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REVIEW ARTICLE

Transanal TME: new standard or fad?

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Abstract:

Transanal total mesorectal excision (taTME) has been developed to overcome the difficulty of laparoscopic dissection and transection in the deep pelvis. TaTME has several clinical benefits over laparoscopic surgery, such as better exposure of the distal rectum and direct determination of distal resection margin. Although evidence demonstrating the true benefits of taTME over laparoscopic TME (LapTME) is still insufficient, accumulating data have revealed that, as compared with LapTME, taTME is associated with shorter operative time and a lower conversion rate without jeopardizing other short-term outcomes. However, taTME is a technically demanding procedure with specific complications such as urethral injury, and so sufficient experience of LapTME and step-by-step acquisition of the skills needed for this procedure are requisite. The role of transanal endoscopic surgery is expected to change, along with the recent progress in the treatment of rectal cancer, such as robotic surgery and the watch-and-wait strategy. Optimization of treatment will be needed in the future in terms not only of oncological but also of functional outcomes.

Keywords:

rectal cancer, laparoscope, transanal TME, surgery

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Introduction: Why the Transanal Approach?

The laparoscopic approach has gradually gained acceptance in rectal cancer surgery. However, recent clinical trials from western countries comparing the laparoscopic and open approach for rectal cancer surgery, high rate of conversion to open surgery (around 10%), and some concerns about margin status have been reported[1,2]. For some difficult cases such as narrow pelvis or bulky tumor, these results might be due to the difficulty of laparoscopic rectal dissection and transection in the deep pelvis.

The transanal approach (under direct vision) was reported to be beneficial in terms of margin status[3,4], but the limited visibility under direct vision has hampered the widespread adoption of it. With the recent advances in minimally invasive surgery, such as transanal endoscopic microsurgery[5] and single-port surgery, a combination of the transanal and minimally invasive approaches was introduced and is referred to as transanal TME (taTME)[6]. In this paper, we will review the current status and future prospects of taTME.

Operative Procedure

Several operative procedures are performed in the transanal endoscopic approach for treating rectal cancer (Figure 1). In this review study, we will focus on the transanal TME/ISR and transperineal APR.

Typically, the transanal approach is used with the laparoscopic approach, simultaneously (two-team approach) or sequentially (one-team approach). The extent of dissection in each approach usually differs from case to case, however, rectal transection and dissection of the extra-peritoneal part of the rectum is performed transanally. There are several potential benefits of the two-team approach over the one-team

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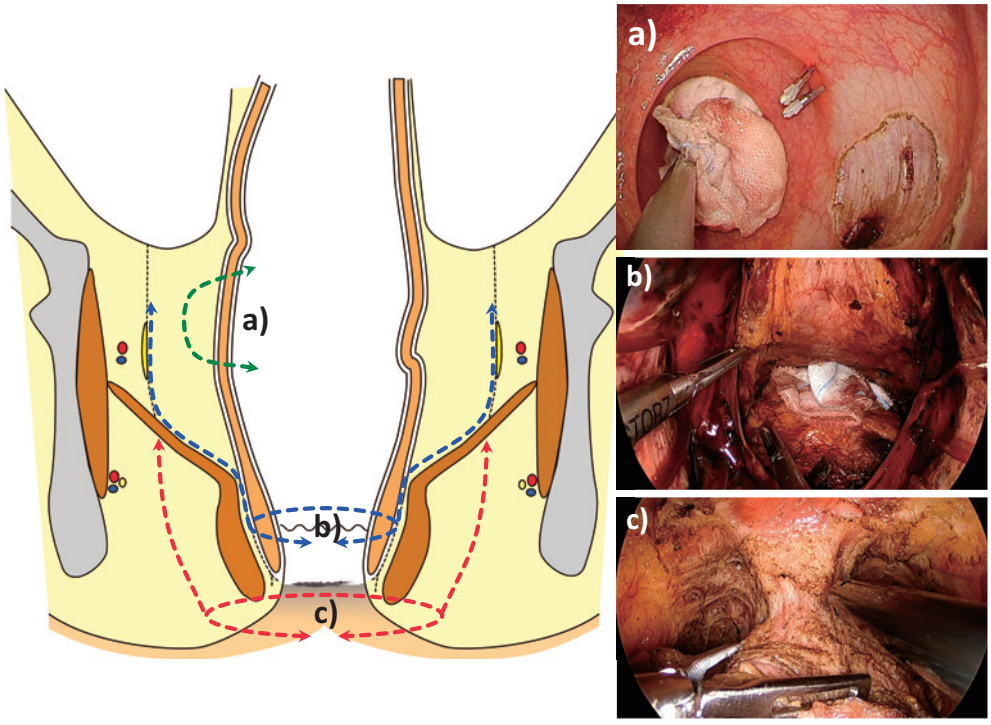

