

Early rectal cancer: the European Association for Endoscopic Surgery (EAES) clinical consensus conference

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Abstract

Background The last 30 years have witnessed a significant increase in the diagnosis of early-stage rectal cancer and the development of new strategies to reduce the treatment-related morbidity. Currently, there is no consensus on the definition of early rectal cancer (ERC), and the best management of ERC has not been yet defined. The European Association for Endoscopic Surgery in collaboration with the European Society of Coloproctology developed this consensus conference to provide recommendations on ERC diagnosis, staging and treatment based on the available evidence.

Methods A multidisciplinary group of experts selected on their clinical and scientific expertise was invited to critically review the literature and to formulate evidence-based

recommendations by the Delphi method. Recommendations were discussed at the plenary session of the 14th World Congress of Endoscopic Surgery, Paris, 26 June 2014, and then posted on the EAES website for open discussion.

Results Tumour biopsy has a low accuracy. Digital rectal examination plays a key role in the pre-operative work-up. Magnification chromoendoscopy, endoscopic ultrasound and magnetic resonance imaging are complementary staging modalities. Endoscopic submucosal dissection and transanal endoscopic microsurgery are the two established approaches for local excision (LE) of selected ERC. The role of all organ-sparing approaches including neoadjuvant therapies followed by LE should be formally assessed by randomized controlled trials. Rectal resection and total mesorectal excision is indicated in the presence of unfavourable features at the pathological evaluation of the LE

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specimen. The laparoscopic approach has better short-term outcomes and similar oncologic results when compared with open surgery.

Conclusions The management of ERC should always be based on a multidisciplinary approach, aiming to increase the rate of organ-preserving procedures without jeopardizing survival.

Keywords Early rectal cancer · Local excision · Neoadjuvant chemoradiation · Laparoscopy · Total mesorectal excision

During the last three decades, the widespread introduction of population-based screening programs has led to a significant increase in the early detection of rectal cancers. In addition, new developments in the diagnosis, staging and treatment modalities, including endoscopic submucosal dissection (ESD), transanal endoscopic microsurgery (TEM) and neoadjuvant (chemo) radiation therapy (CRT), have occurred increasing treatment options.

However, there is no consensus regarding the clinical definition of early rectal cancer (ERC) and the best management of ERC is controversial. While several consensus conferences focusing on the diagnosis, staging and treatment of locally advanced rectal cancer have been recently published [1–3], there are no specific consensus conferences on ERC.

The aim of this consensus conference developed by the European Association for Endoscopic Surgery (EAES) in collaboration with the European Society of Coloproctology (ESCP) is to define ERC and provide clinical recommendations about diagnosis, staging, treatment and quality of life of ERC patients, according to the currently available evidence.

Materials and methods

Selection of topics and experts

A panel of experts was selected according to their scientific and clinical expertise in the field of ERC and geographical distribution in January 2014. It included surgeons (MM, SB, TYF, YP and ER), pathologists (MR and PQ), endoscopists (YS and BR), a radiologist (RBT) and a radiotherapist (KB). A surgical research fellow (MEA) assisted the entire project in Torino.

The group of experts formulated and consented the list of items and key questions. The contribution of the experts included the literature search and critical appraisal; the formulation, discussion and presentation of the recommendations; the moderation of the consensus conference at

the World Congress of Endoscopic Surgery; and the revision of the draft of this manuscript.

Literature searches and appraisal

A systematic literature search of articles published between 1985 and 2014 was performed in the electronic databases MEDLINE and the Cochrane Library on each item. The searches were conducted using medical subject headings (MeSH) and free-text words and limited to articles published in English language.

Reference lists from the included articles were manually checked, and additional studies were included when appropriate. The critical appraisal of the literature was performed grading the studies according to the Oxford hierarchy of research evidence (<http://www.cebm.net>).

Consensus development

Based on the literature review, a draft of statements with their corresponding evidence level (EL) and grade of recommendation (GoR) (Table 1) followed by comments supporting the statements was created and discussed by the experts at a 1-day face-to-face meeting that was held in Torino, 3 March 2014, and chaired by the consensus conference coordinator (MM) (first Delphi round). The draft was then modified according to the experts' suggestions, and the revised document was circulated among the members of the expert panel for further evaluation and approval (second Delphi round).

The resulting statements were presented to the scientific community for further discussion at the plenary session of the 14th World Congress of Endoscopic Surgery that took place in Paris, 26 June 2014. The document was then posted on the EAES website for 3 months. Comments collected during the plenary session and from the web were considered in the third Delphi round to achieve the final version of the document. The level of the expert panel's consensus (ExpC) is reported as percentage of agreement.

Results

Definition

This consensus conference is centred on the clinical management of ERC. Therefore, after a thorough discussion, the panel of experts has achieved a consensus on the following clinical definition: *ERC is a rectal cancer with good prognostic features that might be safely removed preserving the rectum and that will have a very limited risk of relapse after local excision [ExpC: 90.9 %].*

Table 1 Grades of recommendation and levels of evidence

A	1a	Systematic review (with homogeneity) of randomized controlled trials
	1b	Individual randomized controlled trial
	1c	All or none
B	2a	Systematic review (with homogeneity) of cohort studies
	2b	Individual cohort study (including low-quality randomized controlled trials)
	2c	Outcomes research
C	3a	Systematic review (with homogeneity) of case–control studies
	3b	Individual case–control study
C	4	Case series (and poor quality cohort and case–control studies)
D	5	Expert opinion without explicit critical appraisal, or based on physiology, bench research or “first principles”

Several definitions of ERC based on microscopic and macroscopic findings have been proposed. Some pathological classifications aim to define an ERC according to the degree of submucosal infiltration. The submucosal invasion for pedunculated lesions can be estimated by using the Haggitt levels [4], ranging from 1 (invasion of submucosa limited to head of polyp) to 4 (invasion of submucosa beyond the stalk). The Kikuchi classification [5] aims to describe the depth of submucosal invasion in non-pedunculated lesions, by dividing the submucosa in three parts: sm1, sm2 and sm3 T1 cancers. Even though the term ERC is widely used to indicate submucosal cancers with low risk of lymph node metastases [6], this definition does not thoroughly reflect the clinical implications that ERC has in terms of both management and long-term outcomes.

The most recent classification is the Paris classification of superficial neoplastic lesions and its revised edition. A neoplastic lesion is defined as “superficial” when there is no endoscopic evidence of muscularis propria infiltration, i.e. the depth of penetration in the wall is limited to the submucosa. A polypoid lesion may be pedunculated (0-Ip), sessile (0-Is) or with a mixed pattern (0-Isp). Non-polypoid lesions are either slightly elevated (0-IIa, with elevation <2.5 mm above the level of the mucosa), completely flat (0-IIb) or slightly depressed (0-IIc). The mixed types include elevated and depressed lesions (0-IIa + IIc), depressed and elevated (0-IIc + IIa) and sessile and depressed (0-Is + IIc) [7–10]. The non-depressed types (i.e. 0-IIa, 0-IIb) might progress to polypoid or laterally spreading tumours (LST). LSTs are at least 10 mm in diameter lesions that typically extend laterally and circumferentially rather than vertically along the colonic wall [11, 12]. They are further classified based on their granular or non-granular, homogenous or non-homogenous appearance [9].

