Transanal minimally invasive surgery for benign large rectal polyps and early malignant rectal cancers: experience and outcomes from the first Canadian centre to adopt the technique

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Background: Transanal minimally invasive surgery (TAMIS) has emerged as a relatively new technique in treating early cancer and benign lesion of the rectum. The technique is likely to be widely adopted, surpassing other comparable techniques owing to its simple setup and cost-effectiveness. We assessed the outcomes of TAMIS at our centre.

Methods: We retrospectively reviewed prospectively collected data on 50 patients who underwent TAMIS for benign, malignant T1 or T2 cancers that were unfit for radical surgery over a 4-year period. Outcomes, including 30-day complications and recurrence, as well as our ability to implement and integrate this technique at our centre were assessed.

Results: All 50 TAMIS procedures were successful. The average lesion was 7 cm from the anal verge, the average tumour size was 2.5 cm, the average duration of surgery was 73 minutes, the average length of stay was 1.1 days, and the margin negativity was 84%. Major indications in our series included 25 lesions that were too large for endoscopic resection, 14 early cancers or high-grade dysplasia, 10 margin checks postpolypectomy, 6 cases of recurrent polyposis, and 4 medically unfit patients. There were no deaths. The rate of short-term complications, including rectal bleeding, reoperation and urinary retention, was 16%. The rate of long-term complications, including anal incontinence and stenosis, was 4%. Benign and malignant recurrence rates were 2% and 6%, respectively. Overall long-term requirement for invasive procedures, low anterior resection or abdominoperineal resection, was 12%.

Conclusion: To our knowledge, this is the first Canadian study showing TAMIS to be an efficient and safe procedure for the treatment of well-selected patients with rectal lesions. Outcomes from our centre are comparable with those found in the literature.

Contexte : La chirurgie transanale mini-invasive (TAMIS) s'est imposée comme une technique relativement nouvelle pour le traitement du cancer précoce et des lésions bénignes du rectum. La technique est en voie d'être adoptée à grande échelle, voire de supplanter d'autres techniques comparables, en raison de sa mise en place facile et de sa rentabilité. Nous avons évalué les résultats de la technique TAMIS dans notre centre.

Méthodes : Nous avons fait une analyse rétrospective de données recueillies de façon prospective sur 50 patients traités par TAMIS pour cause de cancer T1 ou T2 malin ou bénin et non candidats à la chirurgie radicale, sur une période de 4 ans. Nous avons évalué les résultats, y compris les complications et la récurrence sur 30 jours, ainsi que notre capacité d'adopter et d'intégrer cette technique dans notre centre.

Résultats : Les 50 chirurgies TAMIS furent une réussite. La taille moyenne de la lésion était de 7 cm à partir de la marge anale, la taille moyenne de la tumeur était de 2,5 cm, la durée moyenne de la chirurgie était de 73 minutes, la durée moyenne d'hospitalisation était de 1,1 jour et le taux de marges négatives était de 84 %. Parmi les principales indications dans notre série, mentionnons 25 lésions trop grandes pour la résection endoscopique; 14 cancers précoces ou dysplasies de haut grade; 10 vérifications des marges post-polypectomie, 6 cas de récurrence de la polypose et 4 patients non candidats au traitement médical. Il n'y a eu aucun décès. Le taux de complications à court terme, incluant le saignement rectal, les interventions répétées et la rétention urinaire, était de 16 %. Le taux de complications à long terme, incluant l'incontinence anale et la sténose anale, était de 4 %. Les taux de récurrence bénigne et maligne étaient respectivement de 2 % et de 6 %. Le taux global de besoin à long terme d'une intervention efficace, d'une résection antérieure basse ou d'une résection abdominopérinéale était de 12 %.

Conclusion : À notre connaissance, notre étude est la première au Canada qui démontre que la technique TAMIS est une intervention efficace et sécuritaire pour le traitement de patients soigneusement choisis atteints de lésions rectales. Les résultats de notre centre sont comparables à ceux trouvés dans la littérature.

