Role of MRI in rectal cancer staging

Thesis

Submitted for partial fulfillment of Master degree in

Radio-diagnosis

Presented

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2016

الرنين المغناطيسي في تشخيص مراحل سرطان المستقيم

رسالة

مقدمة توطئة للحصول على درجة الماجستير في الأشعة التشخيصية

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Abstract

Rectal cancer is a common malignancy. Success of tumor excision depends on accurate staging& appropriate surgical technique. Phased-array surface coil magnetic resonance imaging is used to determine which patients can be treated with surgery alone and which will require

neoadjuvant therapy& proved useful in the relationship between tumor and the mesorectal fascia (the circumferential resection margin) at total mesorectal excision.

keyword:FDG-PET/CT-CRC-PET/CT

Introduction

Colorectal cancer is the third most common cancer worldwide. Around 30-40% of colorectal cancers are located in the rectum, accounting for 5% of malignant tumors, and ranking as the fifth most common cancer **(Jemal et al., 2014)**.

Rectal cancer is defined as a tumor whose distal margin measured with the rigid rectoscope is 16 cm or less from the anocutaneous line. The prognosis of rectal cancer is influenced by several factors, such as local tumor extent, involved lymph nodes and the presence of distant metastases **(Harmeet et al., 2012).**

Endorectal ultrasound (EUS) is the preferred imaging technique for the evaluation of superficial (confined to the rectal wall) rectal tumors when local excision is considered .The close position of the image probe to the rectal wall provides detailed anatomical information of the individual rectal wall layers but the image quality is insufficient for deeper pelvic structures because of signal drop off. Combined with the high interobserver disagreement of this technique, it is not suitable for the evaluation of more advanced rectal cancer and its relationship to clinical important structures like the mesorectal fascia and pelvic organs **(Cascani et al., 2015).**

For years, comuted Tomography (CT) could not compete with the equisite anatomical detail provided by MRI and therefore it played a non-important role in the local tumor staging of rectal cancer **(Capirci et al., 2014).**

Recently, improvements of the image quality of CT have been achieved by the invention of Multi-Detector row techniques. The main

advantage of Multi-Detector row CT (MDCT) is the capability to perform a quick one. The local staging capabilities of MDCT have been addressed in high accuracies (86-95%) for the prediction of T stage which is encouraging but rather irrelevant for daily practice. MDCT is as good as MRI for predicting the tumor relationship to the clinical important mesorectal fascia **(Cascani et al., 2014).**

Most important, the depth of invasion outside the muscularis propria can be assessed with a high degree of accuracy .In addition, high-resolution T2-weighted images allow the morphologic assessment of pelvic nodes, thereby improving accuracy in the characterization of nodes as benign or malignant, since size criteria have proved to be of limited value **(Harmeet et al., 2012)**.

The prognosis of rectal cancer is influenced by several factors, such as local tumor extent, involved lymph nodes, and the presence of distant metastases. Among these, the presence and extent of extramural tumor spread influence both long-term survival and the risk of local recurrence. With the more widespread acceptance of neoadjuvant concepts, there is an increasing need for preoperative imaging methods to aid adequate management because treatment strategies need to be individualized according to the depth of tumor invasion and the status of the regional lymph nodes, while previously patients were considered for surgery without undergoing preoperative cross-sectional pelvic imaging. Accurate preoperative assessment is an important first step in assigning patients to one of the available treatment strategies **(Jemal et al., 2005).**

Currently, surgical resection with stage-appropriate neoadjuvant combined-modality therapy is the mainstay in the treatment of rectal

cancer. In the past decade, the increasingly widespread adoption of total mesorectal excision (TME) has resulted in a dramatic decline in the prevalence of local recurrence from 38% to less than 10% **(Mulla et al., 2010).**

Aim of the Work

To assess the role of MRI as a non-invasive diagnostic tool in local staging (T and N stages) of rectal carcinoma.

Chapter (1)

Anatomy of Rectum and Perirectal Region

Rectum:

The rectum extends approximately 12-16 cm from the anocutaneous line that is identified by physical examination as well as with a proctoscope/sigmoidoscope. The sagittal plane offers the best view of the anocutaneous line that is recognized as the inferior margin of the sphincter complex **(Torkzad et al., 2010)**.

The rectum is divided into 3 arbitrary parts of 5 cm each. Based on this, rectal tumors are also divided as low (0-5 cm from line), middle (5-10 cm), or high (10-15 cm) **(Klessen et al., 2010)**.

The rectum has 3 lateral curves/flexures; the upper and lower curves deviate to the right and the middle to the left. The location where the rectum becomes covered by the peritoneum is considered the rectosigmoid junction **(Torkzad et al., 2010)**.