Figure 1. Operations performed using transanal endoscopic approach.
a) Local excision (also referred to as transanal minimally-invasive surgery "TAMIS").
b) Intersphincteric resection (ISR) / total mesorectal excision (TME).
c) Abdominoperineal resection (APR) (also referred to as "transperineal" APR).

approach, including assistance with exposure of the operative field and/or enhanced comprehension of the surgical anatomy[7]. However, the two-team approach requires extra human and device resources that might not always be available with the exception of in specialized centers.

The anastomotic method depends on the height of anastomosis. Conventional hand-sewing is performed for low anastomosis and stapled anastomosis is perfomed for high anastomosis. Stapled anastomosis is performed in a single staple manner, using a purse-string suture around the distal rectal stump[8]. This method is relatively technically demanding, as it is not always easy to make a full-thickness circumferential purse-string suture.

Abdominoperineal resection (APR) is another indication for this approach, and is often referred to as "transperineal APR"[9,10]. This approach gives the option, depending on the extent of the tumor, of several perianal dissection lines, including intersphincteric, extralevator, and ischioanal[11]. Although this approach offers good surgical exposure of the anterior aspect through minimal skin incision around the anus, which is the most dangerous area for positive circumferential resection margin (CRM)[12], the risk of urethral injury is not negligible because of the complex anatomy of this area[13].

Some aggressive surgeons have reported an absolute transanal approach without laparoscopic assistance or abdominal scar[14]. Although this concept of "no-scar surgery" or natural orifice transluminal endoscopic surgery (NOTES) is attractive, transanal mobilization of the splenic flexure/sigmoid colon and division of the inferior mesenteric vessels is still difficult using current operative instruments[15].

Operative Devices (Setup)

Several types of energy devices are used for transanal dissection, which include ultrasonic scissors, vessel sealing devices, and electrocautery (hook or spatula). Many surgeons seem to prefer electrocautery as the energy device of use, with its the main benefit being that it facilitates identification of the striated muscles such as the external anal sphincter and levator ani muscle by electrical stimulation, which are crucial surgical landmarks in taTME.

Several types of transanal platforms have been used, including rigid type (i.e., TEO) or single-port devices[16]. Currently, the most popular platform is the GelPOINT path transanal access platform (Applied Medical, Ranco Santa Margarita, CA), which allows for better instrumental triangulation in the narrow operative field.

One of the technical problems specific to taTME is associated with CO_2 insufflation and smoke evacuation. The transanal approach is performed through a very a narrow operative field causing unstable perirectal pressure called "bel-

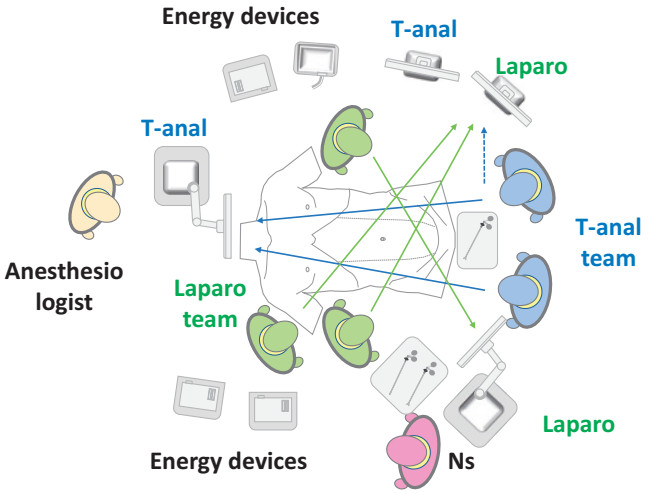

Figure 2. Example of set up of operative room.

lowing". Although the use of a pressure-sensitive insufflator such as the AirSeal® system is recommended for prevention of bellowing and for smoke evacuation from a surgical field, several effective methods have been reported even without such a costly device[17].

The arrangement of the operating room with respect to devices is important, especially for the two-team approach, so surgeons in the laparoscopic and transanal teams can see both operative images; an example setup of the operating room is shown in Figure 2.

