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FDG-avid presacral soft tissue mass in previously treated rectal cancer: Diagnostic outcome and additional value of MRI, including diffusion-weighted imaging

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ABSTRACT

Introduction: This study aimed to determine the positive predictive value (PPV) of positron emission tomography/computed tomography (PET/CT) with an ^{18}F-fluoro-2-deoxy-D-glucose (FDG)-avid presacral lesion for locally recurrent rectal cancer, and the additional value of magnetic resonance imaging (MRI), including diffusion-weighted imaging (DWI).

Materials and methods: This retrospective study included 38 patients who completed primary rectal cancer treatment and who presented with a suspicious FDG-avid presacral lesion on PET/CT. Twenty-seven patients also underwent MRI, of whom 24 with DWI. PPV of FDG-PET/CT and additional value of MRI, including DWI, for the diagnosis of recurrent presacral cancer were determined.

Results: The PPV of PET/CT with an FDG-avid presacral lesion for the diagnosis of locally recurrent rectal cancer was 58% (22/38). Air in the FDG-avid presacral lesion, as visible on the CT component of the PET/CT examination, favoured the diagnosis of benign presacral tissue with a sensitivity of 56.3% (9/16) and a specificity 81.8% (18/22). Areas under the receiver operating characteristic curve (AUCs) of MRI without DWI for the diagnosis of locally recurrent rectal cancer in FDG-avid presacral tissue were 0.765 and 0.840, for observers 1 and 2. AUCs of MRI with DWI were 0.803 and 0.811, for observers 1 and 2. There were no significant differences among any of these AUCs ($P = 0.169$ to 0.906).

Conclusions: FDG-PET/CT has a poor PPV for locally recurrent rectal cancer in the presacral space. The observation of air in the FDG-avid presacral lesion and additional MRI assessment are diagnostically helpful, without a significant additional value of DWI.

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Introduction

The annual incidence and mortality of rectal cancer in the Western world are approximately 15–25/100,000 and 4–10/100,000, respectively [1]. Five-year local recurrence rates after total mesorectal excision surgery and preoperative (chemo)radiation therapy are around 5–10% [2]. Surgery in these patients is complex and associated with significant morbidity [3]. In the 59% of patients in whom the local recurrence can be treated with a complete R0 resection, five-year cancer-specific survival has been reported to be 44% in high volume institutions [3]. For those with R1 and R2 resections, the five-year survival drops to 26% and 10%, respectively [3]. Timely diagnosis of locally recurrent rectal cancer is important because of its therapeutic and prognostic implications.

^{18}F-fluoro-2-deoxy-D-glucose positron emission tomography (FDG-PET)/computed tomography (CT) plays an important role for the detection of locally recurrent and metastatic disease in patients with an unexplained increase in carcinoembryonic antigen (CEA) levels, unexplained symptoms, and/or suspicious abnormalities

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found on other imaging modalities such as routine CT screening [1,2]. FDG-PET/CT has been reported to be an accurate technique in the detection of pelvic recurrence after resection of rectal cancer [4,5]. This holds up for central and lateral pelvic side wall recurrences [2], because excess FDG-avid tissue in these locations is generally due to disease recurrence, in our experience. However, a potentially challenging and poorly investigated area is the evaluation of presacral soft tissue masses. These are found in up to 50% after primary treatment for rectal cancer, and might represent fibrosis (after radiation therapy and/or subclinical anastomotic leakage) or recurrent cancer [4]. FDG-PET has been suggested as a useful method to discriminate presacral fibrosis from cancer, based on the hypothesis that the former is not metabolically active while the latter is [4]. However, in our experience, both benign presacral alterations and cancer can appear FDG-avid on PET scans. Similarly, although magnetic resonance imaging (MRI) has a proven role in the detection of pelvic recurrence [6–8], its value in the evaluation of (FDG-avid) presacral lesions in patients with suspected recurrent disease has not been established yet. The same applies to the value of diffusion-weighted imaging (DWI) in this setting, which is a functional MRI sequence that has been suggested as a potentially useful method to discriminate fibrosis from recurrent rectal cancer [7,8].

The aims of this study were to determine the positive predictive value (PPV) of PET/CT with an FDG-avid presacral lesion for locally recurrent rectal cancer, and the additional value of MRI, including DWI.

