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SPECIAL SECTION: RECTAL CANCER

Guidelines for MR imaging in rectal cancer: Europe versus United States

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Abstract
The aim of this study was to compare and contrast recently published guidelines for staging and reporting of MR imaging in rectal cancer from the European Society of Gastrointestinal and Abdominal Radiology and the North American Society of Abdominal Radiology. These guidelines were assessed on the presence of consensus and disagreement. Items were compared by two reviewers, and items with agreement and disagreement between the guidelines were identified and are presented in the current paper. Differences between guidelines are discussed to offer insights in practice variations between both continents and among expert centers, which to some extent may explain the differences between guidelines.

Keywords Rectal cancer · MRI · Staging · Guideline

Introduction

Rectal cancer accounts for one-third of colorectal malignancies, with approximately 40,000 new cases in the USA and 125,000 in the European Union, every year [1, 2]. Diagnosis is based on digital examination of the rectum, endoscopy, and biopsy for histopathological evaluation. Before undergoing treatment, patients are staged by evaluating local tumor extension and assessment of the presence of metastases. International guidelines recommend MRI as part of the standard work-up, because it was shown to be the most accurate technique for assessment of local tumor stage. Standardization of the MR technique is important. The European Society of Gastrointestinal and Abdominal Radiology (ESGAR) has issued a consensus-based guideline for MR imaging in rectal cancer [3], which was recently updated [4]. Additionally, a panel from the North American Society of Abdominal Radiology (SAR) published their recommendations on the same subject [5]. Given the short time between publication of both papers, it is interesting to compare and contrast the guidelines between the societies and to identify potential discrepancies as well as attempt to explain the differences. Therefore, this study aims to compare and contrast the guidelines for staging and reporting of MR imaging in rectal cancer from the European Society of Gastrointestinal and Abdominal Radiology (ESGAR) and the North American Society of Abdominal Radiology (SAR).

Methods

The recent guidelines from ESGAR and SAR were assessed on the presence of consensus. Items were compared by two reviewers (JK, MM) and items with agreement and disagreement between the guidelines were identified and are presented in the current paper, followed by a discussion.

Results

The European expert panel consisted of 14 radiologists, and the SAR panel had 17 radiologists. General information between the North American and European panel (e.g., type of MR vendor et cetera) is shown in Table 1. European consensus was based on a questionnaire with 246 items, which was followed by a face-to-face meeting (the Delphi Method). The cut-off percentage for *consensus agreement*

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Table 1 MRI technique by expert panels in Europe and North America (data acquired from the original guideline papers (4, 5))

Question	Frequency (%)	
	Europe	North America
Number of patients diagnosed with rectal cancer per year per hospital—median (range)	110 (30–300)	155 (55–350)
MRI used as a standard staging technique for rectal cancer	100	100
Restaging after chemoradiation performed routinely	86	76
MR vendors		
Siemens	57	23
Philips	21	18
GE	21	23
Multiple	21*	36
Unknown	29	0
Field strength		
1.5 T	50	29
3.0 T	7	18
Both	43	53
Type of coil		
Endorectal coil	0	0
Pelvic surface coil	100	100
Bowel preparation		
Use of spasmolytics	43	47
Use of endorectal filling	29	23
Use of rectal enema	14	*
Use of intravenous contrast material	29	65

*European panelists' vendor use percentage was calculated without Multiple Vendor category

between the panelists was ≥ 80%; *no consensus* was noted if this level of agreement was not met. The SAR guideline contained 268 questions. Consensus was defined as ≥ 70% agreement based solely on the questionnaire; there was no face-to-face meeting between the panelists.

The European panel of radiologists reached consensus in 226 of the 246 items (92%), while the North American panel reached consensus in 232 of the 268 items (87%).

Consensus between guidelines (Table 2)

Imaging techniques and requirements

Both panels agreed that MRI should be used routinely for primary staging and restaging of rectal cancer. Endorectal ultrasound is advised in both guidelines to differentiate between cT1 and cT2 tumors.

