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Original article

IMPORTANCE OF EXTRAMURAL VASCULAR INVASION IN PREOPERATIVE STAGING OF RECTAL CANCER WITH MRI

ЗНАЧЕЊЕТО НА ЕКСТРАМУРАЛНАТА ВАСКУЛАРНА ИНВАЗИЈА ВО ПРЕДОПЕРАТИВНИОТ СТЕЈДИНГ НА РЕКТАЛЕН КАРЦИНОМ СО МАГНЕТНА РЕЗОНАНСА

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Abstract

Introduction. Rectal cancer is the third most common malignant disease worldwide with a high mortality rate in developed countries. The prognosis of rectal cancer has been significantly improved over the past decade, and this is mainly due to progress in preoperative staging, which has been reflected in the therapeutic approach, where a significant change was made from simple surgical treatment to multimodal treatment. Although extramural vascular invasion (EMVI) is not included in the classical protocol for preoperative staging, it is a significant prognostic indicator of the recurrence rate.

Methods. The study is a prospective one, and it included 61 hospital patients with previously proven rectal cancer, who had been operated on at the Department of Abdominal Surgery of the University Clinic for Surgical Diseases "St. Naum Ohridski" in Skopje, and who underwent a magnetic resonance staging preoperatively.

Results. Comparison of extramural vascular invasion determined with MR preoperatively with pathohistological postoperatively obtained result.

Conclusion. MR as an ideal imaging method in preoperative staging of rectal carcinoma. It is a tool that determines with high accuracy the extramural vascular invasion in patients with rectal cancer.

Keywords: rectal cancer, magnetic resonance, preoperative staging, extramural vascular invasion

Абстракт

Вовед. Ректалниот карцином е трета по честота малигна болест ширум светот со висока стапка на морталитет во развиените земји. Прогнозата на ректален карцином е значајно подобрена во измината-

ва декада, и ова е главно благодарјеќи на напредокот во предоперативниот стејдинг, што рефлектираше во терапискиот пристап, каде што значајна промена е направена од едноставен хируршки третман до мултимодалити третман. Иако не спаќа во класичниот протокол за предоперативен стејдинг-екстрамуралната васкуларна инвазија (ЕМВИ) е значаен прогностички показател за стапката на рецидивирање.

Методи. Студијата е проспективна, и вклучува 61 болнички пациенти со претходно докажан ректален карцином, кои се оперирани на Абдоминална Хирургија при УК по хируршки болести Св.Наум Охридски-Скопје, и кај кои предоперативно е направен стејдинг со магнетна резонанса.

Резултати. Компарација на Екстра муралната васкуларна инвазија одредена со МР предоперативно со патохистолошки постоперативно добиениот резултат.

Заклучок. МР како идеална имиџинг метода во предоперативен стејдинг на ректален карцином. Алатка која со висока точност ја одредува Екстра муралната васкуларна инвазија кај пациенти со ректален карцином.

Клучни зборови: ректален карцином, магнетна резонанса, предоперативен стејдинг, екстра мурална васкуларна инвазија

Introduction

Rectal cancer is the third most common malignant disease worldwide with a high mortality rate in developed countries. The prognosis of rectal cancer has been significantly improved over the past decade, and this is mainly due to the progress in preoperative staging, which reflected in the therapeutic approach, where a significant change was made from simple surgical treatment to multimodal treatment [1]. This reduced the local recurrence rate by 11% and increased the 5-year survival rate by 58% [1,2].

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About 50% of colorectal cancer is localized in the rectum. Rectal cancer is defined as a tumor whose upper margin is measured with a rigid rectoscopy at 16cm or less of the anocutaneous line. The highest percentage of rectal cancer belongs to adenocarcinoma (98%). The remaining rectal tumors are relatively less common, carcinoid (0.1%), lymphomas around 1% and gastrointestinal stromal tumors (GIST) less than 1% [2].

Mesorectal fascia is a significant anatomic indicator for the diagnostic evaluation of the local tumor spread. Fascia is a connective tissue that surrounds the rectum and mesorectal fat, including lymph nodules and lymph vessels to the pelvic floor, and is actually a natural barrier to tumor spread [3,4].

Surgical treatment of rectal cancer is a challenge to achieve a balance between minimizing the risk of local recurrence and preserving the anorectal and genitourinary function. Total mesorectal excision (TME) is the removal of the tumor, rectum and surrounding mesorectal fat [4-6]. Today, TME is a surgical choice for treatment of rectal cancer. The introduction of this surgical technique has reduced the rate of mortality from rectal cancer from 16% to 9%.

