

## LAPAROSCOPIC, OPEN AND TRANSANAL MESORECTAL EXCISION IN RECTAL CANCER SURGERY

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**INTRODUCTION:** there are no studies comparing laparoscopic, open, and transanal mesorectal excision for rectal cancer.

**AIM:** to compare quality of total mesorectal excision (TME) according to the P. Quirke protocol, to assess circular resection margins (CRM), to assess distal resection margins (DRM) and perioperative morbidity.

**PATIENTS AND METHODS:** prospective study was performed to compare the effectiveness of different methods of TME.

**RESULTS:** eighty-eight patients were included in the study, 29 – in the laparoscopic (LA TME) group, 29 – in the open TME group, 30 – in the transanal (TA TME) group. The groups were comparable in clinical, demographic and tumor parameters. There was no significant difference between LA TME, open TME and TA TME in quality of mesorectal excision ( $p=0.67$ ). There was also no significant difference in rates of positive CRM and positive DRM ( $p=0.38$ ). No significant difference was obtained between intraoperative and postoperative complications rates ( $p=0.38$ ;  $p=0.45$ ).

**CONCLUSION:** all three methods of TME showed the same results for quality, circular and distal resection margins and perioperative morbidity.

[Key words: rectal cancer, surgery, mesorectum, total mesorectal excision, TME, laparoscopy, transanal, TA TME]

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### INTRODUCTION

Total mesorectumectomy (TME) is the standard surgical approach for rectal cancer [1].

Mesorectal fascia integrity, tumor-free distal resection margin (DRM) and circular resection margin (CRM) are the main criteria for assessing the quality of TME [2,3], which in turn are factors in the prognosis of recurrence and survival of patients.

The use of TME can reduce the recurrence rate from 17% to 6% and increase the overall 5-year survival rate by 50% [4].

With the advent of minimally invasive surgery, the laparoscopic technique of TME has gained great popularity, despite the difficulties associated with the long training curve of the surgeon.

Severe visceral obesity, narrow pelvis, abdominal surgery in history, concomitant cardiopulmonary diseases, also create certain difficulties for the surgeon with this approach.

Multicenter randomized trials CLASICC, COLOR II, COREAN, ACOSOGZ6051, ALaCaRT demonstrated certain

advantages of laparoscopic technique in comparison with open: reduction of postoperative pain intensity, better cosmetic effect, shorter postoperative hospital stay.

The quality of the removed specimen, the recurrence rate, and the overall 5-year survival in laparoscopic TME were comparable with the open one [5-9].

Transanal TME is a new method of minimally invasive surgery used since 2010 [10]. The technology of mobilization of the rectum «from bottom to top», provides better visual control in the allocation of the lower parts of the rectum, which in turn facilitates the work in the pelvis, especially in the anterior semicircle, which theoretically should reduce the incidence of conversion to open surgery [11,12].

Transanal TME showed similar results in the quality of the removed specimen, when compared with open and laparoscopic methods [13,14], however, randomized studies comparing all the three methods have not been done at the moment. This paper reflects the results of a prospective clinical study in selected groups.

## PATIENTS AND METHODS

Hypothesis of the study: open, laparoscopic and transanal TME have comparable results on the quality of the removed specimen, circular and distal resection margins.

Inclusion criteria: patients with rectal adenocarcinoma of different grades of differentiation, depth of invasion T1-T3, according to CT/MRI of the pelvic organs.

Exclusion criteria: tumor site above the level of the pelvic peritoneum; involvement of the anal sphincter, lateral resection margin according to CT/MRI of the positive pelvis; recurrence of rectal cancer, comorbidities in the stage of decompensation.

The primary point of the study: quality of TME by Quirke, P., circular and distal resection margins.

The secondary points of study: incidence and structure of perioperative complications.

From November, 2017 to September, 2019, a clinical prospective single-center study included 88 patients who underwent radical surgeries in the volume of total mesorectumectomy by open, laparoscopic, and transanal methods.

Transanal total mesorectumectomy was performed by one surgeon who had done a training curve.

### Surgery technique

Total mesorectumectomy with each of the three methods was performed according to generally accepted standards. Access for «open TME» was a lower-median laparotomy (Fig. 1).

For «laparoscopic TME» (LA TME) and «transanal TME» (TA TME), the insertion of trocars on the anterior abdominal wall was performed according to the standard procedure (Fig. 2). Also, during the surgery for laparoscopic TME and, if necessary, transanal TME, Pfannenstiel access was used.

In transanal TME, a rigid surgical rectoscope with a multifunctional port was used for the perineal stage (Fig. 3) for transanal endomicrosurgery.