The minimal field strength requirement for the MRI system is 1.5 T and an external body coil is recommended. Two dimensional (2D) T2 weighted sequences should be performed in 3 orthogonal planes for primary staging and restaging purposes. Axial and coronal sequences should be angulated perpendicular and parallel to the tumor axis, respectively. Additionally, a coronal sequence parallel to the anal canal is recommended in distal tumors (lower third of the rectum), to assess sphincter involvement. The optimal slice thickness for T2 weighted images is 3 mm (for the axial and coronal sequences in Europe), but no more than 3–4 mm (North America).

Diffusion-weighted imaging is recommended for restaging, specifically for the yT stage. The European and North American panels agreed that fat-suppressed T1, contrast-enhanced T1 weighted images and dynamic contrast-enhanced (DCE) sequences are not routinely recommended.

MRI assessment

Primary staging T2 weighted sequences can be used to reliably differentiate between T2 and T3 tumors and can be reliably used to determine tumor involvement of the mesorectal fascia. Panels agreed that the mesorectal fascia is involved if the minimal distance between the tumor and MRF is ≤ 1 mm. The use of nodal morphology criteria is recommended. This item is more extensively described in the European guidelines, which provides a practical guideline on nodal evaluation [4].

Restaging On T2 weighted images, complete response can be diagnosed when there is a normalized two-layered

Table 2 Panel recommendations reaching consensus in both guidelines

Imaging techniques and requirements
MRI should routinely be performed for primary staging and restaging of rectal cancer
Endorectal ultrasound is the preferred technique to differentiate T1–2 tumors
MRI should be performed on a minimum 1.5 T field strength
External body coil is recommended. Endorectal coil is not recommended
2D T2 weighted images in 3 planes should be performed for (re)staging
Diffusion-weighted imaging is recommended for restaging (of yT stage)
Contrast-enhanced T1 weighted images and dynamic contrast-enhanced (DCE) sequences are not routinely recommended
Fat-suppressed T1 weighted sequence are not routinely recommended
Slice thickness for T2 weighted images should be ≤ 3 mm (for the axial and coronal sequences in Europe) versus an optimal slice thickness of 2–3 mm or maximal of 3–4 mm (North America)
Transverse and coronal T2 weighted sequences should be angulated perpendicular and parallel to the tumor axis, respectively
Additional coronal sequence parallel to the anal canal is recommended in distal tumors (lower third of the rectum), to assess sphincter involvement
MRI assessment
Primary staging
T2 can be used to reliably (≥ 80% accuracy) differentiate between T2 and T3 tumors and determine involvement of the mesorectal fascia
The use of nodal morphology criteria is recommended
Mesorectal fascia is involved if the distance between the tumor and MRF is ≤ 1 mm.
Restaging
Complete response can be diagnosed when there is a normalized two-layered rectal wall on T2 weighted images
Reappearance of a fat pad between the tumor and the mesorectal fascia indicates clearance of MRF involvement. Persistent stranding after neoadjuvant treatment is doubtful for presence of tumor
Reporting
Structured reporting is recommended

aspect of the rectal wall. When there is a normalized fat pad between the tumor and the mesorectal fascia, in case of pretreatment MRF involvement, this accurately indicates clearance of MRF involvement. Persistent stranding of this fat plane after neoadjuvant treatment is doubtful for presence of tumor involving the MRF.

Both panels agreed on recommending structured reporting in primary and restaging MRI in rectal cancer.

Discrepancies between guidelines (Table 3)

Imaging techniques and requirements

(1) The American guidelines agreed on PET-CT as a second-choice modality for staging and restaging rectal cancer, whereas the European panel did not reach consensus but CT and EUS were both mentioned.

