Use of magnetic resonance imaging in rectal cancer patients: Society of Abdominal Radiology (SAR) rectal cancer disease-focused panel (DFP) recommendations 2017

Marc J. Gollub,[1] Supreeta Arya,[2] Regina GH Beets-Tan,[3] Gregory dePrisco,[4] Mithat Gonen,[5] Kartik Jhaveri,[6] Zahra Kassam,[7] Harmeet Kaur,[8] David Kim,[9] Andrea Knezevic,[5] Elena Korngold,[10] Chandana Lall,[11] Neeraj Lalwani,[12] D. Blair Macdonald,[13] Courtney Moreno,[14] Stephanie Nougaret,[15] Perry Pickhardt,[9] Shannon Sheedy,[16] and Mukesh Harisinghani[17]

[1]Department of Radiology, Memorial Sloan Kettering Cancer Center, New York, NY 10065, USA

[2]Tata Memorial Centre, Dr. E Borges Road, Parel, Mumbai 400 012, India

[3]Netherlands Cancer Institute, Plesmanlaan 121, 1066 CX Amsterdam, Netherlands

[4]Baylor University Medical Center, 3500 Gaston Ave, Dallas, TX 75246, USA

[5]Department of Biostatistics and Epidemiology, Memorial Sloan Kettering Cancer Center, 1275 York Avenue, New York, NY 10065, USA

[6]University of Toronto University Health Network, 399 Bathurst Street, Toronto, ON M5T 2S8, Canada

[7]Schullich School of Medicine, Western University, 1151 Richmond St, London, ON N6A 5C1, Canada

[8]The University of Texas MD Anderson Cancer Center, 1515 Holcombe Blvd, Houston, TX 77030, USA

[9]University of Wisconsin School of Medicine and Public Health, 750 Highland Ave, Madison, WI 53726, USA

[10]Oregon Health and Science University, 3181 SW Sam Jackson Park Rd, Portland, OR 97239, USA

[11]UC Irvine Health, 101 The City Dr S, Orange, CA 92868, USA

[12]Department of Radiology, Section of Abdominal Imaging, Wake Forest University and Baptist Medical Center, 1 Medical Center Blvd, Winston-Salem, NC 27157, USA

[13]University of Ottowa Medical Center, 75 Laurier Avenue East, Ottawa, ON K1N 6N5, Canada

[14]Emory University School of Medicine, 1648 Pierce Dr NE, Atlanta, GA 30307, USA

[15]IRCM INSERM U1194, SIRIC, 124 Avenue des Apothicaires, 34090 Montpellier, France

[16]Mayo Clinic of Rochester, 200 First St. SW, Rochester, MN 55905, USA

[17]Massachusetts General Hospital, 55 Fruit Street, Boston, MA 02114, USA

Abstract

Purpose: To propose guidelines based on an expert-panel-derived unified approach to the technical performance, interpretation, and reporting of MRI for baseline and post-treatment staging of rectal carcinoma.

Methods: A consensus-based questionnaire adopted with permission and modified from the European Society of Gastrointestinal and Abdominal Radiologists was sent to a 17-member expert panel from the Rectal Cancer Disease-Focused Panel of the Society of Abdominal Radiology containing 268 question parts. Consensus on an answer was defined as ≥ 70% agreement. Answers not reaching consensus (< 70%) were noted.

Results: Consensus was reached for 87% of items from which recommendations regarding patient preparation, technical performance, pulse sequence acquisition, and criteria for MRI assessment at initial staging and restaging exams and for MRI reporting were constructed.

Conclusion: These expert consensus recommendations can be used as guidelines for primary and post-treatment staging of rectal cancer using MRI.

Key words: Rectal MRI—Rectal cancer—Expert panel—Consensus recommendations—White paper

The use of pelvic MRI for staging of rectal cancer is well established and standard of care in Europe for initial evaluation and increasingly for restaging after therapy. [1–8] Guidelines for the performance and interpretation for this emerging indication of MRI have been previously issued by our European colleagues based on evidence and experience, with an intent to bring about quality control and standardization [9, 10]. In our opinion, the US and, to a lesser extent, Canada have been slower to adopt MRI for this particular indication and have done so with a potentially greater variation in practice patterns, perhaps related to a comparatively free-market healthcare environment in the former. The situation is rapidly changing wherein MR is quickly becoming the dominant method of staging for rectal cancer.

