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Survey of rectal cancer MRI technique and reporting tumour descriptors in the UK: a multi-centre British Society of Gastrointestinal and Abdominal Radiology (BSGAR) audit

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AIM: To evaluate variation in magnetic resonance imaging (MRI) technique and reporting of rectal cancer staging examinations across the UK.

MATERIALS AND METHODS: A retrospective, multi-centre audit was undertaken of imaging protocols and information documented within consecutive MRI rectal cancer reports between March 2020 and August 2021, which were compared against American and European guidelines. Inclusion criteria included histologically proven rectal adenocarcinoma and baseline staging MRI rectum only.

RESULTS: Fully anonymised data from 924 MRI reports by 78 radiologists at 24 centres were evaluated. Thirty-two per cent of radiologists used template reporting, but these reports offered superior documentation of 13 out of 18 key tumour features compared to free-text reports including T-stage, relation to peritoneal reflection and mesorectal fascia (MRF), nodal status, and presence of extramural venous invasion (EMVI; $p<0.027$ in each). There was no significant differences in the remaining five features. Across all tumour locations, the tumour relationship to the MRF, the presence of EMVI, and the presence of tumour deposits were reported in 79.5%, 85.6%, and 44% of cases, respectively, and tumour, nodal, and distant metastatic stage documented in 94.4%, 97.7%, and 78.3%. In low rectal tumours, the relationship to the anal sphincter complex was reported in only 54.6%.

CONCLUSION: Considerable variation exists in rectal cancer MRI acquisition and reporting in this sample of UK centres. Inclusion of key radiological features in reports must be improved

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for risk stratification and treatment decisions. Template reporting is superior to free-text reporting. Routine adoption of standardised radiology practices should now be considered to improve standards to facilitate personalised precision treatment for patients to improve outcomes.

Introduction

Rectal cancer accounts for a third of colorectal cancer, which is the fourth commonest cancer in the UK.[1] Magnetic resonance imaging (MRI) is central to the management of rectal cancer by assessing additional features beyond tumour–node–metastasis (TNM) staging that helps guide personalised patient treatment.[2] MRI identifies patients with locally advanced rectal cancer with poor prognostic imaging features including extramural venous invasion (EMVI), tumour deposits, and involvement of the mesorectal fascia (MRF) suitable for neoadjuvant treatments including chemoradiotherapy (CRT). These imaging features are prognostically significant, separating "high"- and "low"-risk patients, thereby guiding non-surgical and surgical decisions about the types, radicality, and order of treatments.[2–4]

Rectal cancer management varies globally, reflected in the different imaging protocols and reporting standards for rectal cancer MRI from European Society of Gastrointestinal and Abdominal Radiology (ESGAR)[5] and North American Society of Abdominal Radiology (SAR).[6] For example, European guidelines sub-classify T3 tumour extramural invasion depth (T3a–d)[5] as rectal cancer T3b with ≤5 mm extension (T3a or b) without MRF involvement can be considered for non-surgical treatment with curative intent or proceed straight to total mesorectal excision (TME) surgery, whereas North American guidelines do not subclassify T3 disease with most patients proceeding to CRT and surgery.[7] These differences in international consensus highlight controversies for initial staging of rectal cancer and may contribute to variation in clinical practice leading to regional inconsistency in treatment decisions.

The present study evaluated current practice and performance in a national multicentre retrospective audit of protocols and reporting in the primary staging of rectal cancer using MRI to assess the variance against standards based on ESGAR[5] and SAR[8] guidelines.

Materials and methods

A national retrospective, multicentre audit was coordinated by BSGAR. An open invitation to participate in this audit was distributed among BSGAR members working in NHS Trusts in the UK. Hospitals where radiologists reported across more than one site within the same Trust were counted as a single centre.

Audit standards were adapted by the investigators from the ESGAR[5] and SAR[8] guidelines. The audit included two components: the first collected details of the routine rectal cancer staging MRI protocol. Then MRI reports were assessed from centres in consecutive patients with histologically proven rectal adenocarcinoma (inclusive of confirmatory post-operative histology), and baseline pre-treatment staging MRI rectum. Post-treatment MRI reports, and patients with unconfirmed histology, pathology other than adenocarcinoma, or a tumour location other than the rectum (including distal sigmoid colon and anal canal) were excluded. An aspirational target of 10 case submissions per radiologist reporting MRI rectum at each centre and 30 per centre was requested. MRI examinations were performed between 1 March 2020 and 31 August 2021 inclusive. Staging information included in patient reports was assessed against a standard set of 18 key tumour descriptors to assess completeness.[9]

RedCAP (Research Data Collection Service) was used as a secure portal for centres to submit anonymised data[10] (Electronic Supplementary Material for data forms). Descriptive statistics were used to summarise the data. Cases with missing data were excluded from the summary statistics. The chi-square test was used to test assess for differences in reported tumour descriptors between free-text and template reports (Microsoft Excel 365).