Table 3 Items lacking consensus in both guidelines (Europe vs. North America)

Imaging techniques and requirements
Use of spasmolytic recommended 57% versus 65%
Use of endorectal filling was recommended by 29% versus 35%
MRI assessment
Primary staging
T2 WI to differentiate between N0 and N + stage (69% not reliable for both panels)
Restaging
T2 weighted imaging for determining yT0 or yN0
T2 weighted imaging is accurate for determining involvement of MRF (62% reliable Europe)
T2 weighted imaging is reliable for assessment of EMVI (54% Europe)
Diffusion-weighted imaging is reliable for determining complete response (54% vs. 69%)
Diffusion-weighted imaging is reliable to differentiate between yT1–2 and yT3–4 tumors
Diffusion-weighted imaging cannot differentiate MRF involvement (69% Europe, no consensus North America)

(2) The European panel agreed with full consensus (100%) not to recommend the use of a cleansing enema nor rectal filling. The North American panel did not reach agreement: 35% *did* recommend an enema.
(3) A non-enhanced T1 weighted sequence is recommended or mandatory in North America, while in Europe this was not recommended.
(4) Diffusion-weighted imaging is recommended for primary staging in North America, while there was no consensus for primary staging in Europe.
(5) Notably, use of intravenous contrast material was more prevalent at the institutions from the North American radiologists with 65%, compared to the 29% in Europe, while a contrast-enhanced T1 sequence was not routinely recommended in both guidelines.

MRI assessment

Primary staging

(6) The North American panel agreed on the high diagnostic accuracy of T2 weighted sequences for determining the T stage, N stage and for the detection of extramural vascular invasion, while there was no agreement in Europe on sufficient diagnostic accuracy of T2 W-MRI for these parameters. Only 31% of the European panel found T2 sequences reliable for N staging and found 2D T2 weighted sequences to be accurate in detection of EMVI, but with 69% consensus only.
(7) T2 weighted imaging was deemed not accurate to differentiate between T1 and T2 tumors in Europe and on this item no consensus was reached in North America.
(8) The European panel found T2W imaging accurate for distinction between T2 and T3 tumors, but no consensus was reached in North America.
(9) The European panel agreed DWI is not accurate for discrimination of T1–2 tumors, discerning N0 from N+ stage, involvement of MRF, and assessment of EMVI. The American panel did not reach consensus on these items.
(10) In primary staging of lymph nodes, there was no consensus on the use of size criteria in North America. The European panel had agreed upon nodal size criteria, partly depending on the morphological features on T2 weighted sequences.
(11) The USA panel did not agree on a specific distance to define a threatened MRF, but a tumor distance of ≤ 2 mm was deemed a threatened MRF for the European panel.

Restaging

(12) On T2 weighted imaging, the European panel agreed, when differentiating between fibrotic scar or possible tumor residue, that lack of an isointense mass indicates a complete or possible complete response. For this item, there was no consensus by the North American panel.
(13) At restaging, all nodes with a short axis diameter of < 5 mm are considered benign by the European panel, while downsizing of the node was associated with nodal sterilization regardless of other features according to the North American panel.
(14) DWI is not considered accurate to differentiate between yT1–T2 tumors, yN0 and yN+ stage, nor to assess yEMVI by the European panel; the North American panel did not reach consensus.
(15) No consensus was reached by both panels on the value of DWI to determine a complete response after neoadjuvant treatment, although the North American panel nearly reached consensus with 69% of the panel agreeing.

Reporting

When comparing the items for the structured reporting between the guidelines, some differences emerged.

(16) The North American guideline recommends reporting the distance from the lower tumor pole to the anal verge, in addition to the distance measurement to the anorectal junction, while the European guideline only recommends the latter measurement.
(17) In the North American recommendations, reporting should include the measurement (mm) of the extent of tumor invasion beyond the bowel wall, while the European guideline recommends specifying only whether the tumor is T3ab or T3cd based on the cut-off of 5 mm extramural invasion.
(18) At primary staging, the European panel recommends categorization of anal sphincter invasion based on which part of the sphincter is involved (lower, middle, and upper third). The North American panel does not specifically mandate this.
(19) At restaging, the North American panel recommends reporting of the presence of mucinous tumor degeneration. The European recommendations do not include this.

Table 4 shows an overview of the discrepancies with potential explanations.

