شبكة المعلومات الجامعية

التوثيق الإلكتروني والميكروفيلم

بسم الله الرحمن الرحيم

HANAA ALY

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جامعة عين شمس

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قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات

يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار

HANAA ALY

INTRODUCTION

Rectal cancer is defined as cancer occurring in the distal 15 cm of the intestinal tract. It is one of the major causes of cancer-related mortality globally. Colorectal cancer is the third most common cancer in males and the second most common cancer in females ***(Jemal et al., 2007).***

The prognosis of rectal cancer depends on several factors, some of which are traditionally assessed by histo-pathological examination of the surgical specimen. These include the degree of tumor invasion into and beyond the bowel wall, the number of lymph nodes involved by tumor, and involvement of the mesorectal fascia (MRF), which can also be assessed preoperatively by Magnetic resonance imaging (MRI) ***(Brown et al., 2003)***. Other factors with proven prognostic importance include the plasmatic level of carcino- embryonic antigen (CEA) as well as histological factors such as the tumor differentiation grade or the presence of lymphangio-vascular invasion (LVI) ***(Gu et al., 2011).***

The introduction of preoperative, rather than postoperative, adjuvant chemoradiation therapy (CRT) has led to a reduction in local recurrence rates and has become standard of care for patients with locally advanced rectal cancer. In 10–24% of patients, no residual tumor is found at histology after surgery. These complete responders are known to have a very good prognosis, in terms of overall and disease-free survival. A

complete response also raises the hotly debated question of whether surgery is still necessary for these patients or not, especially because total mesorectal excision (TME) may have associated morbidity and even mortality and has the potential risk of a permanent colostomy. Recently, a more conservative treatment is advocated in patients who show a good or complete response to neoadjuvant treatment ***(Doenja et al., 2011).***

At present, the use of diffusion-weighted imaging (DWI) incorporated into a standard MR protocol is gradually increasing because of its proven benefit not only for tumor detection/characterization but also for monitoring treatment response. Diffusion-weighted imaging measures water diffusion characteristics, which are dependent on multiple factors such as cell density, vascularity, viscosity of extracellular fluid, and cell membrane integrity. By quantifying these properties and expressing them as an apparent diffusion coefficient (ADC), DWI could potentially be used as an imaging biomarker to better select patients with poor prognosis who will truly benefit from a more aggressive neoadjuvant treatment. The pretreatment tumor ADC values may reflect the tumor profile of aggressiveness ***(Curvo et al., 2012).***

Additionally, some reports mentioned that ADC can predict therapy success in rectal cancer. There is increase in the mean tumor ADC during the course of neoadjuvant chemoradiation. Moreover, a strong negative correlation

between the mean pre-treatment tumor ADC and tumor regression after neoadjuvant chemoradiation was found. Therefore, ADC can help predict or assess the response of rectal cancer to neoadjuvant chemoradiation at an early time point ***(Surov et al., 2017).***

AIM OF THE WORK

The purpose of this study is to determine the role of different parameters of DWI-MRI in the pretreatment prediction and early response monitoring to neoadjuvant treatment in rectal cancer.

Chapter 1

ANATOMY

The rectum is the part of the gastrointestinal tract extending from the upper end of the anal canal to the rectosigmoid junction ***(Iafrate et al., 2006).***

Both proximal and distal limits of the rectum are controversial: the rectosigmoid junction is considered to be at the level of the third sacral vertebra by anatomists but at the sacral promontory by surgeons, and likewise, the distal limit is regarded to be the muscular anorectal ring by surgeons and the dentate line by anatomists **(*Figure 1) (Herold et al., 2008).***

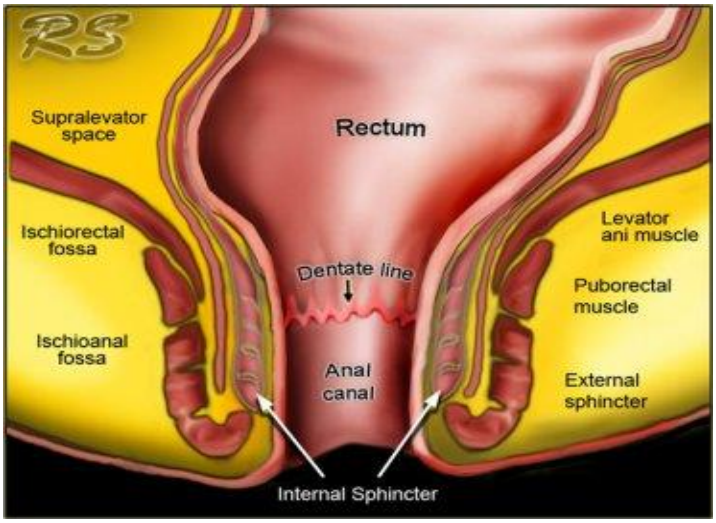

Figure (1): Anatomy of the rectum & anal canal ***(Tonino and Smithuis., 2010).***