This work comprised an observational service evaluation without deviation from normal practice and in accordance with clinical governance guidelines. Formal research ethics committee approval was not required.

Results

Twenty-four UK centres (11 university teaching hospitals, 13 other centres), geographically spread across the UK (Fig 1), submitted data for 924 patients reported by 78 radiologists. Three patients had incomplete datasets for the tumour characterisation, so 921 patients are included in the statistical analysis. The number of MRI reports per radiologist ranged from 1–47 (median 10). The number of radiologists reporting rectal cancer MRI at each centre ranged from 1–10 (median 5). In the preceding 12 months, all reporting radiologists attended the colorectal multidisciplinary team (MDT) meeting in 13 of 24 centres (54.2%), while in eight centres (33.3%), 60–67% of reporting radiologists attended the MDT meeting and in three centres (12.5%), only 50% attended the MDT meeting.

Imaging protocols and patient preparation

Of the centres, 70.8% (17/24) exclusively used 1.5 T MRI, 25% (6/24) used a combination of 1.5 and 3 T, and 4.2% (1/24) used only 3 T. Routine spasmolytics were used in 12

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Figure 1 Map of the UK with red pins to mark the site of centres from which data were submitted. A blue pin denotes three independent centres within Greater London that submitted data. There is a notable spread throughout the UK including centres in Wales and Scotland and across England.

centres (46.2%) with a higher proportion in centres using 3 T MRI (5/7; 71.4%) compared to sites that used 1.5 T (9/17; 52.9%; p=0.2). MRI scan duration varied between 20–50 minutes (median 40 minutes, SD 8.1).

All centres used axial T2 and sagittal T2 sequences with orthogonal plans perpendicular to the tumour axis. A coronal T2 sequence was performed in 22 centres (91.6%) and an axial T1 sequence in nine (37.5%). Diffusion-weighted imaging was routinely used in 19 centres (79.1%) with 800 s/mm^2 as the commonest high b-value in 10 (52.6%); 1,000 s/mm^2 in six (31.6%); 1,200 s/mm^2 in two (10.5%); and 1,400 s/mm^2 in one (5.3%).

Referral information

The location of the rectal tumour was included in the clinical history in 607 of 901 (67.4%) MRI referrals. The biopsy histology was documented in only 44 of 897 (4.9%) of referrals for MRI.

MRI reporting

Primary tumour location, size, and morphological features

Although "basic" descriptors of tumour location and length are reported in >90% of cases (Table 1) the height of the tumour in the rectum was reported in a lower proportion compared to fixed landmarks (anorectal junction/puborectal sling in 62.2%, anal verge 85.8%, and peritoneal reflection 64.9%). Furthermore, the radial location (82.5%), morphology (84.3%), and signal intensity (34.5%) were also not reported reliably. Interestingly, there was no difference in reporting of the radial location when T1/2 tumours were compared to more advanced T3/4 tumours (223/268 [83.2%] compared to 499/601 [83%], respectively).

Primary tumour and resection margin status

Although the tumour T staging was reported in 94.4%, all other tumour descriptors were reported in <90% of cases including depth and location of tumour invasion, tumour relationship to the MRF, or anal sphincter and pelvic floor (Table 2). A criterion for defining a threatened MRF (e.g., <2 mm, or another measurement) was stated in 183/274 (66.8%) of reports. Furthermore, additional adverse features of EMVI and tumour deposits were commented on in 85.6% and 44.4% of cases, respectively.

N-stage

The N-stage subcategories (i.e., N1a,b,c, N2a,b) were specified in the report in 842/921 (91.4%) of cases, with location and number of the malignant nodes where relevant in 422/505 (88.6%) and 283/498 (56.8%) of cases, respectively. The relationship of the mesorectal nodes to the MRF was recorded in 204/483 (42.2%) of applicable cases. Lymph node evaluation was assessed per radiologist. Table 3 describes the variation in methods of lymph node assessment across the reporting radiologists.

Table 1
Tumour location, size, and morphological factors included in magnetic resonance imaging (MRI) reports.