Materials and Methods

Study design and patients

The local institutional review board approved this retrospective study and waived the requirement for informed consent. The Picture Archiving and Communication System of our institution was searched for all patients who completed primary treatment for rectal cancer, and who underwent FDG-PET/CT during follow-up between March 2010 and November 2017. Each of these FDG-PET/CT scans was evaluated by one of six nuclear medicine physicians (each with more than 5 years of PET/CT experience) as part of routine clinical care. Patients were included if their PET/CT report mentioned the presence of a presacral lesion (i.e. a lesion that abuts the sacrum or coccyx [2]) that was FDG-avid (i.e. FDG uptake above mediastinal blood pool) and considered suspicious for locally recurrent disease at the time of prospective clinical reading. Patients with non-adenocarcinoma histology, patients with adenocarcinoma in locations outside the rectum at primary diagnosis, patients with FDG-avid lesions elsewhere in the pelvis (i.e. central and lateral pelvic side wall lesions [2]), patients who underwent FDG-PET/CT during treatment for pathologically proven recurrent presacral cancer, patients with a presacral urinoma, and patients in whom the nature of the presacral lesion could not be determined based on available histopathological data and follow-up imaging, were excluded. MRI scans of included patients were considered eligible for analysis if performed within 2 months of FDG-PET/CT and without any intervening therapy.

FDG-PET/CT acquisition and evaluation

FDG-PET/CT scans were performed using integrated PET/CT systems. After a fasting period of at least 6 h and after confirming that blood glucose levels were less than 11 mmol/L, an average dose of 3 MBq FDG/kg body weight was injected intravenously. Approximately 60 min after FDG injection, PET scanning was done from proximal femur to cranial vertex. A low-dose CT scan was acquired for attenuation correction and anatomic correlation. In 10 of 38 patients included, a full-dose portal venous contrast-enhanced CT-scan was performed in the same session.

FDG-PET/CT scans were re-evaluated by a radiologist (T.C.K.) with more than 5 years of PET/CT experience. This reader was unaware of the nature of the presacral lesion, and blinded to clinical, laboratory, and other imaging findings, including MRI. FDG uptake of the presacral lesion was visually assessed on a three-point grading scale as 1) FDG uptake above mediastinal blood pool but below or equal to liver uptake, 2) FDG uptake slightly or moderately higher than liver, or 3) FDG uptake markedly higher than liver. Corresponding low-dose or full-dose CT images were also assessed for the presence of air in the presacral lesion.

MRI acquisition and evaluation

Twenty-seven of 38 patients included also underwent MRI. The decision to perform MRI after FDG-PET/CT was at the discretion of the multidisciplinary tumor board, and was mainly influenced by the presence or absence of metastatic disease elsewhere. MRI scans were performed using 1.5-T and 3.0-T MRI systems. Two-dimensional T2-weighted sequences (with slice thickness $\leq$3 mm) were applied in three planes in 22 patients and in two planes in five patients. Twenty-four of 27 patients also underwent DWI (with slice thickness of 4–5 mm), with low b-values ranging between 0 and 100 s/mm2 (median: 0 s/mm2), and high b-values ranging between 600 and 2000 s/mm2 (median: 800 s/mm2), from which corresponding apparent diffusion coefficient (ADC) maps were calculated.

MRI scans were independently evaluated by two radiologists (R.J.d.H. and J.P.P.) with 6 years and 8 years of experience in rectal MRI. Both readers were unaware of the nature of the presacral lesion, and blinded to clinical, laboratory, and other imaging findings, including FDG-PET/CT. Presacral lesions were first evaluated on T2-weighted sequences only, with the finding of rounded or lobulated borders considered to be suggestive of recurrent rectal cancer, and the finding of straight angular margins considered to be suggestive of fibrosis. The likelihood of recurrent rectal cancer was assessed on a five-point grading scale as 1) very unlikely, 2) unlikely, 3) unclear, 4) likely, and 5) very likely. Maximum presacral lesion size in any plane was also assessed. Immediately after evaluation of the T2-weighted sequences, DWI and ADC maps were assessed together with the T2-weighted sequences, with recurrent rectal cancer considered to be present in case of high signal on DWI and corresponding low signal on the ADC map compared to background. If the lesion had no high DWI signal and no low signal on the ADC map, it was considered to represent fibrosis, unless the lesion had round or lobulated borders. The likelihood of recurrent rectal cancer was then assessed using the same five-point grading scale.

Reference standard

Locally recurrent rectal cancer was considered present if histopathologically proven, if follow-up imaging demonstrated growth of the presacral lesion, or if the lesion decreased in size after chemo- and/or radiation therapy. Locally recurrent rectal cancer was deemed absent if surgical excision and subsequent histopathology were negative, or if follow-up imaging of at least 6 months without any intervening treatment showed no increase in lesion size.

Statistical analyses

Differences in age, gender, presence of metastases at primary diagnosis, pathological tumor stage and radicality after primary resection, previous history of local recurrence, time between end of primary treatment and FDG-PET/CT, and presence of symptoms, presence of metastases, CEA, C-reactive protein (CRP) and leukocyte levels at the time of FDG-avid presacral lesion detection were assessed between patients with recurrent presacral cancer and benign presacral tissue using the unpaired *t*-test for Gaussian continuous data, the Mann-Whitney *U* test for non-Gaussian continuous data, and the Fisher's exact test for binary data.