Recognition of the lower limits of the rectum is important because determining the distance between a

neoplastic lesion and the levator ani muscle is vital to surgical planning. The lower end of the rectum is characterized by the insertion of the levator ani muscle onto the rectal muscular layer. The rectum forms an acute anorectal angle with the anal canal as it is pulled forwards by the sling formed by the puborectalis muscle forming a U –shaped sling ***(Laghi et al., 2002).***

The rectum has three lateral curves: the upper and lower are convex to the right and the middle is convex to the left. These curves correspond intraluminally to the folds or valves of Houston. The two left-sided folds are usually noted at 7–8 cm and at 12–13 cm, respectively, and the one on the right is generally at 9–11 cm. The middle valve is the most consistent in presence and location and corresponds to the level of the anterior peritoneal reflection, they can vary in number or even be absent ***(Beck and Roberts, 2009).***

The rectum is characterized by its wide, easily distensible lumen, and the absence of taenia, epiploic appendices, haustra, or a well-defined mesentery ***(Beck and Roberts, 2009).***

Mesorectum & Mesorectal Fascia:

The mesorectal fascia, or visceral layer of the endopelvic fascia, encircles the rectum and the mesorectal fat, nodes, and lymphatic vessels to form a distinct anatomic unit. The

mesorectal fascia runs along the anterior aspect of the sacrum, where it fuses with the presacral fascia, and then laterally on either side of the rectum, where it is easily identified on axial T2-weighted images as a thin hypointense line. Anteriorly in males, it forms a dense band of connective tissue posterior to the seminal vesicle and prostate gland called the Denonvilliers' fascia ***(Figure 2) (Kaur et al., 2012).***

Denonvilliers' fascia covers the dorsal aspect of the prostate and seminal vesicles in men ***(Lindsey et al., 2004).***

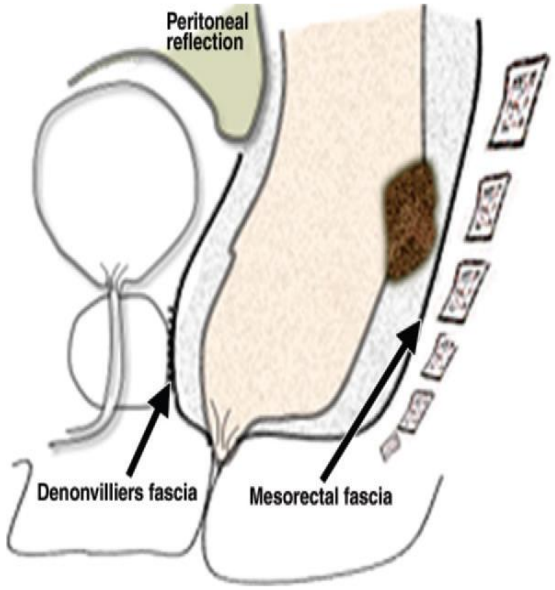

Figure (2): Drawing of the pelvis (sagittal view) shows a tumor (brown) arising from the rectum (tan) and invading the mesorectal fat (gray). The mesorectal fascia runs along the anterior aspect of the sacrum. The presacral fascia is not defined as a separate layer, since it is frequently indistinguishable from the mesorectal fascia at imaging. Anteriorly in males, the mesorectal fascia forms the Denonvilliers fascia and superiorly fuses with the peritoneal reflection ***(Kaur et al., 2012).***

Peritoneal Coverings

The rectum has a serosal lining only above the peritoneal reflection, which is along the anterior and lateral surfaces in the upper-third and the anterior surface in the middle-third ***(Figure 3) (Arya et al., 2015).***