What is the role of pre-treatment rectal tumour biopsy?

The goal of a tumour biopsy is to establish the microscopic features of the lesion. Targeted tumour biopsy is required unless the tumour can be endoscopically removed with a complete excision, without compromising possible further treatments. However, tumour biopsy has a low accuracy [EL: 4; GoR: C; ExpC: 90.9 %].

Histological definition is considered fundamental in the diagnosis of a rectal lesion, and therefore, a mucosal biopsy is obtained in most cases. The pathological evaluation of the biopsy specimen aims to diagnose the lesion and define its microscopic features, including the type of tumour, and the grade of differentiation. The assessment of these microscopic parameters is key for the proper management of rectal cancer patients. However, biopsies are prone to sampling errors resulting in suboptimal sensitivity and interobserver variation in the grade of tumour differentiation [13–16]. The main reasons for these discrepancies are the frequent superficiality of the biopsy and technical difficulties of sampling in particular anatomic locations. In addition, taking biopsies of the colorectal mucosa can cause fibrosis and is associated with the non-lifting sign, making subsequent endoscopic removal more difficult [17]. Kim et al. [18] commented that biopsies prior to endotherapy did not provide useful information and interfered with endoscopic removal, finding a significant association between the use of biopsy and subsequent fibrosis. Han et al. [19] found that a history of previous biopsy significantly increased the incidence of the non-lifting sign, especially if lifting was attempted over 21 days post-biopsy. All lesions assessed under 21 days post-biopsy did lift, however, and a conclusion was drawn that biopsies should be minimized, but if undertaken, an advanced endoscopy attempt should be made as soon as possible after biopsy.

These factors suggest that caution is required with biopsy use, especially when malignancy is not suspected and prompt repeat endoscopy cannot be guaranteed [20]. While biopsies are appropriate if malignancy is a concern, careful targeting should be used to improve diagnostic accuracy and minimize fibrosis in the event of endoscopic ablation. A targeted biopsy performed by an expert endoscopist is also suggested when a first endoscopic tumour biopsy is negative for cancer in cases where there is a high index of suspicion for malignancy.

During the last two decades, the concept of routine endoscopic colorectal biopsy has been challenged also by the development of novel imaging technologies for characterizing polyp histology, such as narrowband imaging (NBI) and magnifying chromoendoscopy (MCE). Several classification systems have been proposed to help predict submucosal invasion by colorectal cancers by using NBI

with or without optical magnification, such as the NBI International Colorectal Endoscopic (NICE) classification [21, 22] and the Sano classification [23]. The NICE classification differentiates three types of lesions according to the colour, presence of vessels and surface pattern: hyperplastic, adenomatous and superficial submucosal invasive, and deep submucosal invasive. The Sano classification includes three types of lesions according to mucosal capillary pattern (CP): CP type I, hyperplastic; CP type II, adenomatous; CP type IIIA, carcinoma with submucosal invasion $<1,000 \mu\text{m}$, and CP type IIIB, carcinoma with submucosal invasion $\geq 1,000 \mu\text{m}$.

The overall diagnostic accuracy, sensitivity and specificity of this classification in distinguishing intramucosal from invasive cancers are 95.5, 90.3 and 97.1 %, respectively [24]. The reported sensitivity, specificity and diagnostic accuracy of CP types IIIA and IIIB for differentiating intramucosal or slight submucosal invasion $<1,000 \mu\text{m}$ from deep submucosal invasion $\geq 1,000 \mu\text{m}$ are 84.8, 88.7 and 87.7 %, respectively [25].

MCE is a standardized procedure that allows detailed analysis of the morphological architecture of colorectal mucosa crypt orifices (pit pattern). In expert centres, the diagnosis of invasive or non-invasive pit pattern observed by MCE has been proven to be the most reliable method to differentiate a neoplastic from a non-neoplastic lesion [20, 26, 27] and to be highly effective in predicting the depth of invasion of colorectal neoplasms [28]. Some large prospective multicentre studies [29–31] have shown that the “non-lifting sign” during conventional endoscopy has lower sensitivity and accuracy in predicting deep cancer invasion.

Should digital rectal examination (DRE) and rigid proctoscopy be part of the pre-operative work-up?

Proper assessment of tumour localization and sphincter function by digital rectal examination (DRE) and rigid proctoscopy should be part of a full physical examination. Rigid proctoscopy is most useful in better defining the exact location of the tumour on the rectal wall in case of non-palpable lesions [EL: 4; GoR: C; ExpC: 81.8 %].

Digital rectal examination (DRE) should be performed by the operating surgeon as part of a full physical examination in order to assess the distance of the tumour from the anal verge, its hardness, its mobility (freely mobile, tethered or fixed), the percentage of circumferential bowel wall involvement, and tumour location within bowel wall (anterior, posterior, lateral) and to evaluate its position in relation to the sphincter complex [32–35]. Proper identification of the tumour on the rectal wall and assessment of the anal sphincter function also allow for tailoring the

surgical approach to rectal cancer patients (i.e. sphincter preservation versus abdominoperineal resection).

Rigid proctoscopy is easy to perform with very low risk of complications [36] and indicates the exact location of the tumour on the rectal wall in case of non-palpable lesions [37]. Even though colonoscopy is the gold standard for detection of colorectal cancer, there are concerns regarding its ability to provide the precise localization of the cancer. For instance, Piscatelli et al. [38] reviewed the endoscopic, pathologic and operative reports of 236 patients who had a diagnosis of colorectal cancer by colonoscopy and subsequently received a treatment. They found that colonoscopy was inaccurate for tumour localization in 49 cases (21 %).

An error in tumour localization for rectal carcinomas may have substantial clinical implications in terms of treatment options, with a substantial risk of over or under treatment according to the localization. Piscatelli et al. [38] found that in 12 cases, errors in localization of rectal carcinomas required a change in operative approach. However, they stressed the fact that all errors in localizing the rectal tumour were “corrected” by performing a rigid proctoscopy routinely in any patient with a tumour described at colonoscopy in the rectosigmoid junction or in the rectum, or for lesions $<20 \text{ cm}$ from the anal verge. Similar results were recently reported by Schoellhammer et al. [39]. They conducted a retrospective review of 647 patients with rectal and rectosigmoid cancer aiming to determine how often localization of rectal and rectosigmoid cancers by using rigid proctoscopy altered treatment according to the localization obtained in the same patients by colonoscopy. They observed a change in tumour location after rigid proctoscopy in 25 % of patients with subsequent changes in the treatment options.