Despite advances in endoscopic techniques and technology, surgical excision remains the cornerstone for treatment with a curative intent for colorectal lesions. A multitude of surgical interventions for mid to low rectal lesions have been developed over the last 30 years. The degree of radical resection directly affects disease-free survival, yet aggressive surgical options often negatively impact the quality of life (QOL) thereafter. Hence, there is a need for a surgical technique that is oncologically equivalent to radical surgery but that is safer and functionally superior.

From a historical point of view, transanal endoscopic microsurgery (TEM) was first described by Buess and colleagues^{1,2} in 1983. It is an effective modality for treating a number of rectal lesions. The platform for TEM is highly complex, and the instruments used are quite specific to the platform. In addition, the setup is cumbersome, and surgeons' familiarity with the setup and the technique falls on a long learning curve.³ The equipment carries substantial cost to a centre.⁴ These factors limit TEM from being widely adopted. Hence, any oncological and functional benefit therein is not widely available.⁵

Fortunately, with the rising popularity of laparoscopic surgery and technological advances over the last 2 decades, an alternative to TEM has become available. Transanal minimally invasive surgery (TAMIS) was introduced in 2010 to replace TEM.⁶ The technique has been shown to be effective and safe, with low morbidity and with good QOL postoperatively for patients with early rectal cancer and adenomas of the mid and distal rectum.⁷⁻⁹ Furthermore, TAMIS is associated with substantially lower cost at US\$800 per single use. It is disposable and requires fewer pieces of equipment to achieve the same or even better exposure than TEM.⁴ Also, setup for TAMIS is easier and more manoeuvrable than TEM.^{10,11} The TAMIS platform allows regular laparoscopic instruments to be used.

Despite its versatility and increasing adoption, there is little evidence in the literature that examined the clinical outcomes of TAMIS. Our centre adopted the TAMIS procedure for treating benign and early-stage rectal tumours in 2012 — the first in Canada. To date, we have successfully completed more than 50 rectal excisions using the TAMIS platform. Here we describe our technique, experience and outcomes with TAMIS as well as any challenges currently associated with it.

METHODS

We conducted a retrospective review of prospectively collected data on patients who underwent TAMIS for benign or early malignant rectal lesions between May 2012 and August 2016 at Health Sciences North, Sudbury, Ont., a tertiary care centre. The study was approved by our institutional review board. All procedures were performed by a single colorectal surgeon (A. C.-M.). The TAMIS proced-

ure considered for this study included local excision and fistulas involving the rectum. Patients with benign lesions, T1 lesions, or T2 lesions that were unfit for radical surgery were also considered for TAMIS local excision after staging confirmed no metastatic disease.

Staging was accomplished using endoscopic biopsy, computed tomography (CT), pelvic magnetic resonance imaging (MRI) and endoscopic ultrasonography (EUS). Patients with nonmalignant polyps and T1 lesions were offered the TAMIS procedure with the understanding that intraoperative findings or final pathology analysis may precipitate further and more invasive operations, such as low anterior resection (LAR) or abdominoperineal resection (APR). Patients with T2 lesions who were unsuitable surgical candidates for invasive pelvic resections were also offered the TAMIS procedure.

We examined the following outcomes: procedure feasibility, margin negativity, length of stay in hospital (LOS) and early complications. Histological outcome was assessed through microscopic resection margin status.

Surgical technique

Our technique is based on that described by Attalah and colleagues⁶ in 2010 (Fig. 1). The patient is placed in a lithotomy, prone, Sim left lateral decubitus or right lateral decubitus position such that the lesion is at 6 o'clock. Use of the lone star retractor is optional. We used the GelPOINT Path Transanal Access Platform for all procedures. Three working ports are placed into the GelCap: 2 regular ports, including a camera port, are inserted at the 11 o'clock and at the 6 o'clock positions, and 1 AirSeal port is inserted at the 2 o'clock position.¹² The GelCap is then mounted onto the platform. Pneumorectum is achieved at a pressure of 15 mm Hg with carbon dioxide gas. An Endo-Eye Laparoscope (Olympus) with a multiangulation camera is introduced. The rectal lesion is identified and marked with hook electrocautery circumferentially, taking care to leave adequate margins in all directions. We often strive to achieve full thickness resection, avoiding dissection down to the plane of the mesorectal fat. In most cases, we reapproximate the defect with 3-0 Vicryl (polyglactin) sutures without narrowing the rectal lumen; use of a piece of GelFoam is optional. The specimen is carefully pinned to a soft board and sent to pathology.

