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Peritoneal perforation during transanal endoscopic microsurgery is not associated with significant short-term complications

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Abstract

Background In patients treated by transanal endoscopic microsurgery (TEM), breach of the peritoneal cavity is a feared intraoperative challenge. Our aim is to analyze predictors and short-term outcomes of patients with peritoneal perforation (TEM-P) when compared to similar patients with no peritoneal compromise (TEM-N).

Methods At St. Paul's Hospital, demographic, surgical, pathologic, and follow-up data for all patients treated by TEM is maintained in a prospectively populated database. A retrospective review was performed and two groups were established for comparison: TEM-P and TEM-N. Statistical analysis was performed using student's *t* or chi-squared test, where appropriate.

Results Of 619 patients treated by TEM between 2007 and 2016, 39 (6%) patients were in the TEM-P group and 580 (94%) in the TEM-N group. There were no differences between the groups in patient age, gender, histology, or tumor size. Patients who had peritoneal perforations had more proximal lesions (11 vs. 7 cm, $p < 0.0001$), anterior lesions (56 vs. 43%, $p < 0.05$), and longer operations (80 vs. 51 min, $p < 0.005$). While most defects were closed endoluminally, 2 patients with perforation were converted to transabdominal surgery. There was a difference in overall hospital stay with TEM-P patients staying on average 2 days in hospital with fewer patients managed as day surgery (31 vs. 73%, $p < 0.0001$). There were no mortalities or significant 30-day complications in the TEM-P group and only one patient required readmission.

Conclusions The St. Paul's Hospital TEM experience suggests patients with peritoneal breach during TEM can be safely managed with outcomes similar to patients without peritoneal entry. Proximal, anterior lesions are at highest risk of peritoneal perforation.

Keywords Transanal endoscopic microsurgery · Peritoneal perforation · Rectal cancer · Adenoma

In 1983, Buess et al. introduced the concept of transanal endoscopic microsurgery (TEM), a safe and effective transanal approach to rectal lesions [1]. TEM has become a less invasive way to treat certain types of early-stage rectal cancers or rectal polyps [2–6]. It has replaced more extensive procedures such as low anterior resections, abdominoperineal resections, and conventional transanal excisions for a subgroup of patients with adenomas and early rectal cancers. Compared to transabdominal approaches, TEM has been associated with its advantages of no abdominal incision, less bleeding, less risk of infection, post-op complications, shorter operating times and hospital stay [7–13]. Compared to conventional transanal excisions, it has advantages of better access to more proximal and larger lesions as well as lower cancer recurrence rates and superior negative margin status [14].

One of the feared complications of TEM is perforation into the peritoneal cavity. Limited studies have investigated the short- and long-term complications of peritoneal cavity breach [15–19]. A review of the literature suggests peritoneal perforation during TEM occurs in 0–32% of TEM procedures [15]. Morino et al. and Baatrup et al. have shown that patients with peritoneal perforations have similar postoperative outcomes and complications when compared to patients without breach of the peritoneal cavity. Our study aims to further analyze potential risk factors and outcomes of patients with peritoneal perforation (TEM-P) when compared to similar patients with no peritoneal compromise (TEM-N).

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Materials and methods

Between March 2007 and August 2016, demographic, surgical, pathologic, and outcomes data were collected and maintained prospectively for all patients undergoing TEM treated by four subspecialty colorectal surgeons at St. Paul's Hospital in Vancouver, Canada. This was a retrospective review of this database. This study was submitted and approved by the Providence Health Care Research Ethics Board.

Surgical approach

All patients were evaluated preoperatively with colonoscopy, lesion biopsy, and, in cases of suspected cancer, endorectal ultrasound. Rigid rectoscopy was performed in most patients to confirm the height and location of the lesion. The TEM procedure was performed with patients in a lithotomy or prone position, depending on the location of the lesion. For the procedure, we utilized the Richard Wolf Medical Instrument Corporation TEM instrument system and the KARL STORTZ GmbH & Co. insufflator with pressures set to 15 mm Hg. The conventional laparoscopic camera (Storz Medical Ag, Tagerwilen, Switzerland) and high-definition video tower was used. Full thickness rectal wall excision was performed for all malignant lesions and selectively for adenomas. Peritoneal entry was defined by clear visualization of intra-abdominal cavity or contents through the defect. For patients with rectal wall defect into the peritoneum, the defect was sutured using running 2-0 PDS (Ethicon Inc, Cincinnati, USA) and secured with suture clip forceps (Richard Wolf GmbH, Knittlingen, Germany). In all patients, the rectal vault was irrigated with saline prior to completion of the procedure.

Post-operative care

There was no standard post-operative and imaging protocol used for this study. Discharge criteria for all patients were at the surgeon's discretion and were met if patients were at their preoperative baseline orientation and activity level, vital signs within 20% of preoperative value, pain, nausea, and vomiting controlled with oral medications and minimal to no rectal bleeding.

Data collection and analysis

All patient demographics, operation details, pathology, post-operative complications, and follow-up information were prospectively collected and maintained in the secure St. Paul's Hospital TEM Database. Patients were followed up at 30 days either in person or by telephone. Patients were excluded if they failed to follow-up or if their operation was aborted if their lesion was deemed not suitable for safe resection with TEM.

We performed statistical analysis using student's *t* test or chi-squared test, where appropriate.