However, rigid proctoscopy does not allow assessment of whether the rectal tumour is within the true pelvis. Conversely, computed tomography (CT) and magnetic resonance imaging (MRI) indicate whether the tumour is intra- or extra-peritoneal, being therefore helpful in determining the treatment approaches, such as the use of neoadjuvant CRT [40].

Should a complete colonoscopy always be obtained to rule out the presence of synchronous colorectal tumours?

Complete colonoscopy is necessary to rule out the presence of synchronous colorectal tumours or lesions [EL: 4; GoR: C; ExpC: 100 %].

The incidence of synchronous colorectal cancer ranges from 2 to 4 %, and synchronous polyps are diagnosed in up to 30 % of cases [41–43]. Therefore, a pre-operative complete colon and rectal examination should be always

obtained. Colonoscopy is the method of choice since it offers the opportunity for histopathological diagnosis and the possibility to remove synchronous tumours [44]. The recognition of flat, elevated and depressed lesions is crucial in order to detect colorectal tumours in their early stages [45, 46]. However, colonoscopy might be incomplete due to poor bowel mechanical preparation or technical difficulties. In these particular cases, a CT colonography may be performed [47]. If a complete pre-operative endoscopic colonic evaluation is not performed, an early complete colonoscopy should be obtained within 3–6 months after surgery.

Staging modalities

Endoscopic ultrasound (ERUS) and MRI are the imaging modalities of choice for the staging of rectal cancer and should be considered complementary. ERUS is the method of choice for staging superficial tumours (T1), while MRI is the modality of choice for staging T2 or large tumours. An alternative modality to assess depth of invasion is represented by MCE [EL: 2; GoR: B; ExpC: 100 %].

Pre-operative staging is crucial for treatment decision-making in rectal cancer patients. Local tumour extension, its relationship with the sphincter complex or the peritoneal reflection, involvement of perirectal lymph nodes and extramural tumour invasion are all factors that affect the patient's prognosis and influence the treatment strategy.

ERUS and MRI are the modalities of choice for the local staging of rectal cancer. Both have strengths and weaknesses in terms of primary tumour and lymph node involvement assessment; therefore, they should be considered complementary. ERUS is the most accurate imaging modality to discriminate between T1 and T2 rectal cancer, with the highest accuracy reported in expert centres. In uT1 there is under-staging in 15–20 % of cases, and in uT2 in 15–30 %. The risk of T2 rectal cancer over-staging is higher in case of previous LE and in the presence of peritumoural inflammation and a desmoplastic reaction. Over-staging in uT3 occurs in 25–30 % of cases [48–50]. One major limitation of ERUS is the low accuracy in discriminating T1 substages (sm1–2–3), even though some recent reports suggest that high-frequency mini-probe ultrasound might significantly increase the accuracy of ERC local staging [51].

MCE is a standardized validated modality for the endoscopic estimation of the depth of invasion of colorectal neoplasms, based on the morphological architecture of colonic mucosal crypt orifices (pit pattern). It allows the identification of intramucosal or sm1 cancers from sm2 to 3 cancers with high sensitivity, specificity and accuracy, thus determining the proper (endoscopic vs. surgical) treatment of colorectal lesions [28].

When en bloc endoscopic resection is planned, histological assessment of the ESD specimen provides excellent staging and prognostic information, including level of submucosal infiltration, grade of tumour differentiation and the presence of lymphovascular invasion.

High-resolution MRI is the imaging modality of choice when a T2 or larger tumour is suspected, since it has higher accuracy than ERUS for detection of mesorectal infiltration. MRI has been demonstrated to stratify, with a high accuracy, rectal cancer patients into different prognostic groups according to the extramural extent into the mesorectal fat [40, 52]. MRI is also useful for the assessment of other prognostic factors, including the extramural venous invasion, defined as the invasion of tumour in the extramural blood vessels [53], and for the assessment of mesorectal fascia involvement [54]. For very low tumours, the corresponding border is the anal sphincter since the mesorectal fascia does not extend beyond the puborectalis muscle. Phased-array MRI is as accurate as ERUS for the evaluation of sphincter complex infiltration. MRI, however, has the advantage of providing information on the full extent of a low-lying rectal tumour. It shows the relation of the tumour not only to the anal sphincter, but also to the pelvic floor, lateral and dorsal pelvic wall and anterior pelvic organs. Lastly, MRI has a good accuracy in measuring the length of the tumour and defining its location with respect to the peritoneal reflection and origin of the sigmoid mesentery.

Both ERUS and MRI have low sensitivity and specificity for the detection of lymph node metastases. However, MRI is the preferred imaging modality because of its larger field of view allowing visualization of nodes in the entire mesorectal compartment as well as visualization of lateral nodes outside the mesorectum [55]. Lymph node size is not a good predictor for malignancy, while specific MRI lymph node morphological features, such as the presence of a round shape, mixed signal intensity and irregular borders have been demonstrated to have high sensitivity and specificity in predicting mesorectal lymph node involvement [56].

A computed tomography (CT) of the pelvis is less accurate for primary tumour and lymph node staging assessment than ERUS and MRI, particularly for low rectal cancers [57]. Therefore, it should be performed in mid- and high tumours only if ERUS or MRI cannot be obtained. CT cannot replace MRI in low tumours. A CT scan of the chest and abdomen is recommended to rule out distant metastases [3].

The role of FDG PET/CT is still under evaluation. At present, there is no strong evidence supporting the routine use of PET/CT in the staging of both primary rectal cancer [58] and mesorectal lymph nodes [59] and in the detection of distant metastases. FDG PET/CT, however, has been

proven useful for excluding extrahepatic metastases in patients scheduled for liver metastasis resection, thus preventing unnecessary laparotomies.

Table 2 summarizes the optimal pre-operative work-up.

Pathology

Histologically defining early cancer (endoscopic biopsy vs. surgical specimen)

What is the predictive value and the reliability of biopsy for the histological diagnosis of early cancer?

Biopsy is often inconclusive for the histopathological diagnosis of early cancer. It is, however, predictive of the risk of finding an invasive carcinoma in the resected lesion [EL: 3b; GoR: C; ExpC: 100 %].

Considerable discrepancies have been reported between the diagnosis of adenomas containing invasive carcinoma from endoscopic biopsies and resected specimens of the same lesion because biopsy-based diagnoses are subject to the limitations of superficiality and sampling errors. It has been shown, however, that by applying the revised Vienna classification to biopsy specimens the risk of finding an invasive carcinoma in the resected lesion can be effectively assessed [60]. Biopsy is of limited value in predicting the depth of invasion assigned to the resected specimens, especially for the diagnosis of early cancer.

Substaging and microstaging

A. What is the optimal method to measure the depth of submucosal invasion in the presence and in the absence of an identifiable muscularis mucosae?

