INTRODUCTION

Colorectal cancer is the third leading cause of cancer worldwide; it accounts for a large number of tumor related deaths.

As with all types of cancer, early diagnosis of colorectal cancer is the key for its cure. If diagnosed early, before it has metastasized, the disease is considered curable.

If the cancer has already spread to distant organs, the long term survival is much lower ***(Jemal et al., 2008).***

Determining the stage of colorectal cancer often requires multi-modality, multi-step imaging approach. Optical colonoscopy represents the reference standard in terms of cancer detection and tissue sampling. However optical colonoscopy only offers an endo-luminal view. Complete "conventional" staging concepts require additional imaging procedures to assess potential metastatic spread to lymph nodes and solid organs ***(Cohade et al., 2003).***

Of these conventional imaging procedures, contrast enhanced computed tomography (CT) is the most common for both the abdomen and pelvis. However, A limitation of CT and other radiological imaging procedures pertains to their lack of functional data, , as they offer only morphological data for the evaluation of tumor stage, , which may help in determination of lesion size, potential infiltration of adjacent organs or involvement of loco-regional lymph nodes ***(Cohade et al., 2003).***

Glucose analogue [18 F] fluorodeoxyglucose-positron emission tomography (FDG-PET), on the other hand, can display functional information. This functional data have been reported to have an important complementary role in staging primary and recurrent colorectal cancer, detection of distant metastases and local recurrence and the differentiation of tumoral and non-tumoral masses in patients with colorectal cancer ***(Kalff et al., 2007).***

Thus fusion of functional with morphological data may be of benefit for tumor staging. As a consequence, combined "POSITRON EMISSION TOMOGRAPHY – COMPUTED TOMOGRAPHY" [PET/CT] scanner has been introduced into clinical practice. Its ability to detect and characterize malignant lesions, with advantages over morphology and function alone has been documented for different tumors including colorectal cancer ***(Valk et al., 1999).***

Before PET was introduced, it was extremely difficult to monitor for suspected recurrence as other techniques lack sensitivity and precision ***(Kamel et al., 2007).***

Whole body PET/CT imaging is said to be the most accurate diagnostic test for detection of recurrent colorectal cancer, and is a cost effective way to differentiate resectable from non-resectable disease ***(Kantorova et al., 2007).***

AIM OF THE WORK

The aim of this study is to evaluate the role of PET/CT in: diagnosis, staging and monitoring the treatment response of patients with colorectal cancer.

COLORECTAL ANATOMY

The large intestine extends from the end of the ileum to the anus. It is about 1.5 meters long. It differs from the small intestine in its larger caliber, its more fixed position, and in possessing appendages of fats at its external coat (the appendices epiploicae). Further, its longitudinal muscular fibers do not form a continuous layer around the gut, but are arranged in three flattened longitudinal bands (taenia coli) which are about 30 cm shorter than the colon causing the sacculated form. The large intestine is divided into the cecum, colon, rectum, and anal canal***(Gray, 2008).***

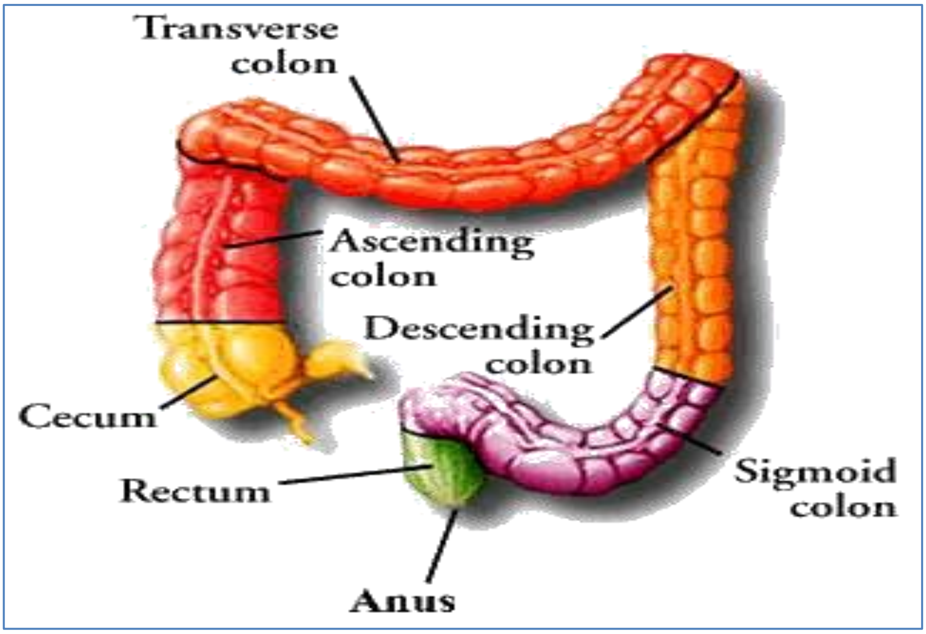

Fig. 1: large intestine *(Quoted from Brewer, 2008).*

I-The Cecum:

