Introduction

Colorectal cancer is the fourth most common cancer in men and the third most common cancer in women worldwide. The new study, led by American Cancer Society epidemiologist Melissa Center, MPH, found that colorectal cancer incidence rates for both males and females increased for 27 of 51 cancer registries, considered in the analysis between 1983-87 and 1998-2002. The increases were more prominent for men than for women. Some of the increases were dramatic, especially in economically transitioning countries ***(Center et al., 2009).***

The increase in colorectal cancer in economically transitioning countries may reflect the adoption of western lifestyles and behaviors. Many of the established and suspected modifiable risk factors for colorectal cancer including obesity, physical inactivity, smoking, heavy alcohol consumption, a diet high in red or processed meats, and inadequate consumption of fruits and vegetables, are also factors associated with economic development or westernization ***(Center et al., 2009).***

The presence of symptoms and their particular type appear to be of some prognostic importance, Patients who are symptomatic at diagnosis have a somewhat worse prognosis. In one report, the five-year survival rate for symptomatic and asymptomatic patients was 49 versus 71 %. The total number of symptoms may be inversely related to survival for colon, but not for rectal cancer ***(Carraro et al., 2001)***.

Surprisingly, however, the duration of symptoms is not an accurate predictor of prognosis. Obstruction and/or perforation, although uncommon, carry a *poor prognosis*, independent of stage ***(Carraro et al., 2001).***

Tumors presenting with hemorrhage have been thought to have a better prognosis because of their tendency to be diagnosed earlier; however, bleeding is not an independent predictor of outcome ***(Bullard and Rothenberger, 2007).***

Screening for colorectal cancer begins with risk stratification in order to determine the appropriate timing of initiation and follow-up ***(Chang and Morris, 2006).***

Several methods are currently available for the screening. Less-invasive methods, such as stool sample analysis, cause minimal discomfort but some patients consider them a hassle, and the tests need to be performed regularly to be effective. And although these methods occasionally detect precancerous polyps, their primary purpose is detecting early stage cancers.

Colonoscopy and sigmoidoscopy are endoscopic screening methods used both for early cancer detection and for precancerous polyp removal. Although sigmoidoscopy has demonstrated clear benefits in preventing cancers in the lower colorectum, U.S. doctors have increasingly relied on colonoscopy and have made it the most common method of colon cancer screening ***(Myer, 2012)***.

Tumour visualization is traditionally performed using anatomical imaging techniques such as computed tomography (CT), ultrasound (US) and magnetic resonance imaging (MRI). Functional imaging may be of additional value via visualization of metabolism with fluoro-deoxyglucose positron emission tomography (FDG-PET) is a valuable tool for detection of primary and recurrent colorectal cancer. Tumour sites may be detected throughout the body with high contrast resolution. However, exact localization and demarcation of lesions with PET is hindered by its relatively low spatial resolution, and lack of anatomical reference ***(Rutter et al., 2004).***

The goal of colon cancer surgery is complete removal of the tumor along with the major vascular pedicle feeding the affected colonic segment and the lymphatic drainage basin ***(Brand, 2003).***

Although segmental resection alone may be sufficient for primary tumor removal, wider resection is generally needed to achieve a sufficient lymphadenectomy. The blood vessels should be divided at their origin in order to obtain a wide resection and maximize the number of lymph nodes in the specimen ***(Kaiser and Nunoo-mensab, 2007).***

Adjuvant chemotherapy, delivered after surgical resection of the primary tumor, increases cure rates by about 10% for stage III disease and about 3-4% for stage II disease. Encouraging reductions in local relapse rates have been

observed in patients with early rectal cancer who have undergone chemoradiotherapy, and increasingly complex regimens are currently being explored in phase II clinical trials in an attempt to increase both the operability and long-term local control of colorectal cancer. The greater the therapeutic choice, the greater the cost (both financial and in terms of toxicity), thus the keener the clinical community becomes to develop biomarkers to select patient populations who will be most likely to benefit from a specific agent ***(Midgley, 2009).***

Recurrenc following surgery occurs locally and in the lung, and remains a significant problem. In surgical treatment for local recurrence, surgeon-related factors are crucial. A staging system using degree of fixation and other prognostic factors should be developed so that appropriate treatment modalities are applied to each case ***(Yoshihiro Moriya, 2006).***

Aim of the work

This work aims at better understanding of the patho-physiology of colo-rectal carcinoma, as well as the new modalities in the diagnosis and treatment of such condition.