The PPV of the FDG-PET scan with an FDG avid presacral lesion for the diagnosis of locally recurrent rectal cancer was calculated. The PPVs were also calculated for only those presacral lesions that demonstrated FDG uptake that was markedly higher than liver, and for those patients who had not received any treatment within 6 and 12 months before FDG-PET/CT. Furthermore, in the entire group of patients with an FDG-avid presacral lesion, the diagnostic value of the absence or presence of intralesional air was assessed.

In the subset of patients who also underwent MRI, receiver operating characteristic (ROC) analyses were done, and areas under the ROC (AUCs) were calculated, for MRI without and with DWI separately. In addition, sensitivity, specificity, PPV, and negative predictive value (NPV) of MRI without DWI and with DWI for locally recurrent presacral rectal cancer were calculated. Likelihood scores of 1–3 were considered negative and likelihood scores of 4–5 were considered positive for this purpose. Observer agreement between the two MRI readers was assessed using the weighted κ statistic, defined as poor (<0.2), fair (>0.2 to ≤0.4), moderate (>0.4 to ≤0.6), good (>0.6 to ≤0.8), and very good (>0.8 to ≤1) agreement. Differences in lesion size (mean of both observers) between recurrent presacral cancer and benign presacral tissue were assessed using an unpaired *t*-test.

P-values less than 0.05 were considered statistically significant. Statistical analyses were performed using MedCalc version 17.9.7 Software (MedCalc, Mariakerke, Belgium).

Results

Patients

A total of 120 consecutive patients were potentially eligible for inclusion, of whom 82 were excluded for reasons mentioned in Fig. 1. Thus, 38 unique patients (mean age of 63.3 ± 10.2 years, age range of 44–80 years, 26 men and 12 women) were finally included. 24 patients underwent low anterior resection (LAR) (13 with additional radiation and eight with additional chemoradiation therapy), 13 underwent abdominoperineal resection (APR) (11 with additional chemoradiation therapy), and one underwent total exenteration. All 38 patients only had FDG-avid presacral tissue and no FDG-avid tissue elsewhere in the pelvis. Twenty of 38 patients had no FDG-avid lesions elsewhere in the body, while eight patients had FDG-avid lesions in the liver, four patients had suspicious FDG-avid lymph nodes, two patients had FDG-avid lung lesions, two patients had FDG-avid abdominal wall lesions, one patient had both FDG-avid liver and lung lesions, and one patient had FDG-avid lung lesions and suspicious FDG-avid lymph nodes. Other basic clinical and laboratory characteristics of included patients are shown in Table 1.

Reference standard

The diagnosis of locally recurrent rectal cancer was based on biopsy in 14 patients (CT-guided: n = 8; ultrasound-guided: n = 3; endoscopic: n = 3), on histopathology after surgical resection in three patients, on an increase in lesion size on follow-up imaging in four patients (at 3, 9, 11, and 11 months follow-up), and on a decrease in lesion size after radiation therapy at 3 months follow-up in one patient. Locally recurrent rectal cancer was deemed absent based on histopathology of the specimen after surgical excision in five patients, on absence of growth of the lesion size on