Guidelines, recommendations, and expert panel consensus white papers have recently been found to be important educational tools for establishing evidence-based practice patterns and for providing more uniform, high-quality patient care. This is exemplified by the many American College of Radiology Appropriateness Criteria publications [11]. Likewise, there is a need to summarize the expanding body of literature and experience with pelvic MRI use for rectal cancer in North America. Furthermore, the growing use of structured reports in radiology, a contemporaneous quality initiative, provides a very timely opportunity to incorporate an educational component which ensures that clinically relevant findings at rectal MRI are incorporated into the report in order to inform proper treatment [12–18].

In view of the growing use of rectal MRI and, in particular, restaging evaluations aimed at determining the potential for organ-sparing treatment alternatives [6, 19, 20], the purpose of this paper is to report the recommendations of a panel of expert gastrointestinal radiologists chosen from the rectal cancer disease-focused panel (DFP) of the Society of Abdominal Radiology (SAR). These recommendations were created out of a consensus questionnaire process drawing on the clinical and research experience of these experts from academic centers across the Unites States and Canada.

Materials and methods (Fig. 1)

Literature review

The authoritative consensus guidelines paper produced by our European colleagues from the European Society of Gastrointestinal and Abdominal Radiologists (ES-
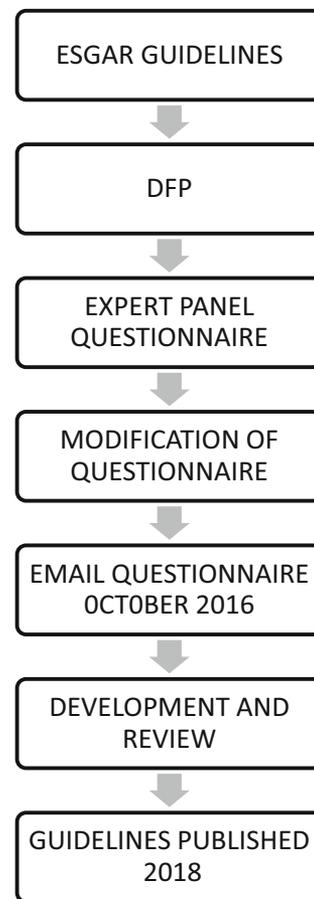

Fig. 1. Process for developing SAR consensus guidelines.

GAR), of which one of the authors (MJG) is a fellow, "Magnetic resonance imaging for the clinical management of rectal cancer patients: recommendations from the 2012 ESGAR consensus meeting," was used as a guide and starting point for the current effort. We used the literature-based facts and same literature review from that publication supplemented by a further literature review (January 2013–February 2018) and the updated Guidelines from that group in 2017 [10] to form our questionnaire.

Expert panel selection

The disease-focused panels (DFPs) were a new initiative of the SAR starting in 2014 with the stated purpose "to improve the care of patients with gastrointestinal and genitourinary diseases. DFPs will improve our ability to meet this mission by focusing on *specific diseases* through organization of passionate and knowledgeable SAR experts who will work together to address unmet needs within medical practice and the imaging community," (http://www.abdominalradiology.org/page/DFP). The Rectal Cancer DFP was formed at the 2016 annual meeting. The members were sent a brief survey document

to make an objective inquiry of their interest and expertise in the subject of rectal cancer and invite them to join an expert panel for the purpose of framing this white paper. They were also asked to suggest potential names of experts outside of the DFP group. The four questions and their summary results are listed in Table 1. There were 17 total panel members. Sixteen were members of the SAR with recognized expertise in abdominopelvic MRI. The other member (BM) was a recognized expert within the Ontario Cancer Care Consortium.