Typically, the rectosigmoid junction is at the S3 level. It is important to understand the rectal peritoneal reflection as it has implications in staging. Normally, the upper third of the rectum is intraperitoneal, the middle third has peritoneum on the anterior aspect, and the lower third is extraperitoneal. On a highresolution MRI image (usually a coronal or sagittal), it is possible to see this reflection. Midrectal tumors that infiltrate this structure are categorized as T4a disease.

Internally, the rectal mucosa becomes smooth as it transitions from the rugose mucosa of the sigmoid colon. There are 3 transverse folds called the superior, middle, and inferior rectal valves of Houston corresponding to the 3 lateral curves. It is important to know that these folds consist of mucosa and submucosa only. Hence, full thickness involvement of a fold is a T2 lesion unless the lesion infiltrates the base of the fold **(Torkzad et al., 2010)**.

The rectal wall consists of the mucosa, submucosa, and muscularis propria. The mucosa consists of epithelium, connective tissue, and a thin muscle layer called the

muscularis mucosa. The submucosa is composed of fibrous tissue. The muscularis propria is made up of 2 layers of nonstriated muscle. It should be noted that the thin, outermost layers of connective tissue (subserosa and serosa) that cover most of the colon are lacking in the rectum. The mucosa (presumably due to the small muscle layer) and muscularis propria are hypointense on T2-weighted MRI, whereas the submucosa is hyperintense **(Klessen et al., 2010)**.

Perirectal Region:

The mesorectal fascia (MRF) is an important landmark that surrounds the extraperitoneal portion of the rectum and contains the mesorectal fat. It is bordered by Waldeyer's fascia posteriorly and anteriorly by Denonvilliers' fascia in men, which is the equivalent of the rectovaginal septum in women. Denonvilliers' fascia fuses superiorly with the peritoneal reflection. Inferiorly, the MRF fuses with the internal sphincter **(Kaur et al., 2012)**. The MRF appears as a thin hypointense line on T2weighted images (Fig 1). Identification of the tumor as it relates to

these distinct anatomical landmarks is what allows the radiologist to provide accurate staging.

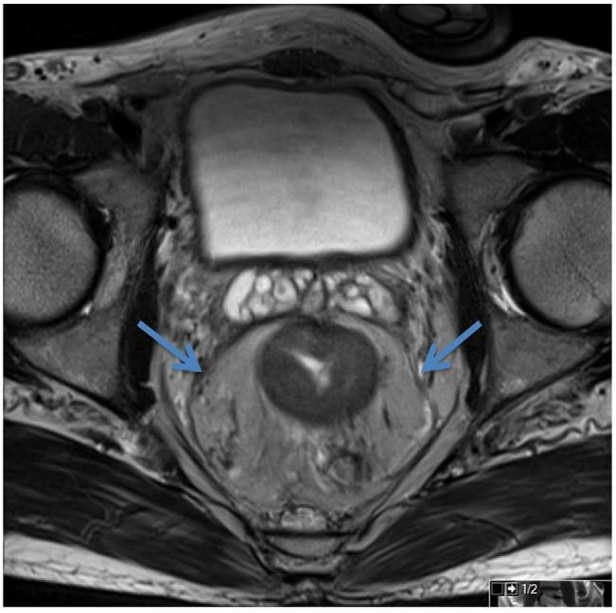

Figure 1. Axial T2-weighted image demonstrates normal appearance of the mesorectal fascia (arrows). **(Kaur H, et al., 2012)**.

Relations of the Rectum:

Posterior to the rectum and mesorectum, and separated from them by the presacral fascia in the median plane are the lower three sacral vertebrae, coccyx, median sacral vessels, and the lowest portion of the sacral sympathetic chain **(Elaine and Patricia, 2013)**.

Anteriorly: In the male, the upper two thirds of the rectum, which is covered by peritoneum, is related to the sigmoid colon and coils of ileum that occupy the rectovesical pouch. The lower third of the rectum, which is devoid of peritoneum, is related to the posterior surface of the bladder, to the termination of the vas deferens and the seminalvesicles on each side, and to the prostate. These structures are embedded in visceral pelvic fascia (Figure 2) **(Jamie Weir and Peter H. Abrahams, 2010).**