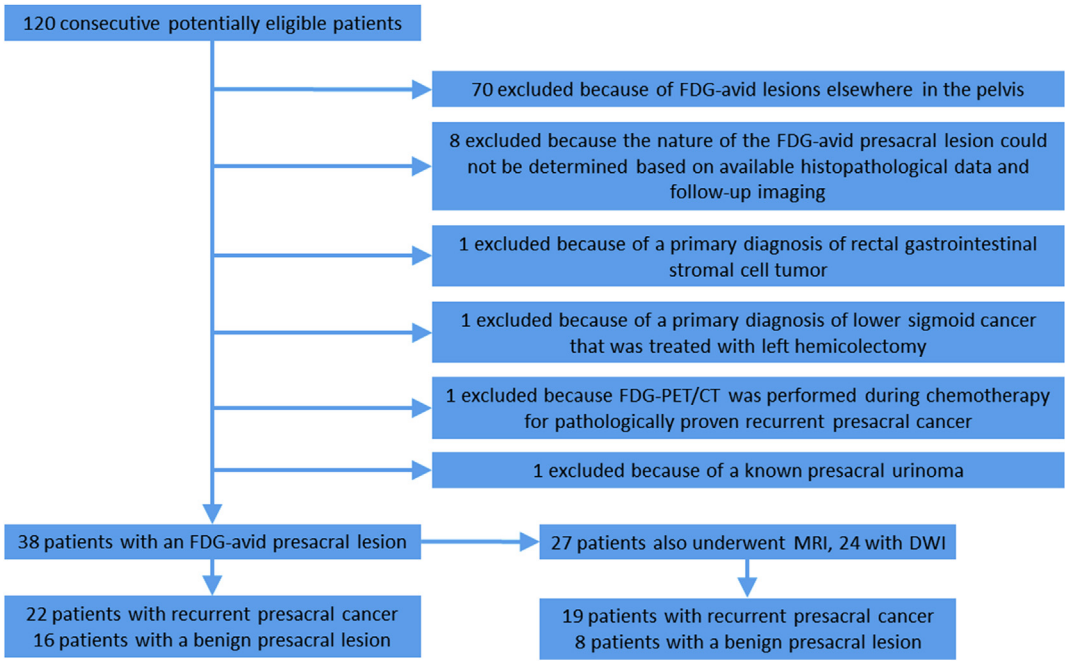

Fig. 1. Flowchart showing the numbers of potentially eligible patients, excluded patients, and included patients.

Table 1
Basic clinical and laboratory characteristics of included patients.

Parameter	All patients	Locally recurrent presacral cancer	Benign presacral tissue	*P*-value[a]
Age (years)	63.3 ± 10.2[b]	64.4 ± 10.6[b]	61.8 ± 9.7[b]	0.442[c]
Gender (M/F)	26/12	11/11	15/1	0.005[d]
Presence of metastases at primary diagnosis (yes/no)	8/30	5/17	3/13	1.000[d]
Pathological tumor stage after primary resection[e]	2 (1–3)[i,f]	3 (2–3)[f]	2 (1–3)[f]	0.049[g]
Radicality after primary resection (R0/R1)	29/6[j]	16/5	13/1	0.366[d]
Previous history of local recurrence (yes/no)	4/34	4/18	0/16	0.124[d]
Time between last treatment and FDG-PET/CT (months)	21.5 (12.0–135.4)[f]	17.5 (11.0–28.0)[f]	28.5 (15.5–44.0)[f]	0.268[g]
Presence of symptoms (yes/no)[h]	15/23	10/12	5/11	0.506[d]
Presence of metastases (yes/no)[h]	18/20	10/12	8/8	1.000[d]
CEA (μg/L)[h]	5.3 (2.8–13.3)[k,f]	7.2 (2.9–15.7)[f]	4.5 (2.5–8.6)[f]	0.377[g]
CRP (mg/L)[h]	6.0 (2.8–9.7)[l,f]	6.0 (3.6–58.8)[f]	6.0 (3.4–9.3)[f]	1.000[g]
Leukocytes (10^9/L)[h]	7.0 (6.1–10.2)[m,f]	7.8 (6.0–10.7)[f]	6.3 (6.1–10.2)[f]	0.744[g]

Notes.
[a] Locally recurrent presacral cancer vs. benign presacral tissue.
[b] Mean ± standard deviation.
[c] Unpaired *t*-test.
[d] Fisher's exact test.
[e] Based on the surgical excision specimen and without considering distant metastases.
[f] Median with interquartile range.
[g] Mann-Whitney *U* test.
[h] At time of presacral FDG-avid lesion detection.
[i] One missing data.
[j] Two missing data and excluding one other case in which the pathologist could not differentiate between R0 and R1.
[k] Four missing data.
[l] Twenty-four missing data.
[m] Nineteen missing data.

follow-up imaging in nine patients (at 6, 8, 11, 13, 15, 24, 32, 32, and 58 months follow-up), and on a decrease in lesion size without any intervening treatment on follow-up imaging in two patients (at 3 and 24 months follow-up).

Clinical and laboratory parameters

Women were significantly more frequently diagnosed with locally recurrent rectal cancer then men ($P = 0.005$), and patients with a higher pathological tumor stage after primary resection more frequently experienced locally recurrent rectal cancer than those with a lower pathological tumor stage ($P = 0.049$). Other clinical and laboratory parameters were not significantly different between patients with and without locally recurrent rectal cancer (Table 1).

Diagnostic value of FDG-PET/CT

The PPV of the presence of an FDG-avid presacral lesion for the diagnosis of locally recurrent rectal cancer was 58% (22/38). The PPV for only those presacral lesions that demonstrated FDG uptake that was markedly higher than liver was 63% (20/32). Further excluding patients who received treatment within 6 and within 12 months before FDG-PET/CT yielded PPVs of 64.5% (20/31) and 59.1% (13/22). Intralesional air was observed in 13/38 patients with an FDG-avid presacral lesion, and favoured the diagnosis of benign presacral tissue with a sensitivity of 56.3% (9/16), a specificity 81.8% (18/22), a PPV of 69.2% (9/13), and a NPV of 72.0% (18/25). Representative examples are shown in Figs. 2–4.