It is the proximal blind end (pouch) of the ascending colon. It is attached to the ileum and extends approximately two and one-half inches below it. The cecum in an adult usually is adherent to the posterior wall of the peritoneal cavity and has a serosal covering on its anterior wall only. The cecum forms a blind pouch from which the appendix projects ***(Gray, 2008).***

As in the colon taeniae, haustra and semilunar folds are found in the cecum but no appendices epiploicae.It rests on the iliacus & psoas major muscles, usually in contact with the anterior abdominal wall ***(Gray, 2008).***

II-The colon:

The colon functions as a reservoir moving its contents caudally toward the anal canal. It is divided into four parts: the ascending colon, the transverse colon, the descending colon, and the sigmoid colon ***(Fenoglio et al., 2003)*****.**

a- Ascending colon:

It is approximately six inches long and extends upward from the ileo-cecal valve to the hepatic flexure. The upper portion of the ascending colon lies behind the right lobe of the liver, in front of the anterior surface of the right kidney and lies retro-peritoneally against the right posterior abdominal wall ***(David et al., 2006).***

b- <u>Transverse colon:</u>

It is the longest segment of the large intestine. It is approximately 20 inches long, begins at the hepatic flexure and ends at the splenic flexure. It lies below the stomach and is attached to the transverse mesocolon ***(David et al., 2006).***

It attaches to the stomach by the gastro-colic ligament and contacts the second part of the duodenum, the pancreas, and the spleen. The position of the transverse colon can vary since it is suspended by the mesocolon and it is a very mobile part of the large intestine. The omentum is attached to its anterior surface ***(Fenoglio et al., 2003).***

The left colic or splenic flexure is situated at the junction of the transverse and descending parts of the colon, in relation with the lower end of the spleen and the tail of the pancreas; the flexure is so acute that the end of the transverse colon usually lies in contact with the front of the descending colon. It lies at a higher level than, and on a plane posterior to, the right colic flexure, and is attached to the diaphragm, opposite the tenth and eleventh ribs, by a peritoneal fold, named the phrenico-colic ligament ***(Gray, 2008).***

c- **Descending colon:**

The descending colon extends downward from the splenic flexure to the area just below the iliac crest and is approximately seven inches long. The iliac portion of the sigmoid colon lies on the inner surface of the left iliac muscle ***(David et al., 2006).***

d- **Sigmoid colon:**

The remaining portion of the colon passes over the pelvic rim into the pelvic cavity and lies partly in the abdomen and partly in the pelvis. It then forms an S-curve in the pelvis and terminates in the rectum at the level of the third segment of the sacral vertebrae ***(David et al., 2006)*****.**

The sigmoid colon lies within the peritoneal cavity and possesses a mesentery that is sometimes called the mesosigmoid or sigmoid mesocolon. The sigmoid colon may rest on the urinary bladder or uterus. As it passes through the peritoneal reflection opposite the third sacral vertebra, the sigmoid colon becomes the rectum ***(Fenoglio et al., 2003).***

III-The rectum:

It commences anterior to S3, curves gently downward and anteriorly along the sacro-coccygeal concavity onto the pelvic diaphragm, for a distance of about 12 cm. It abuts the prostate or the vagina inferiorly before turning posteriorly and caudally through the pelvic floor to become the anal canal at the pelvic floor where the puborectal sling encircles it causing its anterior angulation and directing the anal canal posteriorly almost at right-angles to the rectum ***(Ryan et al., 2011).***

The rectum has no sacculations or mesentery. The rectum is surrounded by perirectal fat. Fascia known as perirectal fascia surrounds the perirectal fat, and lateral to the fascia is the pararectal fat ***(Ryan et al., 2011).***