Questionnaire (Appendix A)

The questionnaire was adapted with permission from the ESGAR consensus panel with modifications as follows: (1) *Clarifications* (changing spelling and terminology from British to American English [e.g., "transversal" changed to "axial"], changing PET to PET/CT and PET/MR, combining redundant questions, and clarifying coronal plane as true to the pelvis or to the tumor or to the anal canal; and (2) *Additions* (adding mucinous degeneration, an emerging dilemma in post-treatment MRI [21–24]), adding the presence of lymph nodes or EMVI 0–2 mm from the tumor to the mesorectal fascia to assess for a common misunderstanding about threatened margins [25], adding 0.5 cm size to the nodes after chemoradiation treatment (CRT) because of an emerging literature on post-CRT node thresholds [27–29], and adding imaging planes related to the anal canal. The questionnaire was designed to address the role of MRI and other modalities in the staging and restaging of rectal adenocarcinoma based on current North American practice patterns and expertise, with a recognized need to establish a set of evidence-based recommendations in North America (USA and Canada). We sought to establish the minimum and optimal imaging requirements including hardware, patient preparation, and especially imaging sequences and the criteria for MRI staging and restaging after neoadjuvant treatment. Finally, we aimed to determine features that should go into an MRI report to be complete and concise for patient management. Answer types most commonly included binomial (yes/no) or categorical and numerical continuous (1, 2, 3 mm, etc.).

Data acquisition and data analyses

After modification of the questionnaire by three lead members (MJG, MH, DK), a single email distribution was sent and answers collected in the ensuing months. An in-person meeting was not opted for due to the tendency of people to move toward the majority [30]. Since an in-person meeting was not planned, and since the level of expertise was assumed to be more heterogeneous compared with our European colleagues, we set a level of $\geq 70\%$ as one of *consensus*.

Data reporting

Consensus for an item was present if the item was answered similarly by $\geq 70\%$ of panelists. Lack of consensus was $< 70\%$ agreement [31]. Some panelists may have chosen not to answer a question (for example, less or no experience with routine post-neoadjuvant treatment MRI) in which case the denominator was adjusted accordingly. Descriptive metrics were calculated in summary tables by AK and MG.

Results

A total of 268 question or question parts (114 single part questions and 154 multi-part questions) comprised the final modified questionnaire (Appendix A). Demographic data from the panelists' hospitals are summarized in Table 2.

Items with consensus

Two hundred thirty-two questions reached consensus (86.6%). Items reaching consensus are listed in Table 3.

Items without consensus

Thirty-six items did not reach consensus (13.4%). Items not reaching consensus are listed in Table 4.

Discussion

Adaptation and modification of the ESGAR guidelines questionnaire provided an excellent and comprehensive instrument to collect responses from a group of experts across the US and Canada. A more simplified, stream-

Table 1. Brief survey for expert panel qualifications and results

Survey question	Yes (n)
I have published one or more peer-reviewed articles regarding imaging and rectal cancer	11
I am regularly involved with my center's Colorectal Multidisciplinary Team meetings	17
The volume of cases I read (as well as keeping abreast of the literature) probably qualifies me although I have not as yet published on this subject. (optional: volume: 7–15 cases/week)	3
I serve on a committee a national level related to this topic	16

Table 2. MRI use by expert panelists in 17 hospitals

Question	Frequency (%)
Number of patients diagnosed with rectal cancer per year—median (range)	155 (55, 350)
MRI used as a standard staging technique for rectal cancer	17 (100%)
MRI used since	1998–2016
Restaging after chemoradiation performed routinely	13 (76%)
MRI used for restaging since	2002–2016
MR vendors	
Siemens	4 (23%)
Philips	3 (18%)
GE	4 (23%)
Multiple	6 (36%)
Field strength	
1.5 T	5 (29%)
3 T	3 (18%)
Both	9 (53%)
Type of coil	
Endorectal coil	0 (0%)
Pelvic surface coil	17 (100%)
Use of spasmolytics	8 (47%)
Use of endorectal filling	4 (23%)
Use of intravenous contrast material	11 (65%)

lined process thus was facilitated allowing a single electronic questionnaire to be sent to the 17 participants. By this process, we achieved consensus in 87% of individual items. Agreement among the items in which consensus was not reached (13%) ranged from 50% to 69%, reflecting some agreement on the remaining issues but also the need to address these issues in a subsequent questionnaire after adequate investigation and after gaining more clinical experience.