Location, size, and morphological features	Yes (n (%))	No (n (%))
Tumour location specified?	894/921 (97.1%)	27/921 (2.9%)
Craniocaudal length of tumour reported?	877/921 (95.2%)	44/921 (4.8%)
Tumour morphology specified (i.e., sessile, polypoid, semi-annular, annular)?	776/921 (84.3%)	145/921 (15.7%)
Distance from ano-rectal junction/puborectalis sling reported?	573/921 (62.2%)	348/921 (37.8%)
Distance from anal verge reported?	790/921 (85.8%)	131/921 (14.2%)
Tumour relationship to peritoneal reflection specified?	598/921 (64.9%)	323/921 (35.1%)
Tumour T2 signal specified (e.g., intermediate soft tissue verses high signal mucinous)?	318/921 (34.5%)	603/921 (65.5%)
Tumour radial location in the bowel specified?	760/921 (82.5%)	161/921 (17.5%)
Is the rectal tumour imaged in a perpendicular plane to the long axis?	768/795 (96.6%)	27/795 (3.4%)

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Table 2
Details of primary tumour and relationship to adjacent structures.

Primary tumour		Yes (*n* (%))	No (*n* (%))
T-stage specified?		869/921 (94.4%)	52/921 (5.6%)
	T1	55/869	
	T2	213/869	
	T3	453/869	
	T4	148/869	
Depth of extra-mural invasion if T3/T4 specified?		451/570 (79.1%)	119/570 (20.9%)
	T3a–d	99/451	
	Millimetres	39/451	
	Both	313/451	
Tumour radial location of extra-mural invasion if T3/T4 specified (i.e., anatomical or clockface)		447/540 (82.8%)	93/540 (17.2%)
Relationship to other adjacent organs specified in T4 disease?		112/132 (84.8%)	20/132 (15.2%)
Mesorectal fascia (MRF)		Yes (*n* (%))	No (*n* (%))
Is relationship of tumour to the MRF specified?		732/921 (79.5%)	189/921 (20.5%)
	Clear	420/732	
	Threatened	116/732	
	Involved	196/732	
Relationship of tumour to the MRF specified when the tumour was T3/T4		500/601 (83.2%)	101/601 (16.8%)
Criteria used for threatened MRF stated (<2 mm, other measurement)?		183/274 (66.8%)	91/274 (33.2%)
Location of MRF involvement mentioned (i.e., anatomical or clockface description)?		263/278 (94.6%)	15/278 (5.4%)
Anal sphincter status		Yes (*n* (%))	No (*n* (%))
Relationship to levator, puborectalis, external or internal sphincters for low rectal tumours		200/366 (54.6%)	166/366 (45.4%)
		N/A	555/921 (60.3%)
EMVI		Yes (*n* (%))	No (*n* (%))
Extra-mural venous invasion (EMVI) specified?		788/921 (85.6%)	133/921 (14.4%)
Tumour deposits		Yes (*n* (%))	No (*n* (%))
Presence of meso-rectal tumour deposits (or N1c) specified?		187/425 (44%)	238/425 (56%)
		N/A	496/921 (53.9%)

N/A, not applicable.

Table 3
Methods of lymph node assessment by radiologist.

Different combinations of criteria used by reporters	Reporters that use the criteria
Combined ESGAR[a]	18/75 (24%)
Combined ESGAR[a] and Chemical shift	16/75 (21.3%)
Combined ESGAR[a] and Chemical shift, node signal	1/75 (1.3%)
Combined ESGAR[a] and Node signal, node border	2/75 (2.7%)
Chemical shift and node signal, node border, node size	5/75 (6.7%)
Chemical shift and node signal, node border	3/75 (4%)
Chemical shift and node signal, node size	2/75 (2.7%)
Node signal, border and size	21/75 (28%)
Node size	1/75 (1.3%)
Node signal	1/75 (1.3%)
Node signal, node size	1/75 (1.3%)
None of the above criteria	4/75 (5.3%)

[a] Combined European Society of Gastrointestinal and Abdominal Radiology (ESGAR) criteria include size AND morphological suspicious criteria: [1] round shape, [2] irregular border, [3] heterogenous signal.

