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TOPIC HIGHLIGHT

2015 Advances in Colorectal Cancer

Transanal total mesorectal excision: A valid option for rectal cancer?

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Abstract

Low anterior resection can be a challenging operation, especially in obese male patients and in particular after radiotherapy. Transanal total mesorectal excision (TaTME) might offer technical advantages over laparoscopic or open approaches particularly for tumors in the distal third of the rectum. The aim of this article is to review the current experience with TaTME. The limits and future developments are also explored. Although the experience with TaTME is still limited, it might be a promising alternative to laparoscopic TME, especially for difficult cases where laparoscopy is too demanding. The preliminary data on complications and short-term oncological outcomes are good, but also emphasize the importance of careful patient selection. Finally, there is a need for large-scale trials focusing on long-term outcomes and oncological safety before widespread adoption can be recommended.

Key words: Transanal; Bottom up; Transanal minimally invasive surgery; Laparoscopy; Robotic; Outcomes; Rectal cancer; Total mesorectal excision

Core tip: The current literature regarding transanal total mesorectal excision of the rectum (TaTME) is presented. Outcomes are encouraging. TaTME might be a promising alternative to laparoscopic TME, especially for difficult cases where laparoscopy is too demanding. The limitations and future developments are explored.

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INTRODUCTION

Rectal adenocarcinoma remains one of the most common cancers in developed countries[1]. Its surgical management has evolved in parallel over the past century from open to minimally invasive surgery, then from local resection to total mesorectal excision (TME), and from abdominal to transanal approach.

The adoption of TME was a major step towards better oncological outcomes[2], as were more precise definitions of distal and circumferential resection margins (CRM) and minimum number of harvested lymph nodes[3]. Indeed, achieving a good quality of surgery is of paramount importance for rectal resection[4]. The interest to develop better surgical techniques has therefore been continuously growing.

Whilst the safety of laparoscopy has been established in several randomized studies[5-8], Low anterior resection (LAR) can be technically challenging, especially in obese male patients, and in particular after chemoradiotherapy due to scarring and distorsion of anatomical planes. The risk of positive margins has been reported to be significant after open or laparoscopic surgery, particularly for low and anterior rectal tumors[5,9].

In addition, in challenging patients, difficulties in pelvic exposure and limitations of instrumentation can affect not only dissection but also the preservation of autonomic pelvic nerves and the achievement of a restorative procedure[10]. These unsolved problems have led surgical innovators to explore the concept of laparoscopy for low rectal cancers. Whilst some groups have successfully employed the robotic approach to reduce these risks[11,12], there remains a paucity of data regarding the superiority of robotics regarding the oncological outcomes thus far.

Based on this, the concept of "bottom-up" or transanal total mesorectal excision (TaTME) is attractive. Whilst not novel, TaTME has benefited from the previous experience with transabdominal-transanal (TATA) operation[13-15]. Following the developments of naturally orifice transluminal endoscopic surgery (NOTES), transanal endoscopic microsurgery (TEM) and transanal minimally invasive surgery (TAMIS), TaTME has been reported as feasible and safe in several large studies[16-23]. However, the real oncological impact of this technique remains under scrutiny. The aim of this article is to analyse the current experience with TaTME. The limits and future developments are also explored.

TECHNICAL CONSIDERATIONS

TaTME has been developed to overcome the inherent limits of standard approaches, either open or laparoscopic. Indeed, a laparoscopic LAR remains particularly challenging, notably regarding exposure, rectal dissection, and distal cross stapling of the rectum. Starting with dissection from the perineum seems to offer advantages, by avoiding distal cross stapling in a narrow pelvis. The use of laparoscopic staplers in this situation is difficult as multiple staple firings across the low rectum increase potential for anastomotic leak[24].