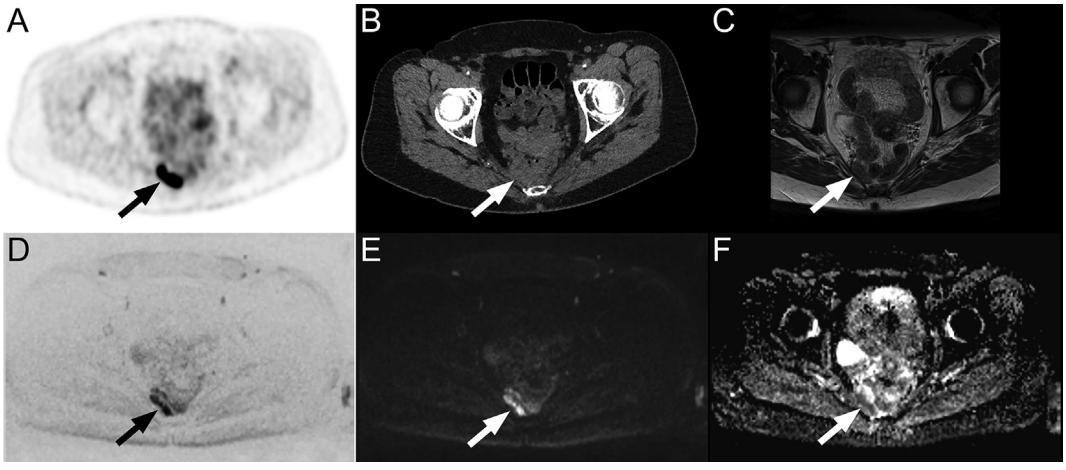

Fig. 2. FDG-PET/CT and MRI in a 65-year-old woman who completed primary treatment for rectal cancer (chemoradiation and APR, ypT3N1, R0-1) and who presented with rising CEA levels 11 months later (Table 2, patient 18). PET (A) and corresponding CT (B) show an FDG-avid presacral soft tissue lesion (arrows). The lesion appears with somewhat rounded borders on T2-weighted MRI (C, arrow). Grayscale inverted and non-grayscale inverted DWI acquired with a b-value of 800 s/mm^2 (D and E), and corresponding ADC map calculated with b-values of 50 and 800 s/mm^2 (F) show the lesion with high signal intensity on DWI and relatively low signal on the corresponding ADC map (arrows). The FDG-avid presacral lesion was judged to likely represent recurrent cancer based on T2-weighted imaging alone, and very likely to represent recurrent cancer based on T2-weighted imaging combined with DWI. CT-guided biopsy confirmed recurrent cancer.