Imaging techniques

The panel reached consensus that MRI, alone or in combination with other imaging modalities or clinical examination, is the imaging technique of first choice for primary local staging of rectal cancer. For lower stage T1 versus T2 tumors, ERUS was recommended as the preferred modality over MRI and for T2/3/4 tumors MRI was recommended as the preferred modality [32–34]. The imaging technique for distinction of T2/3 tumors was standard 2D T2WI. Although consensus for the second-choice modality (i.e., if it were not possible to obtain a good quality MRI for any reason) for rectal cancer staging after MRI was not reached, panelists heavily favored ERUS over CT. For response assessment, MRI with or without other methods such as endoscopy is mandatory or recommended as the imaging modality of first choice. Although MRI was shown to be limited for response assessment, newer techniques routinely incorporated, including DWI, indicate promising results for response assessment [35–38]. The second technique for restaging did not reach consensus and was PET with CT or with MRI (63%) or CT alone (31%).

MR imaging requirements

Although there was consensus that 1.5 Tesla was the minimum field strength required for imaging, there was no consensus on the optimal Tesla between 1.5 T and 3 T, in particular given the increasing indication for DWI in response assessment and the amplification of artifacts at the higher field strength [39, 40]. Endorectal coils were expressly not recommended (100%) given the known discomfort and imperfect coil designs [41, 42], but use of an external phased array coil is mandatory or recommended. Consensus was not reached regarding the various preparatory interventions for image quality including (a) use of a spasmolytic to reduce bowel motion, (b) endorectal filling to achieve better distension, or (c) a cleansing enema to obviate incorrect tumor identification [43, 44]. However, all of these were favored by the panel, each scoring 65%. Arguments for rectal filling [45], and against [41, 42, 46], exist in the literature [47, 48] and personal and institutional preference seems to guide one's choice. Similarly, local practice patterns seem to vary significantly in the use of a cleansing enema, but emerging literature argues in favor of it as the need for DWI increases, to reduce magnetic susceptibility artifact associated with air [43].

MR imaging sequences

The panel agreed on several minimum requirements for a standard protocol for rectal MR. The exam should use 2D fast T2-weighted sequences in the sagittal, axial, and coronal planes mandatorily for both staging and restaging to best assess T-category and relationship of the tumor with the mesorectal fascia. An axial sequence angled perpendicular to the tumor and a coronal sequence angled parallel to the tumor is mandatory irrespective of the tumor location to avoid partial volume effect and an incorrect assessment of T-category depth, involvement of adjacent structures, and involvement of the mesorectal fascia [49]. Furthermore, if the tumor is in the lower third of the rectum near the anal canal and the above sequences do not result in a plane parallel to the anal canal itself, an additional such sequence should be obtained to accurately assess the relationship of the tumor to the anal sphincter complex and intersphincteric space [50]. These additional sequences address the increasing options for treatment including intersphincteric resections [51], stapled colo-anal anastomoses, and robotic abdominoperineal resections (APRs) [52, 53]. An optimal T2WI slice thickness of 2–3 mm and a maximum slice thickness of 3–4 mm were recommended by consensus. The panel agreed that, while other sequences may often be used by some centers, the use of 3D T2-weighted sequences is not recommended, mainly due to increased coverage time and thus significant motion-sensitivity. Although about half of panelists felt there was some

Table 3. Summary of recommendations (items reaching ≥ 70% consensus)

I. Imaging techniques

MRI alone or in combination with other imaging modalities/clinical exam is recommended as the technique of first choice for the overall primary local staging of rectal cancer

To differentiate T1/T2 tumors, ERUS is recommended and for T2/3 and T3/T4 tumors MRI is recommended. MRI is recommended for determination of nodal stage and distance of tumor to mesorectal fascia (MRF)

Radiologic evaluation of response is mandatory or recommended and should include MRI with or without other methods (e.g., endoscopy). MRI with or without other methods is recommended for T downstaging, N stage, and mesorectal fascia (MRF) status

II. MR imaging requirements and sequences

Hardware and patient preparation

    A minimum field strength of 1.5 T is required for imaging

    An endorectal coil is not recommended but an external coil is mandatory or recommended

Sequences and sequence angulation

    Sagittal, axial, and coronal 2D T2-weighted sequences are mandatory for (re)staging

    An unenhanced T1-weighted sequence is recommended or mandatory

    3D T2-weighted, contrast-enhanced T1, dynamic contrast-enhanced, and fat-saturated sequences are not routinely recommended

    A DWI sequence is mandatory or recommended for (re)staging

    A maximum of 3 or 4 mm slice thickness is recommended and an optimal slice thickness is recommended to be 2 or 3 mm