The depth of submucosal invasion corresponds to the vertical distance from the muscularis mucosae to the deepest point of submucosal cancer invasion. When the muscularis mucosae are not clearly identifiable, either the line between the ends of the residual muscularis mucosae or the tumour surface is used as a baseline [EL: 5; GoR: D; ExpC: 100 %].

When the muscularis mucosae are identifiable, the measurement coincides with the distance from it to the deepest portion of submucosal cancer invasion. Problems exist when the muscularis mucosae are completely disrupted by tumour invasion. In such cases, measured submucosal invasion depths might be inconsistent. Although several authors measure the depth of submucosal invasion as the vertical distance from the surface of the lesion and the deepest portion of invasion [6], others consider as a baseline the line between the ends of the residual muscularis mucosae [61] in order to rule out the bias of the effect of the ischaemic erosion or biopsy distortion of the most superficial sectors of the lesion. Conclusive evidence is lacking and further work is needed in this area.

B. Is there a minimal submucosal invasion depth to be considered, even in the presence of qualitative risk factors, as “NO Threshold” (i.e. no metastatic potential)?

Evidence exists that submucosal cancer invasion, confined within the range 500–1,000 μm , is linked with minimal or no risk of lymph node metastasis [EL: 2b; GoR B; ExpC: 100 %]. The precise depth of invasion corresponding to the “NO Threshold” of ERC has not been established yet.

It has been observed that the precise quantitative evaluation of the early submucosal invasion could allow identification of tumours with no or minimal risk of nodal involvement, independently on the status of the qualitative histological risk factors [6]. Unfortunately, the depth of submucosal invasion reported in early cancers without lymph node metastasis ranges 200–1,500 μm [62, 63]. Although the threshold found by Kitajima et al. [6] (1,000 μm) is currently widely accepted for non-pedunculated lesions among Japanese authors, intermediate lymph node metastasis has been occasionally reported in cases with minor submucosal invasion depth. No nodal involvement was observed in pedunculated and non-pedunculated pT1 cancers with a submucosal invasion <500 μm , but the proportion of tumours meeting these conditions is too small to use these categories as the criterion for a conservative approach [64].

C. What degree of clearance is acceptable to rule out cancer involvement of the vertical margin?

Clearance of 1 mm or less indicates cancer involvement of the vertical margin. Uncertainty about the margin status because of the artefacts induced by resection or surgery should be recorded in the pathological report [EL: 4; GoR: C; ExpC: 100 %].

It seems reasonable to refer to the clearance of the endoscopic resection margin of pedunculated adenomas containing cancer, considering that the presence of cancer cells at or near the resection margin is a reliable histological marker of adverse outcome. Here, a negative margin is reported in the absence of cancer within the

Table 2 The optimal pre-operative work-up

Physical examination
Digital rectal examination
Complete colonoscopy
ERUS \pm MRI (if high tumours, suspected > T1 and/or suspected N+)
CT scan of the abdomen and the chest to rule out distant metastases.

ERUS endoscopic ultrasound, MRI magnetic resonance imaging, CT computed tomography

diathermy burn or more than 1 mm from the actual margin of resection [65], even if higher distances (up to 3 mm) have been suggested. The precise measurement has to consider the possible artefacts induced by endoscopic resection or surgery (e.g. submucosal injection of solutions elevates the lesions from the muscle layer artificially to increase the area of connective tissue between neoplasia and diathermy, simulating a distance carcinoma border—resection margin >1 mm).

Qualitative risk factors and new biomarkers

A. Which of the following qualitative histological risk factors are effective in driving patient management and worthwhile of being included in the pathological report?"

- Venous invasion
- Lymphatic invasion
- Grade of differentiation and foci of dedifferentiation
- Tumour budding
- Pattern of invasion of the muscularis mucosae

Venous invasion, lymphatic invasion, grade of differentiation of carcinoma and foci of dedifferentiation are the qualitative histological risk factors to be reported in ERC [EL: 2b; GoR: B; ExpC: 100 %].

At present, histological parameters alone determine whether a low (7 %) or high (35 %) risk of metastasis exists [66–68]. The following qualitative histological risk factors should be reported:

- Grade of differentiation of the cancer. Although most pT1 cancers display a low grade of differentiation (i.e. well/moderately differentiated, G1–G2), 5–10 % of cases, associated with adverse clinical outcomes, are high-grade cancers (poorly differentiated adenocarcinoma/undifferentiated carcinoma). Most cancers are heterogeneous in terms of histological differentiation, and tumour grading is conventionally based on the least differentiated component for early cancers [61, 69, 70].
- Lymphatic invasion. It has been demonstrated that definite lymphatic invasion without other unfavourable pathologic features is associated with an adverse outcome, above all with lymph node metastases [64]. The positivity rate for lymphatic invasion is not significantly changed by immunohistochemistry so that H&E staining can provide sufficiently useful information in the clinical setting [71].
- Venous invasion. It is associated with the risk of haematogenous and lymph node metastases and therefore worthy of being reported separately from lymphatic invasion. Staining of the elastic fibres located in the venous wall significantly improves the detection of invasion and increases its predictive value [71].

- Tumour budding. Tumour budding, defined as the presence of isolated single cells or small clusters of cells scattered in the stroma at the invasive tumour margin, has been shown to be a strong prognostic factor in early colorectal cancer [67, 71–73]. Several methods of assessing budding have been proposed; however, further research is needed to identify the most reproducible method.
- Although prognostically relevant in early gastric cancer (PEN-A vs. PEN-B according to Kodama et al. [74]), pattern of invasion of the muscularis mucosae in pT1 colorectal cancer (Type A vs. Type B according to Tateishi et al. [75]) did not result relevant in predicting the clinical outcomes at multivariate analysis. At the present time, it is not recommended to report it.

B. Are there validated molecular markers to be used to assess the metastatic risk?

No validated molecular markers are currently available for clinical routinely use [EL: 5; GoR: D; ExpC: 100 %].

Histological risk factors are easily identifiable. Molecular biomarkers are required that are highly predictive of the lymph node metastatic risk of ERC. However, no validated molecular markers are currently available for routine clinical use, although the methylation status of selected target genes seems promising in identifying aggressive T1 colorectal cancers [76].

What is the role of local excision?

According to the definition of ERC adopted during this consensus conference, local excision (LE) is a valid treatment option for ERC. LE should be offered to treat lesions pre-operatively staged as T1 N0 with favourable clinical and pathological features [EL: 4; GoR: C; ExpC: 90.9 %].

In the effort to increase organ-preserving strategies, LE following neoadjuvant treatments might be used in responder early-staged lesions with less favourable clinical and pathological features [EL: 2b; GoR: B; ExpC: 90.9 %].

The term “LE” includes several surgical procedures, ranging from mucosectomy to full-thickness LE with partial resection of mesorectal fat.

