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RESEARCH

Does transanal total mesorectal excision (taTME) result in better quality of life and functional outcomes than traditional TME does? A retrospective propensity score-adjusted cohort study

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Abstract

Purpose The improved prognosis of rectal cancer through modern therapeutic approaches raises questions regarding quality of life (QoL) and functional outcomes. In this study, we compared post-transanal total mesorectal excision (taTME) short- and long-term QoL and functional outcomes with those after abdominal TME (abTME).

Methods Prospective data from patients who underwent elective taTME or abTME for stage I-III rectal cancer followed by anastomosis were retrospectively propensity score-adjusted. The primary endpoint, QoL, was assessed with the European Organization for Research and Treatment of Cancer core questionnaire (EORTC QLQ-C30). Functional outcomes were the secondary endpoints.

Results Among 494 patients during 2013–2022, 187 patients who underwent taTME and 62 patients who underwent abTME were included. QoL was worse after taTME at isolated time points: overall QoL (after 3 years: 72 vs. 82 points, $p=0.017$) and QLQ-total (after 3 years: 81 vs. 87 points, $p=0.028$; after 4 years: 82 vs. 89 points, $p=0.012$). After propensity score matching, the between-group differences were still significant but smaller: overall QoL −6 points, $p=0.021$; QLQ-total −5 points, $p=0.026$.

Conclusion The differences reported at isolated time points have questionable clinical relevance. Therefore, taTME and traditional abTME seem to have comparable long-term QoL and functional outcomes.

Clinical trial registration ClinicalTrials.gov, NCT06505863, https://clinicaltrials.gov/search?id=NCT06505863.

What does this paper add to the literature?

The improvement in the prognosis of rectal cancer through modern therapy modalities raises questions regarding quality of life (QoL) and functional outcomes. Evidence regarding this after transanal total mesorectal excision is lacking. In this study, we compared short-term and long-term QoL and functional outcomes after taTME with abdominal TME.

Keywords Transanal total mesorectal excision · Laparoscopic total mesorectal excision · Rectal cancer · Quality of life · Functional outcome

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Introduction

Despite intensive scientific research and treatment innovations, rectal cancer remains one of the most common and feared cancer diseases worldwide [1]. Since the description of total mesorectal excision (TME) by Heald et al. [2]. in the 1980s, the laparoscopic, robotic, and transanal approaches have resulted in major changes and improvements in rectal cancer surgery [3–5]. However, rectal cancer surgery remains challenging. In particular, patients with low rectal

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cancer anastomosis are more difficult, resulting in a greater risk of positive resection margins, a greater incidence of anastomotic leakage, and worse survival [6, 7].

In 2009, Sylla et al. [8]. and Zorron [9] were the first to describe transanal TME (taTME). This novel technique seems to have similar postoperative complication rates, local recurrence rates, and long-term survival rates as traditional abdominal TME (abTME) approaches (open, laparoscopic, and robotic) do [10–16]. The improvement in the prognosis of rectal cancer through the TME, neoadjuvant therapy, and adjuvant therapy raises questions regarding post-TME short-term and long-term quality of life (QoL) and functional outcomes [2, 17, 18]. Recent studies have shown varying post-taTME short-term QoL and functional outcomes compared with abTME [19–25]. Data on long-term QoL and functional outcomes are not available in the current literature.

The aim of this study was to compare the short-term and long-term QoL and functional outcomes after elective taTME with those after abTME for primary rectal cancer patients.

Materials and methods

Patients

Patients who underwent elective TME followed by reconstruction with anastomosis for primary rectal cancer between January 2013 and December 2022 at the Cantonal Hospital of St.Gallen were enrolled in this study. The patients were identified retrospectively in the electronic hospital records and were divided into two cohorts: the intervention group, who underwent taTME, and the control group, who underwent abTME. The operating surgeon decided whether to perform taTME or abTME and which approach to use (e.g., open abTME after a previous complex abdominal operation).

The exclusion criteria were diagnoses other than rectal cancer, recurrent rectal cancer, partial mesorectal excision (PME), discontinuity resection (no anastomosis), incomplete TNM staging information, metastatic cancer, 30-day mortality, lack of QoL data, patients who declined to have their information included in the scientific data analysis, and patients under 18 years of age. All patients were asked to provide consent for scientific analysis of their data before inclusion in our clinic database. A "decline for scientific data analysis by patients" indicated that the patients either did not sign the consent or withdrew the approval later.

The following patient characteristics were collected: age, sex, American Society of Anaesthesiologists (ASA) classification, body mass index (BMI, kg/m^2), (neo-) adjuvant therapy, and tumour height (assessed from the anal verge using a rigid rectoscope).

Neoadjuvant and adjuvant therapy were administered as recommended by an interdisciplinary team meeting and included long-course radiochemotherapy, short-course radiotherapy, and/or chemotherapy.

All operations were performed by experienced colorectal surgeons using the same technique as described previously by our team for a different patient cohort [13].

A true conversion was classified as a conversion from laparoscopic or robotic access to an open access. Primarily planned open surgeries were excluded from the conversion analysis.

Postoperative morbidity was classified according to the Clavien–Dindo classification [26]. All patients underwent regular surveillance follow-up, including an annual CT scan, according to the guidelines of the Swiss Society of Gastroenterology [27].