Table 4 Discrepancies between the European and North American consensus guidelines

Discrepant guideline	Europe	North America	Putative explanation
(1) Second-choice modality for staging	CT or EUS	PET-CT	PET-CT is of added value for detection of hepatic metastasis; economic reason or greater availability in US
(2) Enema or filling	Consensus against	65% yes 25% no	Necessity for rectal filling in US due to relative inexperience. Rectal enema is currently investigated in Europe
(3) Unenhanced T1WI	Consensus against	Consensus for	Sequence used in US for detection of bony metastasis and evaluation of mucinous tumors
(4) DWI for baseline staging	Consensus against	Consensus for	DWI helps identify small lesions; it does not help with staging and is omitted in Europe at primary staging, lowering cost, and examination time
(5) IV contrast usage	29% usage	65% usage	Additional IV contrast is highly recommended by the guideline of American College of Radiology. No consensus or evidence exists for routine use
(6) T2WI overall accuracy	Less accurate overall	Overall felt more accurate	Due to general experience with the limitations of MRI at primary staging
(7) cT1 versus cT2 using T2WI	Not accurate	No consensus	Maybe due to growing use of ERUS in Europe
(8) cT2 versus cT3 using T2WI	Accurate	No consensus	Difference due to reliance on ERUS in US, and varying approaches in definition of T3 disease
(9) DWI for T1/2, N0/1, MRF, EMVI	Not accurate	No consensus	Related to lag in the adoption of MRI over ERUS and familiarity with DWI limitations in US
(10) Primary LN size criteria	Partly accurate with morphology	No consensus	European panelists' familiarity with the Dutch Consensus Criteria for lymph nodes
(11) MRF distance equated with "threatened"	≤ 2 mm	No consensus	Possibly choosing for clear margin of safety in Europe to avoid insufficient treatment and disease recurrence
(12) T2WI for cCR	Definition agreed upon	No consensus	Use of mrTRG system in North America over T2WI. Non-operative management probably more common in Europe, radiologists more comfortable with suggesting complete response on MRI
(13) N0 size at restaging	< 5 mm benign	Downsizing?	Probably a practical cut-off size since cut-off of < 5 mm can still over- and understage patients
(14) DWI for yT1/2, yN0/1, yEMVI	Not accurate	No consensus	Lag of routine use of DWI in US
(15) DWI can determine complete response	No consensus	Near consensus (69%)	Possibly due to higher reliance on additional endoscopy in Europe. Recent adaptation and education of the US panelists
(16) Anal verge (AV) distance	Only distance to ARJ not AV	Recommended	ARJ is easy to recognize on MRI and is probably important for surgical planning in Europe
(17) T3ab/cd or T3a, b, c, d	T3ab or T3cd	T3a, b, c, d	Probably practical to dichotomize (Europe) due to treatment-related cut-off point of 5 mm
(18) Anal sphincter invasion by location	By thirds of rectum	Not described	Probably to provide the clinician with additional information for (surgical) treatment planning

Table 4 (continued)

Discrepant guideline	Europe	North America	Putative explanation
(19) Discuss mucin at restaging	No mention	Recommended	Macroscopic mucin at restaging relates to prognosis. Possibly differences in treatment or tumor biology influence the incidence of mucin areas?

Discussion

Several discrepancies were found between the two guidelines

Regarding MR techniques and preparation, MRI was unanimously voted to be the first choice for staging and restaging rectal cancer.

(1) The European panel did not reach consensus on the preferred second-choice modality, but CT and EUS were both mentioned as possibilities. The North American panel recommended PET-CT as the second-choice modality. There is no evidence to support routine PET-CT in the staging of rectal cancer. T staging is not accurate due to the low resolution and N staging can be false negative due to the limited resolution. PET-CT does have a clear additional value for detection of hepatic metastases [6, 7], which may be a reason that in the US PET-CT was recommended. Other reasons might be economic or a greater availability in clinical practice, as Gollub et al. already suggested [5].