Potential Advantages of taTME

There are several potential advantages and disadvantages of taTME as compared with laparoscopic surgery. Compared with the transabdominal approach, secure determination of the distal margin under direct (endoscopic) vision can be performed in the transanal approach. There are two important technical points for the determination of the distal margin. Firstly, circumferential marking with adequate distance from the tumor should be done before closure of the rectum. Secondly, because of the restriction of the direction of the instrument, incision of the rectal wall tends to go obliquely and that might threaten the CRM. Instead, rectal incision should be performed perpendicularly.

Theoretically, the transanal approach offers an in-line vantage point to the distal rectum, which facilitates the dissection of the distal rectum, especially for cases with narrow pelvis or bulky tumor[18]. This good accessibility to the distal rectum will facilitate identification and preservation of the pelvic autonomic splanchnic nerves, better specimen quality, proper CRM, and low conversion rate to open surgery. Reduction of operative time, especially when a two-team approach is used, is another benefit.

Disadvantages and Specific Complications of taTME

In this approach as compared with the abdominal approach, the dissection line tends to move laterally, so there is a possibility of damage to structures, such as the urethra or pelvic autonomic nerves, which are not usually damaged during conventional open and laparoscopic surgery.

Among these, urethral injury is one of the most serious and specific complications of this procedure. The complex surgical anatomy around the anal canal, especially in male patients, is another possible cause of this complication. Anatomically, urethral injury does not occur in cases with relatively high-lying tumor in which dissection starts above the inferior border of the prostate. According to a review by Atallah[19], the risk factors for urethral injury are as follows: prostatic hypertrophy, history of radiation therapy for prostate cancer, and prior history of surgery for prostate and anal pathology. To avoid this severe complication, other measures, such as intraoperative identification of the prostate or membranous urethra by digital examination, lighted urethral stent placement, ultrasound guidance, and stereotactic navigation are recommended[19].

Purse-string rupture is another significant complication specific to this procedure and might lead to implantation of tumor cells and bacterial contamination[20]. Adequate training for correctly making a secure purse-string suture is necessary before performing this procedure.

Also, transanal specimen extraction is attractive from a cosmetic perspective. However, extracting a bulky tumor through the anus without a protector might implant cancer cells around the anal canal, as in port-site recurrence in the early stages of the development of laparoscopic surgery for colorectal cancer[21].

There are some concerns about the effect of dilatation of the anal canal on anal function when placing the device[22,23]. As compared with rigid anoscope like TEO/TEM, applying single port device into anus for local excision might be a comparable procedure for anal function[24,25]. However, its effect in patients who underwent TaTME, in which long-time application of transanal device is needed, has not yet been fully demonstrated and should be carefully evaluated[26].

Clinical Evidence

As this procedure is relatively new, data evaluating the efficacy of this approach as compared with laparoscopic surgery is scarce.

The largest set of data currently available is the International taTME Registry reported in 2016 and 2018[27,28]. The number of registered patients increased from 720 in 2016 to 1,594 in 2018, concurrent with the widespread adoption of this approach (Table 1). Although this registry is interna-

Table 1. Results of International Registry of taTME.

	2016	2018*
Nations	23	29
No of patients (cancer)	720 (634)	1594 (1540)
Sex (male; %)	68	68
BMI	26.5	26.3
Tumor height (mean; cm)	6	6
≥cT3 (%)	67	69
cN+ (%)	57	56
Operation time (perineal)	128	123
Operation (%)		
HAR	5	8
LAR	86	92
APR	3.2	
(inter-sphincteric)	26.2	20.0
(purse-string)	62.5	72.5
Anastomosis (Manual / Stapled: %)	45 /55	34 / 66
Two-team approach (%)	32.5	41.7
Conversion (Abdominal / Perineal: %)	6 / 2.8	4.3 / 1.5
Intraop.adverse events (%)		
Wrong dissection plane	7.8	5.7
Pelvic bleeding	6.9	4.2
Visceral injury	1.5	1.8
Urethra	0.7	0.8
Rectum	0.3	0.4
Postope adverse events (%)		
Anastomotic leak (early/delay)	5.4 / 1.3	7.8 / 2.0
Pelvic abscess	2.4	4.7
Clavien Dindo ≥ III	11.4	13.2
Pathological findings		
Quality of specimen (Intact + minor defect: %)	96	97
DM (median: mm)	15	16
CRM (median: mm)	8	10
CRM+ (≤1mm: %)	2.4	4.1

*only cases with anastomosis

tional, the majority of patients included in this registry are from western countries. The reported positive CRM rate and specimen quality are promising as compared with those of recent clinical trials from western countries comparing laparoscopic and open surgery[1,2]. Nevertheless, it should be noted with caution that the rates of positive CRM and anastomotic leakage have increased with the widespread use of this procedure in comparison with the previous survey in 2016.