Analysed outcome measures

The primary endpoint of this study was postoperative QoL in patients treated with taTME compared with patients treated with abTME. The secondary endpoints were the functional outcomes. QoL and functional outcomes were assessed by the cancer-specific questionnaire QLQ-C30 of the European Organization for Research and Treatment of Cancer (EORTC) version 3.0 [28]. This questionnaire is regularly used during the follow-up of patients operated on according to the Swiss law for highly specialized medicine (HSM) [29]. It consists of 30 questions about global health, QoL, functioning scales (physical, role, cognitive, emotional, social), and symptoms (fatigue, pain, nausea and vomiting, appetite loss, dyspnoea, insomnia, constipation, diarrhoea, financial difficulties). Patients completed the QLQ-C30 questionnaires 3 months, 6 months, 1 year, 2 years, 3 years, 4 years and 5 years after surgery. All the scales were rated from 0 to 100. A low score on the global health, QoL and functioning scales indicates a bad outcome. On the other hand, lower symptom scores indicate fewer symptoms and therefore better outcomes [28]. Questions about global health and QoL are summarized in the overall QoL, and functioning scales are summarized in the sum score (QLQ-total) according to the EORTC QLQ-C30 scoring manual [30].

This study is an IDEAL stage 4 investigation regarding to the IDEAL collaboration framework (http://www.ideal-collaboration.net/).

Statistical analysis

Statistical analyses were performed via R statistical software (www.r-project.org). A two-sided p value of less than 0.05 was considered to indicate statistical significance. Continuous data are expressed as the mean ± standard deviation (SD). Proportions were compared with the chi-square statistics, and continuous variables were compared with the t test and the Mann–Whitney U test, as appropriate. For logistic regression analyses, p values were estimated via likelihood ratio tests, and 95% confidence intervals (CIs) were obtained via the Wald method [31, 32].

The repeated measurements of the QoL data of the taTME group and the abTME group were compared for each scale and moment via t tests. The p value was calculated and adjusted for multiple testing according to Benjamini and Hochberg [33]. To facilitate visualization, locally weighted (Loess) regression was performed.

To address potential bias further [34, 35], a full bipartite matching and weighting propensity score analysis was performed using the "Matching" R package [36] on the basis of the confounding variable set and the existence of QoL measurements at the schedule timings. The subclasses and weights obtained via propensity score matching were included in marginal mixed effects models. The fitting by mixed effects models optimizes the maximum likelihood using the R lme4 package. The effect of time after operation was modelled with cubic splines using the splines package. Inference was derived via likelihood ratio tests.

Ethics

The study was approved by the Ethics Committee of Eastern Switzerland (BASEC 2024 − 01276), registered at ClinicalTrials.gov (NCT06505863) and is compliant with the STROBE checklist.

Results

Patient selection

Between January 2013 and December 2022, 494 patients underwent elective rectal resection with mesorectal excision for primary rectal cancer. Forty-one patients were excluded because they had metastatic cancer, and 74 patients were excluded because they underwent PME. In 56 patients, discontinuity resection without anastomosis was performed. Two patients died within the first 30 postoperative days, and in one patient, staging was not complete. QoL and functional outcome data were not available for 71 patients. Among the remaining 249 patients, 187 patients underwent taTME (75.1%), and 62 patients underwent abTME (24.9%).

Patient baseline characteristics

Patient baseline characteristics are shown in Table 1. Patients who underwent taTME had a significantly higher BMI ($p = 0.001$), suffered from significantly lower rectal cancer ($p = 0.032$), and had a lower conversion rate ($p = 0.003$).

The logistic regression models indicated that a higher BMI and a later year of operation were significant predictors of taTME according to univariate, multivariate, and stepwise analyses. A lower UICC stage and neoadjuvant therapy were confirmed to be significant predictors of taTME only in multivariate and stepwise analyses; a lower tumour height was confirmed to be a significant predictor only in univariate analysis (Table 2).

QoL and functional outcomes

The QoL and functional outcome data are shown in Table 3; Figs. 1, 2 and 3.

Overall QoL and the QLQ-total score were similar after taTME compared with abTME. There were significant differences only after taTME at three years (overall QoL=-10.3 points, $p = 0.017$; QLQ-total=-8.0 points, $p = 0.028$) and four years (QLQ-total=-7.6 points, $p = 0.012$) postoperative.

Physical functioning, role functioning, cognitive functioning, and social functioning were similar after taTME and abTME. There were significant differences only for role functioning and social functioning, which worsened three years after taTME (role functioning − 17.5 points, $p = 0.005$; social functioning − 16.4 points, $p = 0.005$).

Postoperative fatigue, pain, constipation, and diarrhoea were similar between groups. There were significant differences only for fatigue and diarrhoea, which were worse after taTME at two years (diarrhoea + 22.5 points, $p = 0.012$), four years (diarrhoea + 20.5 points, $p = 0.005$), and five years (fatigue + 12.5 points, $p = 0.034$) postoperative.