RESULTS

Demographic characteristics and indications

A total of 50 patients (31 men and 19 women, mean age 67 ± 1 yr) underwent TAMIS at our centre between May 2012 and August 2016. The average BMI was 30 ± 1 . The demographic and clinical characteristics of the patients are shown in Table 1.

The major indications for TAMIS were benign rectal lesions that were too large for endoscopic resection (EMR) ($n = 25$), followed by early rectal cancers and high-grade dysplasia (HGD; $n = 14$), lesions with inadequate or

unknown margin postendoscopic excision or polypectomy ($n = 10$) and recurrent polyps following previous excision of any kind ($n = 6$; Table 1). Two patients with T2 lesions and 2 patients with T1 lesions on preoperative workup

Fig. 1. Transanal minimally invasive surgery (TAMIS) setup and surgical specimens. (A–C) The patient is usually placed in the lithotomy with steep Trendelenburg position for posterior rectal wall lesions. (D) Positioning of patients should also take into account the location of the lesion. Though some reports suggest that through the TAMIS platform any lesion in the rectum can be accessed in a 360° circumferential manner, we have always positioned the patient such that the lesion is at 6 o'clock. (E) The lone star retractor is placed. (F) The TAMIS platform is placed. (G) Positioning of the surgeon, first assistant and scrub nurse in relation to the viewing screen and the patient. (H) Once the lesion is identified, it is demarcated with a hook electrocautery to mark its boundary with adequate margins in all directions. (I–M) Careful and deliberate dissection from the mucosa onto the plane of the mesorectal fat. (N–O) Once the lesion is removed, the defect is usually reapproximated. (P) The specimen is pinned on a soft board and sent to pathology for analysis.

were offered TAMIS owing to advanced age and medical comorbidities. Two patients underwent redo-TAMIS (Table 1).

Technical success rate

The average lesion distance from the anal verge was 7 ± 1 cm, and the lesions were present in all aspects of the rectal circumference in equal proportions. This was reflected in patient positioning (Table 2).

The average duration of surgery was 73 ± 5 min; stratified by year, the average durations were 99 ± 6 min, 85 ± 13 min, 59 ± 7 min, 71 ± 16 min and 52 ± 7 min. Yearly case load was 6 cases in 2012, 13 in 2013, 7 in 2014, 15 in 2015 and 9 cases in 2016 (Fig. 2). Full thickness resection, including partial mesorectum, was performed in 34 (68%) patients. When the lesion was close to the vaginal plexus or prostate/urethra (4 patients, 8%), we were careful with the depth. When the lesion was too close to the sphincter (12 patients, 24%), only full thickness wall resection was done. We successfully completed TAMIS in all 50 patients. Of these, 47 cases were completed with the TAMIS platform alone, and 3 cases required a hybrid technique using the transanal excision (TAE) and colonoscopic-assisted localization of the lesions. No intraoperative conversion through LAR, APR, or TAE was required.

The average volume of the specimen was 17.8 ± 2.3 cm³ and the volume of tumour resected was 5.5 ± 1.0 cm³. The average tumour diameter was 2.5 ± 0.2 cm. In 43 (86%) patients, the excision defect was closed.

Table 1. Patient demographic and clinical characteristics and TAMIS indications

Characteristic	Mean (range) or no. of patients
Age, yr	67 (45–87)
Sex, male:female	31:19
ASA classification	
2	14
3	12
4	5
Unavailable*	19
BMI	30 (17–56)
TAMIS indications†	
Lesions not amenable to EMR	25
Early adenocarcinoma appropriate for TAMIS	13
High-grade dysplasia	1
Inadequate or indeterminate margin post-EMR	10
Recurrent polyposis	6
Medically unfit for radical resection	4
≥ 2 indications	9
ASA = American Society of Anesthesiologists; BMI = body mass index; EMR = endoscopic mucosal resection; TAMIS = transanal minimally invasive surgery.	
*ASA documentation in operative records was not mandatory at our center prior to 2013.	
†Some patients fall under multiple categories.	