As mentioned, the concept to start the dissection from the perineum is not new. Indeed, the TATA approach has proven feasible and safe for many years[25]. However, the authors did not use either minimally invasive instruments or a platform for the transanal portion of the TATA procedure. TaTME might therefore have advantages in terms of vision and dissection due to utilisation of CO_2 for insufflation. Overall though, the global aims are the same, namely: to increase the sphincter-saving rate, to reduce positive margins, and to avoid low staple firing.

TaTME, like TATA, has the potential to define the radial and distal margins more clearly. This might be ideal in patients for whom a laparoscopic pelvic dissection is difficult (male, obese, preoperative radiotherapy, tumor located in the lower third of the rectum), carrying a risk of inadequate oncological clearance[19]. With TaTME, distal margin is assessed precisely from the beginning of the procedure. It therefore has the potential to (1) improve resection quality, and therefore clinical outcomes; and (2) decrease the incidence of abdominoperineal resection (APR), thereby improving sphincter preservation rates[26].

From a technical point of view, a transanal purse-string suture below the tumor ensures an adequate oncological distal margin will be achieved[27]. This approach has the advantage of providing excellent visualization even in a narrow pelvis. It could facilitate the dissection of the Denonvilliers fascia minimizing injury to the prostate, seminal vesicles, or vagina. This is especially true in anterior tumors, as they have a high risk of positive CRM. It might also afford more precise autonomic nerve preservation[18].

Currently, the majority of authors still use abdominal assistance. However, a purely transanal approach is feasible, as reported by several groups[28-30]. A recent systematic review found 10% of groups using a purely NOTES approach[16]. To illustrate, Chouillard *et al*[29] performed 62.5% of their cases without abdominal assistance. However, if splenic flexure mobilization is required, abdominal assistance seems appropriate. It can be performed by single port also[31]. The same is true for the creation of a difunctioning ileostomy[32], which is better approached laparoscopically than

Table 1 Transanal total mesorectal excision and peri-operative outcomes (case series with $n \geq 5$)

Ref.	Number of patients	ORT	Conversion rate	Complications rate	LOS	Comment
Marks *et al*[25], 2010	79	NA	2.5%	29.9%	5	TATA approach
Tuech *et al*[22], 2015	56	270	7.3%	26%	10	-
Han *et al*[39], 2013	34	151.6	0	6 leaks	9	13 with low rectal tumors, 15 with upper rectal tumors and 6 with sigmoid tumors.
Rouanet *et al*[21], 2013	30	304	7%	Intraop: 10% Postop: 30%	14	Difficult patients (male, high BMI, CRM threatened…)
Muratore *et al*[20], 2015	26	241	NA	26.9%	NA	-
Atallah *et al*[17], 2014	20	243	NA	65%	4.5	-
Buchs *et al*[44], 2015	20	315.3	15%	30%	7	3 benign cases
de Lacy *et al*[18], 2013	20	234	0	20%	6.5	No readmission
Chouillard *et al*[29], 2014	16	265	6.25%	18.8%	10.4%	-
Wolthuis *et al*[43], 2014	14	148	18%	42.9%	8.8	No readmission
Knol *et al*[40], 2015	10	235	0	10%	6	-
Velthuis *et al*[42], 2013	5	175	0	40%	NA	-
Sylla *et al*[41], 2013	5	274.6	0	60%	5.2	

BMI: Body mass index in kg/m^2; ORT: Operative time in minutes; LOS: Length of stay in days; NA: Not available; TATA: Transabdominal-transanal.

transanally. In cases of abdominal assistance, the TaTME technique allows for working simultaneously both from above and below. The operation is then performed in the lithotomy position utilizing a team approach (either metachronously or synchronously). This can have at least one advantage, namely a shorter operating time[19].

The TaTME approach allows for exteriorization of the specimen transanally. However, transanal extraction of the surgical specimen en bloc may not always be possible, particularly in patients with a narrow, deep pelvis, bulky mesentery, and constraints imposed by other pelvic viscera, such as prostatic hypertrophy[33]. When possible, transanal extraction avoids large abdominal extraction incisions and their associated potential complications. A wound protector is advised to minimize the risk of tumor spillage.