TME involves resection of the tumor margins. TME is a mesorectal compartment that includes the rectum, surrounding mesorectal fat weaving, surrounding lymph nodules and mesorectal fascia [6].

The next advancement in the treatment of rectal cancer is a transition from adjuvant to neoadjuvant chemoradiotherapy, which has resulted in an increase in the percentage of five years of survival and a decrease in the recurrence rate, has decreased the percentage of multivisceral and extensive resections in the surgical treatment of the rectal cancer [7-9].

The goal of neoadjuvant therapy is to reduce the size and stage of advanced rectal cancer, to minimize the risk of distant metastases and to allow less extensive surgical therapy and, preferably, a sphincter preservative technique [8].

It is a question whether a patient with a rectal cancer is a candidate for TME alone or a preoperative chemoradiotherapy followed by TME. Preoperative staging with MR may be the answer to this question because it is the most important tool in the staging of rectal cancer [9]. The magnetic resonance imaging method plays a crucial role in the preoperative staging of the rectal cancer. MR is a modality of choice for rectal cancer staging, which assists the surgeon in achieving negative resection margins. In fact, MR assists the surgeon in planning the type of surgical treatment, and helps predict the response to treatment and disease detection [10,11].

Surgical treatment with negative resection margins (no tumor presence within 1mm of resection margins, seen on histopathology) is the only standard for treatment.

Positive postoperative margins often result in relapse of the tumor, the possibility of the disease being incurable, poor quality of life, and a recurrent rate of 5-

year-survival. The initial preoperative staging is aimed at selecting patients requiring chemoradiotherapy.

In patients with rectal cancer, local relapse is difficult to treat; it can cause a variety of symptoms, and most often has a fatal outcome [12-14].



Fig. 1. Example of positive EMVI in rectal cancer

Preoperative staging of rectal carcinoma with MR allows patients, usually in T1, T2 and T3a stage, to benefit from only TME without preoperative neoadjuvant therapy, in contrast to those patients with extrarectal spread that might benefit from a preoperative radiochemotherapy, in order to reduce the tumor [15,17-19]. Extramural vascular invasion (EMVI) is a significant prognostic indicator for the eventual recurrence of rectal cancer after surgery. EMVI is a direct invasion of the blood vessels, usually veins from the tumor itself. This occurs at the macroscopic level and can be detected by MR. It is also a significant prognostic indicator,

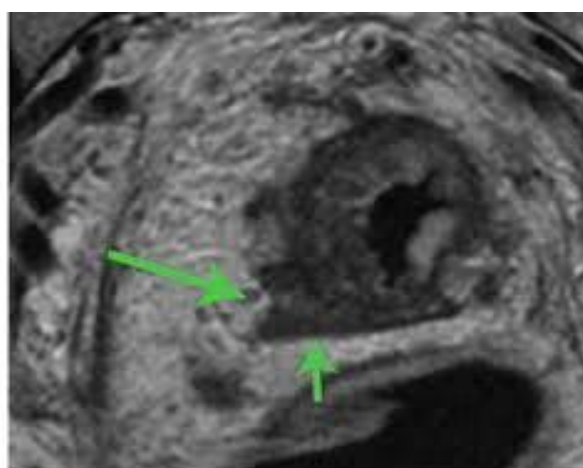


Fig. 2. Positive EMVI in rectal cancer

a predictor of hematogenous tumor spread. MR is a highly specific and moderately sensitive tool in the detection of EMVI [18-20]. EMVI positive is defined as the presence of tumor cells in the blood vessels in

mesorectal fat. Its manifestation is a local advanced tumor that penetrates deeper into the mesorectum and is used as a marker for a lower rate of 5-year-survival and local recurrence [21,22].

Earlier EMVI was detected on the histopathological sample of the operative specimen. Lately, EMVI has been detected in MR before and after neoadjuvant chemoradiotherapy. MR has the ability to determine this parameter *in vivo* [22,23].

Extramural venous invasion (EMVI) plays a role in preoperative risk stratification and influences the choice of possible preoperative neoadjuvant treatment. EMVI responds to chemoradiotherapy by making fibrosis of blood vessels that can be detected on MR. The regression of EMVI as a result of neoadjuvant treatment can be a measurable indicator and can be used as a biomarker to evaluate the effect of treatment [24].