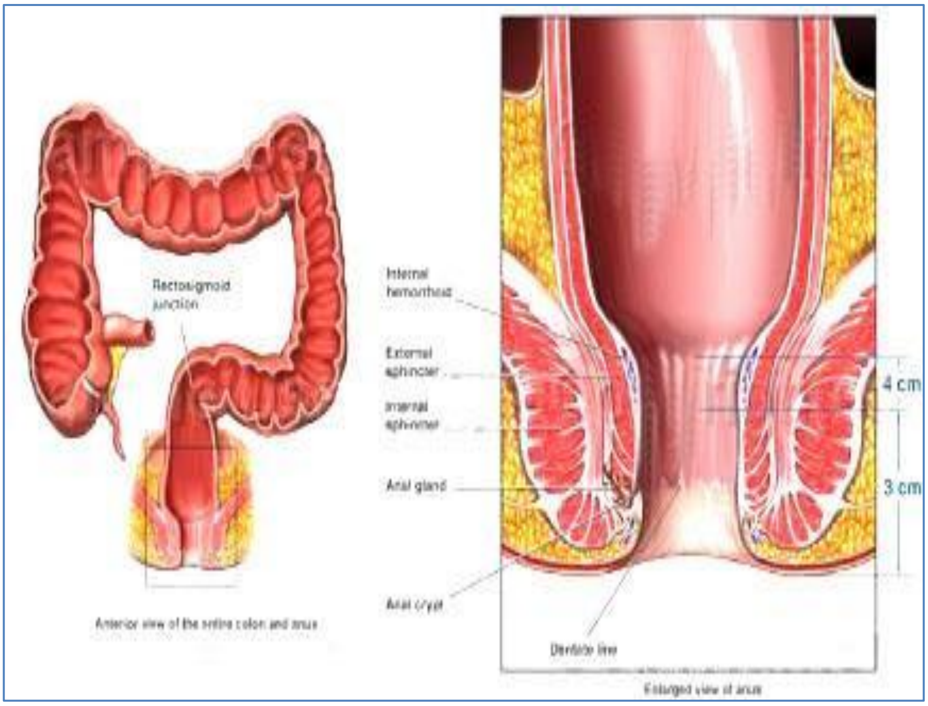

Fig. 2: Anatomy of the anal canal & rectum
(Quoted from Fenoglio et al., 2003).

Peritoneal attachments of the colon:

The coecum is located intraperitoneal but uses the mesentery of the ileum. The ascending and descending parts of the colon are usually retroperitoneal covered anteriorly and on both sides by peritoneum. The transverse colon has a mesentery (the transverse mesocolon) on which it hangs between the hepatic and splenic flexures which are fixed points.The sigmoid colon has a mesentery (the sigmoid mesocolon) attached to the posterior abdominal wall. The rectum is covered by peritoneum on its front and sides at its upperthird, its middle third has peritoneum at its front surface only and its lower third has no peritoneum ***(Ryan et al., 2011).***

Histologic anatomy of the colon:

The wall of the colon is made up of taeniae coli, epiploic appendices, and haustra. The taeniae coli are three longitudinal strips of muscles distributed around the circumference of the colon. The epiploic appendices are fatty appendages along the bowel that have no particular function; the haustra are sacculations that are the outpouchings of bowel wall between the taeniae coli ***(David et al., 2006).***

In general, the gut consists of four concentric layers as one progresses outward from the lumen: the mucosa, submucosa, muscularis propria & serosa ***(David et al., 2006).***

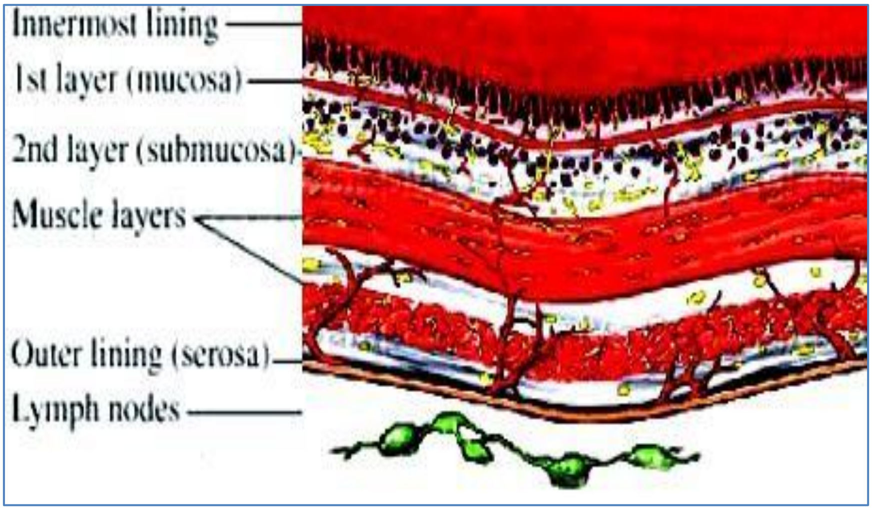

Fig. 3. Colon Layers ***(Quoted from Fenoglio et al., 2003).***

Blood supply of the colon:

I- Arterial supply:

The cecum, ascending colon, and right part of the transverse colon are supplied by the superior mesenteric artery via the ileo-colic, right colic, and middle colic arteries. The left half of the transverse colon, the descending and sigmoid colon, and most of the rectum receive their blood supply from the inferior mesenteric artery through the left colic, sigmoid and superior rectal arteries.