Propensity score matching

The risk factors for age, sex, BMI, ASA group, year of operation, UICC stage, tumour height, neoadjuvant therapy, adjuvant therapy, and available QoL data at three months, six months, one year, two years, three years, four years, and five years after surgery were unevenly distributed in the two groups, as shown by significantly different propensity scores before matching: abTME 0.498±0.258 vs. taTME 0.835±0.182 ($p < 0.001$). Two patients in the abTME group and 17 patients in the taTME group were removed via propensity score matching. A well-matched sample of

Table 1 Patient baseline characteristics

Variable	Label	abTME ($n=62$)	taTME ($n=187$)	p value*
Age (years)	mean (SD)	66.7 (11.6)	64.2 (10.8)	0.200 A)
	range	35.0–91 − 0	32.0–87.0	
Sex	Female	27 (43.5%)	57 (30.5%)	0.059 B)
	Male	35 (56.5%)	130 (69.5%)	
ASA classification	I/II	48 (77.4%)	143 (76.5%)	0.878 B)
	III/IV	14 (22.6%)	44 (23.5%)	
BMI (kg/m^2)	< 18	1 (1.6%)	3 (1.6%)	0.628 C)
	18–30	54 (87.1%)	151 (80.7%)	
	> 30	7 (11.3%)	33 (17.6%)	
	mean (SD)	24.6 (4.0)	26.8 (4.5)	**0.001 A)**
Tumour height†	< 6 cm	9 (14.5%)	47 (25.1%)	**0.032 C)**
	6 to < 12 cm	45 (72.6%)	131 (70.1%)	
	12 to 16 cm	8 (12.9%)	9 (4.8%)	
UICC stage	I	23 (37.1%)	99 (52.9%)	0.051 B)
	II	19 (30.6%)	34 (18.2%)	
	III	20 (32.3%)	54 (28.9%)	
Neoadjuvant therapy	No	27 (43.5%)	65 (34.8%)	0.214 B)
	Yes	35 (56.5%)	122 (65.2%)	
Adjuvant therapy	No	33 (53.2%)	118 (63.1%)	0.168 B)
	Yes	29 (46.8%)	69 (36.9%)	
Planned surgical access	Open	6 (9.7%)	0 (0.0%)	**< 0.001 C)**
	Laparoscopy	40 (64.5%)	187 (100.0%)	
	Robotic	16 (25.8%)	0 (0.0%)	
Conversion	Primary open access	6 (9.7%)	0 (0.0%)	
	Laparoscopic to open	7 (12.5%)	6 (3.2%)	
	Robotic to open	1 (1.8%)	0 (0.0%)	
	Robotic to laparoscopic	5 (8.9%)	0 (0.0%)	
	No	48 (85.7%)	181 (96.8%)	**0.003 D)**
	True conversion	8 (14.3%)	6 (3.2%)	
Anastomosis	Suture	6 (9.7%)	34 (18.2%)	0.114 B)
	Stapler	56 (90.3%)	153 (81.8%)	
Stoma formation	No	6 (9.7%)	9 (4.8%)	0.189 D)
	Yes	56 (90.3%)	178 (95.2%)	
Postoperative complications (Clavien–Dindo)	0 to 3a	44 (71.0%)	154 (82.4%)	0.054 B)
	3b to 5	18 (29.0%)	33 (17.6%)	

SD: standard deviation

(A) Mann–Whitney U test, (B) chi-square test, (C) chi-square test, MC simulated, (D) Mid-p test

*: Significant values are bold

†: TME was performed because of a distal polyp, adhesions, previous sigmoid resection or in tumours at exactly 12 cm in patients with long sphincters to be sure to perform an adequate lymphadenectomy distal to the tumour

both groups (abTME $n=60$; taTME $n=170$) was generated, as shown by a similar propensity score after matching: 0.739±0.245 abTME vs. 0.738±0.245 taTME ($p=0.990$).

The mixed effects models after propensity score matching revealed a significantly worse overall QoL (-6.0 points, $p=0.021$), worse QLQ-total score (-4.9 points, $p=0.026$), greater degree of constipation (+8.4 points, $p=0.027$), and greater incidence of diarrhoea + 12.0 points, $p=0.004$) in patients who underwent taTME compared with those who underwent abTME. Physical functioning, role functioning, cognitive functioning, social functioning, fatigue, and pain were not significantly different between the two groups (Table 4).

Discussion

To the best of our knowledge, the present single-centre retrospective study is the first to compare long-term QoL and functional outcomes after taTME with those after traditional abTME. Patients who underwent taTME had a significantly higher BMI, had a lower UICC stage, received neoadjuvant therapy more often, and had a lower height of tumour localization in the rectum.

In summary, the present study revealed comparable long-term QoL and functional outcomes after taTME and after abTME.