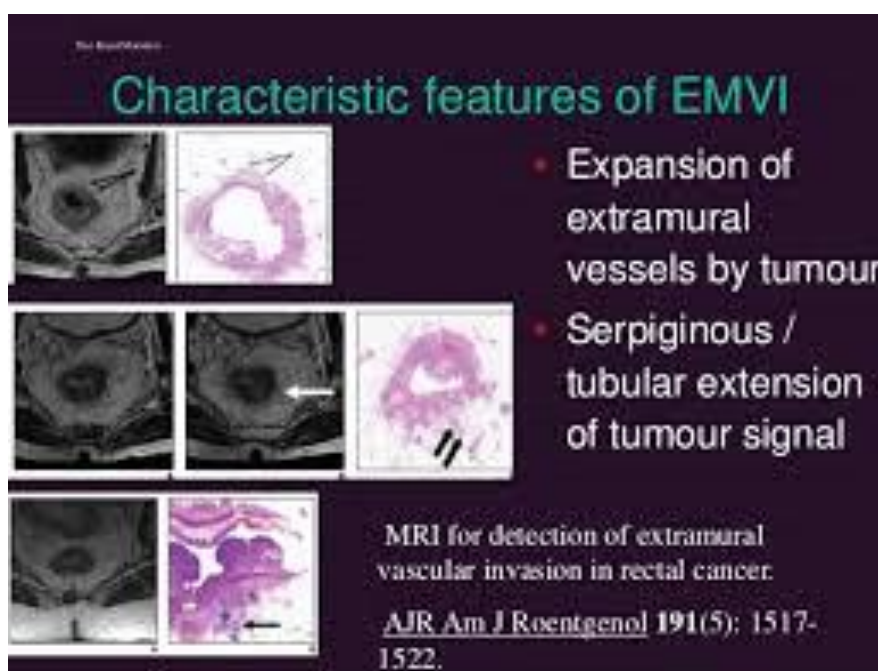


Fig. 3. Characteristic features of EMVI

Material and methods

This was a prospective study, which included 61 hospital patients with previously proven rectal cancer, who were operated on at the Department of Abdominal Surgery of the University Clinic of Surgical Diseases "St. Naum Ohridski" in Skopje.

- Inclusion criteria for participation in the study were: patients in whom rectal cancer had been proven previously by colonoscopy and were scheduled for surgery.
- Patients excluded from the study were those who had a body weight higher than 120 kg, patients who had implanted metal parts and patients who could not undergo the examination due to claustrophobia.

The following parameters were considered: sex, age, family history, localization of the tumor in (low, middle, high) rectum, and T and N stages determined by MR. A CT was preoperatively made to determine the possible existence of distant metastases.

A correlation was then made with the results obtained from the histopathological finding.

MRI should determine the following:

- Localization of the tumor—whether it was a high or low rectal tumor, its size, as well as the way of its growth.
- T staging - T1, T2, T3 and T4
- The distance of the tumor to the mesorectal fascia
- Tumoral growth or the existence of lymph nodes up to 1mm from the margin of resection
- The presence of lymph nodes mesorectally
- The presence of extramural vascular invasion (EMVI positive or negative).

Recent studies performed on 3T MR have shown no significant difference in the differentiation of the T2 stage and early T3 stage. The latest views in the literature show that both 1.5 T and 3 T are equally useful in the TMN staging. The MR protocol includes the SAG T2 pulse sequence that starts the scan [13,14].

The cranial boundary of the scanning field is the level of the vertebrae L5, and the caudal is below the anal duct. This pulse sequence provides a longitudinal cross-section of the tumor giving an insight into its length and the way of its growth. This pulse sequence

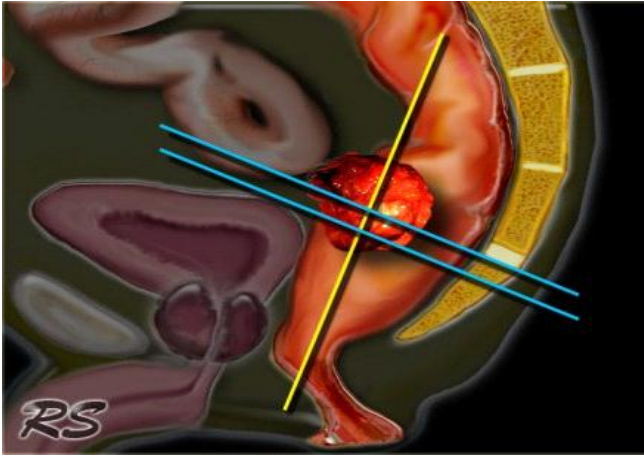


Fig. 4. Scanning of rectal cancer with MRI

measures the distance from anorectal blend to the lower edge of the tumor to determine the localization of the tumor in the rectum [22-24].