The upper rectum is supplied by the superior rectal branch of the inferior mesenteric artery. Middle rectal arteries arise from the internal iliac vessels and the inferior rectal arteries come from the internal pudendal vessels ***(David et al., 2006).***

Anastomosis exist between the superior and inferior mesenteric arteries. Major branches of the ileo-colic, right colic, left colic, and sigmoid arteries anastomose, forming a series of arches. These joined arches form a single continuous artery referred to as the marginal artery of Drummond***(Fenoglio et al., 2003).***

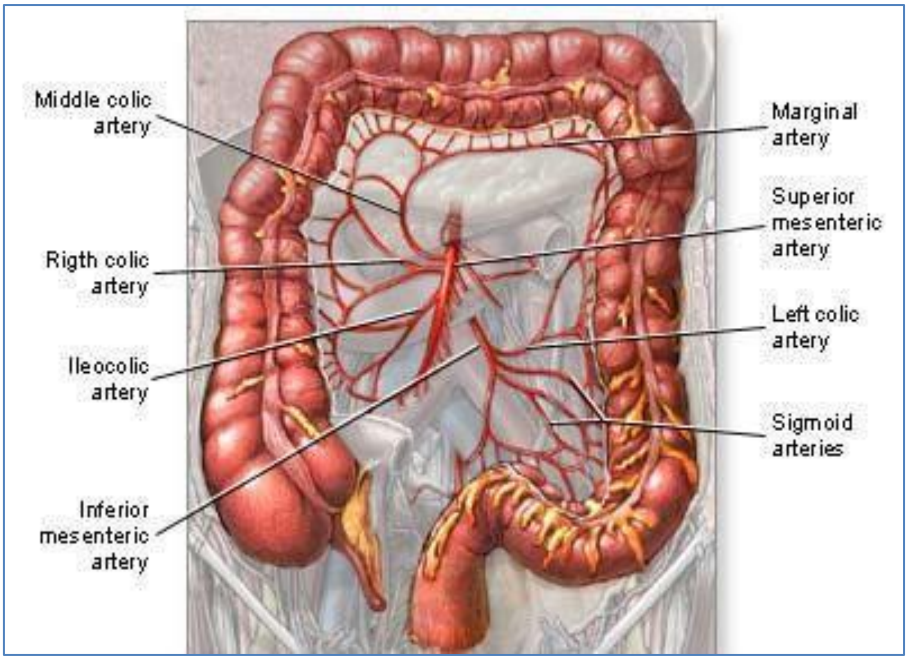

Fig. 4. Blood supply of the large intestine
(Quoted from Fenoglio et al., 2003).

II- Venous drainage:

Veins draining blood from the colon arise from a well-developed submucosal plexus and from a second less well-developed plexus outside the muscularis propria. The main veins correspond to the major arteries and represent tributaries of the portal system.

The venous drainage of the cecum, like the ascending colon and part of the transverse colon, is the superior mesenteric vein. Similarly, the left colon is drained by the inferior mesenteric vein. These veins form part of the portal system with drainage from the gut going directly to the liver.

The proximal part of the rectum is drained by the superior hemorrhoidal vein that flows to the portal system via the inferior mesenteric vein. The middle and distal rectum are drained by the middle and inferior hemorrhoidal veins.

(Fenoglio et al., 2003).