The role of LE in the treatment of ERC is still controversial, mainly because of the absence of adequate lymphadenectomy. While the incidence of lymph node metastases is very low for T1 sm1 (0–3 %), it increases up to 15 and 25 % for T1 sm2–3 and T2, respectively [77–80].

Since the goal of LE is to achieve a R0 en bloc resection, a full-thickness LE down to the mesorectum is considered the procedure of choice. A full-thickness LE can be proposed as a curative surgical procedure only for the treatment of adenomas and selected T1 rectal cancers [81,

82]. There is increasing evidence that this approach can be offered also to patients with intraperitoneal rectal cancers, with no increased morbidity and cancer-related mortality [83–88]. LE has also been proposed in frail patients or in those refusing major surgery to remove more invasive rectal cancers (T1 sm2–3 and T2). However, the risk of recurrence is significantly higher, and therefore, LE alone should be considered only as a compromise procedure [89–92]. The use of neoadjuvant (chemo) radiation therapy followed by full-thickness LE of more advanced T1 and T2 cancer might improve the oncologic outcomes in responder patients [93, 94]. However, more clinical data are needed, preferably from randomized controlled trials, before recommending this treatment strategy as a valid alternative to rectal resection combined with total mesorectal excision (TME).

The criteria for curative LE include well to moderately differentiated tumour, tumour pre-operatively staged as Tis or slightly invasive, the absence of lymphovascular and perineural invasion, tumour diameter smaller than 4 cm and tumour involving <30 % of the rectal wall circumference [6, 32, 62, 64, 77, 78, 95–104]. The risk of recurrence after LE for tumours larger than 4 cm is higher due to the increased rate of positive margins. However, tumour involvement of the resection margins in large T1 rectal cancers is infrequent when a full-thickness LE, such as TEM, is performed.

The depth of submucosal invasion represents one of the most important risk factors for local recurrence and poor survival in patients undergoing LE for ERC [5, 77, 78, 81, 82, 97, 98, 100]. One of the main limitations of the pre-operative staging is the identification of T1 sm1 rectal cancers [105–107]. A full-thickness LE should be considered as an excision biopsy that allows for a more precise pathological staging. The procedure will be curative or will require further treatment depending on the histopathological evaluation. When unfavourable pathologic features, including depth of tumour invasion beyond pT1 sm1, poorly differentiated tumour grading, lymphovascular invasion or positive resection margins, are found in the LE specimen, rectal resection with TME is recommended. There is evidence that LE of rectal cancer followed by radical surgery because of poor prognostic features does not compromise the long-term oncologic outcomes [108–114].

Adjuvant treatment, such as radiotherapy or CRT, is an alternative option in elderly or frail patients at high surgical risk, but long-term results of this therapeutic strategy are poorer than those achieved with radical surgery [115, 116].

What is the recommended approach for LE?

ESD and TEM are the two established techniques to perform LE. LE by conventional transanal excision is

burdened by high local recurrence rates and should be considered only in very selected distal lesions [EL: 4; GoR: C; ExpC: 90.9 %].

The endoscopic approach to ERC includes endoscopic mucosal resection (EMR) and ESD. EMR is inadequate for en bloc resection of laterally spreading tumours (LSTs) larger than 20 mm since it is associated with high rates of specimen fragmentation, positive margins and therefore local recurrence, while ESD allows for en bloc resection of superficial lesions. Even though ESD is a challenging procedure with longer operative time than EMR, it has been gaining wider acceptance for the treatment of early colorectal neoplasms not only in Japan but also in Western countries.

The pre-operative staging is crucial. The indications for colorectal ESD include both granular and non-granular LSTs not suitable for en bloc EMR, a tumour with a non-invasive pattern as described by magnification chromoendoscopy, a shallow infiltrating submucosal carcinoma, a large depressed or elevated tumour, intramucosal tumours associated with submucosal fibrosis induced by previous endoscopic biopsy. Contraindications to EMR are VI (invasive pattern) and V_N pit pattern cancers at magnification chromoendoscopy and circumferential tumours [117–121].

Several studies have focused on ESD as treatment modality of early colorectal neoplasms. For instance, Saito et al. [118] reported in a prospective multicentre study the short-term outcomes in 1,111 patients undergoing colorectal ESD. The en bloc resection rate was 88 %; post-operative perforation occurred in 54 cases (4.9 %), while bleeding was reported in 17 cases (1.5 %). Endoscopic clips successfully treated all bleeding. Emergency surgery was necessary only in five patients: the indications were immediate peritoneal perforation with ineffective endoscopic clipping in two cases and delayed perforation in three cases. The risk of complications was significantly higher after ESD performed for large tumours (≥5 cm) and in low-volume institutions. Further large studies are awaited to assess the long-term outcomes of this procedure.

Several transanal surgical techniques for excision of large rectal neoplasms have been described, including conventional transanal excision (TE) with retractors and TEM. TEM can be performed either under general or spinal anaesthesia [122, 123]. A few studies have investigated the learning curve of colorectal surgeons performing TEM, showing that conversion rate, procedure time and complication rate are influenced by the surgeon's experience, and hence stressing the importance of surgical quality monitoring and centralization of care [124].

A few comparative studies have focused on the surgical outcomes of patients undergoing TEM or TE for large

rectal adenomas and ERCs [125–128]. For instance, Moore et al. [125] compared 82 patients treated with TEM and 89 who had undergone TE for rectal tumours. They found a lower rate of positive margins (10 vs. 29 %, $p = 0.001$) and fewer fragmented specimens (6 vs. 35 %, $p < 0.001$) in the TEM group than the TE group. Recurrence occurred in 5 % of TEM patients and in 27 % of TE patients ($p = 0.004$). Similarly, de Graaf et al. [126] reviewed the outcomes in 43 patients treated by TE and 216 who had undergone TEM for rectal adenomas. They observed that TEM achieved higher negative resection margin rates (88 vs. 50 %, $p < 0.001$) and lower specimen fragmentation rates (1.4 vs. 23.8 %, $p < 0.001$) than TE. Local recurrence rate was 6.1 % after TEM and 28.7 % after TE ($p < 0.001$).

Langer et al. [127] compared outcomes of 162 patients with rectal adenomas or “low-risk” T1 tumours after radical surgery, TE and TEM. A total of 40 patients had a T1 rectal cancer: 20 patients underwent TE and 20 had a TEM. Lower positive (19 %) or indeterminate (5 %) resection margin rates were observed in the TEM group than in the TE group (37 %, positive; 16 %, indeterminate) ($p = 0.001$). Christoforidis et al. [128] reported similar results in a retrospective comparative study including 42 patients with ERC treated by TEM and 129 patients with ERC who had undergone TE. They found that resection margins were more often positive in the TE group (16 %) than in the TEM group (2 %) ($p = 0.017$). All lesions were removed en bloc with TEM, while TE resulted in fragmented specimens in 11 (9 %) cases.