INITIAL EXPERIENCE

The use of minimally invasive instruments and new platforms was inspired by NOTES and TEM/TAMIS. The first experience demonstrated in cadaveric models starting in 2007 by Whiteford *et al*[34] was soon followed by others[35,36]. These authors demonstrated the feasibility of the concept, and recognized the critical steps for this procedure. Three years later, the first human clinical case was published[37]. Although the case was well selected (a female with low BMI and a mid-rectum tumor), the proof of concept was established, confirmed shortly thereafter by several case reports and small case series[28,30,38]. More recently, larger series have been published (Table 1)[17,18,20-22,25,29,39-44], confirming their initial experience.

To illustrate, Tuech *et al*[22] recently published a multicentre study, regrouping 56 TaTME patients. They reported very good short-term (Table 1) and pathological outcomes (Table 2). Interestingly, they also reported their oncological outcomes. They found a local recurrence rate of 1.7% at 24 mo. For their entire series, the overall survival rate was 96.4% after a median follow-up of 29 mo. The estimated 5-year disease-free survival rate was 94.2%. Similar oncological findings were reported by Muratore *et al*[20]. These results compared favorably to large TATA series[25].

In another large published series, Rouanet *et al*[21] reported encouraging outcomes in difficult patients (male, 54% overweight or obese, 83.3% CRM threatened according to preoperative MRI, 96.7% with neoadjuvant treatment). Despite this challenging and unfavourable population, they showed good peri-operative and pathological outcomes. Of note, two cases of urethral injury were observed at the beginning of the experience, emphasizing the need for a significant learning curve and great caution when performing dissection anteriorly. Finally, the overall survival and disease-free survival rates were 80.5% and 88.9% at 24 mo, in a high-risk population.

When assessing a new surgical technique for rectal cancer, the pathological outcomes are of paramount importance. A good quality TME specimen is essential, as it remains an independent risk factor for local recurrence[45]. The majority of authors using TaTME have reported excellent specimen quality and adequate margins (Table 2).

It is quite clear that TaTME, regardless of the specific equipment utilized, the performance of a sequential or synchronous technique, the height of the tumor, or the use of neoadjuvant therapy, seems to influence the ability to achieve a complete or near-complete TME[4], as confirmed in recent systematic reviews[3,16].

COMPARISON TO STANDARD TME

A logical next step was the comparison to standard approaches. Recently, several studies evaluating

Table 2 Transanal total mesorectal excision and pathological outcomes (case series with $n \geqslant 5$)

Ref.	TME quality	Positive CRM	Distal margins	LN
Marks *et al*[25]	NA	6.3%	1.9 cm	11.4
Tuech *et al*[22]	84% intact and 16% nearly intact	5.4%	1 cm	12
Han *et al*[39]	NA	0%	2.43	12.9
Rouanet *et al*[21]	100% good	13.3%	0.9 cm	13
Muratore *et al*[20]	88.5% complete	0%	1.9 cm	10
Atallah *et al*[17]	89.5% complete or nearly complete	5%	5% positive	22.5
Buchs *et al*[44]	94.1% intact and 5.9% nearly intact	5.9%	2.14 cm	23.2
De Lacy *et al*[18]	100% satisfactory	0%	2.6 cm	15.9
Chouillard *et al*[29]	100% intact	0%	3.6 cm	21
Wolthuis *et al*[43]	NA	NA	NA	NA
Knol *et al*[40]	90% intact	0%	1.94 cm	10.5
Velthuis *et al*[42]	100% intact	0%	0 positive	12
Sylla *et al*[41]	100% intact	0%	0 positive	33

TME: Total mesorectal excision; CRM: Circumferential resection margins; LN: Lymph nodes; NA: Not available.