(2) The European panel did not recommend endorectal filling nor cleansing of the bowel, while the North American panel did not reach consensus on rectal filling and even 35% did recommend it. The rationale behind bowel preparation is that it intends to reduce susceptibility artifacts caused by air on T2 and diffusion-weighted images [8]. There are several bowel preparation strategies. Endorectal filling has been advocated and has been reported to improve response evaluation after CRT [9], but it distorts the imaging anatomy, possibly interfering with the tumor distance to the MRF and the anorectal junction, making assessment of MRF invasion more difficult [10, 11]. More recent evidence questions these assertions [12]. DWI can be hampered by endorectal filling as well, specifically when ultrasound gel is used. Ultrasound gel leads to T2 shine through on high b-value DWI, making response evaluation after CRT very challenging, even though correlating with the ADC map might help overcome this limitation partially. The North American panel speculated that the desire to increase tumor conspicuity, e.g., by use of endorectal filling, is caused by relative inexperience imaging rectal cancer with MRI. An alternative strategy is currently being investigated in which the use of rectal enema showed promising results, without drawbacks caused by standard endorectal filling.[13].

(3) A non-enhanced T1 weighted sequence was recommended by the North American guideline for the evaluation of (a) possible bony lesions and (b) mucinous tumors, while this sequence was not recommended in Europe. (a) Bony metastasis is often associated with other metastasis (such as to the lung) and elevated CEA levels, while isolated bony metastasis is rare [14, 15]. After CRT, radiation-induced changes are often encountered during follow-up, specifically when patients undergo repetitive MRI follow-up in case of a wait-and-see policy. While it is true that an unenhanced T1W imaging can be helpful in characterizing bony radiation-induced changes and identification of fractures, such abnormalities can also be well seen on T2 imaging and DWI. Parallel to the increased use of DWI, the bony signal intensity changes that are then found on DWI obviate the need for an unenhanced T1 sequence. (b) The presence of mucinous rectal tumors can correctly be diagnosed by T2 weighted imaging [16, 17]. The North American panelists use the T1 sequence to differentiate mucinous tumor from the mesorectal fat, since the difference in signal intensity on T2 between fat and mucin can occasionally be minimal. However, in experienced hands usually it is possible to identify mucinous tumors on T2W images. Another reason to recommend an unenhanced T1W sequence is to evaluate enhancement when post-contrast images are used. In Europe, contrast-enhanced MRI is not recommended and thus does not require unenhanced T1W sequence either, while in the US contrast-enhanced imaging is much more common (see point 5).

(4) DWI is recommended for restaging in both guidelines. However, it was not recommended for primary staging in Europe, in contrast to North America. From a practical point of view, DWI at primary staging can be helpful, mainly in identifying smaller lesions that are more conspicuous on DWI than on T2 W imag-

ing alone. However, for staging purposes DWI was not deemed accurate in both guidelines and, therefore, it could be omitted at primary staging, leading to decreased examination time and thus less costs. However, possibly in the future functional data derived from primary staging DWI could prove beneficial to predict response to neoadjuvant treatment, which could help guide patient treatment [18].

(5) Notably, intravenous contrast material is administered at most of the North American panel institutions (65%), compared to only 29% in Europe. This was not a specific item panels voted on, contrary to the use of dynamic contrast enhancement. One possible explanation is that additional use of IV contrast has the highest appropriateness score in the pre-treatment staging guideline by the American College of Radiology, slightly superior to pelvic MRI without IV contrast [19]. Still, no consensus or evidence basis exists to routinely use contrast-enhanced MRI in rectal cancer staging.