Based on the evidence available, TEM should be considered the transanal surgical technique for the treatment of ERCs. TE should be limited to a few cases of highly selected distal rectal lesions if ESD or TEM is not feasible for technical reasons.

More recently, a new approach to rectal neoplasms, namely transanal minimally invasive surgery (TAMIS), has been developed. Small case series with a short follow-up have demonstrated the feasibility and safety of this platform in the treatment of extraperitoneal early rectal tumours. To date, there are no clinical prospective studies comparing TEM and TAMIS. Only one small comparative experimental study showed similar accuracy in the tissue dissection between the two approaches and less operative time in completing the dissection and suturing task during the TEM procedure [129]. The largest clinical retrospective series was published in 2013 by Albert et al. [130]. They included 50 patients undergoing TAMIS (25 adenomas, 23 rectal cancers and 2 neuroendocrine tumours). Specimen fragmentation occurred in two cases (4 %). Positive margin rate was 6 % (three patients). Early morbidity rate was 6 %, while no complications occurred after a median follow-up of 20 months.

Both ESD and TEM are minimally invasive procedures that aim to achieve a complete en bloc resection. To date, only a few studies and a systematic review and meta-analysis of the literature have compared these two approaches to early rectal neoplasms. In 2012, Park et al. [131] retrospectively analysed patients with non-polypoid rectal high-grade dysplasia or submucosa-invading cancer who were treated with ESD (30 patients) or TEM (33 patients). No significant differences were observed in en bloc resection rates (96.7 vs. 100 %; $p = 0.476$) and R0 resection rates (96.7 vs. 97.0 %; $p = 1.000$) between ESD and TEM groups. ESD was associated with shorter operative time and hospital stay than TEM. There were no significant differences in complications between the two groups. No local recurrence or distant metastasis occurred during the follow-up. More recently, Kawaguti et al. [132] reported the results of a comparative study including 11 ERC patients treated by ESD and 13 treated by TEM. Patients were not randomly allocated to ESD or TEM, with patients with larger lesions or lesions located more proximally in the rectum being treated with ESD. Complete en bloc resection was achieved in 81.8 % of ESD patients and 84.6 % of TEM patients ($p = 0.40$). The mean operative time was similar: 133 ± 94.8 min in the ESD group and 150 ± 66.3 min in the TEM group ($p = 0.69$). No differences were observed in mean hospital stay: 3.8 ± 3.3 days after ESD and 4.1 ± 1.7 days after TEM ($p = 0.81$). With a mean follow-up of 29 ± 13.4 months in the TEM group and 18.6 ± 5.4 months in the ESD group, two (15.5 %) TEM patients and one (9.1 %) ESD patient experienced local recurrence.

Finally, Arezzo et al. [133] published a systematic review and meta-analysis of the literature comparing safety and effectiveness of ESD and full-thickness TEM in the treatment of non-invasive large rectal neoplasms. The review included 11 ESD and 10 TEM series (2,077 patients). The en bloc resection rate was 87.8 for the ESD group and 98.7 % for the TEM group ($p < 0.001$). The R0 resection rate was 74.6 % after ESD and 88.5 % after TEM ($p < 0.001$). The post-operative morbidity rate was 8.0 % after ESD and 8.4 % after TEM ($p = 0.874$). The recurrence rate was 2.6 % for the ESD patients and 5.2 % for the TEM patients ($p < 0.001$). Further abdominal surgery for the treatment of complications or for oncologic reasons was necessary in 8.4 % of ESD patients and in 1.8 % of TEM patients ($p < 0.001$).

What are the indications for neoadjuvant (chemo) radiation therapy?

Neoadjuvant (chemo) radiation therapy followed by TEM has been proposed in selected T1–2 N0 rectal cancer patients with similar oncologic results to rectal resection

combined with TME. This represents a clinical strategy in elderly and frail patients at high surgical risk, while in patients fit for surgery it should be proposed only in the setting of clinical trials until these results are confirmed by further large prospective randomized trials [EL: 2b; GoR: B; ExpC: 90.9 %].

Rectal resection combined with TME is the current gold standard for the treatment of rectal cancer. However, it is associated with significant post-operative mortality and short- and long-term morbidity, including sexual and urinary dysfunction, anterior resection syndrome and stoma-related complications [134–139].

In locally advanced rectal cancer, both neoadjuvant CRT and short-course radiotherapy (SCRT) induce significant tumour regression, tumour downstaging and sterilization of perirectal lymph nodes, with better local control compared with surgery alone or post-operative CRT [140–143]. A complete response on pathology (pCR) is observed in up to 30 % of patients [144], with significantly better oncologic outcomes in patients with pCR than non-responders in terms of local control, distant metastases rate and both 5-year overall and disease-free survival [144].

It is important to standardize the pathology assessment with the whole area of potential tumour having been embedded and sectioned at three levels before a pCR is diagnosed [145]. Pathologic complete response appears to be a time-dependent process [143]. SCRT followed by surgery within 1 week is associated with lower downstaging rates compared with long-course CRT; however, downstaging rates increase if surgery is delayed [143].

During the last two decades, there has been an increasing interest in selecting patients who might benefit from a less invasive and still oncologically adequate treatment, thus avoiding an “unnecessary” major surgery burdened by significant short-term and long-term morbidity [146]. Since 6 month post-operative mortality after TME is significantly higher in elderly patients [147–151], patients responding to pre-operative (chemo) radiation are those who may benefit most from TEM. LE represents a minimally invasive approach to rectal cancer as an alternative to rectal resection and TME. However, the major drawback of this approach is the lack of an adequate lymphadenectomy. Thus, several retrospective studies have specifically investigated the oncologic outcomes of patients undergoing neoadjuvant (chemo) radiation therapy followed by transanal excision for rectal cancer. Local recurrence is strictly correlated with the pathologic staging observed after neoadjuvant treatment. The strongest prognostic factors are ypT0 (0 % of local recurrence) and ypT1 (2 %), while ypT2 is associated with increasing local recurrence rates of 6–20 % [93].

While several studies have assessed the safety and oncological safety of external beam radiotherapy, there are

no multicentre data supporting the use of contact radiotherapy or brachytherapy for selected ERCs.

A randomized controlled trial compared TEM and rectal resection combined with TME in 70 patients with a pre-operatively staged T2N0M0 G1–2 rectal cancer smaller than 3 cm after neoadjuvant long-course external beam CRT. A pCR was reported in 30 % of patients (32 % in the TEM group and 29 % in the TME group). With a median follow-up of 84 months, similar local recurrence and survival rates were observed in the two groups. All recurrences occurred in patients without significant response to neoadjuvant CRT [152].