Resection margins and pathology

On final pathology, 16 patients had adenocarcinomas, 1 had a neuroendocrine tumour, 23 had adenomas of various subtypes, and 10 had nonmalignant or benign lesions.

All specimens had grossly negative margins at the time of excision, and care was taken intraoperatively to avoid fragmentation. We achieved an R0 negative resection margin in 42 (84%) patients, a microscopically positive margin in 4 (8%) patients and indeterminate margins in 4 (8%) patients. Two of these patients were followed up with flexible sigmoidoscopy (FSIG) every 6 months. One of these patients experienced a recurrence at 16-month follow-up

Table 2. Quality of excision and postoperative findings

Finding	Mean (range) or no. of patients
Lesion distance from anal verge, cm	7 (2–15)
Lesion location	
Posterior	13
Anterior	12
Left	17
Right	8
Patient positioning	
Lithotomy	15
Prone jackknife	14
Sim left lateral decubitus	15
Right lateral decubitus	6
Resection depth	
Mucosa	12
Rectal wall	4
Rectal wall with partial thickness mesorectum	34
Volume of specimen resected, cm ³ *	17.8 (1.4–66.7)
Volume of tumour resected, cm ³ †	5.5 (0.012–27.6)
Tumour size along greatest dimension, cm	2.5 (1–4.9)
Defect closure, yes:no	43:7
Technique	
TAMIS only	47
Hybrid technique	3
Intraoperative conversion (LAR/TAE)	0
Final pathology	
Adenocarcinoma and neuroendocrine tumour	17
Villous adenoma	5
Tubulovillous adenoma	15
Tubular adenoma	2
Serrated adenoma	1
Submucosal lipoma	1
No malignancy	9
Resection margins	
Negative	42
Positive	4
Indeterminate	4

LAR = low anterior resection; TAE = transanal excision; TAMIS = transanal minimally invasive surgery.

*n = 48. Pathology reports do not always include 3-dimensional measurements of the resected specimen.

†n = 37. Some specimens, especially the ones to rule out positive margin, do not contain tumour for measurements.

and subsequently underwent re-excision. Histology on the redo-TAMIS specimen returned as a T2 lesion, and the microscopic margins were positive. Owing to advanced age, medical comorbidities and the patient's unwillingness to undergo a third operation, palliative chemotherapy was prescribed. The other patient had HGD involving the resection margin of the adenoma specimen and was followed with FSIG every 6 months, with no recurrence to date. Two of these 4 patients had no recurrence on follow-up. In the 4 patients in whom the margin was indeterminate, the lesions were fragmented during the operations, hence their margins could not be assessed on pathological analysis. As a routine, these patients also underwent surveillance FSIG every 6 months and were found to have no recurrence of their diseases 3 years after TAMIS.

Of the 15 malignant cases on preoperative diagnosis, only 9 were confirmed to be malignant on final pathology, and of the 35 benign preoperative cases, 8 were found to be malignant on final pathology (Fig. 3).

Recurrence

The median duration of follow-up was 21 (range 2–53) months. There were 4 adenocarcinoma recurrences (8%) in our series: 1 benign and 3 malignant (Table 3). These patients were followed clinically with regular FSIG until local recurrence was identified. The patient with benign recurrence experienced a local recurrence at 13 months on FSIG surveillance. He underwent TAMIS re-excision and has been disease-free since. One patient with a malignant recurrence was found to have multiple liver metastases and a presacral mass at 35 months. He was referred to oncology for medical management. Two patients with cancer had local recurrence. One recurred at 16 months, and the patient underwent re-excision, but pathology returned as pT2 with a positive margin (see the Resection margins and pathology section). The patient was referred for palliative chemotherapy because of poor surgical candidacy. The

Fig. 2. Duration of surgery as a surrogate of the transanal minimally invasive surgery (TAMIS) learning curve. $p = 0.07$, one-way analysis of variance.

other patient also had a local recurrence and was clinically staged as T2N0M0 and was considered for APR.