M-stage

The majority (584/921; 63.4%) were staged as M0 and 137/921 (14.9%) as M1 on any staging method including computed tomography (CT), integrated positron-emission tomography (PET)-CT, or MRI. In 21.7% (200/921) of cases, the M stage was not provided. Subclassification (e.g., M1a, M1b, or M1c) was recorded in 46/137 (33.6%) where distant metastatic disease was present. As expected, the increasing T-stage of the primary corresponded to the M1 status; 0/39 (0%) of T1 tumours versus 6/157 (3.8%) T2 tumours, 83/364 (22.8%) T3 tumours, and 44/126 (34.9%) of T4 tumours.

MRI report summary

A final summary of the key staging information (e.g., tumour location, TNM stage, EMVI, and MRF status) was included in 707/921 (76.8%) of reports.

Template reports versus free-text reports

A reporting template was used by radiologists in 297 of 922 (32.2%) MRI reports. Across the 24 centres, three (12.5%) used template only reports, eight (33.3%) used free-text only reports and the remaining 13 (54.2%) used a combination of free-text and template reporting. Highly significant differences in the majority of key tumour descriptors were observed compared to a free-text alternative (Table 4). There is no significant difference in reporting tumour location as well as two sub-descriptors related to aspects of involved node location, and one sub-descriptor for the position of MRF involvement.

Considerable variation in key tumour descriptors included in reports were demonstrated between centres depending on the reporting format. Further differences existed between centres that used template reports, free-text reports, or a combination. Four key tumour descriptors were further analysed to examine the differences in inclusion between template and free-text alternatives (Fig 2).

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Table 4
Key tumour descriptors and their inclusion on prose and template report styles.

		Total no. of free-text reports including variable/total number of free-text reports (%)	Total no. of template reports including the variable/total number of template reports (%)	Chi-square statistic	*p*-Value
Tumour	Location	602/624 (96%)	292/297 (98%)	1.80	0.18
	Craniocaudal Length	582/624 (93%)	295/297 (99%)	14.93	0.0001
	Distance from the anal verge	495/624 (79%)	295/297 (99%)	64.34	<0.0001
	Shape	483/624 (77%)	293/297 (98%)	66.90	<0.0001
	Radial location of wall involvement	475/624 (76%)	285/297 (95%)	53.53	<0.0001
	MRI signal	166/624 (27%)	152/297 (51%)	52.68	<0.0001
	Relationship to peritoneal reflection	327/624 (52%)	271/297 (91%)	131.62	<0.0001
	T stage	572/624 (92%)	297/297 (100%)	24.69	<0.0001
If ≥T3	Distance through muscularis propria	131/247 (71%)	182/185 (98%)	106.70	<0.0001
MRF	MRF status	441/624 (71%)	291/297 (98%)	90.33	<0.0001
	Location closest to MRF	140/151 (93%)	123/127 (97%)	1.57	0.21
If ≥T4	Which organs involved	69/87 (79%)	43/45 (96%)	4.89	0.027
Nodes	Nodal status	551/624 (88%)	291/297 (98%)	22.82	<0.0001
	Location of involved nodes	284/344 (83%)	138/161 (86%)	0.58	0.45
	Mesorectal node relationship to MRF	141/330 (43%)	63/153 (41%)	0.049	0.82
EMVI	EMVI status	495/624 (79%)	293/297 (99%)	59.28	<0.0001
Metastases	Distant metastatic status	459/624 (74%)	262/297 (88%)	24.58	<0.0001
Overall predicted TNM stage		416/624 (67%)	291/297 (98%)	108.87	<0.0001

MRF, mesorectal fascia; EMVI, extra-mural venous invasion; TNM, tumour–node–metastasis.