Recently, the preliminary results of the American College of Surgeons Oncology Group (ACOSOG) Z6041 trial have been published [153]. This study aimed to evaluate the short-term outcomes of neoadjuvant long-course CRT followed by LE (performed by TE or TEM) in 77 T2 N0 rectal cancer patients. A pCR was achieved in 34 (44 %) patients, while downstaging was observed in 49 (64 %) patients.

The most frequent complications after TEM performed in patients treated with neoadjuvant long-course CRT are related to the rectal wound healing process. Marks et al. [154] retrospectively reviewed the short-term outcomes in 43 rectal cancer patients treated with TEM after neoadjuvant long-course CRT (CRT group) and in 19 patients treated with TEM alone. They found higher morbidity rates in the CRT group than in the TEM group (33 vs. 5.3 %, $p < 0.05$). In particular, the rate of complications related to the rectal suture was 25.6 % (11 cases) in the CRT group and 0 % in the TEM group ($p = 0.015$). Perez et al. [155] assessed the 30-day outcomes in 36 consecutive patients treated by TEM for rectal neoplasm (23 underwent long-course CRT followed by TEM). Patients treated with neoadjuvant CRT had higher rates of suture line dehiscence (60.9 vs. 23.1 %, $p = 0.032$) and hospital readmission (43.5 vs. 7 %, $p = 0.025$).

Only one study has specifically addressed the role of SCRT with delayed LE [156]. Large prospective studies with long follow-up periods are needed to evaluate the risk of post-operative complications and understand the implications in terms of oncologic outcomes of both neoadjuvant SCRT and long-course radiotherapy followed by TEM. A European multicentre prospective study, TEM After Radiochemotherapy for Rectal Cancer (CARTS) has been designed to investigate the role of TEM performed 8–10 weeks after pre-operative long-course CRT on the basis of clinical response [157].

The TREC (transanal endoscopic microsurgery and radiotherapy in early rectal Cancer) [158] is an ongoing phase II open, multicentre randomised controlled trial comparing radical surgery with TME and SCRT followed by delayed (8–10 weeks) TEM in patients with ERC. The

primary end-point is the recruitment measured at 12, 18 and 24 months, while the secondary end-points include safety and efficacy. The TREC and CARTS groups have combined their phase II protocols (STAR-TREC) to produce a single phase III trial that will randomize patients to one of three treatments: (a) standard radical surgery, (b) SCRT + TEM and (c) CRT and TEM.

When is abdominal rectal resection with TME indicated?

Abdominal rectal resection with TME is indicated when the pre-operative staging fails to identify a ERC, and after LE whenever the pathological evaluation of the specimen shows the presence of unfavourable features [EL: 2a; GoR: B; ExpC: 90.9 %].

The results of a recent meta-analysis of the literature [159] of studies comparing TEM and rectal resection with TME for T1 N0 rectal cancer (one randomized clinical trial and four retrospective comparative non-randomized studies) show lower post-operative morbidity (8.2 vs. 47.2 %, $p = 0.01$), with no mortality, and higher local recurrence rates after TEM (12 vs. 0.5 %, $p = 0.004$) than after TME. However, there was a high heterogeneity of the studies that were often underpowered and with extremely variable follow-up periods, different inclusion criteria were used, and there was no differentiation between “low-risk” (well or moderately differentiated adenocarcinoma without lymphatic/vascular invasion) and “high-risk” cancers (poorly or undifferentiated adenocarcinoma with lymphatic/vascular invasion) in the majority of them.

Only two studies [160, 161] have compared long-term outcomes of TEM and TME for T1 rectal cancers classified according to Hermanek’s criteria. Heintz et al. [160] performed a retrospective study comparing the results of TEM and TME in 80 T1 “low-risk” and 23 T1 “high-risk” rectal cancer patients. No significant differences were observed in local recurrence rates after TEM or TME (4 vs. 3 %) in T1 “low-risk” cancer patients, while local recurrence was more likely to occur after TEM than TME in “high-risk” cancer patients (33 vs. 18 %). Similarly, Lee et al. [161] did not observe differences in local recurrence rates in 52 patients who had undergone TEM and in 17 patients treated by TME for well or moderately differentiated T1 rectal carcinomas.

Therefore, the current evidence supports the use of LE only in “low-risk” ERCs, while rectal resection with TME is the standard of care in “high-risk” ERCs [162–164].

When unfavourable pathologic features are present on the LE specimen, rectal resection with TME is recommended in order to minimize the risk of recurrence [108–114]. However, this strategy has some drawbacks. First, the rectal wall and perirectal fat might be affected by a fibrotic

scar after LE, making dissection of the correct planes down to the pelvic floor much more challenging, leading to an increased rate of abdominoperineal resections (APR) [165, 166]. Second, lower rates of complete mesorectal excision after full-thickness LE have been reported, probably secondary to traction on the rectum during the mobilization that may cause a tear in the mesorectum [166]. Finally, more than 50 % of patients undergoing TME after LE result may be over-treated, since no residual cancer cells in the rectal wall and in the perirectal lymph nodes are found. On the other hand, the remnant patients have a definitive staging of the disease after TME [166]. These results reflect the still relatively low accuracy of EUS and MRI in the evaluation of the rectal wall invasion and lymph node involvement before and after LE, even in high-volume centres. Studies that investigate other staging modalities, such as PET/CT and sentinel node biopsy, are awaited to better identify the subgroup of patients who could avoid an unnecessary TME after LE, with the increased risk of an APR.

What is the best approach to abdominal surgery: laparoscopic or open?

The laparoscopic approach to rectal cancer has clinically relevant short-term advantages when compared with the open approach. The impact of the two approaches on 5-year survival seems to be similar. The results of RCTs with longer follow-up are awaited to confirm these findings [EL: 1a; GoR: A; ExpC: 100 %].

Several systematic reviews and meta-analyses of randomized clinical trials and non-randomized comparative studies have shown lower mortality and early post-operative morbidity, and a reduced hospital stay after laparoscopic rectal resection combined with TME [167–172]. No significant differences were observed between a laparoscopic and open approach in anastomotic leakage, circumferential positive margin rates, and number of lymph nodes harvested. Five-year overall survival and disease-free survival are similar. A few studies have confirmed the equivalence of open and laparoscopic surgery at a follow-up longer than 5 years. For instance, Green et al. [173] have recently reported the long-term follow-up results of the Medical Research Council (MRC) CLASICC trial. With a median follow-up of 62.9 months, no differences were observed in overall and disease-free survival after laparoscopic and open rectal resection.

When is abdominoperineal resection necessary?

Abdominoperineal resection for ERC, although rare, might be indicated depending on the tumour site and location [EL: 4; GoR: C; ExpC: 100 %].