Short-term QoL and functioning scores

QoL and physical functioning improved during the first two years after surgery, but statistically significant differences

Table 2 Univariate, multivariate, and Stepwise logistic regression analyses for TaTME

Variable	Label	Univariate OR (95% CI)	*p* value*	Multivariate OR (95% CI)	*p* value*	Stepwise selection OR (95% CI)	*p* value*
Age		0.98 (0.95–1.01)	0.124	0.97 (0.94–1.01)	0.118	0.97 (0.94-1.00)	0.073
Sex	F	Reference	0.063	Reference	0.210	-	-
	M	1.76 (0.97–3.18)		1.59 (0.77–3.28)		-	
BMI		1.14 (1.06–1.23)	**<0.001**	1.16 (1.07–1.28)	**0.001**	1.17 (1.07–1.29)	**<0.001**
ASA classification	I/II	Reference	0.878	Reference	0.931	-	-
	III/IV	1.05 (0.54–2.15)		0.96 (0.42–2.29)		-	
Year of operation	to 2015	Reference	**<0.001**	Reference	**<0.001**	Reference	**<0.001**
	2016–2019	5.54 (2.57–12.62)		11.82 (4.61–33.51)		11.35 (4.49–31.53)	
	since 2020	7.78 (3.82–16.54)		17.56 (6.89–49.26)		16.60 (6.76–44.81)	
UICC stage	I	Reference	0.054	Reference	**0.043**	Reference	**0.021**
	II	0.42 (0.20–0.86)		0.52 (0.21–1.33)		0.50 (0.20–1.22)	
	III	0.63 (0.32–1.25)		0.29 (0.10–0.77)		0.31 (0.13–0.72)	
Tumour height	< 6 cm	Reference	**0.039**	Reference	0.053	Reference	0.068
	6 to < 12 cm	0.56 (0.24–1.18)		0.63 (0.23–1.57)		0.66 (0.25–1.61)	
	12 to 16 cm	0.22 (0.06–0.71)		0.16 (0.03–0.71)		0.17 (0.04–0.77)	
Neoadjuvant therapy	No	Reference	0.217	Reference	**0.021**	Reference	**0.015**
	Yes	1.45 (0.80–2.60)		2.51 (1.15–5.68)		2.57 (1.20–5.70)	
Adjuvant therapy	No	Reference	0.170	Reference	0.636	-	-
	Yes	0.67 (0.37–1.19)		1.24 (0.50–3.10)		-	

Odds ratios (ORs) with 95% confidence intervals

Univariate and multivariate logistic regression were performed with additional stepwise variable selection from full multivariate logistic regression

A higher OR indicates greater odds for taTME than for abTME

* likelihood ratio test; significant values are shown in bold

were not observed between the two groups. This is in line with the findings of other studies on short-term QoL after taTME: A Dutch study described a decrease in QoL immediately after surgery followed by an improvement in QoL during the first six months [37]. Another study revealed worse QoL and bowel function three months after taTME compared with those after abTME, but there were no significant differences twelve months after surgery [25]. This is in contrast to a study by Helbach et al. [22], which reported no significant differences in QoL or functional scores between the taTME and abTME groups at a minimum follow-up of 6.6 months, and a further study showing that QoL is similar after the taTME group compared with the abTME group and improves to baseline values within the first postoperative year [38]. Additionally, a propensity score-matched analysis revealed no significant differences in global QoL one year after taTME compared with abTME [19].

Long-term QoL and functioning scores

In the present study, overall QoL and the QLQ-total score were worse three years after taTME compared with those after abTME. There were no significant differences in overall QoL and QLQ-total after completing the five-year follow-up. Role functioning, social functioning and fatigue after taTME were worse at single time points. Even if there were some statistically significant differences, their clinical relevance is questionable, as they only occurred at isolated time points, and the differences were small [39]. After adjusting for risk factors via propensity score matching, the differences in overall QoL and the QLQ-total score were even smaller.

We found no significant differences in role functioning, social functioning or fatigue between the taTME and abTME groups after propensity score matching. This finding also indicates that the differences detected in QoL and other functional outcomes are influenced by risk factors other than the surgical procedure.

Bowel function and stool frequency

Two and four years after taTME, patients were more likely to report diarrhoea than patients who underwent abTME. This was confirmed in the mixed effects models after propensity score matching. Nevertheless, as mentioned above, small, significant differences at single time points have questionable clinical relevance.

As the EORTC QLQ-C30 questionnaire was originally validated for QoL in patients with all types of malignant diseases, it does not ask for specific complications after TME, such as low-anterior-resection syndrome (LARS). Therefore, we can only assume that patients who reported