At low anterior resection (LAR), the bowel cutting was performed with the CONTOUR® Curved Cutter Stapler (Ethicon, USA) for open TME, with ECHELON (Ethicon, USA) – for laparoscopic access; however, with intraoperative difficulties during laparoscopic surgery, the crossing of the intestine was performed by CONTOUR using Pfannenstiel access.

Anastomosis was created by circular stapler CEEA-31 (Covidien, USA), colo-anal anastomoses were hand-sewn. In the group of TA TME, from the abdominal cavity, the rectum was mobilized to the upper pole of the tumor.

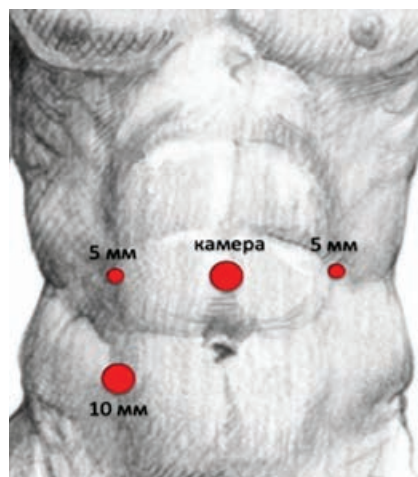


Figure 1. Scheme of trocar sites

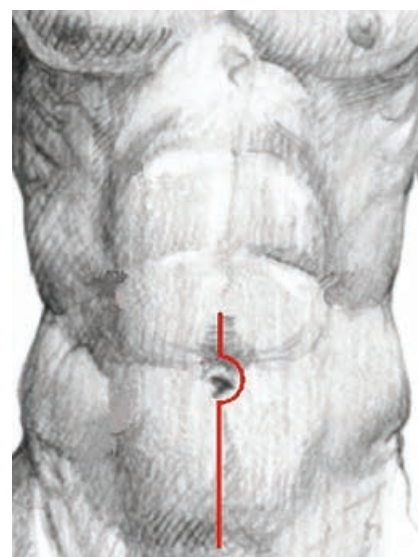


Figure 2. Lower median laparotomy



Figure 3. Platform for transanal access

The beginning of the perineal stage, depending on the surgery type, had differences. When the intersphincteric resection, the retractor was placed on the anal canal, the rectum was cut circularly at the level of the dentate line using electrocoagulation and was mobilized in the intersphincter area for 3-4 cm.

Further, the rectum was sutured with purse-string suture, and the surgical rectoscope was inserted. At low anterior resections after anal sphincter dilation, an operative rectoscope was inserted into the rectum. Distal to 2-3 cm of the lower pole of the tumor, a purse-string suture was applied, which was fixed with a clip. Transanal TME was performed before joining the abdominal surgical team.

All surgeries with intestinal anastomosis were followed with the preventive ileostomy.

If it was not possible to form an anastomosis due to the somatic status of the patient, age, severe changes after neoadjuvant CRT, surgery ended with the end colostomy.

#### Statistical analysis

ANOVA method was used to compare continuous data in the three groups under normal distribution.

In the presence of significant differences, pair wise comparison of the groups was carried out, taking into account the effect of multiple comparison. Continuous data with non normal distribution were described by median and quartiles. Comparison of the three groups with non-Gaussian distribution was performed using the Kruskal-Wallace test. In the presence of statistical differences, the Mann-Whitney pair test was used. By the Yates-corrected  $\chi^2$  test, the binary data were compared in pairs, obtaining a statistical difference when comparing  $\chi^2$ .

The Bonferroni's correction was used for multiple comparisons.

The differences were recognized as significant at  $p < 0.017$  for three groups, at 5% error of the first type. The statistical analysis was performed using Statistica 13.3 (TIBCO, USA) program.

## RESULTS

The groups were homogenous in gender, age, BMI, anesthetic risk (ASA), history of previous abdominal surgery, tumor site, the presence of synchronous