Morbidity and mortality

The average LOS was 1.1 ± 0.2 days. Most (42 of 50, 84%) patients went home on the same day or on postoperative day (POD) 1. The remainder went home on POD-2 or POD-3 and were kept for observation owing to medical comorbidities, urinary retention and reoperation. One patient experienced hospital-acquired pneumonia and pleural effusion with no intra-abdominal or rectal issues; this extended his LOS to 10 days, as he required medical management.

The overall 30-day morbidity was 16% (8 of 50). A breakdown of complications is listed in Table 3. Mortality was 0%. Short-term complications included 1 small suture line perforation requiring laparoscopic repair on POD-1. We had 4 cases of postoperative rectal bleeds; the patients were admitted for observation. One of them required transfusion. One patient had a urinary tract infection. Long-term complications included 1 rectal stenosis that resolved after 4 endoscopic dilatations during the first year after surgery. The patient has remained asymptomatic.

DISCUSSION

The treatment of benign and early tumours hinges on a balance between curative intent and functional preservation. The TAMIS technique is safe and effective for removing rectal lesions with good functional and oncological

Fig. 3. Preoperative clinical staging is not 100% accurate. From a diagnostic point of view, transanal minimally invasive surgery (TAMIS) may be considered the ultimate biopsy.

outcomes. It exceeds TAE and TEM with several advantages. The rapid setup for TAMIS is more efficient than the setup for TEM. It can be completed in about 5 min. The platform does not need to be fixed to the operating table and is therefore mobile and manoeuvrable. In addition, TAMIS allows the use of any laparoscopic instruments, making the procedure universal. This translates into greater familiarity or transferability of existing skills for the surgeon, increased cost-effectiveness, and better and safer care for patients. These benefits have been widely reported in the literature.^{4,5,13,14} Compared with TAE, TAMIS allows for better exposure and visualization of lesions along the entire length of the rectum. Contrary to previous indications for TAMIS, we found that excision of high rectal lesions were feasible with this technique; albeit slightly more challenging to perform, the surgery was less invasive and required shorter LOS.

Despite these advantages, there are still a few challenges commonly encountered with TAMIS. First, lesions behind a valve of Houston are difficult to excise on a TAMIS platform. In one such case, our initial dissection was delayed owing to an inability to identify the lesion. The platform had to be taken down, and an intraoperative flexible endoscope was introduced to finally identify the lesion behind a fold 10 cm above the anal verge. The dissection itself was difficult, as the surgeon struggled to expose the lesion and provide adequate traction. The closure of the defect was equally challenging, and it was left open after hemostasis was achieved. Second, TAMIS is challenging in obese patients with abundant adiposity in the gluteal region. To overcome this problem, we place stay sutures to efface the anal canal. Once pneumorectum is achieved, then the adiposity poses little problem for the procedure. Third, though this had not posed a problem for us, one should anticipate rectal spasms and the resulting difficulty in dissection and closure thereafter. A case series of 25 patients

reported a positive outcome after using spinal anesthesia during TAMIS; the proposed advantage was improved rectal wall relaxation.¹⁵ We did not experience any difficulty with pneumorectum with the patients under general anesthesia, nor did we experience any important postoperative problems. More studies are likely needed to validate any true clinical benefit of spinal anesthesia. Finally, TAMIS requires a camera assistant, and therefore needs synchrony and communication between the surgeon and the assistant. As the pioneers in TAMIS in Canada, we have elected to use the EndoEye. It is a combination of rigid with a flexible endoscopic camera tip. It allows us to achieve a wide angle view of the rectum.

Our data showed adequate margin status, with negative R0 margins in 42 patients and a positive margin in 4 patients. To achieve a full thickness resection for T1 adenocarcinoma or large polyps, we deliberately entered the plane of the mesorectum and resected portions of it with the lesion; the advantage was the achievement of R0 negative margins, but the disadvantages were longer duration of surgery and inadvertent peritoneal entry, especially in patients with mid to high rectal lesions. We have not needed to convert to laparoscopic repair for peritoneal violation. However, it may be necessary, as suggested previously by others.¹³

One caveat with aggressive resection to achieve R0 margin is peritoneal violation. These cases were often associated with lesions that were relatively large, occupying up to 40%–50% rectal circumference, and located anteriorly or left anterolaterally in the rectum at 7–10 cm from the anal verge. We had a total of 5 peritoneal violations. They were suture-repaired in all 5 patients, who were admitted overnight for observation. One patient was kept in hospital for 10 days owing to respiratory complications. This patient did not require any surgical intervention. Entry into the peritoneal cavity should be considered a complication.