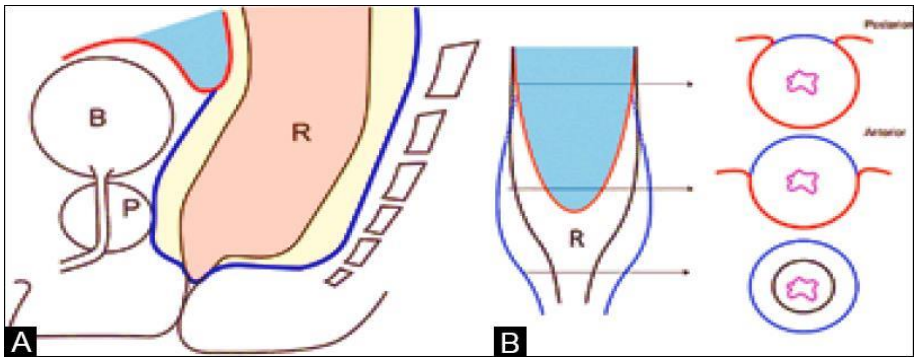

Figure (3): (A and B): (A) Sagittal and (B) coronal diagrams show rectum (R), mesorectal fat (yellow), mesorectal fascia (MRF) in blue, anterior peritoneal reflection (red), bladder (B), prostate (P). (b) Cross section at upper, mid, and low rectum shows peritoneal reflection (red) and MRF (blue) ***(Arya et al., 2015).***

Anal Canal:

The surgical anal canal extends about 3-4 cm, being shorter in women (2-3 cm), and ends at the anorectal ring or at the upper portion of the puborectalis muscle. The puborectalis muscle is the thicker portion of the pelvic floor musculature, and is less prominent in women than in men ***(Salerno et al., 2006).***

The inner muscular wall of the anal canal consists of the internal sphincter, which is the direct continuation of the circular layer of the muscularis propria of the rectum. The outer

muscular wall of the anal canal is cranially composed of the puborectal muscle and caudally of the external sphincter ***(Salerno et al., 2006).***

Arterial Supply of the Rectum (Figure 4 A):

- **The superior rectal artery:** Terminal branch from the inferior mesenteric artery. Contributing more than 80% to the rectal blood supply ***(Herold et al., 2008).***

- **The middle rectal artery:** Arises from the internal iliac artery. They are inconstant and bilaterally present in only 10 % ***(Herold et al., 2008).***

- **The inferior rectal artery:** Arises from the internal pudendal artery ***(Herold et al., 2008 and Skandalakis et al., 2009).***

Venous Drainage of the Rectum (Figure 4 B):

- **The superior rectal veins:** which enter the inferior mesenteric veins (IMV) and drain into the portal system ***(Skandalakis et al., 2009).***

- **The middle rectal veins and Inferior rectal veins:** both enter the internal iliac vein and thus drain into the systemic circulation ***(Skandalakis et al., 2009).***

This helps explain the two distinct hematogenous metastatic patterns of rectal cancer. In the absence of liver

metastases, rectal cancer can manifest with lung metastases when a distal tumor is drained by the systemic venous system and the inferior vena cava to the pulmonary capillary bed. However, liver metastases are more commonly formed by way of the IMV and portal venous system or by means of endolymphatic spread along the course of the IMV, which is the usual pathway for the rest of the gastrointestinal tract ***(Alvin et al., 2006).***

Lymphatic Drainage of the Rectum (Figure 5):

Similar to the blood supply, the main lymphatic drainage of the rectum is achieved by intramural lymphatic vessels passing initially to mesorectal lymph nodes, which shows:

- Upward spread along the ascending branch of the inferior mesenteric vein to inferior mesenteric lymph nodes.
- Lateral lymphatic drainage along the middle rectal artery into the internal iliac lymph nodes.
- Low rectum and anal canal shows downward spread to the perineum and inguinal lymph nodes ***(Herold et al., 2008).***

Pelvic tumors usually metastasize first to regional lymph nodes, which are specific groups of nodes for each tumor, and are classified as N-stage disease. If tumor spreads to a lymph node outside the defined regional nodes, this is considered M-stage disease. Para-aortic nodes and Inguinal nodes are non-regional, and spread to these nodes constitutes M1 (stage IV) disease ***(McMahon et al., 2010).***