Table 3 Comparative studies and peri-operative outcomes

Ref.	Number of patients	ORT	Conversion rate	Complications rate	LOS	Readmission
Denost *et al*[46], 2014	50 lap TME	263	10%	44%	8	NR
	50 Perineal TaTME[1]	240	4%	32%	7	
Fernandez-Hevia *et al*[19], 2015	37 lap TME	252	0	51%	9	22%
	37 TaTME	215	0	32%	6.8	6%
Velthuis *et al*[23], 2014	25 lap TME	NR	NR	NR	NR	NR
	25 TaTME					

[1]Perineal dissection. No use of laparoscopic instruments. Lap: Laparoscopy; TaTME: Transanal total mesorectal excision; ORT: Operative time in minutes; LOS: Length of stay in days; NR: Not reported.

Table 4 Comparative studies and pathological outcomes

Ref.	Group	TME quality	Positive CRM	Distal margins	LN
Denost *et al*[46]	Lap TME	62% complete	18%	1 cm	17
	Perineal TaTME[1]	70% complete	4%	1 cm	17
Fernandez-Hevia *et al*[19]	Lap TME	94.6% complete	0	1.7 cm	14.7
	TaTME	91.9% complete	0	2.8 cm	14.3
Velthuis *et al*[23]	Lap TME	72% complete	8%	2.5 cm	13
	TaTME	96% complete	4%	2.3 cm	14

[1]Perineal dissection. No use of laparoscopic instruments. Lap: Laparoscopy; TaTME: Transanal total mesorectal excision; CRM: Circumferential resection margins; LN: Lymph nodes.

TaTME in comparison to laparoscopic TME have been published (Tables 3 and 4).

Lately, Denost *et al*[46] published a randomized trial, comparing standard laparoscopic TME with perineal transanal TME for low rectal cancer (< 6 cm from the anal verge). In contrast to other groups, they performed the perineal dissection using traditional instruments rather than laparoscopic instruments. While they recognized that TEM equipment was an option, they did not need special platforms. Although it was not sensu stricto a TaTME, this experience confirmed the proof of concept, demonstrating that starting from the perineum has some advantages. They showed that the positive CRM rate was reduced in the perineal group (4% *vs* 18% for standard TME; $P = 0.025$). After multivariate analysis, the abdominal dissection was the only independent factor of positive CRM. Furthermore, the quality of the TME specimen was similar in both groups. In addition, the rate of anastomotic leakage (2% *vs* 10%), the operative time (240 min *vs* 263 min) and the conversion rate (4% *vs* 10%) were decreased in the perineal group compared with the abdominal group. These differences did not reach the level of statistical significance.

In a recent case-matched series, Fernández-Hevia *et al*[19] proffered interesting results. They compared 37 laparoscopic TME resections with 37 transanal endoscopic TME resections. Overall they showed better short-term outcomes following TaTME, with a shorter operative time (minus 37 min; $P < 0.01$), a shorter hospital stay (minus 2.2 d; $P = 0.1$), and less readmission (6% *vs* 22% for standard TME; P

Table 5 Robotic transanal total mesorectal excision

Ref.	Number of patients	ORT	Complications	LOS	Comments
Huscher *et al*[51], 2015	7	165.7	1 rectal bleeding, requiring blood transfusion	4.8	Negative margins, 6 complete and one nearly complete TME
Gomez Ruiz *et al*[50], 2015	5	398	1 anastomotic leak	6	Negative margins, complete TME
Atallah *et al*[48], 2014	3	376	Pulmonary embolism, stoma high output	4.3	All complete or nearly complete TME. Negative margins
Atallah *et al*[49], 2013	1	381	0	3	Negative margins, nearly complete TME
Verheijen *et al*[52], 2014	1	205	0	3	Negative margins, complete TME

ORT: Operative time in minutes; LOS: Length of stay in days.

= 0.03). The TaTME group tended to present less complications as well (32% *vs* 51%), although this did not reach statistical significance (*P* = 0.16). Regarding anastomotic leak, there was a trend in favour of TaTME group (5% *vs* 11%, *P* = 0.39). Finally, with the exception of a longer distal margin (overall + 1.1 cm; *P* < 0.01), the transanal group showed similar pathological data.