Table 3 Quality of life (QoL) and functional outcomes

		3 months *n* = 77	6 months *n* = 95	1 year *n* = 106	2 years *n* = 136	3 years *n* = 140	4 years *n* = 134	5 years *n* = 136
Overall QoL	abTME	62.5 (13.8)	76.1 (14.7)	69.2 (25.1)	75.5 (17.0)	82.2 (11.8)	78.7 (18.3)	78.3 (16.0)
	taTME	64.7 (17.2)	65.6 (17.1)	71.1 (16.6)	73.0 (17.8)	71.9 (18.6)	73.4 (16.1)	71.3 (18.8)
***p*value**		0.850	0.170	0.919	0.839	**0.017**	0.357	0.120
QLQ-total	abTME	77.9 (8.3)	84.2 (11.3)	77.7 (16.6)	83.8 (10.8)	88.6 (9.8)	89.3 (9.6)	86.1 (15.3)
	taTME	76.3 (14.0)	78.4 (12.9)	81.2 (14.4)	80.4 (14.0)	80.6 (15.6)	81.7 (12.6)	79.2 (15.9)
***p*value**		0.850	0.351	0.730	0.491	**0.028**	**0.012**	0.087
Physical functioning	abTME	77.3 (16.4)	85.2 (15.5)	81.8 (17.9)	85.5 (17.6)	92.6 (15.5)	90.4 (15.9)	89.7 (18.1)
	taTME	79.9 (17.6)	83.4 (17.5)	85.6 (18.4)	84.8 (18.3)	83.7 (20.0)	85.1 (17.3)	81.1 (21.6)
***p*value**		0.850	0.893	0.737	0.919	0.120	0.321	0.087
Role functioning	abTME	58.4 (26.4)	79.5 (20.2)	72.8 (30.6)	77.3 (28.3)	90.5 (15.0)	85.6 (22.2)	85.5 (24.7)
	taTME	54.2 (30.8)	65.0 (26.5)	74.4 (23.8)	73.8 (26.0)	73.0 (28.4)	77.8 (25.5)	73.2 (30.7)
***p*value**		0.850	0.172	0.919	0.850	**0.005**	0.307	0.086
Cognitive functioning	abTME	90.0 (11.7)	87.9 (18.8)	80.1 (23.2)	87.5 (13.5)	88.6 (12.7)	90.8 (12.1)	87.0 (17.9)
	taTME	83.8 (17.4)	84.6 (18.7)	86.9 (17.0)	83.2 (19.7)	84.7 (20.5)	82.8 (19.1)	82.2 (21.7)
***p*value**		0.381	0.839	0.569	0.491	0.491	0.054	0.392
Social functioning	abTME	60.0 (16.1)	81.8 (15.7)	69.9 (26.9)	72.2 (24.9)	90.2 (14.9)	82.2 (25.5)	79.3 (27.3)
	taTME	64.9 (26.1)	67.0 (25.6)	71.6 (24.8)	71.2 (26.2)	73.8 (27.1)	75.9 (27.2)	69.4 (30.0)
***p*value**		0.679	0.087	0.919	0.919	**0.005**	0.491	0.187
Fatigue	abTME	40.0 (15.0)	30.3 (28.5)	34.2 (32.6)	24.1 (23.5)	12.4 (17.3)	15.7 (23.2)	16.7 (21.4)
	taTME	34.3 (22.5)	26.4 (23.0)	23.2 (21.8)	24.5 (22.5)	23.2 (23.2)	24.4 (22.5)	29.2 (26.5)
***p*value**		0.569	0.850	0.496	0.964	0.087	0.227	**0.034**
Pain	abTME	21.7 (24.9)	12.1 (11.4)	21.2 (25.1)	12.5 (25.6)	8.0 (14.2)	12.2 (21.9)	11.6 (23.8)
	taTME	21.1 (26.0)	17.7 (24.2)	14.7 (22.3)	13.5 (19.8)	16.5 (24.0)	13.5 (19.3)	17.1 (23.7)
***p*value**		0.964	0.443	0.644	0.919	0.120	0.919	0.443
Constipation	abTME	10.0 (22.5)	18.2 (18.9)	16.6 (16.6)	18.5 (28.5)	18.9 (24.3)	12.2 (22.3)	17.4 (28.8)
	taTME	12.9 (25.9)	19.2 (24.2)	24.8 (24.5)	26.1 (28.8)	25.8 (29.2)	21.2 (28.7)	18.3 (26.4)
***p*value**		0.882	0.919	0.351	0.556	0.491	0.227	0.919
Diarrhoea	abTME	23.3 (27.5)	21.2 (19.9)	35.9 (32.5)	15.7 (23.2)	22.7 (27.5)	16.7 (24.4)	30.4 (27.1)
	taTME	29.4 (34.6)	40.6 (28.7)	38.0 (26.0)	38.5 (26.2)	37.0 (29.7)	37.2 (27.2)	39.8 (30.8)
***p*value**		0.811	0.077	0.919	**0.012**	0.139	**0.005**	0.227

Mean value with standard deviation; *p* values were adjusted for multiple testing, significant values are bold

