Radiology Case Reports 19 (2024) 3042–3048

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.elsevier.com/locate/radcr

Case Report

The role of rectal magnetic resonance imaging in accurate localization and designation of colorectal cancer for optimal management: Case study ☆

Olanrewaju Ogunleye, MD[a], Sebastian Feuerlein, MD[b], Abraham Ahmed, MD[b], Arthur Parsee, MD[b], Daniel Jeong, MD, MS[b], Jonathan Henning[c], Jessica Frakes, MD[d], Amalia Stefanou, MD[e], Julian Sanchez, MD[e], Sarah Hoffe, MD[d], Sophie Dessureault, MD, PhD[e], Seth Felder, MD[e], James Costello, MD, PhD[b,]*

[a] *McGovern Medical School at The University of Texas Health Science Center at Houston, Department of Diagnostic and Interventional Radiology, 6431 Fannin, Houston, TX 77030, USA*
[b] *H. Lee Moffitt Cancer Center and Research Institute, Department of Diagnostic Imaging and Interventional Radiology, 12902 USF Magnolia Drive, Tampa, FL 33612, USA*
[c] *University of South Florida Morsani College of Medicine, Tampa, Florida, 560 Channelside Drive, Tampa, FL 33602, USA*
[d] *H. Lee Moffitt Cancer Center and Research Institute, Department of Radiation Oncology, 12902 USF Magnolia Drive, Tampa, FL 33612, USA*
[e] *H. Lee Moffitt Cancer Center and Research Institute, Department of Gastrointestinal Oncology, 12902 USF Magnolia Drive, Tampa, FL 33612, USA*

ARTICLE INFO

Article history:
Received 25 March 2024
Revised 13 April 2024
Accepted 15 April 2024

Keywords:
Colorectal
Cancer
Sigmoid take-off
Rectum
Sigmoid
Chemoradiation
Surgery

ABSTRACT

Colorectal cancer, developing from malignant transformation of the distal gut epithelium, is the second leading cause of cancer death in the United States. We present a gentleman in his 60s who was diagnosed with colorectal cancer during a routine screening colonoscopy with no evidence of distant metastasis on subsequent staging with positron emission tomography and computed tomography (PET-CT). The outside rectal MR (magnetic resonance) imaging report localized a mass to the upper rectum. Review of the MRI at an institutional, Multidisciplinary Tumor Board designated the tumor as "rectosigmoid," straddling the rectosigmoid junction at the level of the "sigmoid take-off" (STO) or alternatively at the level of the last sigmoid artery take-off (SAT) at the origin of the superior rectal artery. The anatomic differentiation between upper rectal and lower sigmoid colon cancers carries clinical importance which is highlighted in this case report and brief literature review. Optimal anatomic

☆ Competing Interests: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

* Corresponding author.
E-mail address: James.Costello@moffitt.org (J. Costello).

https://doi.org/10.1016/j.radcr.2024.04.044

localization of colorectal cancers helps direct the clinical team to tailor an individualized patient care plan.

Introduction

Colorectal cancer develops as the transformation of the normal large bowel epithelium to an initial precancerous lesion (e.g. adenomatous polyp) and potentially to an invasive carcinoma [1]. Colorectal cancer represents a commonly occurring cancer, the third most amongst men and the second amongst women [2].

The most frequent signs and symptoms of colorectal cancer include blood per rectum, abdominal pain, and anemia [1]. The mortality rates of colorectal cancer have been decreasing in the United States due to an increase in screening and in early treatment [3,4].

Sigmoid colon cancer is routinely approached with upfront colectomy with en bloc removal of regional lymph nodes. If an incomplete or extended surgical resection is anticipated, some centers may consider neoadjuvant chemotherapy +/- chemoradiation to downsize and to facilitate an R0 resection. Rectal cancer is associated with a much higher risk or local recurrence rate than sigmoid colon cancer. With higher rates of recurrence, risk adapted treatments are mobilized to treat rectal cancer. In particular local preoperative therapies are recommended for intermediate and high-risk rectal cancers that are extraperitoneal. Current NCCN guidelines for rectal cancer recommend preoperative chemoradiation for treatment of all Stage II (T3-T4, N0, M0) and Stage III (any T stage, N1-N2, M0) disease. This difference in treatment approach underscores the importance for accurate anatomic localization of sigmoid versus rectal masses [10,14,15].

