DW-MRI in detection and delineation of rectal cancer local recurrence

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**Purpose**

Improvement of rectal cancer management and new treatment options led to gradual decrease in locally recurrent rectal cancer rates; however relapse is still reported to occur in 15-35% of patients following rectal cancer surgery [1-4]. Majority of relapses occur within two years following rectal cancer surgery and three-fourths within 5 years [4-5].

Abdominopelvic pain is the most frequent presenting symptom and together with CEA levels rise is a reliable, but not an unreserved indication of rectal cancer local recurrence. However assessment of CEA levels alone is not adequate follow-up as recurrence may occur in the absence of CEA lift, but identification of local recurrence before symptomatology may allow earlier and more effective treatment [6].

It has already been shown that MRI is the best modality for rectal cancer patients follow-up [7-13], however standard sequences not always allow to differentiate fibrotic tissue from tumor relapse areas, thus makes it difficult not only to detect local recurrence at the initial stage of the disease but also to evaluate response of the relapse tumor to the received therapy.

In our study we tried to assess Diffusion-weighted MR feasibilities in identification and delineation of rectal cancer local recurrence.

**Methods and Materials**

Fifteen patients with previously treated rectal cancer were included in the study. There were 7 males and 8 females (mean age 54.8; range from 33 to 79 years). Three patients suffered from planocellular carcinomas of the anus, 12 patients were previously diagnosed and treated for rectal adenocarcinomas. Fourteen patients underwent surgery treatment, so that 2 APE (abdomino-pelvic extirpation), one#artmann's surgery and 11 TME (total mesorectal excision) were performed, in one case surgery treatment was omitted due to no tumor presentation after neoadjuvant treatment. All of the patients included in the study received either neoadjuvant or adjuvant (radio- or combined chemoradio therapy).

MRI scans to all of the patients were performed on 1,5 T scanners (Avanto/Espree, Siemence, Germany) with standard pelvic MRI protocol included: T2 cor (large FOV, 4 mm), T2 sag (small FOV, 4 mm), T2 tra (small FOV, 3 mm), DWI with identical parameters to T2 tra images (b value 0,800,1000 c/mm$^2$) and automatic ADC maps reconstructions. After sequential reading of all the images, we fused T2 tra and DW images (b value 1000 c/mm$^2$), T2 tra and ADC maps (on MultiModality Workstation, Siemens) and assessed results interpretation confidence.
Results

After complex diagnostic examination, no recurrent disease was identified in three patients, other 12 patients had relapse either at sites of sutural lines or extraintestinal pelvic compartments (involvement of any pelvic region); 8% of patients developed recurrence in three month period after surgery, in 58.7% relapse occurred within a year and 33.3% had recurrence in 1.5-2 years period. From those with relapse disease blood cancer markers testes showed rise in 70% of cases.

Areas of tumor presence had intermediate SI (signal intensity) on T2 images, hyperintense areas on DWIs with b values of 800 and 1000 c/mm², and low SI areas on ADC maps. Since limited spatial resolution of high b values DW images and artifacts from bowel, free fluid collections (etc.) could cause difficulties in imaging interpretation, we noted that it was much easier to depict and differentiate tumor areas from either edema or fibroses on fused T2-DW images compared with separate reading of both sequence images. In the majority of cases fused T2/DW images helped us to overcome some imaging reading problems, thus providing more accurate information about tumor presence and spread to adjacent organs and pelvic structures; so that imaging accuracy increased from 65% up to 87% (in each case patient had either biopsy of suspicious region or surgical excision of the relapse tumor with postoperative specimen histological examination). Those patients who were considered as inoperable at the moment of initial examination, received either radio-, chemo-, or combined radiochemotherapy and had follow-up MRI scans with the same protocols and scanning parameters.

We counted ADC values for all the tumor zones seen on the fused T2 axial/DW images, however could not sort out precise threshold values for tumor presence. Residual tumor areas had heterogeneous SI (signal intensity) on T2 and showed multivendor average ADC values (from 850+/-50 to 2000+/-50) (pic. 1), so that we could not suggest using ADC index as a reliable marker of recurrence identification; however ADC maps could help in assessment of relapse tumor response to treatment (pic. 2). Fibrotic tissue formation at the sites of previously seen tumor corresponded with average ADC values decrease. We could not note any significant difference in ADC values between patient groups with different pre- and post treatment therapy regimes. Three patients also underwent PET-CT examination (pic. 3), in all cases results agreed with DW-MRI findings.