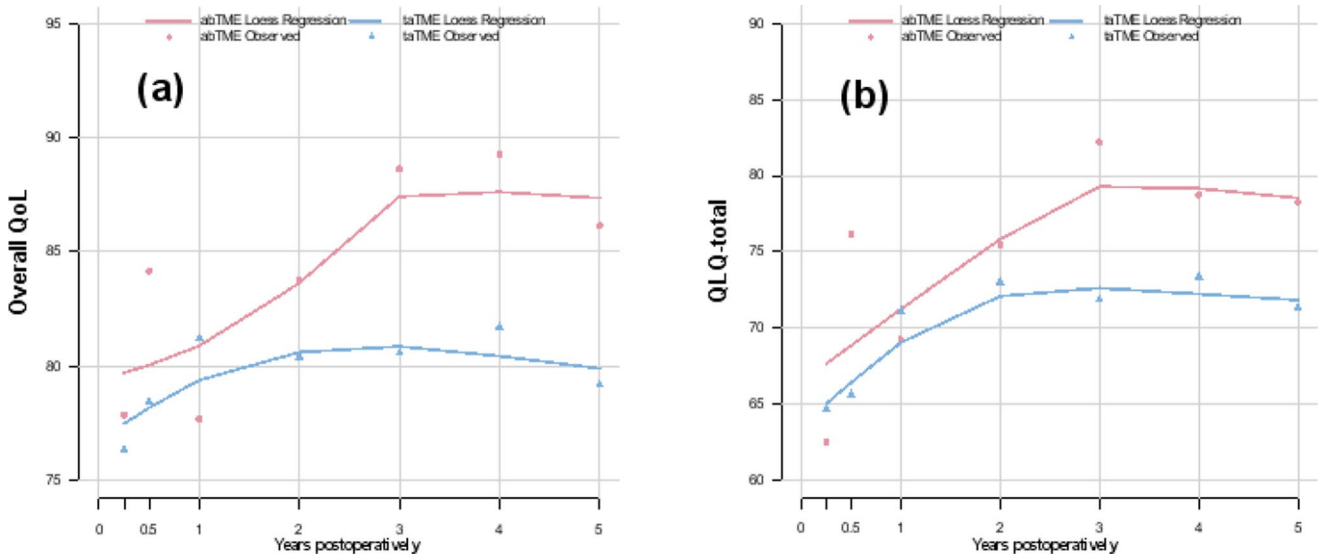

Fig. 1 Overall QoL (**a**) and sum score of functioning scales (QLQ-total) (**b**) according to the EORTC QLQ-C30 visualized with Loess regression for abTME (red line) and taTME (blue line). The scores are rated from 0 to 100, with higher scores indicating better overall QoL and QLQ-total

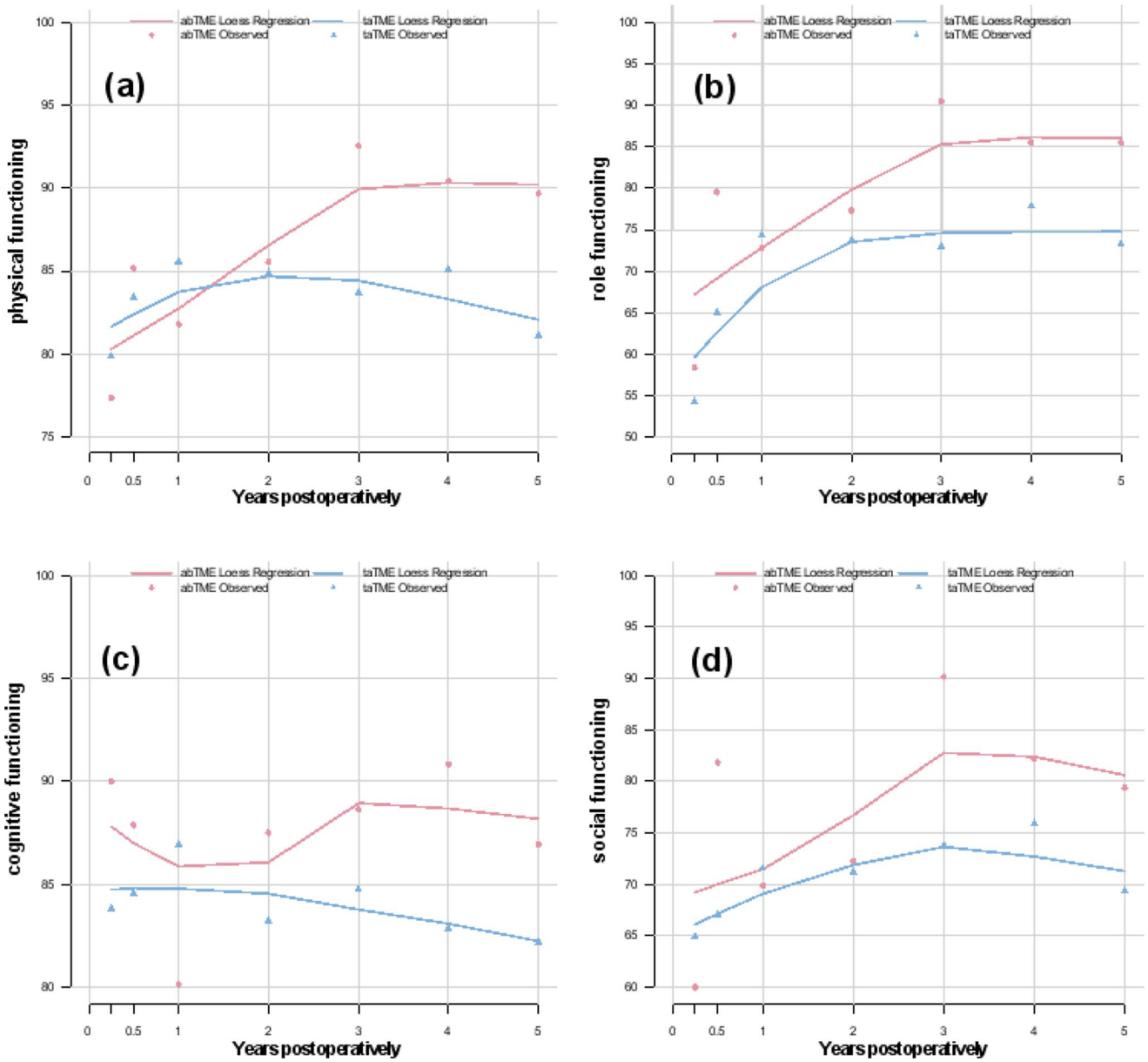

Fig. 2 Physical functioning (**a**), role functioning (**b**), cognitive functioning (**c**), and social functioning (**d**) according to the EORTC QLQ-C30 visualized with Loess regression for abTME (red line) and taTME (blue line). The scales are rated from 0 to 100, with higher scores indicating better functioning