Table 3. Early postoperative and long-term outcomes of TAMIS

Complication	No. of patients	Details
Short-term		
UTI	1	Resolved spontaneously
Leak	1	Small 3–4 mm closure leak (40% circumferential tumour resected), requiring laparoscopic repair; the patient recovered well postoperatively without experiencing any other complications
Readmission	4	Four patients with rectal bleed were admitted for observation
Bleeding	4	Patients were admitted for observation; 1 patient required transfusion
Urinary retention	1	Resolved with trial void and medical therapy
Pneumoperitoneum	1	Extended LOS; the patient required antibiotic treatment for hospital-acquired pneumonia
Long-term		
Anal stricture	1	Resolved after 3 endoscopic dilatations
LAR/APR requirement	6	For indication in first TAMIS surgery, final pathology more advanced or recurrence
Recurrence		
Benign	1	Local recurrence, redo-TAMIS; the patient has been disease-free since redo-TAMIS
Malignant	2	Metastatic recurrence and palliative chemotherapy in 1 patient; local recurrences, APR and palliative chemotherapy in 1 patient

APR = abdominoperineal resection; LAR = low anterior resection; LOS = length of stay; TAMIS = transanal minimally invasive surgery; UTI = urinary tract infection.

However, this can be repaired intraoperatively without the need to convert to any other approach. In our experience, all of the peritoneal violations were amendable to repair through the TAMIS platform with suture closure. Based on our experience, we recommend that anterior lesions that are suspected to be above the peritoneal reflection should not be operated using the TAMIS method unless the surgeon is experienced with suturing through the TAMIS platform.

There is some debate in the literature as to whether the postresection defect should be reapproximated. In 86% of our patients, we reapproximated the defect as part of hemostasis or controlling perforations into the peritoneum. Such defects were left open when the lesion was close to the anal sphincter to avoid sphincter injury and subsequent fecal incontinence. Overall, we did not find any anorectal malfunctions due to this type of closure, nor did we find any significant difference in postoperative outcomes. A series by Hahnloser and colleagues¹⁶ showed the rectal defect can be left open without increasing complications or compromising rectal continence.¹⁶ Haugvik and colleagues¹⁷ left the rectal defect open in 25% of their cases and did not find any increase in surgical morbidity. These studies will likely help guide practice when the lesion is too close to sphincters and too technically difficult to close.

Based on our study, even with adequate preoperative workup, adenomas and T1 early tumours can be more advanced on final pathology. Consequently, patients with a preoperative workup of cancer or positive margin status can be found to have no malignancy on final pathology (Fig. 3). These findings are echoed in the literature, in which up to 44% of rectal lesions can be incorrectly staged even with adequate preoperative workup.¹¹ In our series, 6 cases were overestimated on initial workup and 8 cases were underestimated, in which final pathology revealed T2 lesions compared with T1 or adenoma on initial workup; the overall rate of incorrect staging was 28%. As onco-

logical outcome with local excision for pathological T2 adenocarcinomas is likely inadequate, 3 of these 6 patients underwent LAR, 1 had APR, 1 had re-excision with FSIG surveillance, and 1 was not treated owing to comorbidities.

The TAMIS technique can be both a curative and staging procedure for lesions in the grey zone between benign and malignant on preoperative assessment. In malignant cases, TAMIS is undertaken only for early lesions without features of aggressiveness, such as poor differentiation, lymphovascular invasion (LVI), perineural invasion (PNI), T2 or positive lymph node. The only exceptions will be in patients with significant medical morbidities that prevent them from undergoing a radical intervention. In some cases, we cannot establish with certainty whether a patient has any malignancy, therefore TAMIS can be considered the ultimate biopsy. In some cases these biopsies can lead to a more radical procedure. In order to prevent increasing complexity at the time of radical surgery, full thickness of the mesorectum is avoided at all cost, as it will be a direct violation of the mesorectal plane.