Chapter (1)

Embryology and Anatomy of Colon and Rectum

(I) Embryology of Colon and Rectum:

The embryonic gastrointestinal tract begins developing during the fourth week of gestation. The primitive gut is derived from the endoderm and divided into three segments: foregut, midgut, and hindgut. Both midgut and hindgut contribute to the colon, rectum and anus ***(Bullard and Rothenberge, 2007).***

The midgut develops into the small intestine, ascending colon, and proximal transverse colon, and receives blood supply from the superior mesenteric artery. During the sixth week of gestation, the midgut herniates out of the abdominal cavity, and then rotates 270 degrees counterclockwise around the superior mesenteric artery to return to its final position inside the abdominal cavity during the tenth week of gestation (figure 1) ***(Chang and Feig, 2006).***

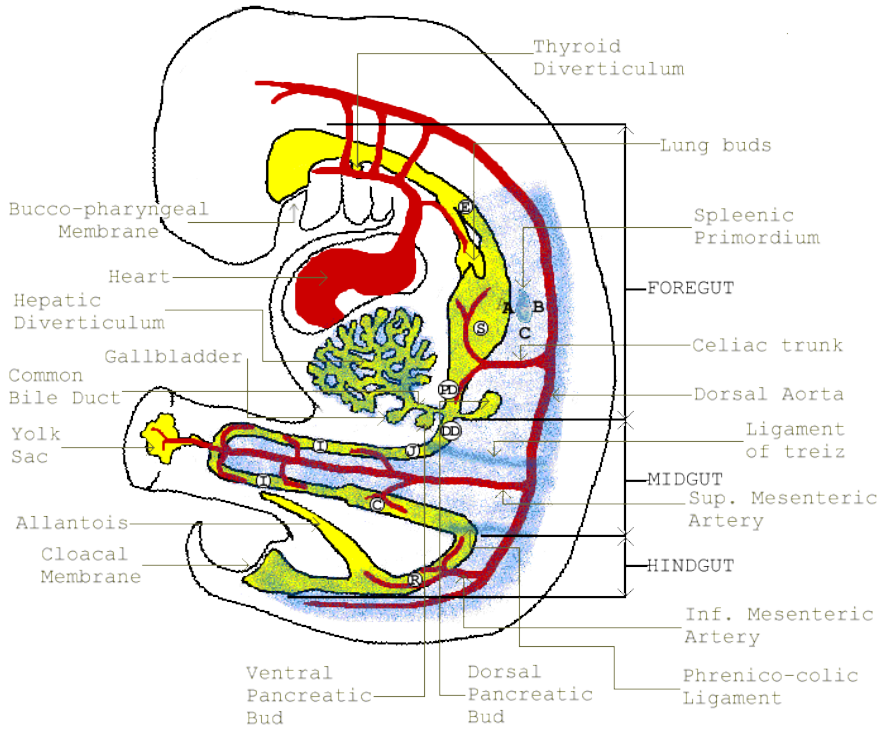

Fig. (1): Primitive gastrointestinal system ***(Hugo, 2004).***

The hindgut endoderm develops into the left 1/4 of the transverse colon, the descending colon, sigmoid colon and the rectum down to the ano-rectal line (the endoderm-ectoderm junction), all of which receive their blood supply from the inferior mesenteric artery. During the sixth week of gestation, the distal-most end of the hindgut, The cloaca divides into a dorsally placed rectum and a ventrally placed urogenital sinus (figure 2) ***(Hugo, 2004)***.