Case summary

We present the case of a 70-year-old man who underwent his first screening colonoscopy and was found to have three small (5 mm) transverse colon tubular adenomas and a 4-cm fungating mass with friable edges that occupied 30 percent of the lumen circumference in the proximal rectum/rectosigmoid junction at an endoscopic length of 10 to 14 cm from the anal verge. Biopsies confirmed invasive and moderately differentiated adenocarcinoma. He underwent a PET-CT, showing pronounced, hypermetabolic rectal wall thickening. His CT scan images showed circumferential wall thickening of the rectosigmoid colon which extended over a craniocaudal length of 4 cm with no definite evidence of metastatic disease.

He subsequently underwent an MRI of the rectum at an outside facility which reported a near circumferential rectal mass within the upper rectum at 12 cm from the physiologic anal verge, resulting in 50 percent luminal obstruction. There was no evidence of extramural venous invasion. His serum CEA was 2.7 ng/mL. Rigid proctosigmoidoscopy confirmed that the distal end of the tumor was 11 cm from the anal verge with the tumor involving more than 50 percent of the lumen circumference (Figs. 1-5). At the outside facility, radiation oncology was consulted and recommended neoadjuvant chemoradiation with capecitabine.

Outside radiation oncology and surgery recommended total neoadjuvant therapy (TNT) with neoadjuvant induction chemoradiation followed by consolidation chemotherapy with the plan for eventual surgical resection. The patient completed his chemoradiation and subsequently finished 8 cycles of consolidation chemotherapy.

Prior to initiating chemoradiation, the patient denied any GI symptoms. He reported 3-4 bowel movements per day with no blood in his stools and no change in his bowel habits. Following the initiation of chemoradiotherapy, he had alternating diarrhea and constipation, fecal urgency, but he denied any incontinence. He also described a decreased appetite with chemoradiation. Lastly, the patient reported some excoriation and erythema of the perinal skin and gluteal cleft that resolved within 3 months following the completion of chemoradiation.

Following the completion of TNT, the patient sought surgical consultation at our facility. We discussed the details of a low anterior resection (LAR) including his expected postoperative care as well as the expected creation of a temporary diverting loop ileostomy.

At our institution using our center's multiparameter and multisequence protocol, a new post-TNT MRI was obtained.

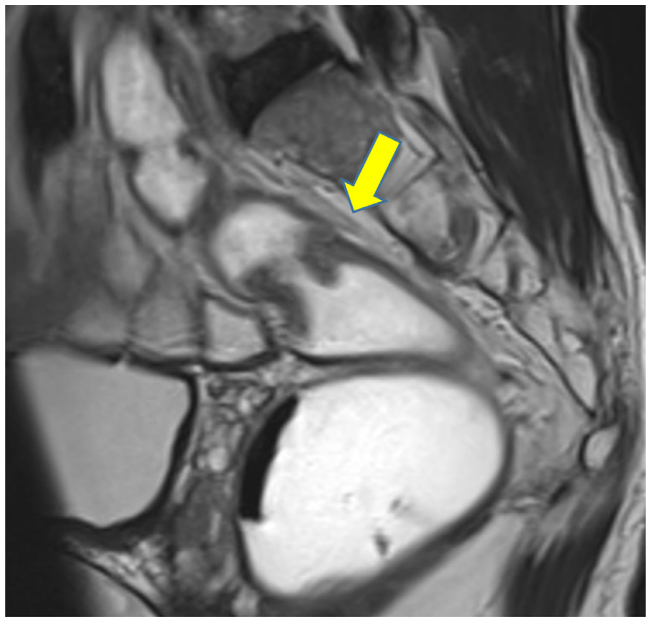

Fig. 1 – Sagittal T2w MR showing the colorectal mass (arrow) which was initially reported by imaging interpretation as an upper rectal mass.