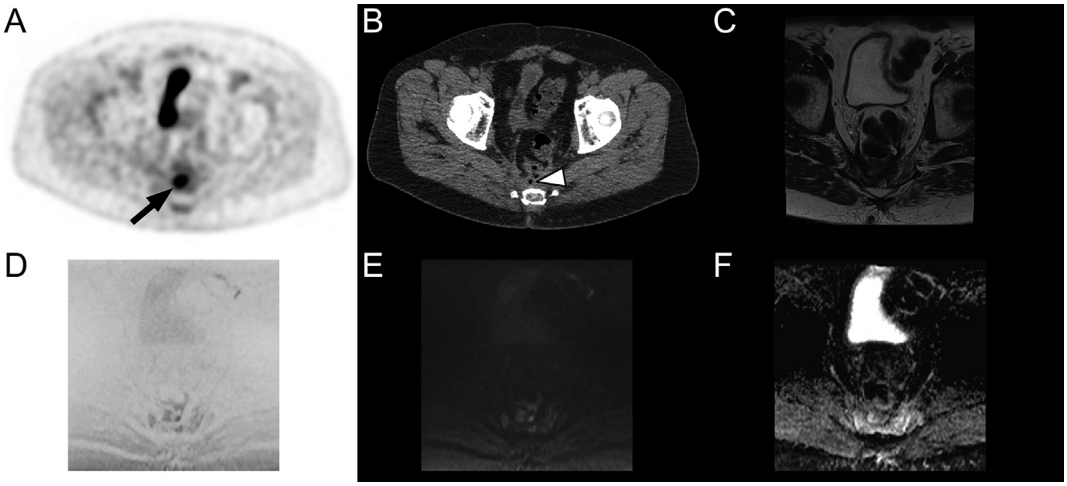

Fig. 3. FDG-PET/CT and MRI in a 67-year-old man who completed primary treatment for rectal cancer (chemoradiation and LAR, ypT1N0, R1) and whose surveillance CT-scan (not shown) suggested an increase in presacral soft tissue 82 months later (Table 2, patient 11). PET (A) and corresponding CT (B) show an FDG-avid presacral soft tissue lesion (arrow), with some intralesional air (arrowhead). T2-weighted MRI (C) shows presacral tissue with irregular and ill-defined borders. Grayscale inverted and non-grayscale inverted DWI acquired with a b-value of 800 s/mm^2 (D and E), and corresponding ADC map calculated with b-values of 50 and 800 s/mm^2 (F) do not show any circumscribed lesion. The FDG-avid presacral lesion was judged of unclear nature based on T2-weighted imaging alone, and unlikely to represent recurrent cancer based on T2-weighted imaging combined with DWI. Two endoscopic biopsies were negative for tumor and the lesion remained unchanged on follow-up imaging, which indicated a benign nature of the presacral lesion.

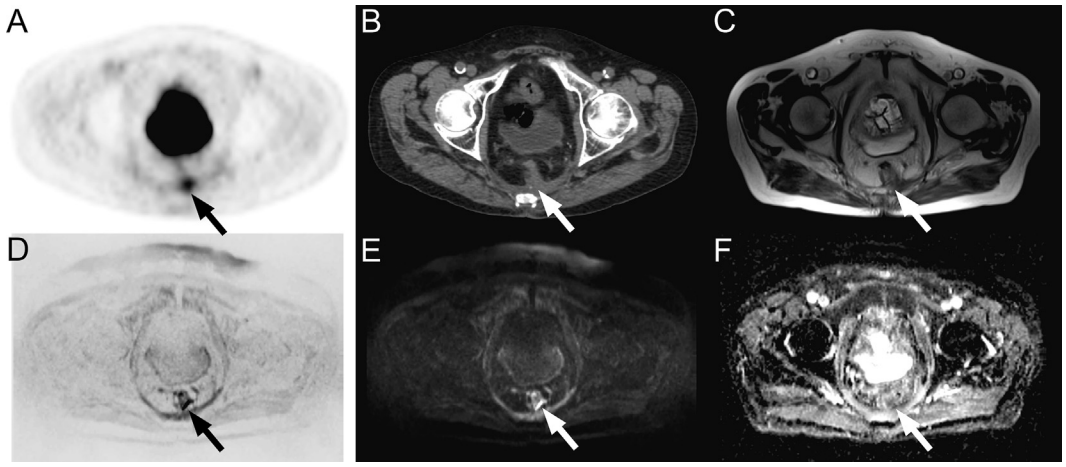

Fig. 4. FDG-PET/CT and MRI in a 76-year-old man who completed primary treatment for rectal cancer (radiation and LAR, ypT3N1, R0), and who also underwent liver metastasectomy (Table 2, patient 4). Follow-up PET/CT showed an FDG-avid presacral lesion (A and B, arrows). The lesion does not show clear rounded or lobulated borders on T2-weighted MRI (C, arrow). Grayscale inverted and non-grayscale inverted DWI acquired with a b-value of 800 s/mm^2 (D and E), show the lesion to be slightly hyperintense (arrows), but without any clearly decreased signal intensity compared to background on the corresponding ADC map calculated with b-values of 0 and 800 s/mm^2 (F, arrow). The FDG-avid presacral lesion was judged unlikely to represent recurrent cancer both on T2-weighted imaging alone and combined T2-weighted imaging and DWI. However, endoscopic biopsy revealed recurrent cancer.

Diagnostic value of MRI

AUCs of MRI without DWI for the diagnosis of locally recurrent rectal cancer in FDG-avid presacral tissue were 0.765 and 0.840, for observers 1 and 2, respectively. AUCs of MRI with DWI were 0.803 and 0.811, for observers 1 and 2, respectively (Fig. 5). There were no significant differences among any of these AUCs ($P = 0.169$ to 0.906). When considering likelihood scores of 1–3 as negative and likelihood scores of 4 and 5 as positive for locally recurrent cancer, MRI without DWI achieved sensitivity and specificity values of 52.6% (10/19) and 100% (8/8) for observer 1, and 73.7% (14/19) and 100% (8/8) for observer 2. MRI with DWI achieved sensitivity and specificity values of 70.6% (12/17) and 100% (7/7) for observer 1, and 70.6% (12/17) and 85.7% (6/7) for observer 2. Observer agreements for MRI without and with DWI were both moderate with weighted κ values of 0.522 and 0.528, respectively. Mean lesion size of recurrent presacral cancer (4.6 ± 1.7 cm) was not significantly different ($P = 0.832$) from that of benign presacral tissue (4.8 ± 2.5 cm). Representative examples are shown in Figs. 2–4. Table 2 displays the visual scores for the likelihood of recurrent rectal cancer on MRI without DWI and with DWI for the 27 patients who underwent both FDG-PET/CT and MRI.