In further case-matched study, Velthuis *et al*[23] focused on pathological outcomes. They showed some advantages for the TaTME approach with 96% of patients having a complete TME specimen, while in the laparoscopic group, only 72% presented an intact specimen (*P* < 0.05). The difference is even more obvious when considering abdominoperineal excision (83% *vs* 33%). There were less positive CRMs in the TaTME group (4% *vs* 8%), although the difference was not statistically significant.

Overall achievement of oncological resection principles is confirmed by an identical number of lymph nodes harvested in both groups and by similar, if not better, R0 rate after TaTME (Table 4). The same is reported for the quality of TME. Better short-term outcomes might also be expected. So far however, the differences have not reached statistical significance. This could be accounted for by small sample sizes. Nonetheless, these results are promising and should motivate further research.

ROLE OF ROBOTICS

One feature robotic technology offers the surgeon is a 3-dimensional (3D) view. It is thought that this could provide advantages in terms of more accuracy during dissection. Others have also reported the use of 3D laparoscopic camera with success[19]. However, beyond the quality of vision, the interest of robotics is more associated with the manoeuvrability of the instruments and the stability of the platform. After initial successful cadaveric experience[47], published data regarding the clinical use of robotics for TaTME are encouraging albeit limited (Table 5)[48-52]. Of note, the use of robotic technology in this situation might restrict the possibility to work simultaneously from the abdomen and the perineum (concept of a two-team approach), which might have been a source of time saving. Regarding this experience, the feasibility has been established. Although the number of patients remains limited, the safety seems to be similar as standard TaTME. Real advantages are still hypothetical but robotic technology might help to overcome the steep learning curve, which seems to be associated with TaTME. New single-site surgery platforms are awaited. They may facilitate docking and transanal access[53].

LIMITS AND FUTHER DEVELOPMENTS

New technique, new complications?

When any new surgical technique is adopted, safety is of paramount importance. Whilst an increase in complication rates could be anticipated at the beginning of the learning curve, the global safety has to be guaranteed. However, as it was previously shown for other procedures or technique[54,55], the risk of encountering new or unexpected types of complications is real. Whilst the safety profile of TaTME seems at least similar to the standard approach, the risk of local abscess or collection formation needs to be emphasized. Indeed, Velthuis *et al*[56] found a positive pelvic culture in 39% of patients during TaTME. Of these, four (44%) developed presacral abscesses. The remainder of the cultures were negative with none of these patients developing infectious complications. On the other hand, pelvic collection (or anastomotic leak) does not seem to be over-reported in the current literature. Meticulous washout is therefore advocated before and during the procedure, especially before the rectotomy.

One of the most common complications reported was urinary retention and transient urinary dysfunction. Sylla *et al*[41] found 2 patients with urinary dysfunction (40% in their pilot study). Urodynamic testing one month postoperatively demonstrated minimal detrusor activity consistent with a neurogenic bladder. These data were confirmed on a smaller scale by Tuech *et al*[22]; 5 patients presented transient urinary dysfunction (8.9%). This was corrected at 3 mo. On the other hand, in their randomized study, Denost *et al*[46] did not find any statistical differences between perineal and abdominal dissection in terms of urological complications (6% *vs* 10%, *P* = 0.715). It is therefore worthwhile mentioning the risk of urethral lesions[21] as TaTME may result in an increased incidence of urethral injury, especially at the level of the post-prostatic urethra and particularly in the setting of anterior tumors, and prior pelvic irradiation[26]. It is worthwhile mentioning that this complication rarely, if ever, occurs for standard TME.

Finally, pneumopelvis is worthy of mention, as an aid during dissection. Atallah[26] has noted that CO_2 might also show areolar planes beyond the scope of dissection thus leading the surgeon astray. This could occur in two distinct areas: (1) laterally, at the level of the mid rectum; and (2) posteriorly, at the level of the mid and upper rectum, placing the operating surgeon in a plane that is "too deep", thereby entering the pre-sacral space. Going off plane can result in inadvertent injury to both pelvic sidewall autonomic nerves and the sacral venous plexus posteriorly, resulting in haemorrhage[26].