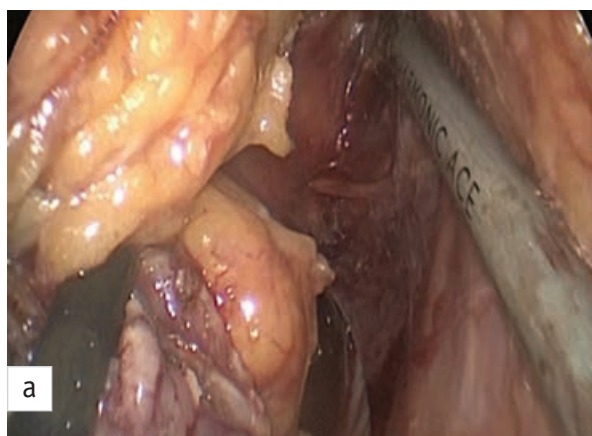


Figure 4 a,b. Transanal total mesorectumectomy

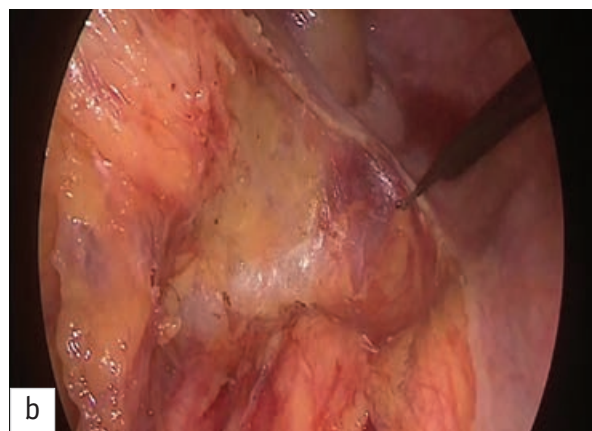


Figure 5 a,b. Laparoscopic total mesorectumectomy



**Table 1.** Clinical features

Indications	Open TME, n=29	LA TME, n=29	TA TME, n=30	p
Sex				0.105
Females	9 (31%)	17 (59%)	13 (43%)	
Males	20 (69%)	12 (41%)	17 (57%)	
Age Me (quartiles)	63 (59-70)	62 (56-65)	63 (56-66)	0.569
BMI kg/m <sup>2</sup> Me (quartiles)	25 (24-26)	25 (22-27)	25 (24-26)	0.97
The ASA degree				0.233
ASA 1	9 (31%)	8 (28%)	11 (37%)	
ASA 2	5 (17%)	11 (38%)	8 (27%)	
ASA 3	11 (38%)	10 (34%)	10 (33%)	
ASA 4	4 (14%)	–	3 (3%)	
Surgery of the abdominal cavity in history	11 (38%)	6 (21%)	5 (17%)	0.136
Tumor site in the rectum				0.252
m/a section	23 (79%)	20 (69%)	26 (87%)	
l/a section	6 (21%)	9 (31%)	4 (13%)	
Synchronous cancer	–	–	2 (7%)	0.138
Distance of the tumor from the edge of the anus, cm Me (quartiles)	7 (7-8)	7 (6-9)	8 (7-9)	0.688
Semicircle				0.084
anterior	9 (30%)	5 (17%)	10 (33%)	
posterior	6 (21%)	8 (28%)	8 (27%)	
left	6 (21%)	5 (17%)	4 (13%)	
right	–	8 (28%)	3 (10%)	
circular tumor	8 (28%)	3 (10%)	5 (17%)	
Tumor size, cm Me (quartiles)	4 (4-5)	4 (3-5)	4 (3-5)	0.063
Involvement of the lateral resection margin according to CT/MRI	4 (14%)	2 (7%)	1 (3%)	0.297
Tumor size according to CT/MRI, cm Me (quartiles)	4 (3-4)	4 (4-5)	5 (3-5)	0.326
Neoadjuvant CRT	9 (31%)	10 (34%)	4 (13%)	0.138
The surgery type				0.057
LAR	22 (76%)	20 (69%)	28 (93%)	
Intersphincteric resection	7 (24%)	9 (31%)	2 (7%)	
Mobilization of the left flexure	10 (34%)	10 (34%)	22 (73%)	0.0025
The anastomosis creation	26 (90%)	29 (100%)	30 (100%)	0.042

tumors, the tumor distance from the anal edge and circumferential tumor growth.

Also, there were no significant differences on tumor size, involvement of the lateral resection margin according to CT or MRI of the pelvic organs preceding neoadjuvant CRT, tumor size according to CT or MRI, neoadjuvant CRT.

Intraoperative indicators as the surgery type, the anastomosis type, blood loss, the complications rate did not differ significantly (Table 2).

However, left flexure mobilization rate was significantly higher in the TA TME group in 22/30 (73%) patients versus 10/29 (34%) patients in the LA TME group and 10/29 (34%) in the Open TME group,  $p=0.00025$  (LA TME vs. TA TME  $p=0.004$ ; Open TME vs. TA TME  $p=0.004$ ; Open TME vs. LA TME  $p=1.0$ ).