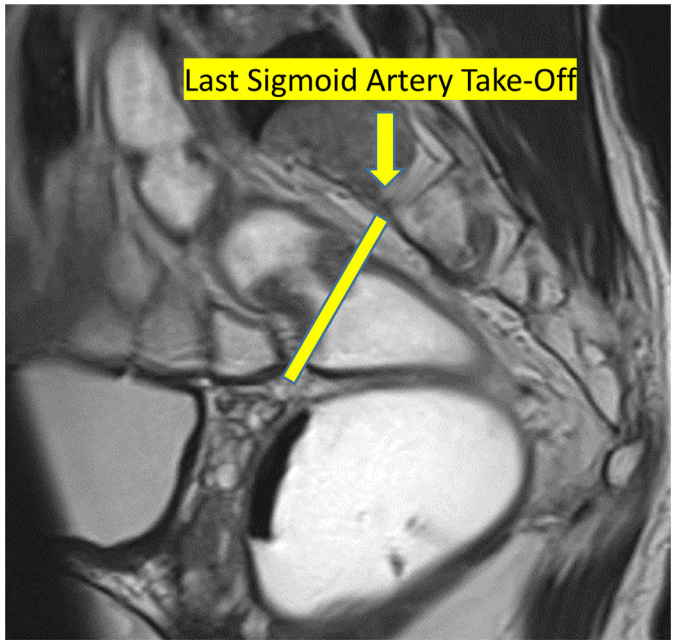

Fig. 2 – Sagittal T2w MR showing the position of the last sigmoid artery take off (SAT). The perpendicular plane (yellow line) outlines the the rectosigmoid junction.

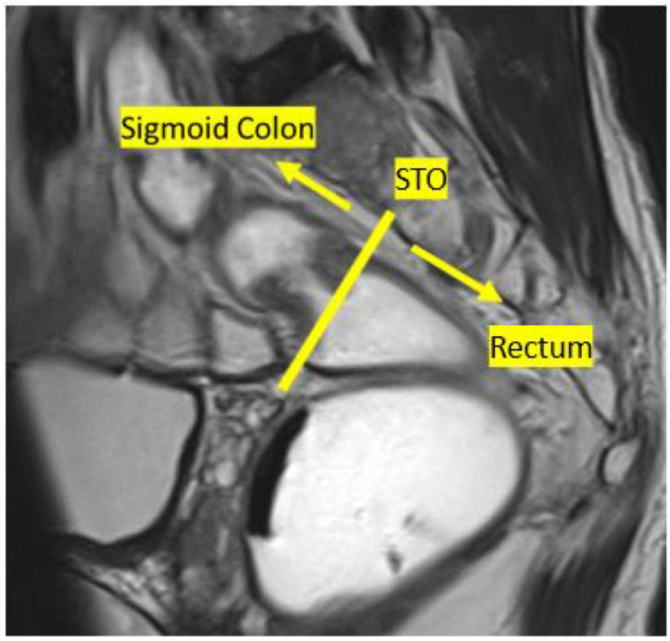

Fig. 3 – Sagittal T2w MR. The sigmoid takeoff (STO) (yellow line) and last sigmoid artery takeoff (SAT) outline the distinction between the upper rectum and the distal sigmoid colon.

The new imaging detailed bowel wall thickening straddling the rectosigmoid junction and spanning an oblique cranial-caudal length of 1.7 cm (Fig. 6). The new imaging report detailed the post-treatment site as crossing the rectosigmoid junction as opposed to residing soley within the upper rectum. Post-treatment change was located above the level of the anterior peritoneal reflection, was 15 cm from the physiologic anal verge, and was greater than 2 cm removed from the sphincteric complex. On T2w axial and small FOV images, there was well defined dark T2 signal seen along the right lateral wall of the rectum with some mildly heterogenous T2 signal seen within the left lateral wall of the rectum (Fig. 6). Within the left lateral wall there was no high signal on either high b-value DWI (1000 s/mm^2) or calculated b-value DWI(1600 s/mm^2). On ADC map, there was T2 dark through (Fig. 7). Overall, there were no imaging findings of residual disease, and the het-