    For tumors at any location in the rectum an axial slice perpendicular to and a coronal slice parallel to the tumor axis should be obtained. Additionally, for tumors in the lower third of the rectum, if the coronal view parallel to the tumor axis is not also parallel to the anal canal, an additional coronal sequence parallel to the anal canal is recommended to assess sphincter involvement

Performance of MRI

    For assessment of T and N stage, tumor height, and MRF status, T2 WI is mandatory

    In primary staging, T2WI can be used to accurately determine T stage, N stage, MRF status and extramural vascular invasion (EMVI)

    There was consensus that although T2WI should be used for nodal staging, it could not reliably differentiate between N0 and N1 (69%, near consensus)

    For restaging after treatment, T2WI should be used for tumor height, yT, yN stages, MRF involvement, and EMVI detection

    For restaging, there was near consensus for using DWI to differentiate residual tumor from complete response (yNT0) (69%)

III. Criteria for MR imaging assessment

Primary staging

    The use of node borders, signal heterogeneity, and shape are recommended or mandatory in primary staging of lymph nodes

    There was consensus that tumor within 0–1 mm of the MRF defined an involved MRF

    Assessment of EMVI is mandatory or recommended in all cases

    There was consensus to not use CE T1WI for T stage and MRF status

Restaging after chemoradiation

    A complete response after CRT can be diagnosed when there is a normalized 2-layer rectal wall

    A sterilized node after treatment includes downsizing with or without other features

    Regarding the MRF after CRT, appearance of a fat pad between tumor and MRF indicates regression from MRF. It is doubtful that persistent stranding into the MR fat after treatment represents tumor

IV. MRI reporting

Primary staging

    It was agreed upon that the report for primary rectal cancer staging should include distance from the anal verge (AV) and anorectal junction (ARJ), tumor length, involvement of the mesorectal fascia (MRF), o'clock position (with the stipulation that given the prone position in which surgeons examine patients, this nomenclature may be confusing) and T stage, T3 tumor extent (mm) of extramural growth, presence/absence of tumor deposits within the mesorectum, N stage, number of suspicious lymph nodes, presence/absence of extra-mesorectal/lateral lymph nodes, the location of the smallest distance between primary tumor and the mesorectal fascia and location, the presence of extramural vascular invasion (EMVI), and the morphological pattern of tumor growth (e.g., annular, polypoid, ulcerated)

Restaging after neoadjuvant treatment

    An adequate report describing the restaging of rectal cancer after neoadjuvant treatment (CRT) should include

Distance from tumor to AV and ARJ, remaining tumor length, o'clock position of remaining tumor, presence/absence of remaining tumor, presence/absence of fibrosis, presence/absence of mucinous degeneration, yT stage, yT3 depth, presence/absence of remaining tumor deposits in the mesorectum, yN stage, number of remaining suspicious nodes, presence/absence of suspicious extra-mesorectal/lateral nodes, persisting involvement of the MRF, smallest distance from primary tumor to MRF, presence of any remaining lymph nodes and/or EMVI within 2 mm of MRF, presence of EMVI, morphological growth pattern of remaining tumor

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value to intravenous contrast usage, it was overall not recommended to use gadolinium-based contrast-enhanced static or dynamic sequences (DCE-MRI). These have not been conclusively shown to be of use in staging or restaging [54–63] in spite of intriguing studies on both quantitative and qualitative DCE-MRI suggesting some efficacy in complete response detection. In contradistinction, recognition of the growing value of DWI-MRI has led to consensus on the need (or recommendation) to perform DWI sequences at both staging and restaging examinations [64]. Although DWI is only recommended

at restaging by our European colleagues, it was suggested that the minimal added time to obtain such sequences and the conspicuity afforded for both the primary tumor and the nodes [65, 66], along with the opportunity for assessment of volumetric changes [67, 68] or simple subjective changes in tumor bulk, behooved its performance at baseline as well.

The use of an additional unenhanced T1-weighted sequence was supported by (76%) of panelists to characterize coincidental bone findings in the pelvis. This sequence is not recommended in the European version.