Discussion

The results of this study show that FDG avidity of a presacral lesion in previously treated rectal cancer patients, is not a specific sign for locally recurrent disease, with an overall PPV of only 58%. In subanalyses that only included patients with very high presacral FDG uptake (i.e., markedly higher than liver) and that excluded patients who were relatively recently treated, the PPV only marginally increased to 64.5% for patients who were not treated

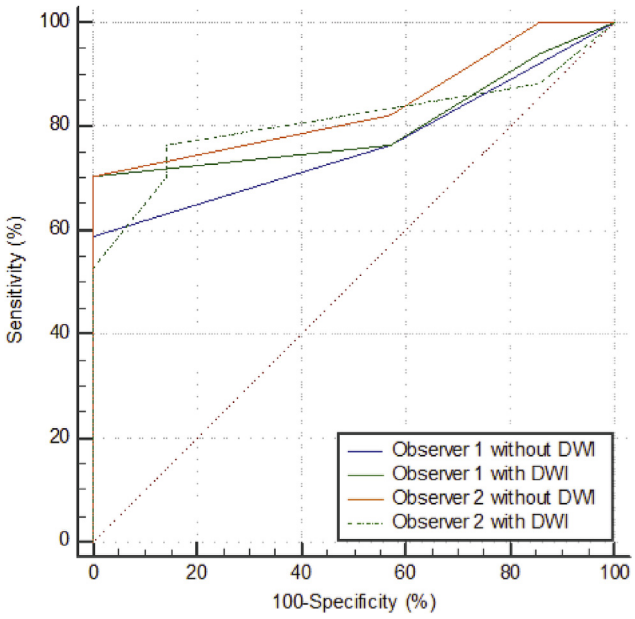

Fig. 5. ROC curves for MRI without and with DWI, for observers 1 and 2. AUCs of MRI without DWI for the diagnosis of locally recurrent rectal cancer in FDG-avid presacral tissue were 0.765 and 0.840, for observers 1 and 2, respectively. AUCs of MRI with DWI were 0.803 and 0.811, for observers 1 and 2, respectively. There were no significant differences between any of these AUCs ($P = 0.169$ to 0.906).

within 6 months before FDG-PET/CT and to 59.1% for patients who were not treated within 12 months before FDG-PET/CT. These findings contradict previously reported opinions that FDG-PET can accurately differentiate between presacral "scar" and viable tumor, that the reliability of FDG-PET improves with time (assumed due to resolution of early postradiation inflammation), and that FDG activity at 6 months after completion of radiation therapy most likely represents tumor recurrence [9,10]. FDG-avid presacral lesions should thus be interpreted with caution, and treatment decisions should not be made without histopathological confirmation.

Interestingly, in the present study that included patients with FDG-avid presacral soft tissue abnormalities, women were significantly more frequently diagnosed with local recurrent rectal cancer than men, and locally recurrent rectal cancer was significantly more frequent in patients with higher pathological tumor stage after primary resection. Although the latter is not unexpected, the former is rather surprising. According to a post-hoc Mann-Whitney test, there was no significant difference in pathologic tumor stage distribution between men and women ($P = 0.682$). Therefore, the higher frequency of locally recurrent presacral cancer in women cannot be attributed to differences in pathologic tumor stage distribution. A clear explanation for this finding cannot be given at this moment. Further research with a larger sample size is necessary to confirm or refute this finding.

We also looked at the phenomenon of presacral intralesional air on CT. Although this sign was not very sensitive, its specificity for the diagnosis of benign FDG-avid presacral tissue was rather high (81.8%). We speculate that it may be due to microleakage from the rectal stump or anastomosis that causes presacral inflammatory changes (intralesional air was observed in eight patients with benign presacral tissue after LAR and in only one patient with benign presacral tissue after APR). However, intralesional air was also seen in locally recurrent rectal cancer (in three patients after LAR and in one patient after APR). Therefore, it is not pathognomonic of benign presacral tissue.

We also investigated the value of MRI in determining the nature of presacral FDG-avid soft tissue abnormalities. MRI proved to be diagnostically helpful, with AUCs of around 0.8. MRI particularly achieved a high specificity when only considering indeterminate

Table 2
Visual scores for the likelihood of recurrent rectal cancer on MRI without DWI and with DWI (1 = very unlikely; 2 = unlikely; 3 = unclear; 4 = likely; and 5 = very likely) for 27 patients who underwent both FDG-PET/CT and MRI, for observers 1 and 2. Final diagnosis (recurrent presacral rectal cancer vs. benign presacral tissue) is also given.