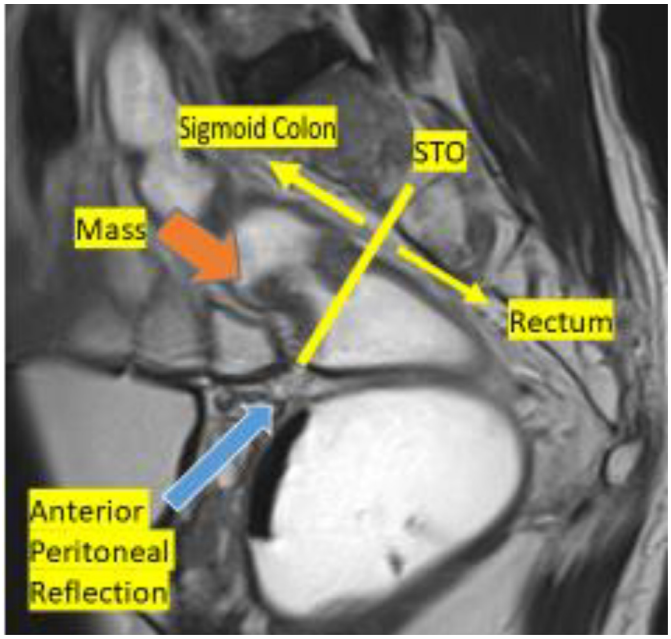

Fig. 4 – Sagittal T2wMR. After identifying the sigmoid take-off, the mass is reclassified as a colorectal mass with the distal end just below the sigmoid take-off (STO) (yellow line) and the last sigmoid artery takeoff (SAT). The colorectal mass is identified by the (orange arrow). The anterior peritoneal reflection (APR) is designated by the (blue arrow).

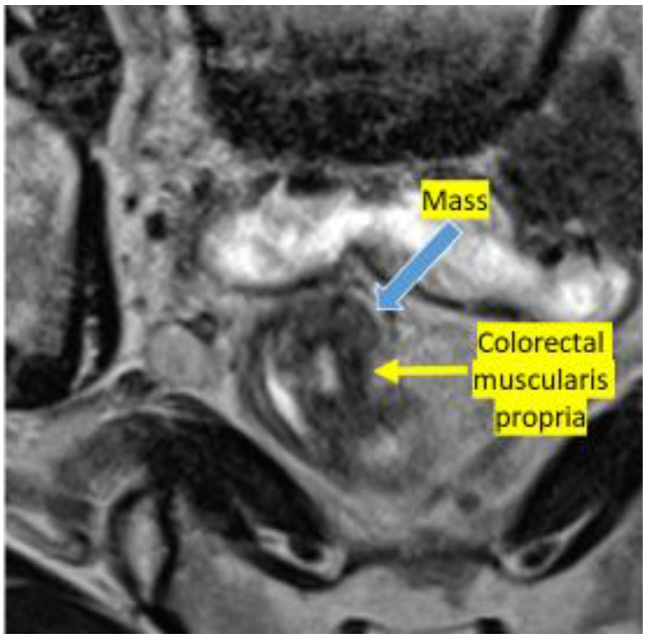

Fig. 5 – Axial T2w MR showing the rectal mass (blue arrow) extending beyond the confines of the muscularis propria (yellow arrow).

erogenous T2 signal seen within the left lateral bowel wall may have been attributable to motion, post-treatment change, volume averaging, and/or residual inflammation. There was no disease extending across the muscularis propria and into the mesorectal fat. The tumor was staged as mrTXN0. The MRI Tumor Regression Grade was assessed as Grade 2 (Good response - Dense (>75%) fibrosis without obvious residual tumor).

At our institution, the patient underwent a low anterior resection with a temporary diverting loop ileostomy. Exploration showed no carcinomatosis and no palpable liver lesions. Ileostomy takedown was completed 7 weeks later. Final pathology showed a 1.8 cm scar with focal acellular mucin deposit and a residual (0.4 cm) tubular adenoma component. No viable cancer cells were seen, and there were no signs of lymphovascular or perineural invasion. All resection margins were negative for carcinoma, consistent with a pathologic complete pathologic response (pCR). The patient's postoperative course was uneventful. Since his surgery, he has returned to the clinic, and he has been doing very well.

Discussion

Sigmoid colon cancer is routinely treated with upfront surgery, including colectomy with en bloc resection of lymph nodes. In comparison, rectal cancer is associated with a much higher risk of local recurrence than colon cancer. The extraperitoneal or non-peritonealized portion of the rectum largely accounts for this higher rate of local recurrence. With higher rates of recurrence, rectal cancer is treated with risk-adapted treatments. Depending upon whether the rectal cancer is staged as locally invasive, this frequently includes chemoradiation followed by post-treatment surgical evaluation for operative candidacy. New treatment regimens, such as TNT, deliver the neoadjuvant and adjuvant therapy in combination with either short or long course radiation therapy prior to surgical consideration. Some patients (15%-25%) will experience a successful response to preoperative treatment, and they may elect