Images for this section:
**Fig. 1:** A 38-year-old patient had TME for middle rectal cancer treatment. Within 6 month period relapse disease was diagnosed. T2 image shows heterogeneous tumor tissue, that involves posterior pelvic compartment. Heterogeneous tumor structure is also displayed on fused T2/DWIs and ADC maps (with different ADC index).

**Fig. 2:** A 65-year-old patient was surgically treated for low rectal adenocarcinoma (TME) in 2010, developed recurrence disease in 2012. (pic. 2) Initial MRI scan, T2 images demonstrate hypo/isointense tumor node next to left pelvic side wall, which infiltrating obturator internus m, left seminal vesicle, muscular fascicles of the left piriformis m. On fused T2/DWI tumor recurrence zone shows high SI. Average ADC index is 1040. (pic. 3,4) Follow-up scans were made during (3) and after (4) chemoradiotherapy. Increase in fibrotic tissue formation is seen on T2 images with correspondent loss of high SI on fused images and decrease of ADC parameter.

**Fig. 3:** A 65-year-old patient was surgically treated for low rectal adenocarcinoma (TME) in 2010, developed recurrence disease in 2012. (pic. 2) Initial MRI scan, T2 images
demonstrate hypo/isointense tumor node next to left pelvic side wall, which infiltrating obturator internus m, left seminal vesicle, muscular fascicles of the left piriformis m. On fused T2/DWI tumor recurrence zone shows high SI. Average ADC index is 1040. (pic. 3,4) Follow-up scans were made during (3) and after (4) chemoradiotherapy. Increase in fibrotic tissue formation is seen on T2 images with correspondent loss of high SI on fused images and decrease of ADC parameter.

**Fig. 4:** A 65-year-old patient was surgically treated for low rectal adenocarcinoma (TME) in 2010, developed recurrence disease in 2012. (pic. 2) Initial MRI scan, T2 images demonstrate hypo/isointense tumor node next to left pelvic side wall, which infiltrating obturator internus m, left seminal vesicle, muscular fascicles of the left piriformis m. On fused T2/DWI tumor recurrence zone shows high SI. Average ADC index is 1040. (pic. 3,4) Follow-up scans were made during (3) and after (4) chemoradiotherapy. Increase in fibrotic tissue formation is seen on T2 images with correspondent loss of high SI on fused images and decrease of ADC parameter.

**Fig. 5:** A 60-year-old patient developed rectal cancer relapse in a year period after neoadjuvant and surgery treatment of the primary rectal tumor. (pic. 5) PET-CT scans
show right pelvic side zone of increased 18-FDG uptake. (pic. 6) MR T2 image depicts low/intermediate SI tumor area, involving right lateral and anterior pelvic compartments, with posterior bladder wall and right ureter infiltration (due to native soft tissue contrast MRI clearly identifies relation of tumor tissue to adjacent organs). Fused T2/DWI displays tumor as high SI area, opposite to fused T2/ADC maps, where tumor is seen as low SI zones.

Fig. 6: A 60-year-old patient developed rectal cancer relapse in a year period after neoadjuvant and surgery treatment of the primary rectal tumor. (pic. 5) PET-CT scans show right pelvic side zone of increased 18-FDG uptake. (pic. 6) MR T2 image depicts low/intermediate SI tumor area, involving right lateral and anterior pelvic compartments, with posterior bladder wall and right ureter infiltration (due to native soft tissue contrast MRI clearly identifies relation of tumor tissue to adjacent organs). Fused T2/DWI displays tumor as high SI area, opposite to fused T2/ADC maps, where tumor is seen as low SI zones.
Conclusion

DW-MRI has already shown its feasibility in rectal cancer complete responders detection and is widely used in oncology imaging [13-15]. Rectal cancer recurrence is a difficult to treat condition; its earlier identification could help to increase overall survival of colorectal cancer patients. DW-MRI could be considered as quiet a reliable imaging modality for colorectal cancer recurrence, but more studies should be carried out.

References


Personal Information