The distance between the lower edge of the rectal tumour and the anal verge has been traditionally considered the key factor in the decision-making process for sphincter-saving resection due to the potential risk of microscopic involvement of the rectal wall below the tumour. Until the 1980s, a 5-cm free distal margin was required, and then, a 2-cm clear distal margin was considered oncologically adequate. As a consequence, all rectal cancers located within 2 cm from the anal ring were removed by APR [174]. In the early 2000s, there was a progressive shift from the concept of distance between the tumour and the anal verge to the concept of infiltration of the external sphincter. Rullier et al. [175] assessed the oncologic outcomes of 92 patients with a rectal cancer at 3 cm (range 1.5–4.5) from the anal verge undergoing conservative surgery with intersphincteric resection. There was no peri-operative mortality, and post-operative morbidity rate was 27 %. Complete microscopic resection (R0) was achieved in 89 % of patients, with 98 % negative distal margin and 89 % negative circumferential margin. In 58 patients with a follow-up of more than 24 months, local recurrence rate was 2 %; the 5-year overall and 5-year disease-free survival rates were 81 and 70 %, respectively.

Currently, a sphincter-preserving rectal resection is an option for the treatment of supra-anal, juxta-anal and intra-anal T2 rectal tumours, while APR should only be performed in patients with tumour involvement of the external anal sphincter or levator ani muscle. However, the surgical treatment of low rectal cancer is heterogeneous, and APR is still performed in up to 55 % of patients in the UK [176] and in up to 100 % in the USA [177]. To standardize the surgical treatment of these tumours, a new surgical classification of low rectal cancer (defined as located at <6 cm from the anal verge) according to the relationship between the lower border of the tumour and the anal sphincter at MRI has been recently proposed [178]. Type I, supra-anal cancer (more than 1 cm from the anal sphincter), can be treated with a low anterior resection; type II, juxta-anal cancer (<1 cm), can be treated with partial intersphincteric resection (pISR); type III, intra-anal cancer (involving the internal sphincter), can undergo total intersphincteric resection (tISR); and type IV, trans-anal cancer (invading external sphincter or levator ani), is treated with abdominoperineal resection (APR).

Both pISR and tISR are technically challenging procedures and in some cases present a suboptimal outcome in terms of function and quality of life; therefore, APR is still the procedure of choice in many patients with type II–III T2 rectal cancers.

Anorectal function and quality of life after LE

A. Are anorectal function and quality of life impaired after LE of ERC?

TEM alone for ERC does not have adverse long-term effects on anorectal function or quality of life. Urological and sexual dysfunctions that frequently occur after abdominal surgery for rectal cancer are uncommon after TEM. Radiotherapy followed by transanal excision may be associated with worse functional results [EL: 2b; GoR: B; ExpC: 100 %].

Several studies have assessed anorectal function and quality of life (QoL) in patients undergoing TEM [179–186] for ERC. Even though the transanal introduction of a 40-mm-diameter rigid proctoscope with continuous endorectal CO₂ insufflation is necessary to perform a TEM procedure, post-operative faecal continence is not compromised in pre-operatively continent patients. Duration of the procedure does not significantly affect continence. Transient urgency might occur at 3 months after TEM due to partial reduction in the rectal reservoir secondary to the scar inside the rectal wall in patients with tumours >4 cm. As a consequence, a transient worsening of QoL is frequently observed at 3 months. However, QoL significantly improves at 1 year post-operatively, and excellent outcomes are reported at 5 years [186].

Some recent studies have shown that anorectal and sexual function, and QoL after neoadjuvant radiotherapy followed by LE are similar to that observed after anterior resection alone, suggesting a detrimental effect of neoadjuvant radiotherapy. For instance, Gornicki et al. [187] evaluated retrospectively the functional outcomes in 44 patients undergoing neoadjuvant radiation therapy followed by LE for cT1N0, cT2 N0 and borderline cT2–3 N0 G1–2 rectal cancer smaller than 3 cm. They compared this group of patients with a control group of 38 patients who had undergone anterior resection alone for cT2 N0 rectal cancer. The evaluation of anorectal and sexual functions was performed 1 year after treatment. A self-administered non-validated questionnaire was sent to the patients and returned to the trial office by regular post. No significant differences were observed in the mean number of bowel movements, gas and faecal incontinence, clustering of bowel movements and urgency between the two groups of patients. Thirty-eight percentage of patients claimed that their QoL was affected by anorectal dysfunction; 19 % of men and 20 % of women claimed that the treatment negatively influenced their sexual life.

Coco et al. [188] recently published the results of a small cohort comparative study comparing 22 patients

treated with CRT and TEM for locally advanced rectal cancer and 25 treated by TEM for ERC. At 1-year follow-up visit, all patients were asked to answer a pool of questions aiming to assess the anorectal function. The morbidity rate was 36.4 % in the CRT + TEM group and 16 % in the TEM group ($p = 0.114$). The most frequent complication was the suture dehiscence: 22.7 vs. 4 % ($p = 0.068$). At 1-year follow-up, no significant differences were observed in terms of continence between the two groups.

Based on the evidence currently available, no definitive conclusions can be drawn regarding the functional outcomes in patients undergoing neoadjuvant radiotherapy followed by LE for rectal cancer. Further large and prospective studies are needed to better clarify the impact of neoadjuvant radiotherapy on anorectal function in these patients.

B. How does radical surgery for ERC affect patient anorectal function and quality of life?

Rectal resection and TME alters faecal and sexual functions with a negative impact on quality of life [EL: 4; GoR: C; ExpC: 100 %].

Most evidence concerning the impaired anorectal and sexual function and the poor quality of life after anterior resection comes from studies that included locally advanced rectal cancer patients treated with neoadjuvant CRT followed by surgery [189]. There are very few data regarding the anorectal function and quality of life after abdominal rectal resection and TME for ERC. Only two retrospective studies [190, 191] comparing quality of life after TEM and TME for ERC have been published. Doornebosch et al. [190] compared 31 patients undergoing TEM for a T1 rectal cancer with a sex- and age-matched sample of 31 T + N0 rectal cancer patients (3 T1 and 8 T2) undergoing sphincter-saving rectal resection with TME and a sex- and age-matched community-based sample of healthy people. Pre-operative radiation therapy was used in eight TME patients. None of the TME patients had a diverting ileostomy and all were disease-free at the time of evaluation. The median time interval between the operation and the evaluation was 28 months (range 5–91 months). The questionnaires used were the EuroQol EQ-5D, EQ-VAS, EORTC QLQ-C30 and EORTC QLQ-CR38. From the patients' and social perspective quality of life was similar in the three groups. Defecation problems were reported more frequently after TME than TEM; a trend towards worse sexual function was observed after TME than after TEM, particularly in male patients.

More recently, Lezoche et al. [191] showed that the impact of LE by TEM on QoL of 17 T1 rectal cancer patients was limited to the first post-operative month, while

laparoscopic TME had a negative impact on QoL of 18 T1 rectal cancer patients at both 1 and 6 months post-operatively. However, no significant worsening of QoL was observed 12 months after either procedure.

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