The surgery time was statistically significantly less in the Open TME group – 150 (130-180) minutes than in the LA TME – 190 (175-235) min. and TA TME – 240 (220-290) min. groups,  $p<0.0001$  (Open TME versus LA TME,  $p=0.006$ ; Open TME versus TA TME,  $p<0.0001$ ; LA TME versus TA TME,  $p=0.0001$ ).

The postoperative complications rate and their struc-

ture (bleeding, postoperative urinary retention, postoperative ileus, hematomas, anastomotic leakage) as well as postoperative hospital stay did not differ significantly. No mortality occurred. Pathomorphological data such as tumor type, depth of invasion, regional lymph node involvement, distant metastases rate, lymphovascular invasion, perineural growth, perivascular growth, number of removed and number of affected lymph nodes did not differ significantly.

The quality of the removed specimen according to Quirke, P. in the Open TME, LA TME and TA TME groups was, respectively, Grade 3 in 15/29 (52%), 17/29 (59%) and 14/30 (47%); Grade 2 in 9/29 (31%), 7/29 (24%) and 11/30 (37%); Grade 1 in 15/29 (17%), 5/29 (17%) and 5/30 (17%) patients, but no difference was achieved ( $p=0.67$ ).

Positive distal resection margin occurred in 1/29 (3%) in Open TME group ( $p=0.357$ ). Positive circular resection margin were: 1/29 (3%) in Open TME, 4/29 (14%) in LA TME and 3/30 (10%) in TA TME group ( $p=0.382$ ).

R1 resection, the circular and distal resection margins rates did not achieve a significant difference (Table 3).

**Table 2. Direct results**

Complications, surgical outcomes	Open TME, n=29	LA TME, n=29	TA TME, n=30	p
Time of surgery, min. Me (quartiles)	150 (130-180)	190 (175-235)	240 (220-290)	0.000001
Intraoperative blood loss, ml Me (quartiles)	100 (80-100)	90 (90-100)	100 (90-100)	0.379
Incidence of intraoperative complications				
Perforation of the rectum	–	–	1 (3%)	0.376
Postoperative complications (30 d)				
Bleeding	10 (34%)	6 (21%)	7 (23%)	0.446
Urinary retention	1 (3%)	–	–	0.357
Post-op ileus	1 (3%)	1 (3%)	3 (10%)	0.453
Hematoma	8 (28%)	4 (14%)	3 (10%)	0.169
Leakage	–	1 (3%)	–	0.357
	–	1 (3%)	1 (3%)	0.604
Postoperative hospital stay Me (quartiles)	9 (7-12)	7 (7-9)	7 (7-10)	0.0406

**Table 3. Morphological characteristics**

Pathomorphological features	Open TME, n=29	LA TME, n=29	TA TME, n=30	p
Tumor type				
Adenocarcinoma	29 (100%)	27 (93%)	28 (93%)	0.357
Mucous adenocarcinoma	–	2 (7%)	2 (7%)	
pT				
T0	–	3 (10%)	–	0.205
T1	1 (3%)	2 (7%)	1 (3%)	
T2	7 (24%)	9 (31%)	11 (37%)	
T3	20 (69%)	13 (45%)	18 (60%)	
T4	1 (3%)	2 (7%)	–	
pN				
N0	18 (62%)	15 (52%)	17 (57%)	0.545
N1a	3 (10%)	3 (10%)	6 (20%)	
N1b	3 (10%)	2 (7%)	3 (10%)	
N1c	–	–	1 (3%)	
N2a	1 (3%)	2 (7%)	2 (7%)	
N2b	4 (14%)	7 (24%)	1 (3%)	
M1	2 (7%)	2 (7%)	2 (7%)	0.999
L1	18 (62%)	19 (66%)	17 (57%)	0.78
V1	9 (31%)	8 (28%)	10 (33%)	0.89
pn1	3 (10%)	3 (10%)	2 (7%)	0.85
R1	3 (10%)	4 (14%)	3 (10%)	0.88
Number of lymph nodes removed (M±δ)	28±13	26±13	29±10	0.481
Number of affected lymph nodes Me (quartiles)	0 (0-2)	0 (0-5)	0 (0-1)	0.406
The TME quality as to P. Quirke				
Grade 3	15 (52%)	17 (59%)	14 (47%)	0.884
Grade 2	9 (31%)	7 (24%)	11 (37%)	
Grade 1	5 (17%)	5 (17%)	5 (17%)	
The distal resection margin, mm Me (quartiles)	20 (10-30)	15 (10-25)	20 (15-30)	0.098
Positive DRM	1 (3%)	–	–	0.357
The circular resection margin, mm Me (quartiles)	3 (3-6)	6 (4-10)	5 (3-8)	0.116
Positive CRM	1 (3%)	4 (14%)	3 (10%)	0.382

Due to the fact that there was one omitted value in the TA TME group, the number of the removed lymph nodes was 82, changing the distribution in the variation series. This group is reduced to normality by removing values in the variation series [13,82].