diarrhoea might have suffered from LARS. Other symptoms, such as soiling and incontinence to confirm the diagnosis of LARS, are missing. Recent studies by van der Heijden et al. [23]. reported a high rate of incontinence and LARS after taTME, and a propensity score-matched analysis revealed greater major LARS and a higher stool frequency 12 months after taTME compared with those after abTME [19]. A meta-analysis revealed a greater incidence of LARS after taTME [40]. There are several possible explanations for the higher incidence of LARS after taTME. It can be difficult to maintain a good transanal endoscopic view in a naturally confined surgical field, especially in cases of diathermy-induced smoke, billowing, or unstable pneumorectum [41]. Anal trocar placement and anal gas insufflation may damage the anal sphincter and the autonomic nerve plexus in the small pelvis [42–44]. However, another meta-analysis could not confirm increased anal sphincter damage after taTME compared with abTME [45], and good anorectal functioning in anorectal manometry after taTME was reported [24]. Impaired bowel function after taTME might also be biased by other risk factors, especially as the taTME was initially developed for easier access in patients with low tumour height to enable a lower level of anastomosis [8, 9]. This is in accordance with the current literature, as bowel

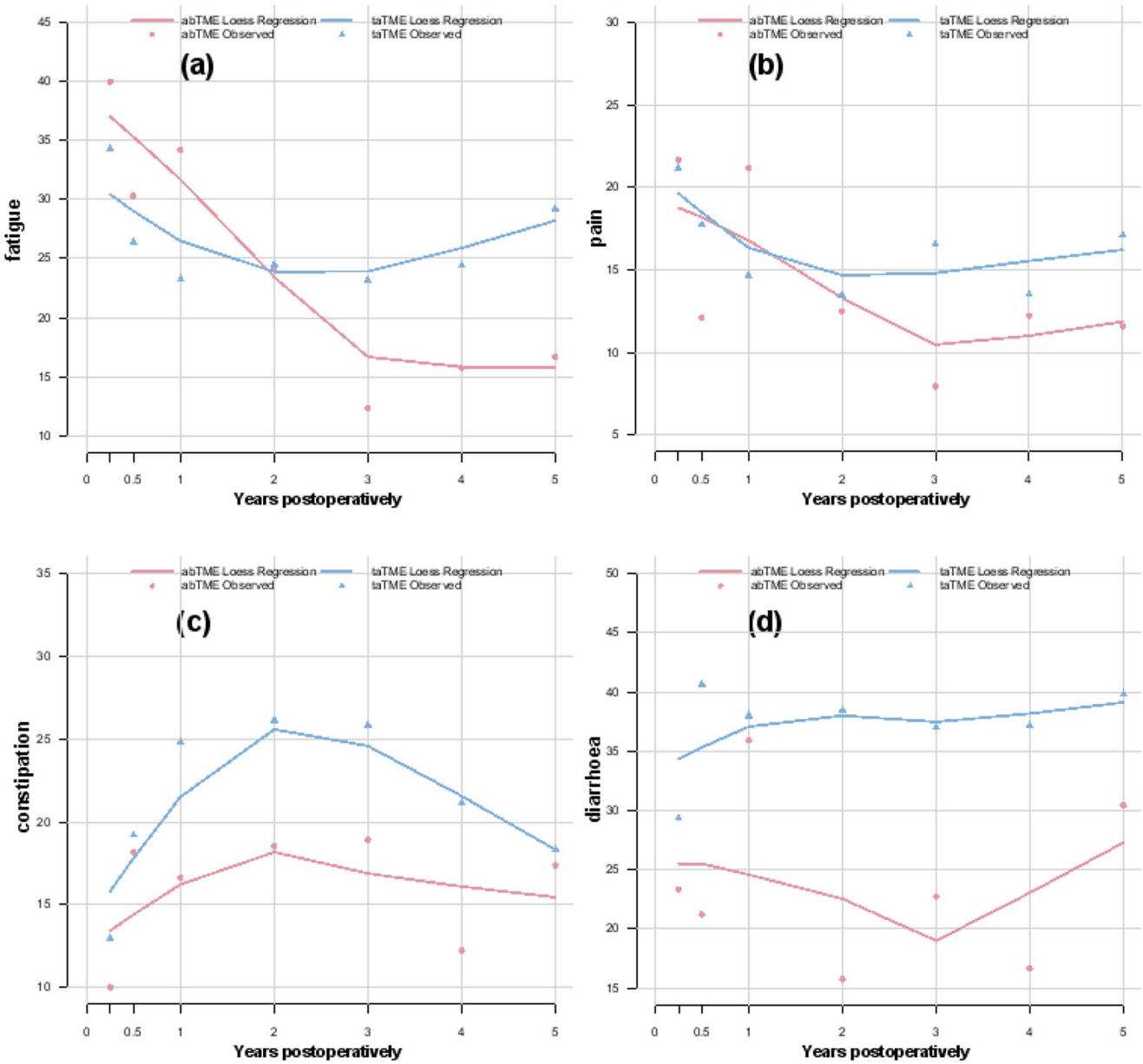

Fig. 3 Symptom scores for fatigue (**a**), pain (**b**), constipation (**c**), and diarrhoea (**d**) according to the EORTC QLQ-C30 visualized with Loess regression for abTME (red line) and taTME (blue line). The scales are rated from 0 to 100, with higher scores indicating more symptoms