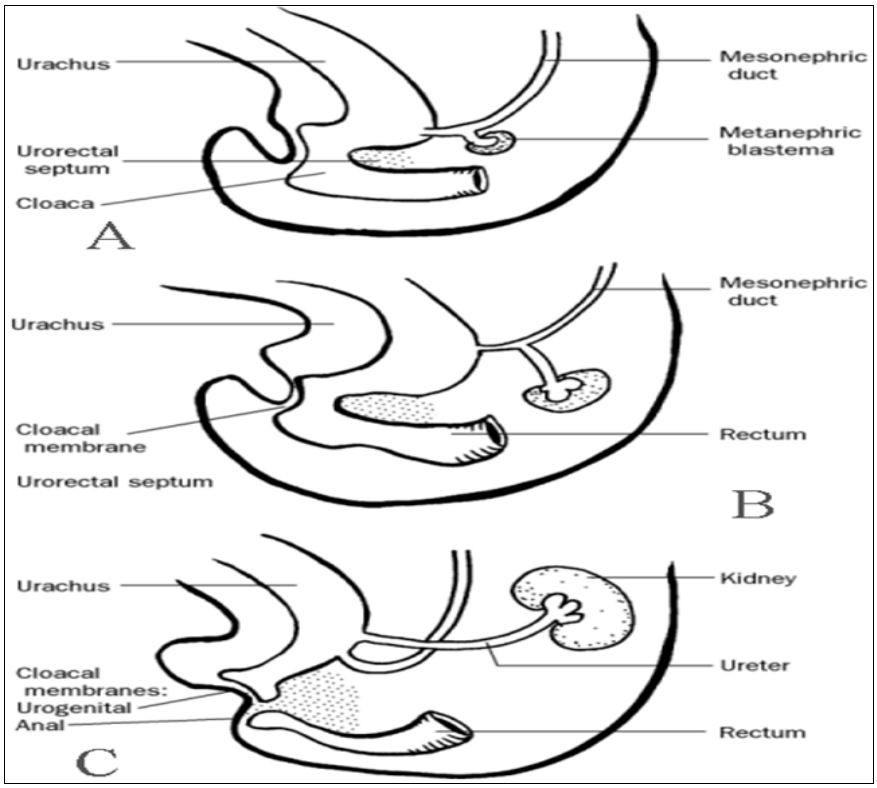

Fig. (2): Partitioning of the common cloaca ***(Bullard and Rothenberger, 2007).***

The distal anal canal is derived from ectoderm and receives its blood supply from the internal pudendal artery. The dentate line divides the endodermal hindgut from the ectodermal distal anal canal ***(Bullard and Rothenberger, 2007).***

(II) Anatomy of the colon, rectum and pelvic floor:

Although much of our fundamental understanding of the anatomy of the colon, rectum, and anus comes from the efforts of researchers of the 19th and early 20th centuries, comprehensive observations of this region had been made as early as 1543 by *Andreas Vesalius* through anatomic dissections. However, anatomy of this region, especially that of the rectum and anal canal, is so intrinsically related to its physiology that much can be appreciated only in the living. Thus, it is a region in which the surgeon has an advantage over the anatomist through in vivo dissection, physiologic investigation, and endoscopic examination. However, anatomy of the pelvis is also challenging to the surgeon: the pelvis is a narrow space, packed with intestinal, urologic, gynecologic, vascular, and neural structures, all confined within a rigid and deep osseous-muscular cage. Therefore, detailed anatomy of this region is difficult to learn in the setting of an operating room and it demands not only observations in vivo, but historical reviews, anatomy laboratory studies, including dissections of humans and animals, with in-depth descriptions and drawings and sometimes associated with physiologic evaluation ***(Yeatman and Bland, 1989).***

The colon extends from the end of the ileum to the rectum. The cecum, ascending colon, hepatic flexure, and proximal transverse colon comprise the right colon. The distal

transverse colon, splenic flexure, descending colon, sigmoid colon, and rectosigmoid comprise the left colon (figure 3) ***(Yeatman and Bland, 1989).***

The ascending and descending portions are fixed in the retroperitoneal space; the transverse colon and sigmoid colon are suspended in the peritoneal cavity by their mesocolons. The caliber of the lumen is greatest at the cecum and diminishes distally ***(George et al., 2003)***.