## DISCUSSION

Transanal TME is a new method that demonstrates comparable, and in some cases better, intraoperative, postoperative and oncological results compared to laparoscopic TME [14,15].

In laparoscopic surgery for middle and lower rectal cancer, the surgeon often faces technical difficulties performing TME.

Limitation of the surgical area in the conditions of

small pelvis and severe visceral obesity, as well as the large size of the tumor and altered tissues after previous neoadjuvant CRT, create poor conditions for visualization of the distal and circular resection margin in the lower mesorectum, which can lead to a decrease in the quality of the removed specimen, positive DRM and CRM.

These factors force the surgeon to abandon laparoscopy and perform conversion to open surgery.

However, TA TME, despite such difficulties, allows to do without conversion and achieve good both postopera-

tive and early oncological results [14,16].

Open rectal surgery is devoid of such a limitation of the working area as laparoscopic, but visual control of the resection margin, with anatomical difficulties, in the lower rectal parts is also hard.

This circumstance, in turn, can also contribute to a decrease in the removed specimen quality.

Perdawood S.K., comparing all the three methods, showed that in 68 patients in the Open TME group, the removed specimen corresponded to Grade 3 by Quirke P. versus 58 patients in the TA TME group, but at the same time there were fewer cases with Grade 1 in the TA TME group than with Open TME, and it was close to a significant difference, 14 vs. 17, respectively,  $p=0.08$ .

When comparing laparoscopic TME with transanal TME, there were more cases with Grade 3 in the LA TME group, 68 vs. 58, but at the same time there were fewer cases with Grade 1 in the TA TME group, 14 vs. 20,  $p=0.016$ .

Cases of involvement of the circular resection margin were fewer in the TA TME group, compared with the LA TME group, 7 vs. 13, and involvement of the distal resection margin was not observed at all, versus 1 observation in the LA TME group and 1 in the Open TME group; however, no significant difference was achieved. It should be noted that the involvement of the circular resection margin in the Open TME group was detected in 10 observations [14].

Similar results when comparing TA TME with LA TME were obtained in most publications [15-19].

According to multicenter randomized trials COLOR II, COREAN, ACOSOGZ6051, ALaCaRT, comparing open and laparoscopic methods, data on the specimen quality, CRM and DRM were comparable, thereby showing the safety, at the time of the innovation, laparoscopic technique in comparison with the open one [5,7-9].

In our study, total mesorectumectomy was performed by laparoscopic, transanal and open methods.

The data obtained had no significant differences on the quality of the removed specimen.

Demonstrating undoubted advantages, the technique of transanal TME negatively affects the functional results in patients after surgery, because of use of rigid surgical rectoscopes. Velthamp Helbach M., comparing the quality of life in patients after laparoscopic and transanal TME, demonstrated comparable results in general health, the severity of pain, the presence and clinical manifestation of low anterior resection syndrome, sexual function, urination function.

However, according to the results of the EQ-5D-3L questionnaire, the item relating to anal incontinence was worse for TA TME,  $p=0.0032$  [20]. It is possible that the use of flexible platforms for TA TME, will help to reduce the incidence of anal incontinence.

In our study, no instrumental evaluation of anal continence was performed.

According to many authors, the frequency of intra- and postoperative complications during transanal TME is comparable with laparoscopic technique [15,19-21].

When comparing all the three methods, the incidence of anastomotic leakage was higher in the Open TME group 26%, versus 17% in the LA TME group and 10% in the TA TME group,  $p=0.05$  [14].

The rate of intra- and postoperative complications, as well as the volume of blood loss and postoperative hospital stay did not achieve significant differences.

Comparative studies have shown that the surgery time in transanal TME was not inferior to the laparoscopic one [20,21], and according to deAngelis and Perdawood data, it was less [15,17] even in comparison with the open and laparoscopic methods [14].

Given that the technique of transanal TME is relatively new, the difference in the surgery time depends on the training curve done by the surgeon.

In this study, the longest surgery was the TA TME, and the shortest – the Open TME.

## SUMMARY

In the study, all the three methods of total mesorectumectomy in patients with middle and low rectal cancer showed comparable results, both in the removed specimen quality, circular and distal resection margins, and rate of intra- and postoperative complications, which indicates that all these methods are equally safe and can be used in clinical practice.

However, at this time, it is not possible to determine the role and place of each technique of total mesorectumectomy.

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*The authors declare no conflict of interest.*

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