Although there are no randomized controlled studies comparing taTME and laparoscopic TME (LapTME), several comparative retrospective studies have been reported. A meta-analysis combining the available data has revealed that taTME is associated with longer CRM, distant metastasis, and a lower rate of positive CRM, but there was no significant difference in other pathological parameters, such as number of harvested lymph nodes and quality of resected mesorectum[29]. Hu et al. examined short-term clinical outcomes and found that taTME was associated with lower conversion rate and shorter operative time, despite there being no difference in other parameters, including rate of postoperative complications[30].

Furthermore, data on long-term functional and oncological outcomes are not satisfactory, and these are most important for evaluating the quality of surgery. According to reports in the study by Veltcamp and Koedam, quality of life including anal function after taTME was comparable with that after laparoscopic surgery[31,32]. There are two ongoing large randomized controlled trials comparing taTME and LapTME, namely the COLOR III and GRECCAR 11 studies[33,34]. Results of these studies, including long-term outcomes, are awaited for accurately evaluating the efficacy of taTME.

Table 2. Comparison of Transanal TME and Robotic TME.

Characteristic	Transanal (226)	Robo (370)
Age (mean; year-old)	62.1	62.5
Sex (male; %)	62.8	63.5
BMI	26.1	25.8
Clinical T-stage (cT1-2/cT3/cT4)	22/68/10	21/68/11
cCRM positive (%)	30	29.2
Distance from a.v. (-5cm / 6-10cm; %)	52/48	53/47
Tumor size (cm)	2.8	3
Preoperative RT or CRT (yes; %)	70.7	69.2
Operative time (mean; min)	190	189
Anastomosis (None/Stapled/Hand-sewn; %)	3.5/57/39	6.5/64/30
Diverting stoma (yes; %)	94	81
Conversion (%)	1.3	1.1
30d-postop. complications (%)	33	35
Anastomotic leakage (%)	11	9.5
Reoperation (%)	7.5	6.2
Lymph nodes harvests	16.1	16.8
Pathological CRM+ (%)	6.3	6.2
low rectal tumors	5.4	6.3
mid rectal tumors	5.7	5.5
Distal margin + (%)	1.8	0.3
low rectal tumors	2.7	0.9
mid rectal tumors	0.9	0
Distal margin (length; mm)	16.9	15.1
low rectal tumors	12.2	9.6
mid rectal tumors	22	21.3
TME grade (Complete/Near complete/Incomplete; %)	92.5/6.6/0.9	95.4/3.8/0.8
low rectal tumors	91/8.5/0.9	94/4.6/1.5
mid rectal tumors	94.5/4.6/0.6	97.1/2.9/0
High quality specimen (complete + near complete/CRM, DM-; %)	93.1	93.2
low rectal tumors	93.3	92.1
mid rectal tumors	92.8	94.5

Indications for taTME

The selection of surgical approach depends on patient body habitus (obese, narrow pelvis), tumor status (location and extent), and surgeon preference and experience. As mentioned previously, this technique has been developed because of the limitations in the deep pelvis of laparoscopic surgery, especially in western countries. Therefore, surgeons tend to use this approach for cases in which they expect to be presented with difficulty in dissection and transection of the rectum in the deep pelvis. There are also some differences in indications for taTME between Japan and western countries.

Tumor location is one of the most important factors. According to recent results of the International taTME Registry, where the majority of patients were from western countries, the proportion of high-lying tumor has increased over the past two years[27,28]. On the contrary, in eastern countries like Japan and Korea, as compared with western countries, patient body habitus and anatomical restriction are not so severe, and the benefit of taTME over laparoscopic surgery is not as prominent. Indeed, the reported outcomes of laparoscopic rectal cancer surgery seem fairly satisfactory, having low conversion rate and equivalent oncologic outcomes as compared with open surgery in Japan and Korea[35-38]. Therefore, many Japanese surgeons prefer the laparoscopic approach, which is technically familiar.

With regard to the extent of the tumor, theoretically advanced tumor might be a good indication for taTME because of its greater tendency to gain a more radial margin than laparoscopic surgery. For example, a bulky tumor located in the mid rectum hampers exposure and dissection of the rectum distal to the tumor via the transabdominal approach alone. In such cases, bi-directional dissection from above and below might be a reasonable option to obtain better exposure and subsequent good pathological or oncologi-

cal outcomes.