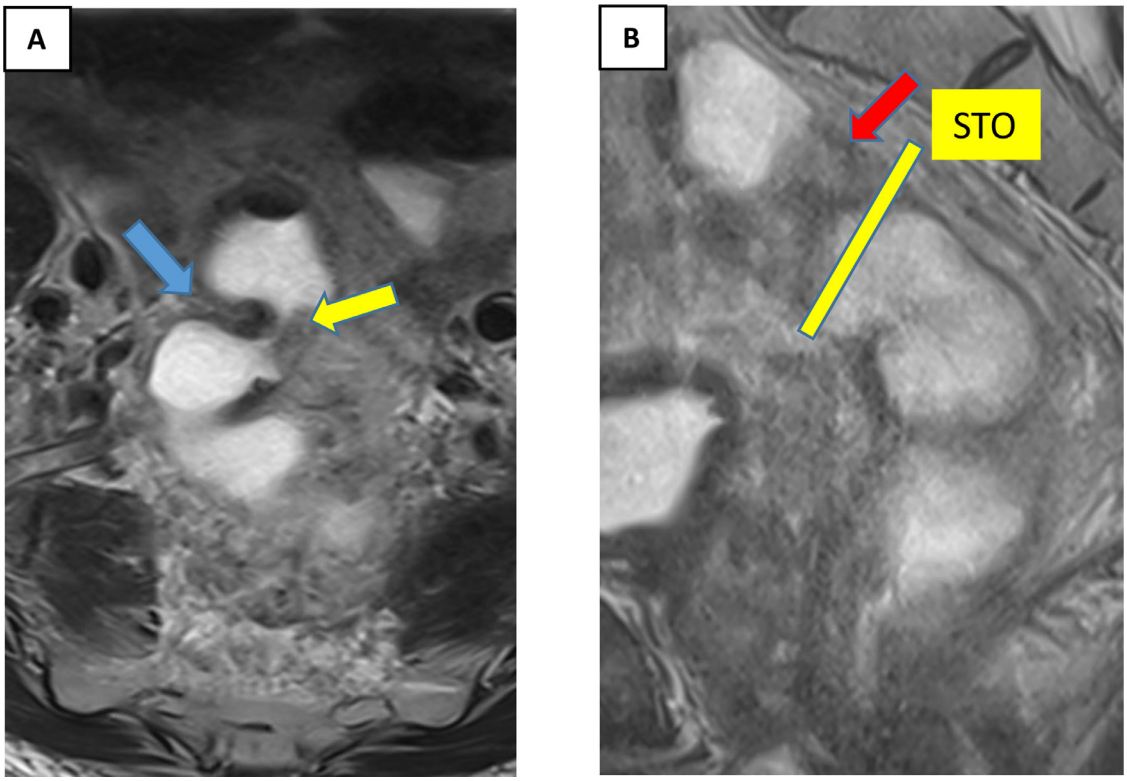

Fig. 6 – (A, B): (A) Axial T2w MR demonstrating dark T2 signal (blue arrow), consistent for excellent response to treatment. There is some heterogeneous T2 signal along the left side of the bowel wall (yellow arrow) which may represent post-treatment change, residual inflammation, volume averaging, and/or patient motion. (B) Sagittal T2w MR demonstrates image degradation secondary to bowel motion. The post treatment sites measures 1.7 cm in oblique craniocaudal dimensions. Please note that the post-treatment site straddles the level of the STO.

for nonoperative management such as "Watch and Wait" with continued endoscopic and imaging surveillance [2,5,6].

Preoperative imaging has assumed an important role in the management of rectal cancer [7]. Magnetic resonance imaging (MRI) represents the gold standard for preoperative evaluation of local disease site, including adjacent organ involvement and the nodal staging [8]. This imaging approach relies heavily on small field of view T2w imaging with high in-plane resolution coupled with functional imaging such as low and high *b* value diffusion weighted imaging (DWI) with generated apparent diffusion (ADC) maps [9].