Oncological outcomes

Oncological outcomes for TaTME are scarcely reported. Preliminary data seem encouraging though. Indeed, in one of the largest series of 56 consecutive patients, Tuech *et al*[22] found a local recurrence rate of 1.7% at 24 mo. After a median follow-up of 29 mo, the overall survival rate was 96.4%. The estimated 5-year disease-free survival rate was 94.2%. These results were substantiated by Muratore *et al*[20], showing an overall survival and disease-free rate of 92.3% after a mean follow up of 21 mo. In addition, they did not report any local recurrence. Even when assessing high-risk patients, Rouanet *et al*[21] found an overall survival and disease-free survival rate of 80.5% and 88.9% at 24 mo respectively.

A word of caution though: the risk of poor outcomes should be mentioned, especially when dealing with locally advanced tumors. In their series, Rouanet *et al*[21] have dealt with 23% of patients presenting an initial T4 tumor. In these circumstances, there is a significant risk of worse pathological and oncological outcomes. The most recent studies[19,44,46] have reported a low rate of preoperative T4 patients. For these challenging patients, it is still not clear which approach is the most appropriate.

Finally, long-term follow-up is required before drawing definitive conclusions regarding the oncological safety of TaTME. Preliminary data are promising though, and at least as good as the standard approach[8,57].

Functional outcomes

In tandem with oncological safety, the issue of functional outcomes should be addressed. Poor function can be attributed to a combination of factors: the increased rate of coloanal anastomosis, partial sacrifice of the internal anal sphincter, and the anal stretch during TaTME. To date, functional outcomes have been poorly investigated but TME experience may yield some clues. Indeed, at least one third of the TME patients might present some degree of temporary incontinence[58]. On the other hand, the extrapolation of these results to TaTME is hypothetical, especially in a population where the rectum has been removed.

Rouanet *et al*[21] showed that at 12 mo after stoma closure, 40% of patients were fully continent, 15% reported incontinence to liquids, 35% to gas, and 25% had stool fragmentation. Atallah *et al*[17] confirmed these results and showed that most of the patients had mild fecal incontinence 8 wk after ileostomy closure. Only one patient presented a life-style-limiting incontinence. In their large multicenter study, Tuech *et al*[22] found 3 patients (5.7%) requiring definitive colostomy because of severe fecal incontinence after inter-sphincteric resection with coloanal anastomosis. In addition, 28% of their studied group reported stool fragmentation and difficult evacuation.

Finally, in sexually active patients, this French group found 66.6% patients with unchanged ejaculation and 11.2% with failure to ejaculate. Impotence was reported in 11.2% of males[22]. These data are in accordance with the standard approach[59,60].

What next?

While promising, it is imperative to raise a note of caution: clearly, only high-volume centres with technically adept, minimally invasive surgeons can produce these results[4]. There is a need to continue to develop and collaborate in an international registry, collecting relevant and high quality data on transanal rectal resection surgery for benign and malignant pathology. This will allow for safe and responsible introduction of a new technology. It may also be a driver for further research and multicentre studies[10]. Recently, the TaTME registry was launched. It is a voluntary database with online access through the LOREC (Low Rectal Cancer Development Program) portal (http://www.lorec.nhs.uk)[10].

Currently, the main open questions can be categorized as follow: (1) How to overcome the technical limitations? (2) Who are the best candidates (selection criteria)? (3) What are the long-term outcomes (oncological and functional)? (4) How to teach this technique? (5) What are the pre-requisite skills for the surgeon? What is the learning curve? (6) What are the associated costs? and (7) Should everyone be doing it (*i.e.*, is there a minimum case volume)?