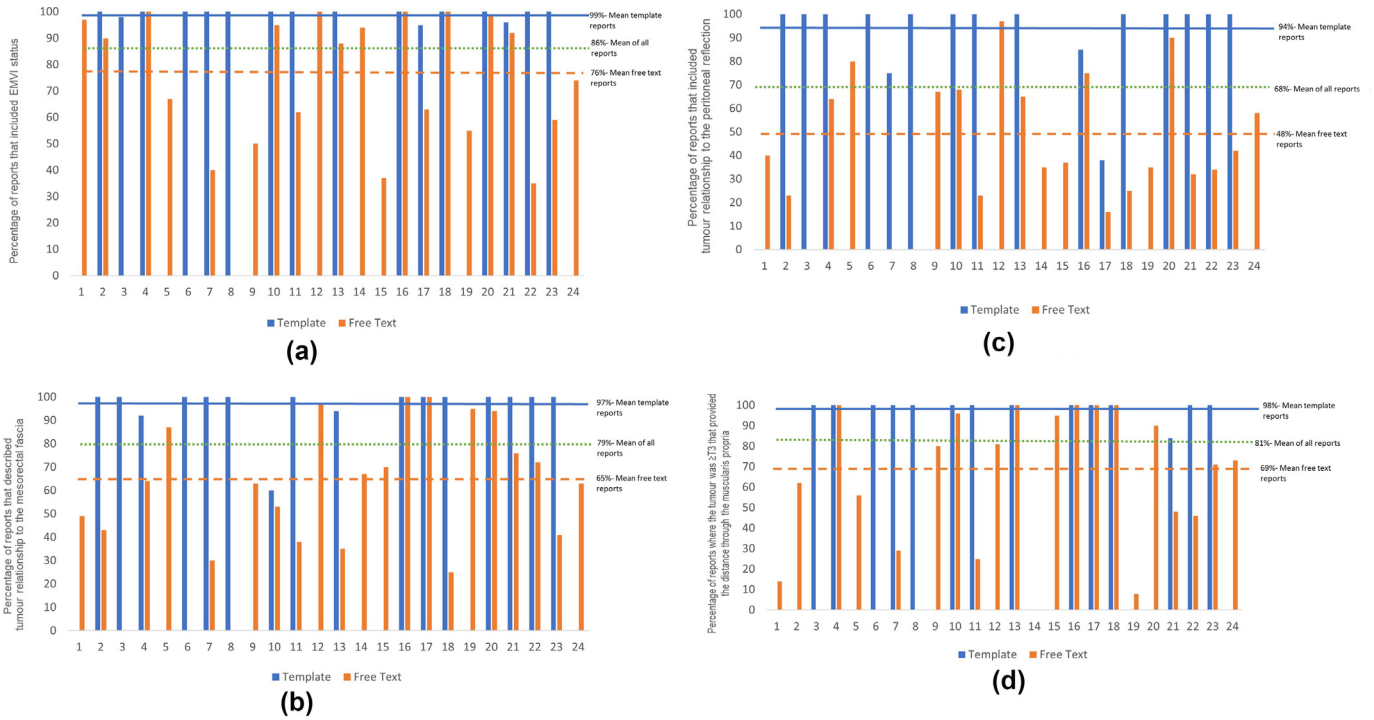

Figure 2 (a) Bar chart illustrating variation in reporting EMVI status by centre comparing template reports and free-text reports. (b) Bar chart illustrating variation in reporting tumour relationship to the MRF by centre comparing template reports and free-text reports. (c) Bar chart illustrating variation in reporting tumour relationship to the peritoneal reflection by centre comparing template reports and free-text reports. (d) Bar chart illustrating variation in reporting depth of tumour invasion through muscularis propria in T3 or T4 tumours by centre comparing template reports and free-text reports.

Discussion

This research confirms considerable variation in image acquisition and reporting of rectal cancer MRI between UK centres. Although outcomes for rectal cancer have significantly improved in line with advances in surgical techniques, preoperative therapies, and imaging methods,[11] important variations exist in radiological practice, which have direct relevance to patient care and may contribute to variation in treatment decisions and outcomes.

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It is clear that structured reporting templates substantially improve the quality of routine MRI reporting documentation for a majority of key tumour features in rectal cancer staging compared to free-text alternatives, which has been established in other research and this practice is preferred by treating clinicians[12–15]; however, a reporting template was only used in 32% of cases. In centres where some radiologists use template reports, but others use free text, the percentage inclusion of key tumour descriptors was higher when template reports were used, showing that a discrepancy exists in free-text reports even where templates are employed by colleagues in arguably higher performing centres. Given the discrepancies that exist in report content, as key tumour descriptors substantially alter management decisions, radiologists should now consider adopting template reports into routine clinical practice and other national radiology organisations are adopting this approach.[8,16]

Specific deficiencies in reporting tumour features could have a predictable clinical impact. For example, high tumour signal was only reported in 27% of free-text and 51% of template reports, despite mucinous adenocarcinoma being associated a worse prognosis, greater propensity for metastatic spread, and higher stage at diagnosis.[17] High-signal mucinous nodal metastases are more difficult to detect on T2 sequences, but is easier on T1; however, this sequence was only performed in 37.5% of centres; missed nodal metastases could lead to under-staging and failure to offer neoadjuvant treatment.