MRI can serve an important role in providing anatomic localization of colon cancer [10]. MRI is particularly useful when distinguishing sigmoid, rectosigmoid, and upper rectal tumors. This information provides critical direction regarding potential treatment options. As earlier described, the treatment for sigmoid colon cancer includes en bloc resection. For those patients with rectosigmoid tumors or high upper rectal tumors, the literature questions the benefits of chemoradiation. In 1998 Lopez-Kostner concluded that the surgical outcomes of upper rectal tumors mirrored those of sigmoid cancers with no statistically significant difference in local recurrence, distant recurrence, or death [11]. Additionally, the large phase III randomized clinical trials performed in the late 1990s and early 2000s presented inconclusive results regarding the benefit of neoadjuvant radiation therapy for upper third rectal tumors. Lastly, a recent meta-analysis published in 2021 concluded that high upper rectal tumors located within the peritonealized rectum and with no extraperitoneal involvement demonstrated no reduction in local recurrence, overall survival, or disease-free survival with neoadjuvant chemoradiotherapy [10,12].

In our patient, careful anatomic localization showed the tumor as straddling the rectosigmoid junction at the level of the last sigmoid artery take-off (SAT) or sigmoid take-off (STO) (Figs. 1–4 and 6). The portion extending beyond the colon wall was located within the sigmoid mesocolon without a threatened retroperitoneal/radial margin and within the peritonealized portion of the upper rectum with no extraperitoneal involvement. For these anatomic reasons, this patient may not have met the criteria for neoadjuvant short or long course radiation therapy due to an expected limited benefit in local disease control; and instead, the patient may have been treated with either neoadjuvant chemotherapy followed by surgery or upfront surgery alone, avoiding potential toxicities of pelvic radiation [11,13–15].

Teaching point

The accurate anatomic localization of colorectal cancers by MR imaging provides important information that impacts

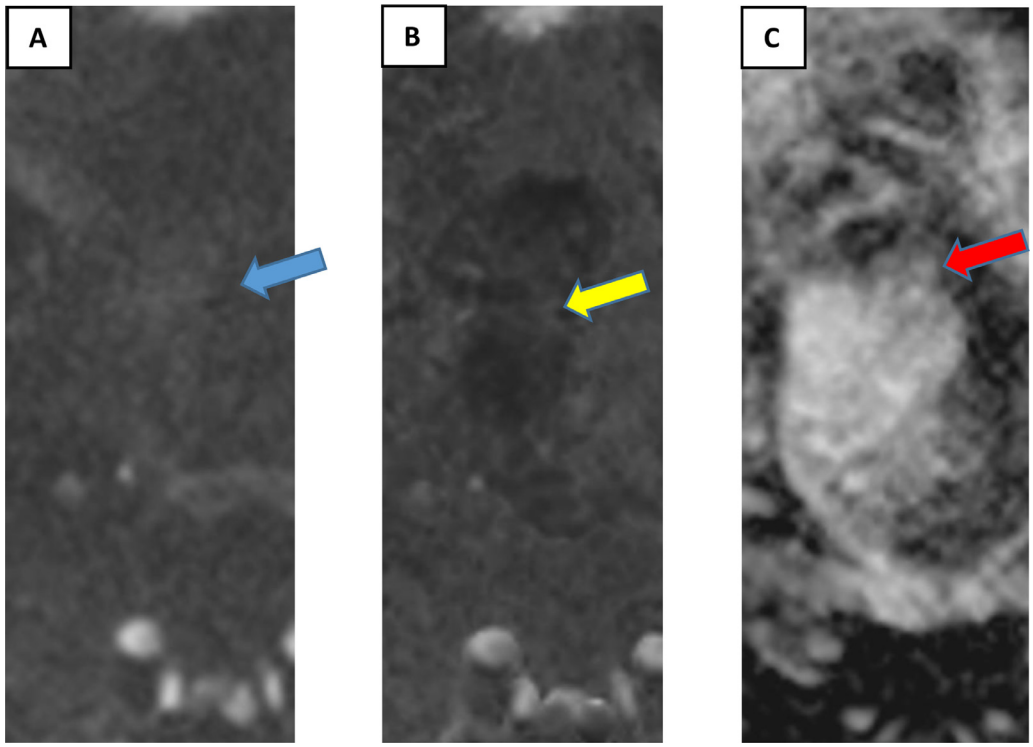

Fig. 7 – (A and C): Axial diffusion weighted imaging (DWI) with high *b*-value (1000 s/mm^2) (A, blue arrow) and calculated *b*-value (1600 s/mm^2) (B, yellow arrow) demonstrate a noted absence of high signal within the treatment site. On ADC map T2 dark through is seen (C, red arrow).

treatment decision-making and the election of the most appropriate treatment(s). Given the difference in treatment paradigms for sigmoid versus rectal tumors, distinguishing these anatomic sites by MRI staging is essential. Accuracte localization by rectal MRI may avoid treatment(s) that are not expected to be of oncologic benefit and may even carry acute and long term toxicities. This case report highlights an important imaging distinction to help tailor treatment(s) with distal sigmoid, rectosigmoid, and upper rectal tumors.