dysfunction, particularly LARS, was shown to be associated with lower tumour height, lower anastomosis, and the use of neoadjuvant radiochemotherapy but not with the taTME approach itself [20, 46–48]. The better visualization of the dissection plane and the sacral nerve plexus might even result in better functional outcomes, such as improved sexual function [25, 49]. Overall, the functional outcomes after taTME seem to be comparable with those after abTME.

Limitations

The main limitations of this study were its retrospective design, the absence of randomization, and the lack of differentiation among open, laparoscopic, and robotic TME. The selection of the procedure was made on the basis of the operating surgeon's preferences. This might have introduced selection bias, especially as healthier patients might have been more likely selected for laparoscopic or robotic surgeries and all taTME procedures were planned minimally invasive. The higher true conversion rate and the higher rate of procedures performed as open surgeries for abTME could result in worse short-term

Table 4 Mixed effect models of quality of life (QoL) and functional outcomes after propensity score matching ($n=230$)

	Variable	Estimate	p value*
Overall QoL	abTME	69.4 (95% CI: 63.7 to 75.0)	
	taTME	-6.0 (95% CI: -11.1 to -0.9)	**0.021**
QLQ-total	abTME	82.8 (95&CI: 78.2 to 87.3)	
	taTME	-4.9 (95% CI: -9.3 to -0.5)	**0.026**
Physical functioning	abTME	83.8 (95% CI: 77.9 to 89.8)	
	taTME	-4.1 (95% CI: -10.1 to 1.8)	0.178
Role functioning	abTME	60.6 (95% CI: 51.3 to 69.8)	
	taTME	-6.0 (95% CI: -14.2 to 2.1)	0.144
Cognitive functioning	abTME	92.8 (95% CI: 86.8 to 98.9)	
	taTME	-4.3 (95% CI: -9.8 to 1.3)	0.119
Social functioning	abTME	71.7 (95% CI: 62.8 to 80.7)	
	taTME	-5.7 (95% CI: -13.7 to 2.3)	0.190
Fatigue	abTME	25.3 (95% CI: 17.4 to 33.2)	
	taTME	+3.8 (95% CI: -3.6 to 11.1)	0.308
Pain	abTME	19.4 (95% CI: 11.6 to 27.2)	
	taTME	+3.5 (95% CI: -3.3 to 10.2)	0.309
Constipation	abTME	2.9 (95% CI: -5.7 to 11.5)	
	taTME	+8.4 (95% CI: 0.9 to 16.0)	**0.027**
Diarrhoea	abTME	15.4 (95% CI: 5.2 to 25.6)	
	taTME	+12.0 (95% CI: 3.7 to 20.2)	**0.004**

abTME: absolute value
taTME: difference to abTME
*: Significant values are bold

postoperative outcomes and QoL in this group [50–52]. The influence of access and conversion on the long-term QoL after rectal cancer surgery is not proven [53–55].

However, most of the introduced differences in baseline parameters were corrected by propensity score matching, ensuring a balanced analysis.

The proportion of available QoL data at 3 months (30.9%), 6 months (37.8%), one year (42.6%), two years (54.6%), three years (56.2%), four years (53.8%), and five years (54.6%) was moderate [56]. Lower response rates for early QoL questionnaires were described in former studies. Possible explanations could be a reduced physical or mental condition after surgery, patients might still be hospitalized, ongoing rehabilitation in specialized facilities or uncertainties while completing the first questionnaire [57–59]. The moderate response rate must be considered in light of the non-response bias when interpreting the present data, as patients in better condition are more likely to attend follow-up and show better response rates [60]. Therefore, the actual QoL in the study population might be lower than the results of this study show.

The proportion of patients with mid- and low rectal cancer (93.5%) included in the present study was greater than that in the rectal cancer population of Switzerland. This results from governmental regulations requiring that such cases be centralized in specialized centres [29].

Conclusion

TaTME seems to have comparable long-term QoL and functional outcomes to abTME after elective TME with anastomosis for primary rectal cancer. Such retrospective QoL analyses are prone to various types of bias, such as selection bias, statistical bias, or nonresponse bias, and should be interpreted with caution.

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Data availability No datasets were generated or analysed during the current study.

Declarations

Ethical approval This study was approved by the Ethics Committee of Eastern Switzerland (BASEC 2024−01276).

Patient consent Patient consent was given in writing before the patients were enrolled in the study. Before their treatment started, all patients treated at our department were asked to sign a declaration of consent to use their data in a scientific study. Only patients who signed this declaration were included in this analysis.

Consent for publication This submission is to Langenbeck's Archies of Surgery. The material is original research, has not been previously published, and has not been submitted for publication elsewhere while under consideration.

Competing interests The authors declare no competing interests.

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