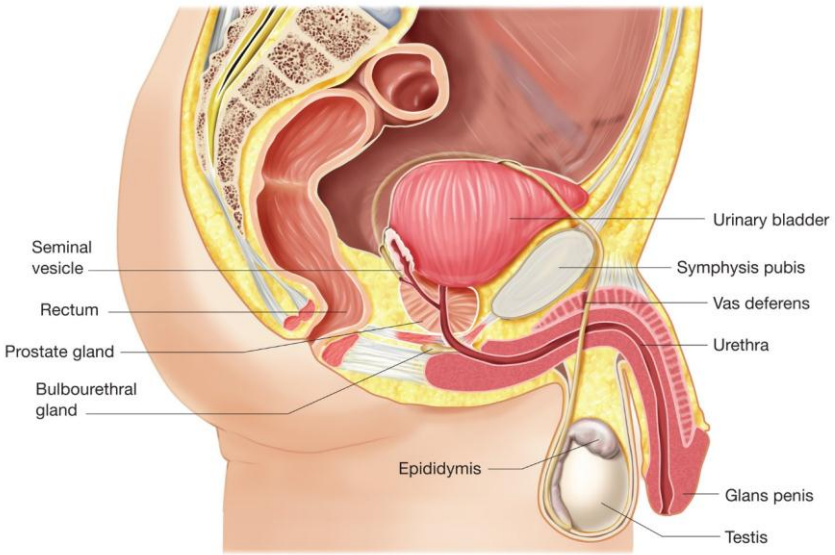

Figure 2. Sagittal section of the male pelvis **(Jamie Weir and Peter H. Abrahams, 2010).**

In the female, the upper two thirds of the rectum, which is covered by peritoneum, is related to the sigmoid colon and coils of ileum that occupy the recto uterine pouch (pouch of Douglas). The lower third of the rectum, which is devoid of peritoneum is related to the posterior surface of the vagina (Figure 3) **(Jamie Weir and Peter H. Abrahams, 2010)**.

Laterally, the upper part of the rectum is related to the pararectal fossa and its contents (sigmoid colon or terminal ileum), while below the peritoneal reflection lie piriformis, the anterior rami of the lower three sacral andcoccygealnerves, sympathetic trunk, lower lateral sacral vessels, the coccygeal and levatores ani muscles **(Jamie Weir and Peter H. Abrahams, 2010)**.

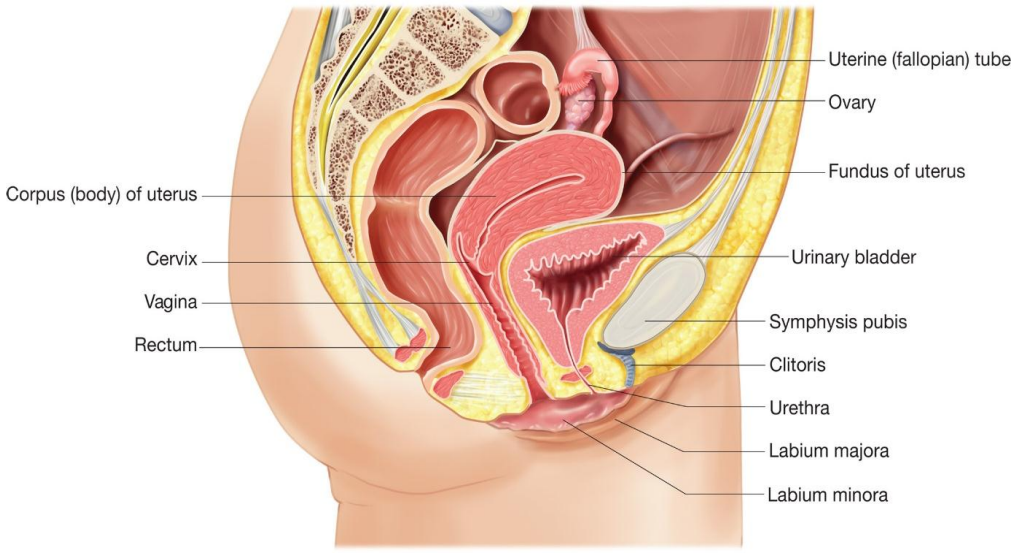

Figure 3: Sagittal section of the female pelvis **(Jamie Weir and Peter H. Abrahams, 2010).**

Arterial supply:

The terminal branch of the inferior mesenteric artery becomes the superior rectal artery as it crosses the left common iliac artery. It descends in the sigmoid mesocolon and bifurcates at the level of the third sacral body. The left and right branches of the superior rectal artery supply the upper and middle rectum. The middle and inferior rectal arteries supply the lower of the rectum.

The middle rectal arteries arise from the internal iliac arteries, run through Denonvilliers' fascia, and enter the anterolateral aspect of the rectal wall at the level anorectal ring. The inferior rectal arteries are branches of the internal pudendal arteries. They traverse Alcock's canal and enter the poterolateral aspect of the ischiorectal fossa. The middle sacral artery arises just proximal to the aortic bifurcation and provides very little blood supply to the rectum **(Stephanie and Michelle, 2010)**.

Veinous drainage:

Veins correspond to the arteries, but anastomose freely with one another, forming an internal rectal plexus in the submucosa and an external rectal plexus outside the muscular wall. The lower end of the internal Plexus is continuous with the vascular cushions of the anal canal. The middle rectal vein may be very small and insignificant; the superior and inferior rectal veins are the main veins and closely follow their arteries so that drainage is to both the portal and systemic systems **(Elaine et al., 2013).**