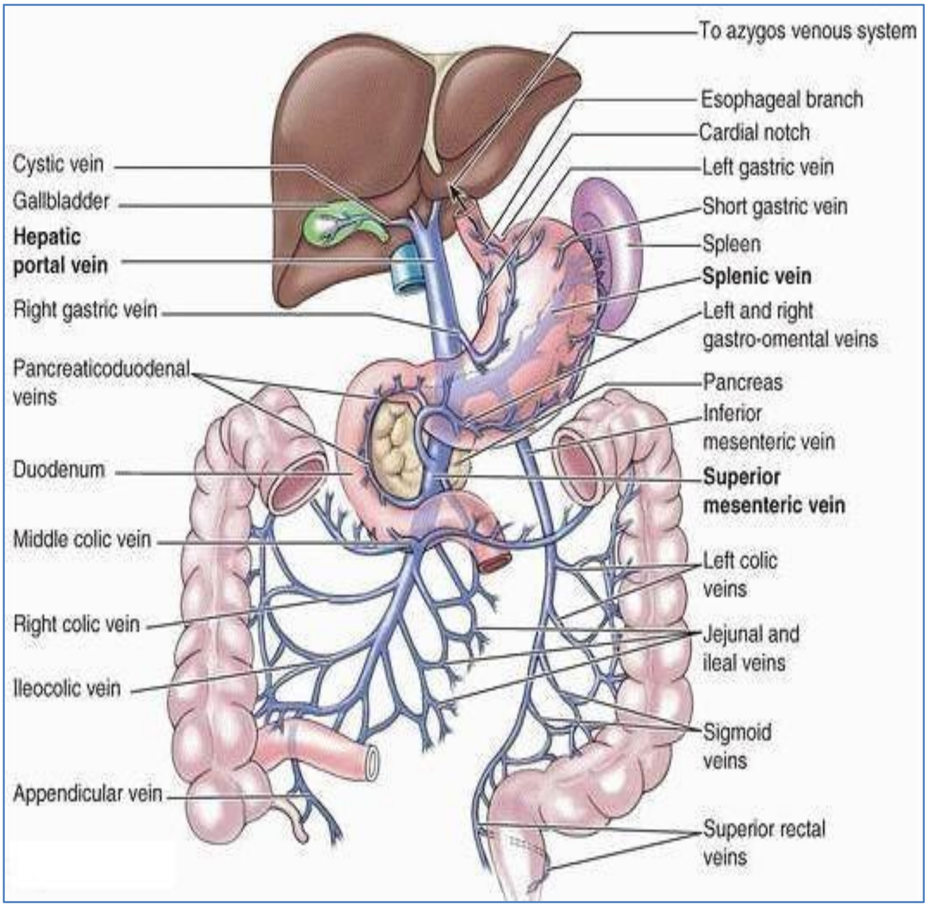

Fig. 5. Venous drainage of the large intestine
(Quoted from Fenoglio et al., 2003).

III-Lymphatic drainage:

The lymphatics begin as a capillary plexus that wraps around the muscularis mucosa. This plexus sends small branches into the mucosa to reach the bases of the crypts of Lieberkuhn. These vessels pass through the submucosa and form another plexus around the muscularis propria ***(Fenoglio et al., 2003).***

The efferent lymphatics from this system form increasingly larger channels, which eventually join lymphatic vessels in the mesocolon. There are generally four groups of external lymphatics: (a) epicolic, which lie on the colon; (b) paracolic, located along the marginal artery; (c) intermediate, located along the main colic vessels and their branches; and (d) principal, located along the superior and inferior mesenteric arteries. They drain to the paraaortic lymph nodes ***(Fenoglio et al., 2003).***

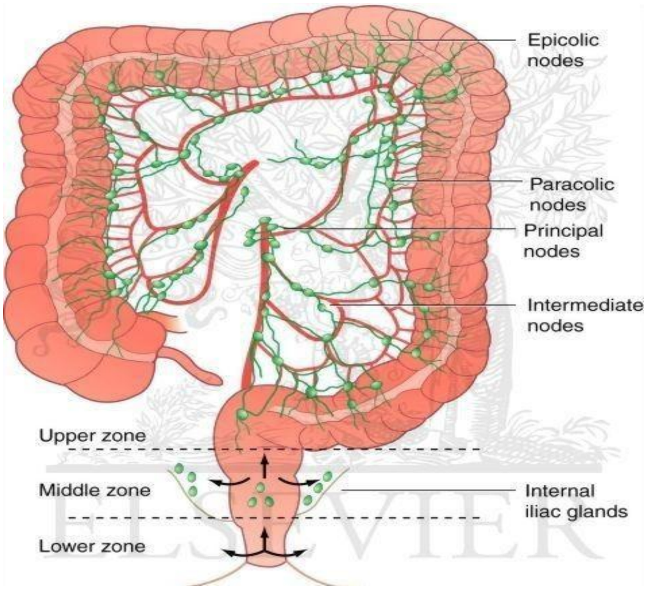

Fig. 6. Lymphatic drainage of the large intestine
(Quoted from Fenoglio et al., 2003).