Education and Training

taTME is a technically demanding procedure, and so appropriate education and training for performing this procedure is vital for safe adoption of this technique[39]. The International TaTME Education Collaborative has published training guidelines[40]. The guidelines recommend step-by-step acquisition of the technique skills as follows: self-learning; training; proctorship; and then independent practice. Adequate knowledge of the surgical anatomy of the anal canal and lower rectum, especially from below, is also mandatory. The development of taTME has been accompanied with further accumulation of knowledge of the surgical anatomy of the anal canal[41-44].

Currently, cadaver training is the most effective method available for mastery of this procedure[45-47]. Trainees can learn some key steps of this procedure, including purse-string suture for rectal closure, full thickness rectal incision, bottom-to-up dissection, and purse-string suture for stapled anastomosis. The use of human cadaver models reportedly facilitates the acquisition of vital skills for rectal cancer surgery because the detailed anatomy of the complex human pelvis can only be represented by a cadaveric model[48]. However, the major problem is their limited availability.

Although the learning curve of taTME has not been fully clarified[7,49], the skills are believed to be difficult to acquire and care should be taken to avoid serious complications, especially in the early learning stages[50]. Deijen et al. in their study performed pooled-analysis and compared clinical outcomes between low-volume (< 30 cases) and high-volume (≥ 30 cases) centers. They stated there might be trends for better outcomes in high-volume centers with regard to conversion rate (4.3% vs. 2.7%), major complications (12.2 vs. 10.5%), complete TME specimens (80.5% vs. 89.7%), and CRM involvement (4.8% vs. 4.5%)[51].

Future Prospects

There is another solution for difficult cases in conventional laparoscopic surgery. Robotic surgery has several advantages over conventional laparoscopic surgery, such as high-dexterity EndoWrist instruments, tremor filtering, and 3 D high-definition imaging. Several reports have also demonstrated the clinical benefits of robotic surgery over laparoscopic surgery, especially for male patients, obesity, or low-lying tumors[52,53]. Thus, transanal and robotic approaches aim at almost the same targets in rectal cancer surgery and there is an argument over which approach is better, robotic TME or taTME for patients with rectal cancer having challenging features[54,55]. Robotic surgery also has several drawbacks such as high cost, longer operative time, and lack of tactile sensation[53,56,57]. Interestingly, there are regional differences in the selection of surgical treatments for rectal cancer, for example, robotic surgery is popular in the US while taTME is popular in other western countries[58].

Several retrospective studies comparing robotic surgery and taTME for rectal cancer have revealed that they are equivalent as per short-term outcomes and/or histopathological outcomes[59,60]. According to a recent paper in the study by Lee et al. comparing the outcomes of robotic and taTME for mid- and low-rectal cancer (≤ 10 cm from the anal verge) using coarsened exact matching, short-term postoperative outcomes and pathological outcomes were closely comparable (Table 2)[59]. It should be noted that distal margin tumor involvement was observed more frequently in the taTME group (1.8% vs. 0.3%; $P = 0.051$) as opposed to the robotic group, despite the longer length to distal margin (16.9 mm vs. 15.1 mm; $P = 0.097$).

We believe that, at any rate, the significance of the transanal approach will endure, particularly in cases with difficulty via the transabdominal approach, whether open, laparoscopic, or robotic[54]. Recently, transanal use of robotic platforms has been reported to reduce the limitations of the ergonomics of single-port surgery[61-64]. Furthermore, with the advent of robotic platforms designed for single-port surgery, robotic transanal surgery has been expected to overcome the limitations of single-port surgery[61,62,64]. While these approaches might not be mutually exclusive, a combination of the modalities might lead to better outcomes, including NOTES.

Although not directly related to TME, the importance of the transanal endoscopic approach might become more prominent in the near future. With the widespread adoption of the watch-and-wait strategy in the treatment of rectal cancer[65,66], local excision following chemoradiotherapy (CRT) to remove residual tumor and evaluate the effect of CRT has gained ground[67,68]. The role of local excision will thus be more important in the treatment of rectal cancer and this approach will become essential procedure for colorectal surgeons.

Conclusions

taTME might have several benefits over laparoscopic surgery, especially for cases in which dissection and transection of the rectum is expected to be difficult. Data demonstrating the true safety and efficacy of this approach is limited. Furthermore, the operative procedure is difficult and is associated with several complications specific to this procedure. There are now multiple surgical approaches available as treatment options for rectal cancer, each with specific benefits and drawbacks. Nonetheless, it is most important to do good surgery, based on the principles of surgical oncology, regardless of surgical approach.

Conflicts of Interest

There are no conflicts of interest.

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