To our knowledge, no study is available to evaluate the equivalency of oncological outcomes between radical surgery and TAMIS; however, QOL is likely better with the latter. Flexible sigmoidoscopic surveillance and clinical follow-up after TAMIS is important to identify any cancer or polyp recurrence, such that reoperation can be done in a timely fashion in order to avoid disseminated cancer. Currently, there is no guideline available.¹⁸ We recommend follow-up every 3–6 months with FSIG for about 2–3 years.

Our recurrence rate in the present study was 8% (4 of 50), which is better than the rate of 17% for local recurrence after TEM reported in the literature.¹⁹ Rectal stenosis is more likely to occur when the circumference of the lesion is large. Likewise, urinary retention occurs more often when the lesion is more circumferential.⁴

Our technique is adequate, with a total TAMIS completion rate of 100% for lesions that averaged 7 cm from the

Table 4. Comparison of the present study with recent TAMIS series

Study	No. of patients	Diameter, cm	Distance from anal verge, cm	Duration of surgery, min	Mean LOS, d	Morbidity, %	Mortality, %	Negative margin, %
Present study	50	2.5	7	73	1.1	16	0	84
Haugvik et al. ¹⁷	51	3.2	8	40	1*	12	0	47
Keller et al. ²²	75	3.2	10	69	1*	5.30	0	NA
Sumrien et al. ⁹	28†	5*	NA	< 60	1.5	29	0	82
Verseveld et al. ²¹	24	6 cm ²	8‡	NA	NA	4	0	NA
Gill et al. ⁸	32	2.1	7.5	131	1.1	50	0	100
Maglio et al. ¹⁰	15	3.5	7	86	2	0	0	NA
McLemore et al. ¹⁸	32	0.5–8.5	1–11‡	123	2.5	16	0	97
Schiphorst et al. ²⁰	37	18 cm ²	7‡	64*	1*	8	0	78
Albert et al. ⁷	50	2.75	8.1	75	0.6	8	0	90

LOS = length of stay in hospital; NA = not available.

*Median.

†80% success rate.

‡Dentate.

anal verge, a positive margin rate of only 8% (4 of 50), morbidity rate of 16% and an average LOS of 1.1 day. Our outcomes were comparable or better than those of other published series in recent years^{7-10,17,18,20-22} (Table 4). The TAMIS technique is efficient, viable and safe for the treatment of rectal lesions.

Limitations

One of the limitations of our study was the lack of QOL measurements. The post-TAMIS clinical follow-up was limited to patients who would present with anorectal complications as opposed to administering QOL assessment in all patients who underwent TAMIS. Measures based on questions 19–23 from the International Consultation on Incontinence Modular Questionnaire (ICIQ) from a small series conducted in the United Kingdom showed anal function to be acceptable post-TAMIS.⁹ Another small series examined functional outcomes using the Fecal Incontinence Severity Index (FISI) and showed no TAMIS-related sphincter injury or fecal incontinence, and a generic QOL measure using the EuroQoL EQ-5D questionnaire showed improved QOL after TAMIS, presumably secondary to tumour excision.²¹ The aforementioned questionnaires are easy for patients to use, are excellent tools for assessing anorectal function over time²⁰ and can potentially be incorporated into routine clinical follow-up at our centre. Another limitation includes the inherent bias with retrospective analysis owing to missing data from medical records; however, our surgical and clinical data set was complete as data were collected prospectively. Pathological records occasionally lacked tumour dimensions, but the margin analyses were well described. Finally, it is important to keep in mind that TAMIS is an evolving surgical technique, and the sample sizes in published series are small, hence surgical outcomes are subject to variation by centre. Likewise, oncological outcomes based on these small series will also vary by centre.

CONCLUSION

In congruency with current evidence, which supports TAMIS as a viable alternative to radical excision of the rectum with less morbidity, faster recovery and greater potential cost savings, we have shown TAMIS to be a safe, efficacious and reproducible technique in this endeavour. Furthermore, we foresee increasing use of this technique for more complex colorectal surgeries at our centre.

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Contributors: All authors designed the study, acquired and analyzed the data, wrote and reviewed the article and approved the final version for publication.

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