Table 4. Items lacking consensus

I. Imaging techniques/requirements
a. No consensus was found for optimal magnet strength between 1.5T and 3.0T
b. The second-choice technique for primary staging was unclear and was ERUS (63%) and CT (25%)
c. The second-choice technique for restaging was unclear and was PET with CT or MRI (63%) or CT (31%)
d. Use of spasmolytic was only recommended or mandated in 65%
e. Use of rectal filling was not recommended in 65%
f. Use of a cleansing enema was not recommended in 65%
II. Criteria for MR imaging assessment
a. Routine 3D T2WI was not recommended (65%; do not use) and neither was a fat-suppressed sequence (59%; do not use)
b. Consensus was not reached on use of fat suppression for yT stage
c. Use of contrast-enhanced static sequence was split 50/50, whereas use of a dynamic contrast-enhanced sequence was slightly favored (53%)
d. Regarding sequence plane of angulation: axial obliquity through the anal canal was not obligatory (69%)
e. For primary staging, there was no consensus for the use of 3D T2WI for sequences for T stage, for N stage, MRF or EMVI
f. For primary staging, there was no consensus for the use of the CE T1WI for N stage and EMVI
g. In primary staging of lymph nodes there was no consensus on the use of size criteria
h. There was no consensus for the use of contrast-enhanced T1 images for EMVI.
i. T2WI did not reach consensus for determining either yT0 or yN0
j. 3D T2WI did not reach consensus for determining T1/2 vs. T3/4 nor MRF status after treatment
k. Consensus was not reached whether DWI could differentiate between yT1/2 and yT3/4
l. For primary staging, there was near consensus that stranding into the MRF is NOT a T3 tumor (69%)
m. There was no agreement on the use of nodal size criteria for nodal staging or for specific distances for threatened or involved MRF
n. There was no consensus reached on the definition of a threatened MRF
o. There was no consensus that a fibrotic scar after treatment meant yT0
Restaging after chemoradiation
    There was no consensus on whether a fibrotic scar without isointense T2 signal constituted a complete response
    For restaging, there was near consensus for any residual node being suspicious (69%)
    For restaging, there was no consensus on the use of DWI for yT, yN stages or MRF status. DWI reached near consensus for determining complete response (69%)
III. MR imaging reporting
a. For restaging reports, there was no consensus on the need to indicate remaining tumor volume
b. There was no consensus for the need to mention the number of remaining non-suspicious nodes

Interestingly, it remains unclear if such a sequence is useful, considering the rarity of bone metastases in colorectal cancer without known widespread metastases elsewhere [69]. Even in cancers with very high pre-test probability for bony metastases, e.g., prostate cancer, although incidental bone lesions are seen in 73% of pelvic MRI, the frequency of metastases was only 1.5% [70]. However, mucinous tumors, which comprise 5–20% of all rectal tumors [24], may spread aggressively into the mesorectal fat and even dissect into tissue planes far from the primary tumor. The border between the mucin and the mesorectal fat may be obscured on standard T2WI sequences since the signal intensity can be identical to the human eye. Therefore, a T1 sequence could help in the distinction of mucin, which will be lower signal intensity than fat on T1WI.

Criteria for MRI assessment

For primary staging, T2W multiplanar sequences are mandatory for T-categorization, N-categorization, tumor height, and tumor distance to the mesorectal fascia (MRF). Nonetheless, no consensus was reached on whether stranding of the mesorectal fat constituted T3 disease. There is admitted limitation in this assessment with some favoring a more broad-based bulge beyond the muscularis propria as indicative of T3 disease, whereas others favor thick strands [21, 71]. In spite of the

MERCURY study findings [72], panelists could not reach consensus on the distance of tumor from the MRF to define a threatened margin. Although the use of node borders, signal heterogeneity, and shape were recommended or mandatory, the use of size criteria reached no consensus [73–75]. Furthermore, although T2W multiplanar sequences are agreed upon as the mainstay for rectal cancer evaluation, T2W images for nodal involvement did not quite reach consensus, with 69% in favor of its ability to distinguish between N0 and N1. Assessment of EMVI is mandatory or recommended in all cases at baseline evaluation [76].