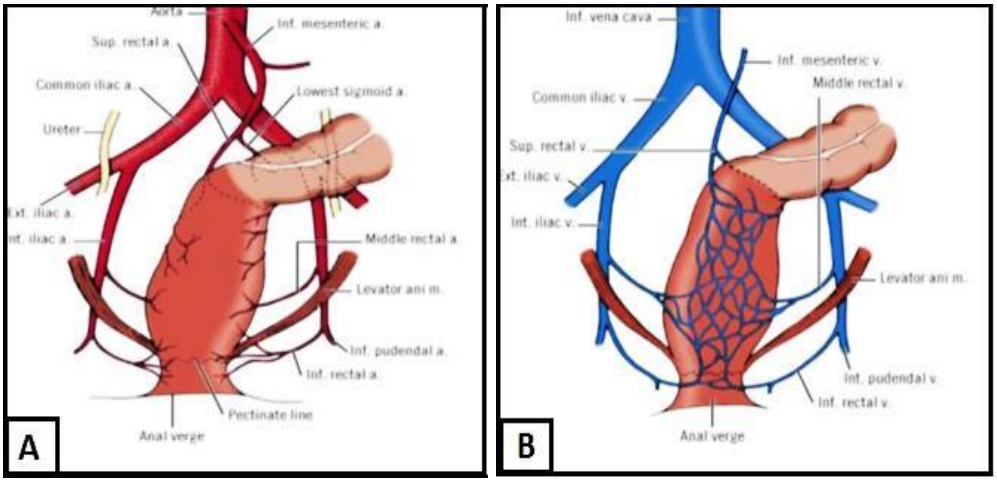

Figure (4): Arterial supply **(A)** & venous drainage **(B)** of the rectum ***(Skandalakis et al., 1983).***

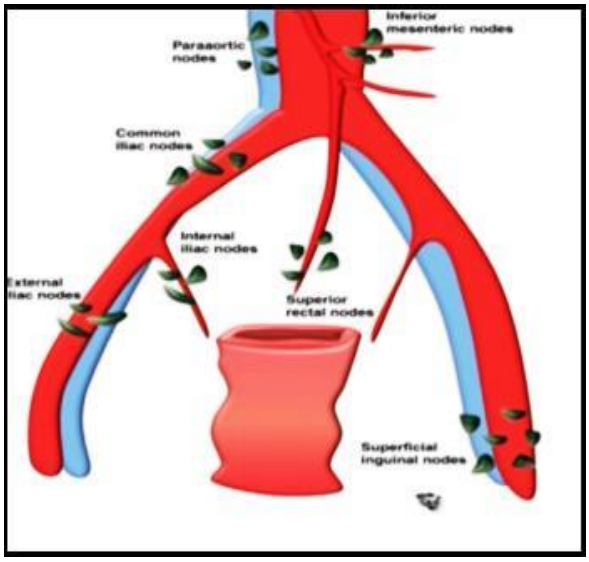

Figure (5): Drawing illustrates the most common nodal pathways of tumor spread in rectal cancer. The most common pathway of nodal spread from all primary rectal tumors is to mesorectal nodes, followed by spread to superior rectal and inferior mesenteric nodes. Midrectal tumors also spread through lymphatic vessels along the midrectal vessels to internal iliac nodes, whereas low rectal tumors may also involve superficial inguinal nodes ***(Libutti et al., 2011).***

Nerve Supply of the Rectum:

The rectum and upper anal canal are supplied by autonomic nerves, the autonomic nerves are at risk during rectal resection, and the lower anal canal and the anus receive a somatic input via the pudendal nerves ***(Herold et al., 2008).***

MRI Anatomy

The rectum is the terminal part of the alimentary tract, located from the anal verge to 15 cm above, nestling along the sacral curve. It is divided into three parts based on distance from anal verge into low rectum (0-5 cm), mid-rectum (5-10 cm), and upper rectum (10-15 cm) as shown in ***Figure (6A)***. The rectosigmoid junction has a variable location from sacral promontory to S3 level ***(Figure 6 A) (Arya et al., 2015).***

On axial sections, it can be identified at the point where the rectum leaves the sacral curve to extend anteriorly to the sigmoid colon ***(Figure 6 B)***. Three layers of the rectum are visible on a phased array external MRI. The innermost mucosa is thin and hypointense, the middle submucosa is hyperintense, and the outer muscularis propria is darkly hypointense ***(Figure 6 C) (Arya et al., 2015).***