Similarly, the description of the precise tumour position in relation to landmarks such as the anal verge, puborectalis, and peritoneal reflection, are missing in almost 40% of reports, which is important for surgical and radiotherapy treatment planning. The depth of tumour extension beyond the muscularis propria and presence of EMVI or tumour deposits are also key features deciding the risk of local recurrence or distant metastatic disease, which is particularly important for case selection with total neoadjuvant therapy involving systemic chemotherapy with short-course radiotherapy or CRT.[18,19] The involvement and description of involvement of the anal canal and pelvic floor in low rectal cancer is a further influential area impacting on decisions related to the extent of surgical resection.

Nodal staging is one of the most challenging and contentious components of preoperative rectal cancer evaluation for most radiologists, but it is still considered an important determinant of outcome and included in the most current guidelines.[5] Almost all radiologists specified an N-stage (98% of cases) and described the lymph node location in this audit; however, other substantial variations exist. Most used either the ESGAR criteria alone (24%) or a modification including chemical shift (23%), as an additional criterion for the assessment of malignant nodes, previously shown to be a helpful predictor of malignant nodal status,[20] but not included in the current ESGAR criteria. The number of involved lymph nodes, and their relationship to the MRF, was given in 57% and 42% of relevant cases, respectively. According to the ESGAR consensus statement, node proximity to the MRF is only considered significant in those with extra-capsular spread, which confers a 20–30% risk of recurrence.[21]

There are undoubted challenges keeping up to date with the proliferation of scientific literature in rectal cancer imaging and AJCC version 8 of TNM[22] presents specific challenges to radiologists interpreting MRI. This highlights the need for an expert to identify and resolve areas of difficulty, with an international multidisciplinary group highlighting a need to improve the definition of involved pelvic structures indicating T4b tumour extension, advice on reporting nodes and tumour deposits as well as the diagnosis of lateral pelvic side wall nodes and the evaluation of anal canal involvement.[21]

Important UK workforce and professional development challenges seem to contribute to this picture with only 50% of centres having radiologists reporting MRI that regularly attend a colorectal MDT. Previous Royal College of Radiologists (RCR) standards required radiologists to attend two-thirds of MDT meetings and a minimum of two radiologists allocated to each MDT meeting,[23] but this may no longer be feasible because of other workload pressures or necessary because of the increasing size of MDTs. Although some centres had 10 reporting radiologists, with some not attending MDTs, smaller centres with only one or two radiologists may benefit from a more comprehensive MDT attendance and peer review of practice. These issues impact a radiologist's educational opportunities to gain in-depth understanding of current advances in rectal cancer treatment strategies and apply these to their routine work. It also raises important questions about which radiologist should report specialist examinations and how reporters get the necessary feedback on their work to allow them to maintain and improve their performance.

Although the interpretation of findings is increasingly important and influential on treatment choices, the performance of the MRI is also diverse. The variation in scan duration from 20–50 minutes is likely to be related to the field strength of the scanner, the number of sequences obtained, the incorporation of diffusion-weighted imaging, and the selected b-values, whether T1 sequences are performed and administration of antispasmodic. Although SAR advises DWI and T1 sequences routinely the ESGAR guidelines do not.[5] There is no current consensus regarding the routine use of spasmolytics,[24] which was reflected in the present cohort. Where 3 T MRI systems are used, ESGAR encourages spasmolytics, particularly for upper tumours (5) which may explain the increased spasmolytic use for 3 T MRI in 71% of centres versus 53% using 1.5 T only.

The present audit has some limitations. Data entry was performed by contributing centres, and combined with the retrospective nature of the audit, makes it prone to selection bias, despite the stipulation to include consecutive cases. Furthermore, the pre-defined audit template did not explore reasons behind some of the observed inconsistencies, for example, MRF status omission based on tumour location and involvement of the peritonealised rectum. In addition, the audit did not collect data on the information provided to clinicians at MDT, which may include additional tumour anatomical detail not stated in

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the original report, but which may have contributed to treatment decision-making; however, the strengths of this work include the representation of diverse participating centres across the NHS in the UK and the depth of analysis or individual case-level data allowing a comparison of reporting performance between hospitals and radiologists.

In conclusion, this large, multicentre audit has demonstrated considerable variation in the acquisition and reporting of rectal cancer MRI in the UK and areas of underperformance. Inclusion of key tumour descriptors in MRI reports, particularly in low rectal tumours, must be improved. Superior performance of structured reporting builds a strong case to standardise UK practice to optimise treatment decisions by developing national rectal cancer imaging standards. Further research should evaluate the professional barriers preventing adoption of consensus guidance in routine clinical practice.

Conflict of interest

The authors declare no conflict of interest.

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