For restaging assessment of EMVI, T2WI is advised [22, 77–79]. Regarding T stage, consensus was not reached that T2WI could determine yT0 stage. Although there was no consensus on whether a fibrotic scar without tumor signal after treatment constituted a complete response, it was agreed upon that complete response (CR) after CRT could be diagnosed when there was normalization of the rectal wall appearing as two layers. Neither 3D T2WI nor DWI-MRI was agreed upon as useful or not useful for T staging after treatment. In spite of this, emerging data suggest that DWI improves upon the ability of T2WI in this determination, but that the accuracy is still problematic for clinical usage [19, 38, 80]. Similarly, there was no consensus that T2WI or DWI could determine N0 status after CRT [66–81]. It was agreed that a sterilized node after treatment must include

downsizing with or without resolution of irregular borders or signal intensity. Near consensus was noted that any residual node after treatment was viewed as suspicious (69%). Consensus was almost reached that DWI could determine CR (69%), but the presence of a fibrotic scar constituting yT0 could not be agreed upon [19, 38, 82, 83]. The usefulness of DWI or 3D T2WI to determine MRF status did not reach consensus [84]. Regarding the lack of consensus that using DWI can differentiate residual tumor from complete response (yN0), in centers in which non-operative management is a treatment option, DWI is recommended in the restaging protocol because it has proven its value to identify complete response; however, there is a learning curve [38].

MRI reporting

There was overall good consensus on the elements that should go into both the baseline report template and the restaging template, with nearly all items reaching agreement. The only items not agreed upon included whether there was any need to indicate the remaining tumor volume in restaging reports or whether there was any utility in mentioning the number of remaining non-suspicious nodes. Staging and restaging recommended templates from the Society of Abdominal Radiology Rectal Disease-Focused Panel are included for reader convenience (Appendices B and C, respectively).

Comparison with European results

Although the same categories of response as in the ES-GAR original version were available to the experts, we opted to combine 'recommended' and 'mandatory' in our analysis in order to make it easier to achieve consensus of 70% or more due to the lack of a face-to-face meeting (a face-to-face meeting may serve both positively to gain consensus and negatively to sway less opinionated experts to the majority) [30]. In addition to using 70% instead of 80% to define consensus, other notable differences in the actual items that reached consensus are worth mentioning although we can only speculate on their cause for the difference. (1) No recommendation against rectal filling in these guidelines (It was a European study that advised against this early on [41, 42]), whereas other studies [47] suggested some utility and as such it was written into the PROSPECT study [85]. Also, relative inexperience may have played a role in the desire to optimize visualization (2) 1.5 Tesla minimum field strength recommended in these guidelines [might reflect industrial or local practice trends and rarity of 1.0 T in the USA]. (3) Use of unenhanced T1 sequence recommended in these guidelines (for detection of bone lesions and mucinous tumor extent). (4) Coronal oblique sequence must include plane parallel to the anal canal in low rectal tumors according to these guidelines (might reflect a greater preponderance of low tumors in

US or perhaps different social values or surgical practices to avoid abdominoperineal resections (APR) or alternatively more expertise in sphincter-sparing operations). (5) Inability of T2WI for discriminating between N0 versus N+ in these guidelines. (6) Fat suppression specifically advised against in these guidelines. (7) No consensus on MRF distance to tumor to define threatened MRF. (8) EMVI at baseline strongly recommended or mandatory in these guidelines (growing evidence in literature) [77]. (9) PET as second method for staging in these guidelines (greater availability? economic/industry pressure?) [64, 86]. (10) DWI needed at baseline per these guidelines (growing literature and volumetry and conspicuity?) [64, 83, 87].

Methodological limitations

One of the prime limitations in conducting this survey is the sheer rate of knowledge turnover in rectal cancer imaging in the last 3–5 years (for example, PubMed search of rectal cancer imaging and MRI over 5 years performed on 2/26/18, $n = 1134$, versus bladder MRI, $n = 557$). Those of us in the field feel as if we are in a growth period similar to that experienced by prostate MRI in the 1990–2010 time period. For example, between the time of the first ESGAR 2012 guidelines and the second one recently published [10], the evolution of knowledge in DWI-MRI alone was astounding and literally practice changing [38]. In the period encompassed by our questionnaire, some experts were not yet performing restaging MRI and we therefore adjusted our denominator accordingly. The overall clinic experience and volume of research publications in comparison with our European colleagues is lower due to a later adoption of MRI for the evaluation of the rectum in North America, albeit the median caseload is higher (Table 2).

In conclusion, 17 expert radiologists, through a questionnaire process, formed consensus recommendations on the performance, interpretation, and reporting of rectal cancer using MRI. These expert consensus recommendations can be used as guidelines for primary and post-treatment staging of rectal cancer using MRI.

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