(6–8) Regarding diagnostic performance, the European panel agreed that a T2W sequence is inaccurate to differentiate between T1 and T2 tumors, while no consensus was reached in North America on this issue. The European panel agreed that a T2W sequence is accurate to differentiate between T2 and T3 tumors, while no consensus was reached in North America on this issue, possibly due to reliance on ERUS historically and on the varying approaches and schools of thought on the definition to use for early T3 disease [20, 21]. Based on the existing evidence, sensitivity and specificity for discrimination between T2 and T3 tumors is relatively low (76–82%) compared to ERUS (75–90%) [22]. With respect to T-stage sub-classification, both guidelines chose to some extent to substage the T3 tumors. The North American guideline advises exact measurement of tumor extent in the mesorectal fat, while the European guideline recommends a cut-off point of >5 mm to differentiate the T3cd tumors from the T3ab. Measurement of extramural spread by MRI compares accurately with histopathological examination, which is an important prognostic factor, with subdivision of T3 tumors in more or less than 5 mm helps to discriminate tumors with a greater chance of local recurrence and difference in survival [23, 24]. Both panels agreed on the importance of T3 sub-staging, but differ on how it should be reported.

(9) The European panel agreed DWI is not accurate for discrimination of T1–2 tumors, discerning N0 and N+ stage, involvement of MRF, and assessment of EMVI. The American panel did not reach consensus. The routine use of DWI for rectal cancer among US radiologists, as well as the incorporation of EMVI, has lagged behind Europe. This is related to a general lag in the adoption of MRI over ERUS and thus familiarity with the limitations of DWI. [25].

(10) In primary staging of lymph nodes, no consensus was reached on the use of size criteria in North America. The European panel had agreed upon nodal size criteria, partly depending on the morphological features on T2 weighted sequences. Familiarity with the emerging Dutch Consensus Criteria for lymph nodes is probably greater in Europe, and particularly among the panelists on this Dutch-led ESGAR effort compared with the US [26].

(11) Both panels agreed on MRF involvement if the distance between the tumor and MRF is ≤ 1 mm. However, there was no consensus on the exact distance to MRF to be regarded as a threatened MRF in North America, while the European guideline has chosen ≤ 2 mm, as stated in the structured reporting form. Both the European and American guidelines on staging note the *importance* of a threatened MRF, but only the European panel suggested an appropriate cut-off point [1, 19]. As this is an important prognostic factor, it could be that the European panel has chosen to be on the safe side and possibly overstage the patients, in order to avoid insufficient treatment and a higher chance of disease recurrence. The European panel agreed DWI does not help to assess MRF involvement, while the North American panel did not reach consensus on this issue. So far, no evidence exists to support or refrain from using DWI for MRF involvement at primary staging, but given the low resolution of DWI, T2WI is currently advised.

(12) On T2 weighted imaging, the European panel agreed when differentiating between fibrotic scar or possible tumor residue, lack of an isointense mass indicates a complete or possible complete response. For this item, there was no consensus by the North American panel. We speculate that the lack of consensus may be twofold; there is admittedly a dichotomy in approach to post-treatment staging MRI in Europe with some centers advocating the mrTRG system [27]. This system has been advanced in Canada and some parts of the USA. In other parts of the USA, the advantages of DWI to analyze scars has proliferated. Some North American panelists were from Canada and this dichotomy may have interfered with consensus. Secondly, perhaps in the US, a more cautious approach is favored where non-operative management is catching on more slowly than in Europe, and so calling 'clinical complete response' is something fewer radiologists are comfortable with.

(13) A notable difference was that nodal downsizing after CRT was deemed a sign of sterilization by the North

American panel, while the European panel reached consensus on nodes with a short axis of 5 mm being sterilized. A study by Pomerri et al., however, showed that after CRT size of malignant nodes can be < 5 mm (even 1 or 2 mm) and even reported a median size of malignant nodes of 4 mm [28]. Heijnen et al. reported that the mean size of nodes in ypN+ patients is larger than in ypN0 patients (4.5 vs. 2.3 mm), and a cut-off of 2.5 mm yielded the highest diagnostic performance of 0.78, which is only moderate [29]. Therefore, the use of any size cut-off should be regarded as a practical guideline, which will likely still lead to over- and understaging.

(14) DWI is not considered accurate to differentiate between yT1–T2 tumors, yN0 and yN+ stage, nor to assess yEMVI by the European panel; the North American panel did not reach consensus. Again, as noted in item 9 for baseline staging, routine use of DWI for rectal cancer among US radiologists, as well as the incorporation of EMVI, has lagged behind Europe. This is related to a general lag in the adoption of MRI over ERUS and thus familiarity with the limitations of DWI [25].