Based on the sagittal pulse sequence, the axial pulse sequences (AX T1, T2, DWI) have to be perpendicular to the axis of the tumor to avoid the partial volume effect. Coronal shots are planned perpendicular to axial and distally localized tumors parallel to the anal canal [19,20].

Discussion

This study shows that MR is a tool with high accuracy for prediction of tumor recidives depending on positive or negative EMVI preoperatively.

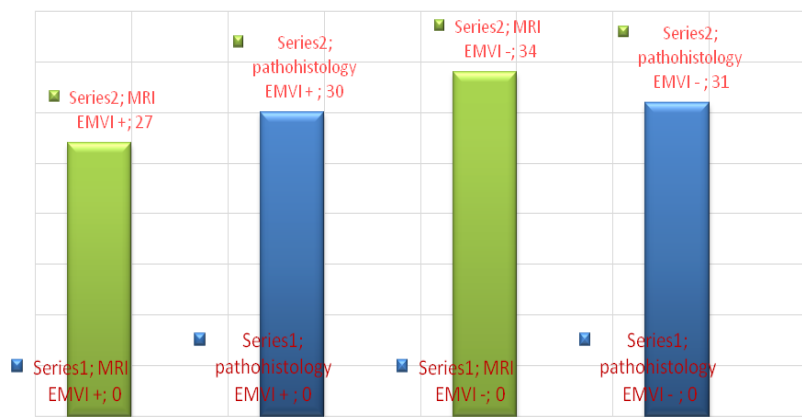


Fig. 5. Correlation of EMVI MRI with pathohistology

The comparison of EMVI detected preoperatively with MR and postoperative pathohistological results give us the right to regard MR as the gold standard in preoperative staging of rectal carcinoma [27,28]

Figure 5 shows correlation of EMVI MR with EMVI pathohistology shows that 27 patients have EMVI MR

positive correlation with the results from pathohistology it have been 30 patients with EMVI positive. MR EMVI negative has been detected within 34 patients correlating to the results from pathohistology there have been 31 patients with EMVI negative.

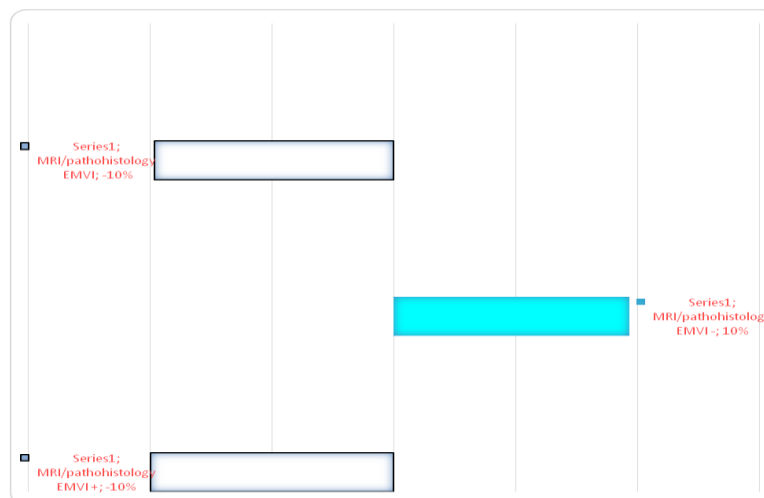


Fig. 6. Percentage of correlation of EMVI MRI with pathohistology

Figure 6 shows that difference between EMVI MR and EMVI pathohistology was not more than 10%, which

was in agreement with the results from the scientific literature.

Although EMVI is not included in the classical protocol for staging of rectal cancer preoperatively, its significance as a prognostic indicator of tumor relapse is indisputable.

MR is a standard procedure in the diagnosis of rectal cancer in developed countries. In addition, there are no exact criteria for performing this imaging technique in our country, which are essential for determining the preoperative stage of the disease, isolation of patients who are candidates for neoadjuvant therapy and multimodal treatment with additional performance of lower rectal UC [29,30].

All these could lead to a reduction in the number of extensive surgeries, and increase of the number of sphincter-preserving surgical procedures. This implies completion of MRI procedure, supplemented with lower rectal US (for better differentiation between T1 and T2 stages), which would improve the diagnostics and radicality of the overall treatment in rectal cancer [31].

MR is an ideal imaging method for preoperative staging for a local or advanced stage of rectal cancer. MR allows evaluation of extramural spread, determines the mesorectal involvement and involves the margins of resection [32,33].

Conflict of interest statement. None declared.

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