Patient consent

The authors declare that written informed consent form for this case-report publication has been obtained from the patient whose medical condition is the subject of this case study and can be produced upon the request of the journal editorial office.

REFERENCES

[1] Lotfollahzadeh S, Recio-Boiles A, Cagir B. Colon Cancer. [Updated 2023 Jun 3]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK470380/.

[2] Bailey CE, Hu CY, You YN, Bednarski BK, Rodriguez-Bigas MA, Skibber JM, et al. Increasing disparities in the age-related incidences of colon and rectal cancers in the United States, 1975-2010. JAMA surgery 2015;150:17–22.

[3] Siegel R, Naishadham D, Jemal A. Cancer statistics, 2013. CA Cancer J Clin 2013;63:11–30.

[4] Ferlay J, Soerjomataram I, Dikshit R, Eser S, Mathers C, Rebelo M, et al. Cancer incidence and mortality worldwide: sources, methods and major patterns in GLOBOCAN 2012. Int J Cancer 2015;136:E359–86.

[5] Sun W, Al-Rajabi R, Perez RO, Abbasi S, Ash R, Habr-Gama A. Controversies in Rectal Cancer Treatment and Management. Am Soc Clin Oncol Educ Book 2020;40:1–11. doi:10.1200/EDBK_279871.

[6] Pignone M, Rich M, Teutsch SM, Berg AO, Lohr KN. Screening for colorectal cancer in adults at average risk: a summary of the evidence for the US Preventive Services Task Force. Ann Intern Med 2002;137:132–41.

[7] Jung EJ, Ryu CG, Kim G, Kim SR, Nam SE, Park HS, et al. Is rectal MRI beneficial for determining the location of rectal cancer with respect to the peritoneal reflection? Radiol Oncol 2012;46:296.

[8] Brown G, Kirkham A, Williams GT, Bourne M, Radcliffe AG, Sayman J, et al. High-resolution MRI of the Anatomy Important in Total Mesorectal Excision of the Rectum. AJR Am J Roentgenol 2004;182:431–9.

[9] Low RN. MRI of colorectal cancer. Abdominal Radiol 2002;27:418–24.

[10] Horvat N, Carlos Tavares Rocha C, Clemente Oliveira B, Petkovska I, Gollub MJ. MRI of rectal cancer: tumor staging, imaging techniques, and management. Radiographics 2019;39(2):367–87. doi:10.1148/rg.2019180114.

[11] Lopez-Kostner F, Lavery IC, Hool GR, Rybicki LA, Fazio VW. Total mesorectal excision is not necessary for cancers of the upper rectum. Surgery 1998;124:612–18.

[12] Sebag-Montefiore D, Stephens RJ, Steele R, Monson J, Grieve R, Khanna S, et al. Preoperative radiotherapy versus selective postoperative chemoradiotherapy in patients with rectal cancer (MRC CR07 and NCIC-CTG C016): a multicentre, randomised trial. Lancet North Am Ed 2009;373(9666):811–20.
[13] Kennedy ED, Simunovic M, Jhaveri K, et al. Safety and feasibility of using magnetic resonance imaging criteria to identify patients with "good prognosis" rectal cancer eligible for primary surgery: the phase 2 nonrandomized quicksilver clinical trial. JAMA Oncol 2019;5(7):961–6. doi:10.1001/jamaoncol.2019.0186.
[14] Sauer R, Becker H, Hohenberger W, Rödel C, Wittekind C, Fietkau R, et al. Preoperative versus postoperative chemoradiotherapy for rectal cancer. N Engl J Med 2004;351:1731–40.
[15] Flanagan M, Clancy C, Sorensen J, Thompson L, Kranenbarg EM, van de Velde CJ, et al. Neoadjuvant short-course radiotherapy for upper third rectal tumors: systematic review and individual patient data metaanalysis of randomized controlled trials. Ann Surg Oncol 2021;28:5238–49.