From a technical point of view, the current platforms are not ideal and relatively unstable. The introduction of Airseal (SurgiQuest) might help to overcome two technical problems: (1) excessive plumes of smoke which obscure the operative field of view; and (2) "bellowing" or collapse and re-expansion of the pelvis with the cycling of CO_2[26]. The experience with TAMIS was encouraging, allowing maintenance of a stable pneumopelvis[61]. However, this technology has a cost and no comparative studies are currently available demonstrating clear objective advantages over standard platforms.

As for laparoscopic LAR, the assessment of CRM is still challenging during TaTME. Developments of intra-operative navigation and augmented reality are both new and interesting fields. Recently, stereotactic navigation has been tested for TaTME[62], to ensure R0 resection. This might be particularly relevant for locally advanced tumors. The accuracy was reported to be ± 4 mm. This technology seems to have potential, especially when applied to pelvic and fixed abdominal organs[63], as it was reported for liver surgery[64,65].

A fully NOTES procedure might be the final step. It has already been reported as feasible and safe by others[28-30]. The main technical advantage of NOTES is the absence of abdominal scars, conferring a cosmetic benefit. In addition, a reduction in pain and incision-related complications might be expected too. This said, the splenic flexure mobilization and the stoma formation are probably best performed by an abdominal approach.

The question of selection criteria is probably the most crucial and will continue to animate debate. Even in very difficult patients, Rouanet *et al*[21] showed comparable results. Although the risk of positive CRM was slightly higher than expected (13.3%), it is worthwhile noting that they are still comparable to previous data (COLOR Ⅱ study: 9%-22%)[5,8].

According to Atallah, the best suited surgical candidates are those[33]: (1) considered difficult to approach from above; and (2) who have a distal rectal tumor, and who are not candidates for local excision.

Several local anatomical and pathological factors may also favour TaTME. These include male gender, locally advanced rectal cancer, tumors in the distal third of rectum, narrow and/or deep pelvis, visceral obesity, prostatic hypertrophy, large tumor diameter, and distorted tissue planes due to neoadjuvant radiotherapy[33]. On the other hand, at least at the beginning of the experience, a locally advanced tumor should be avoided.

Of note, this technique can also be utilized for benign disease, particularly at the beginning of the learning curve. Examples include completion proctectomy for ulcerative colitis or complicated rectovaginal fistulae.

As mentioned, long-term (oncological and functional) outcomes are awaited. There remains little information regarding the ileostomy closure rate and the occurrence of late anastomotic strictures[16]. In addition, while preliminary experience of TaTME in comparison to standard LAR is promising, data remains scarce. There is still a clear need for an RCT, and more multicenter series. Again, the need for an international registry is reiterating.

There is definitively a learning curve. It may be steep. Whilst extensive experience with TEM/TAMIS and LAR is a prerequisite, there are no data evaluating this learning curve so far. As for robotic surgery[66], there is a gap between the will to teach a specific technique and the practical aspects to integrate this new training in the curriculum. Many advocate animal and/or cadaveric training prior to attempting the procedure[16]. Dedicated courses need to be developed. Our preliminary experience with hands on cadaver courses has been encouraging, allowing trainees to perform several successful TaTMEs. Finally, mentoring might also form part of the curriculum.

The cost effectiveness of this new technique is unknown. The direct costs might be higher than the standard approach for variety of reasons: a 2-team procedure requires more staff, more equipment, and personnel familiar with (and trained to use) new devices. However, if the short- then long-term outcomes are confirmed to be better after TaTME, the indirect costs could be in favour of TaTME. This assertion currently remains hypothetical requiring larger dedicated studies.

CONCLUSION

Although the experience with TaTME remains limited, it presents a promising alternative to laparoscopic TME, especially for difficult cases where laparoscopy is too demanding. The preliminary data on complications and short-term oncological outcomes are good. They also emphasize the importance of careful patient selection. Finally, there is a need for large-scale trials focusing on long-term outcomes and oncological safety, before widespread adoption can be recommended.

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