(15) No consensus was reached by both panels on the value of DWI to determine a complete response after neoadjuvant treatment, although the North American panel nearly reached consensus with 69% of the panel agreeing. This is interesting because the USA guideline by the National Comprehensive Cancer Network (NCCN) does not support wait-and-see policy in the routine management of localized rectal cancer [30], while in Europe a wait-and-see policy for complete response after chemoradiotherapy with intensive surveillance can increasingly be considered in expert centers [1]. Several studies have reported that use of DWI (both qualitative evaluation and volumetry) [31] increases accuracy to identify a complete response compared to T2 sequences only [32]. However, the most accurate method to assess response is to combine MRI (including DWI) with endoscopy, which can yield an accuracy of 89% [33]. The authors speculate that in the US panel, recent workshops and lecture material by senior members of the SAR disease-focused panel have educated and advocated the use of DWI in spite of the lesser overall expertise of the individual members at their respective institutions.

(16) The European guidelines did not recommend reporting the distance of the tumor to the anal verge, rather only to the anatomic anorectal junction. This is a curious discrepancy. Tumors are always described at endoscopy and in common parlance as their distance from the anal verge. Possibly, the European panel wanted to stress the importance of the tumor distance to the sphincter apparatus for surgical planning. Among Europeans, there probably also is a greater consensus that the definition of the anal verge is too vague and not reproducible, while the anatomic anorectal junction is believed to be more easily identifiable and reproducible on MRI in Europe [34].

(17) The European guidelines categorize T3 depth of invasion into T3ab (≤ 5 mm) and T3cd (> 5 mm). The US Guidelines recommend detailing the measurement and assigning the appropriate category of T3 a, b, c, or d. While it is accepted that prognoses do hinge on a threshold depth of 5 mm, the T3 sub-staging system is more commonly used in Europe and is only slowly being incorporated into the US staging schema. It is not part of the AJCC system yet and is not used for treatment stratification. As such, its adoption has been without regard to how it translates to treatment yet.

(18) At primary staging, the European panel recommends categorization of anal sphincter invasion based on which part of the sphincter is involved (lower, middle, and upper third). The North American panel does not specifically mandate this. Probable goal of the European panel is to provide the clinician with all the relevant information as could be necessary for treatment planning. Especially for low rectal tumors, complete description of involvement of the anal sphincter complex is important when deciding the surgical approach, whether or not sphincter-saving resection is feasible without compromising local control.

(19) Related to the assessment of complete response, the North American panel further recommended to report mucinous tumor degeneration. Acellular mucin pools in the resected specimen after CRT do not have a prognostic impact, while cellular mucin pools are associated with worse prognosis [35]. At MRI, if macroscopic mucin is visible, it is highly unlikely that presence of cellular components can be determined. Therefore, it appears to be prudent to report the presence of mucin after CRT. The European panel did not specifically address this issue. This discrepancy raises an interesting question as to whether the treatment differences in or biological tumor differences in rectal tumors between Europeans and Northern Americans could be such that fewer mucinous tumors are seen before and or after treatment. For example, more short-course radiation is used in Europe and more induction chemotherapy is used in the US.

Comparison of these two guidelines hopefully provides insights into different subjects on rectal cancer imaging, but it does carry some limitations. There was a difference between the methods applied by the panels, in which the North American panel needed only 70% agreement, while

the European panel opted for 80%. The European panel had a face-to-face panel meeting, which the North American panel did not. Panel meetings can have different results on the outcome by possibly persuading the panelists to consent, or, on the contrary, lead to disagreement. Also, the exact rationale for the voting process per panelist is not available, which could have provided insight into the reasons for certain recommendation discrepancies.

In conclusion, this paper presents a comparison of European and North American evidence-based guidelines for the use of MRI in staging of rectal cancer. The recommendations and discrepancies between both guidelines were compared and discussed and offered insights in practice variations between both continents and among expert centers, which to some extent may explain the differences between guidelines.

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