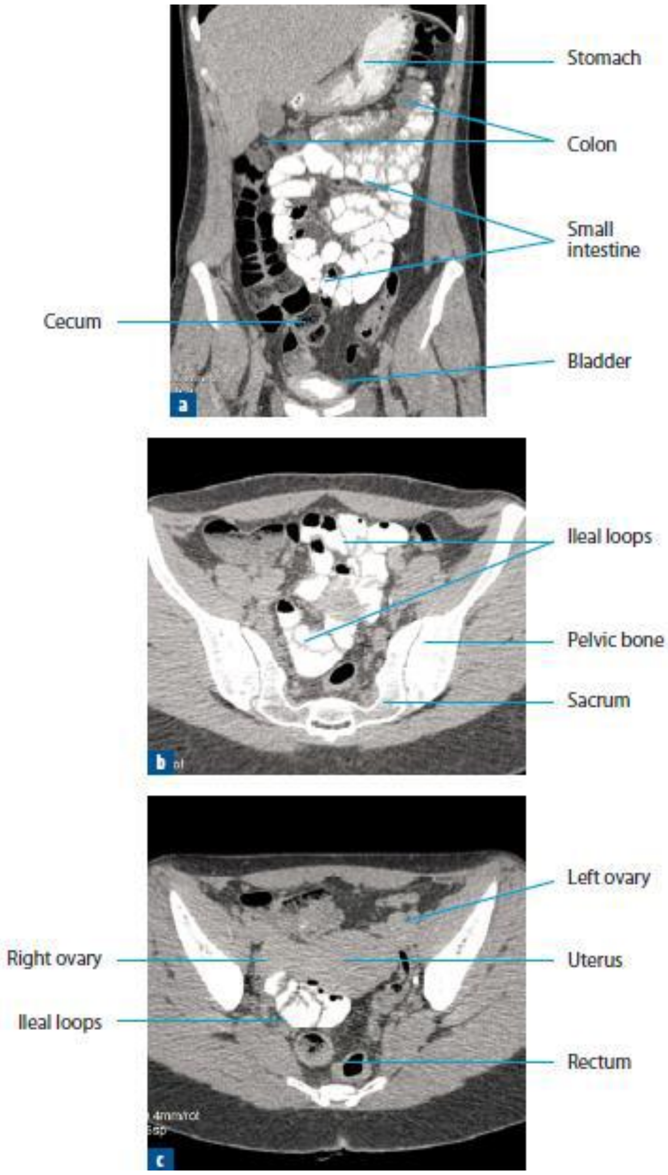

Fig. (10): a. The abdominal coronal view shows the entire small and large intestines. The colon surrounds the small bowel loops, like a picture frame. In this view, all of the gastrointestinal segments can be identified: the stomach and jejunal loops, in the left upper abdominal quadrant; the ileal loops, in the lower abdominal quadrants; and the large intestine, surrounding the small intestine. Small bowel loops are movable and have a characteristic undulating aspect. Symmetric, multiple, adjacent mesenteric recesses result in discrete separation of the ileal loops in the right lower quadrant. b. In the pelvic spaces, the ileal loops occupy all of the peritoneal pouches. c. Axial view of the female pelvis demonstrates the relationships of the ileal loops, ovaries, and uterus ***(Romano et al., 2011).***