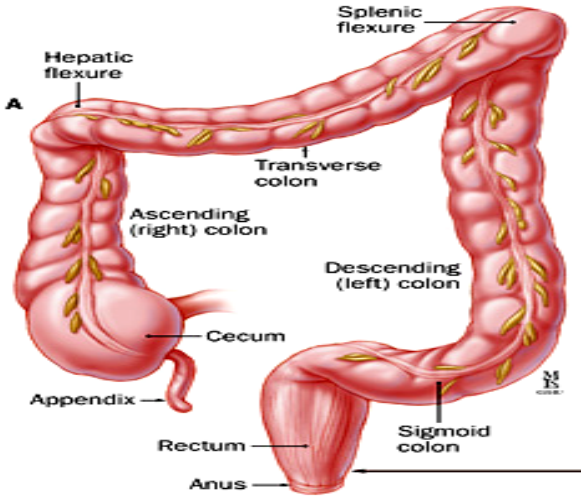

Fig. (3): Anatomy of the colon ***(Yeatman and Bland, 1989).***

The colon and rectum constitute a tube of variable diameter about 150 cm in length. The terminal ileum empties into the cecum through a thickened, nipple-shaped invagination, the *ileocecal valve*. The cecum is a capacious sac-like segment of the proximal colon with an average diameter of 7.5 cm and length of 10 cm. (figure 4) ***(Wolff and Larson, 2007).***

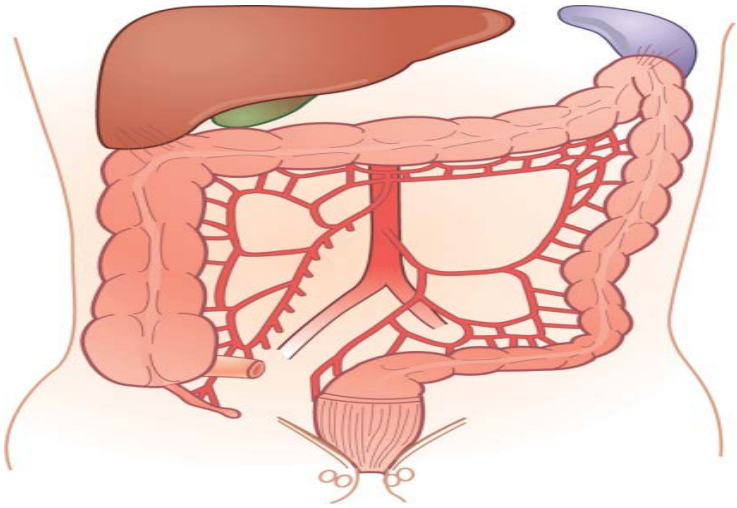

Fig. (4): Anatomy of the colon and rectum: The diameter of the right colon is larger than the diameter of the left side. Note the higher location of the splenic flexure compared with the hepatic flexure ***(Wolff and Larson, 2007).***

1- The cecum and appendix:

The cecum represents the beginning of the large bowel. The ileocecal valve is located in the posteromedial surface of the cecum, and is sustained in place by the superior and inferior ileocecal ligaments, which help maintain the angulation between the ileum and cecum, preventing cecal reflux ***(Moreira and Steven, 2005).*** The appendix extends from the cecum about 3 cm below the ileocecal valve as a blind-ending elongated tube 8 to 10 cm in length ***(Lin and Xiong, 2005)***, due to its mobility, can be in different positions: retrocecal (65%), pelvic (31%), subcecal (2.3%), preileal (1.0%), and postileal (0.4%) ***(Moreira and Steven, 2005).***

2- The ascending colon:

This is the first part of the colon, about 15 cm in length, extends upwards from the ileocecal junction to the right colic (hepatic) flexure. The latter lies on the inferolateral part of the anterior surface of the right kidney, in contact with the inferior surface of the liver ***(Chummy, 2006).*** Like the descending colon, the posterior surface is fixed against the retroperitoneum, whereas the lateral and anterior surfaces are true intraperitoneal structures. The *white line of Toldt* represents the fusion of the mesentery with the posterior peritoneum. This subtle peritoneal landmark serves the surgeon as a guide for mobilizing the colon and mesentery from the retroperitoneum ***(Marcio and Jorg, 2005).***

3- The hepatic flexure:

As the colon ascends, it reaches the under surface of the right lobe of the liver, lateral to the gallbladder, where it angulates acutely medially, downward, and anteriorly. This angle is supported by the nephrocolic ligament ***(Moreira and Steven, 2005).*** The nephrocolic ligament secures the hepatic flexure and directly overlies the right kidney, duodenum, and porta hepatis ***(Paraskeva, 2003).***

4- The transverse colon:

The transverse colon is the longest segment of the colon, very mobile, and enveloped by both layers of the transverse mesocolon attaching the posterosuperior border of the colon to the lower border of pancreas ***(Moreira and Steven, 2005).*** Hanging between fixed positions at the hepatic and splenic flexures, it is completely invested in visceral peritoneum ***(Paraskeva, 2003).***

5- The splenic flexure:

The splenic flexure, the highest and deepest segment of the colon, is attached to the under surface of the diaphragm at the level of the 10th and 11th ribs by the phrenocolic ligament ***(Moreira and Steven, 2005).*** The phrenocolic ligament lies ventral to the spleen and fixes the splenic flexure in the left upper quadrant. The angle of the splenic flexure is higher, more acute, and more deeply situated than that of the hepatic flexure ***(Bullard and Rothenberger, 2007).***

Some attachments of its mesentery to the splenic capsule make traction on the splenic flexure potentially dangerous. At the time of mobilization, the surgeon should take care to avoid inadvertent splenic injury ***(Moreira and Steven, 2005).***

The splenic flexure is typically approached by dissecting the descending colon along the *line of Toldt* from below and then entering the lesser sac by reflecting the omentum from the

transverse colon. This maneuver allows mobilization of the flexure to be achieved with minimal traction required for exposure ***(Bullard and Rothenberger, 2007).***

6- The descending colon:

The descending colon lies ventral to the left kidney and extends downward from the splenic flexure for about 25 cm. It is smaller in diameter than the ascending colon. At the level of the pelvic brim, there is a transition between the relatively thin-walled, fixed, descending colon and the thicker, mobile sigmoid colon ***(Paraskeva, 2003).*** Similar to the ascending colon, the descending colon is covered by peritoneum in the anterior, lateral, and medial surfaces ***(Moreira and Steven, 2005).***

7- The sigmoid colon:

The sigmoid colon varies in length from 15 to 50 cm (average, 38 cm) and is very mobile. It is a small-diameter, muscular tube on a long, floppy mesentery that often forms an omega loop in the pelvis. The mesosigmoid is frequently attached to the left pelvic sidewall, producing a small recess in the mesentery known as the *intersigmoid fossa*. This mesenteric fold is a surgical landmark for the underlying left ureter ***(Paraskeva, 2003).*** The ureter should be seen before any ligation of colonic vessels is attempted ***(Moreira and Steven, 2005).***

❖ Anatomy of the rectum and anal canal:

The rectum, along with the sigmoid colon, serves as a fecal reservoir. The rectum is 12 to 15 cm in length and lacks taeniae coli or appendices epiploicae. It occupies the curve of the sacrum in the true pelvis, and the posterior surface is almost completely extraperitoneal in that it is adherent to presacral soft tissues. The anterior surface of the proximal third of the rectum is covered by visceral peritoneum. The peritoneal reflection is 7 to 9 cm from the anal verge *in men* and 5 to 7.5 cm *in women*. This anterior peritonealized space is called the *pouch of Douglas* or the *pelvic cul-de-sac* and may serve as the site of so-called drop metastases from visceral tumors. These peritoneal metastases can form a mass in the cul-de-sac (called *Bloomer's shelf*) that can be detected by a digital rectal examination (figure 5) ***(Lin and Xiong, 2005).***