Patient no.	Observer 1		Observer 2		Final diagnosis
	Without DWI	With DWI	Without DWI	With DWI	
1	4	5	5	5	Recurrence
2	3	4	4	5	Recurrence
3	5	5	5	4	Recurrence
4	2	2	2	2	Recurrence
5	4	5	5	5	Recurrence
6	2	NA	4	NA	Recurrence
7	4	4	5	5	Recurrence
8	2	2	2	1	Benign
9	4	4	4	4	Recurrence
10	2	1	2	2	Benign
11	3	2	3	2	Benign
12	3	3	3	2	Recurrence
13	3	3	3	2	Benign
14	3	NA	3	NA	Benign
15	3	4	5	5	Recurrence
16	2	3	1	2	Benign
17	2	1	4	4	Recurrence
18	4	5	4	5	Recurrence
19	3	NA	4	NA	Recurrence
20	4	5	5	5	Recurrence
21	4	4	5	5	Recurrence
22	4	5	5	5	Recurrence
23	3	3	3	4	Benign
24	3	3	3	2	Benign
25	2	2	2	1	Recurrence
26	4	4	3	3	Recurrence
27	2	2	2	1	Recurrence

Notes: NA: not available.

scores as negative for locally recurrent cancer, however at the expense of a lower sensitivity. DWI did not improve diagnostic performance. Observer agreement was only moderate, which further underlines that the evaluation of presacral soft tissue in previously treated rectal cancer patients can be challenging, even on MRI.

Evidence on the role of FDG-PET/CT and MRI in the detection of recurrent rectal cancer in the presacral space has been very limited until now. Presacral recurrences should be considered separately from central and lateral pelvic side wall recurrences [2], because presacral soft tissue abnormalities have been reported to occur in up to 50% of patients after primary treatment for rectal cancer [4], which causes diagnostic difficulties in patients who are suspected of recurrent disease. One previous study that investigated the diagnostic value of FDG-PET/CT in the detection of pelvic recurrence in 62 patients with rectal cancer who underwent LAR or APR, reported that seven out of eight FDG-avid presacral lesions were positive for recurrent rectal cancer, which yielded a high PPV of 87.5% [4]. However, the fact that only 16% of patients (10/62) in that study underwent additional radiation therapy [4], compared to 84% of patients (32/38) in the present study, may explain this discrepancy. Moreover, the present study included a considerably higher number of patients with FDG-avid presacral lesions. Another study reported that FDG-PET/CT correctly described recurrence in the presacral region in all 10 patients [5]. In addition, neither false positive nor false negative findings were reported in the presacral region [5]. However, it was unclear what type of surgery was performed in these 10 patients and if they underwent additional radiation therapy [5]. Yet more recent work reported the PPV of FDG-PET/CT to be only 48.1% based on a series of 60 patients with suspicious findings at follow-up CT after curative-intent surgery [11], although this study did not perform a separate analysis for presacral lesions.

With regard to the recent literature on the role of MRI in this setting, one study included only 11 presacral recurrences without any patients with benign presacral tissue [6], another study included only three presacral recurrences without separately reporting on the value of MRI for presacral space assessment [7], and two other studies mixed patients with presacral lesions with lesions elsewhere in the pelvis [8,11]. One recent study that investigated 47 integrated FDG-PET/MRI examinations in 46 patients, reported sensitivity, specificity, PPV, and NPV of 94%, 94%, 97%, and 90%, respectively [12]. However, the MRI part of the examination in that study was inhomogeneous (only 32 of 47 examinations included diagnostic axial T2-weighted sequences), and no separate analysis was made for presacral lesions [12].

The present study had some limitations. First, different integrated PET/CT systems were used, some of which were not EARL/EANM accredited [13], and semiquantitative FDG measurements were not done. Second, ADC measurements were not done, because different b-values were used for DWI. Moreover, such measurements in the posttreatment setting are known to suffer from high interobserver variability [14] and may yield false-positives when fat, which has a low ADC, is inadvertently included in the region or volume of interest analysis [8]. Third, 11 of 38 included patients did not undergo MRI, three patients did not undergo MRI with DWI, and laboratory values (in particular CRP and leukocyte levels) were missing in several patients.

Conclusions

FDG-PET/CT has a poor PPV for locally recurrent rectal cancer in the presacral space. The observation of air in the FDG-avid presacral lesion is diagnostically helpful, and should be routinely evaluated for, given the fact that the CT component is readily available as part of the FDG-PET/CT examination. MRI achieves a relatively high diagnostic performance in the evaluation of the FDG-avid presacral mass (although without a significant additional value of DWI) and is recommended in these patients.

Conflict of interest statement

Declarations of interest: None (all authors).

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