Outcomes

Our prime interest in this study was to assess predictors of peritoneal perforation. We also examined differences in short-term outcomes. These outcomes include length of hospital stay, readmission to hospital, and post-operative complications (bleeding, infection, urinary retention) within 30 days of surgery. Bleeding was defined as presentation of bright red blood per rectum on clinical exam (in- or outpatient) associated with at least one of hemoglobin drop of 20 g/L from preoperative, blood transfusion, readmission to hospital, and/or surgical/endoscopic intervention. Infection was defined as peritonitis or pelvic pain and either fever > 37.9 °C or WBC $> 11 \times 10^9$ c/L or clinician diagnosed post-operative infection. Urinary retention was defined as either catheter reinsertion after surgery because of failure to void or catheter reinsertion within 30 days of surgery.

Results

A total of 619 patients from the TEM database were included in the study with 39 patients in the TEM-P group and 580 patients in the TEM-N group (Table 1). Overall, 6% of patients who underwent TEM had entry into their peritoneal cavity. There was no significant difference in terms of age (67 vs. 67 years, $p = 0.96$), male:female ratio, lesion size (TEM-N 4.1 vs. TEM-P 4.2 cm, $p = 0.78$), and lesion type ($p = 0.33$) between the two groups. Six percent of males and five percent of females had peritoneal perforations.

The mean distance of lesion from the anal verge was significantly different between the two groups with TEM-P having higher lesions (11.1 vs. 6.9 cm, $p < 0.0001$). The majority of TEM-P patients had anterior lesions compared to posterior or lateral lesions (56 vs. 31 vs. 13%, $p < 0.05$). Patients in TEM-P did have longer mean operating time (80 vs. 51 min, $p < 0.005$) and hospital stays (2.2 vs. 0.5 days, $p < 0.005$) than patients in the TEM-N group (Table 2). However, 31% of patients with peritoneal entry were still safely discharged the same day of surgery compared to 73% in TEM-N group ($p < 0.0001$). Lesions types in the TEM-N group included 213 adenocarcinomas, 310 adenomas, 27 neuroendocrine tumors, 9 gastrointestinal stromal tumors (GISTs), and 21 other diagnoses, which included normal rectal tissue, polyps, squamous cell carcinoma, and melanoma. Out of the 39 perforations, 14 were adenocarcinomas and 25

Table 1 Patient demographics, operative details, and pathologic results

	TEM-N	TEM-P	*p* value
Number of patients	580	39	
Mean age (years)	67	67	$p=0.96$
Females (%)	229 (39%)	13 (33%)	p=0.45
Males (%)	351 (59%)	26 (67%)	
Lesion height (cm)	6.9	11.1	$\mathbf{p<0.0001}$
Operating time (min)	51	80	$\mathbf{p<0.005}$
Max lesion dimension (cm)	4.10	4.17	$p=0.78$
Negative margins on pathology	82%	86%	$p=0.45$
Lesion type			$p=0.33$
Adenocarcinoma	213	14	
Adenoma	310	25	
Neuroendocrine	27	0	
GIST	9	0	
Other[a]	21	0	
Lesion location			$\mathbf{p<0.05}$
Anterior	193	22	
Posterior	264	12	
Lateral	118	5	
Circumferential	5	0	

Statistically significant *p* values are highlighted in bold

TEM-N patients with no peritoneal compromise

TEM-P patients with peritoneal compromise

[a]Includes normal tissue, rectal polyp, squamous cell carcinoma, and melanoma

Table 2 Post-operative course and complications

	TEM-N	TEM-P	*p* value
Number of patients	580	39	
Mean length of stay (days)	0.5	2.2	$\mathbf{p<0.005}$
Patients treated as day surgery (%)	73%	31%	$\mathbf{p<0.0001}$
Readmissions (*n*)	18 (3%)	1 (3%)	$p=0.85$
Reoperations (*n*)	2 (0.3%)	0	$p=0.71$
Overall complications (*n*)	40 (7%)	4 (10%)	$p=0.43$
Bleeding	15	1	$p=0.99$
Infection	8	1	$p=0.55$
Urinary retention	15	2	$p=0.35$
Enterovesicular fistula	2	0	$p=0.71$

Statistically significant *p* values are highlighted in bold

TEM-N patients with no peritoneal compromise

TEM-P patients with peritoneal compromise

were adenomas. The TEM-P group did not have a significant difference in negative margins on pathology compared to TEM-N (82 vs. 86%, $p=0.45$).

There was no significant difference in overall morbidity for patients in TEM-P compared to TEM-N (10 vs. 7%, $p=0.43$). Despite undergoing repair for peritoneal perforation, there was also no significant difference in terms of post-operative bleeding, infection, urinary retention, or enterovesicular fistula formation when compared to patients without peritoneal perforation ($p>0.05$).

Two patients in the TEM-P were converted to a laparotomy, as defect was not unable to be repaired using TEM. One patient had a 7-cm adenoma that spanned 15–20 cm from the anal verge with the peritoneal cavity breached anteriorly. After 45 min of trying to endoscopically suture the defect, TEM was aborted due to the difficulty visualizing the defect. A lower midline laparotomy was needed to close the defect in the anterior rectal wall. The second patient had a large 9-cm circumferential adenoma where the peritoneal cavity was entered anteriorly. After intraoperative consultation with another colorectal surgeon, it was determined that the size of the lesion was too large to be removed safely transrectally. A laparotomy ensued with a low anterior resection and diverting loop ileostomy. Even when excluding these two patients from our database, mean operating time was still significantly longer in the TEM-P group.

There were no mortalities within 30 days of surgery. Two patients, both in TEM-N group, had reoperations for control of bleeding. Overall, patients with peritoneal entry did not have a significantly higher readmission or reoperation rate when compared to patients without peritoneal entry, respectively (3 vs. 3%, $p=0.85$, 0 vs. 0.3%, $p=0.71$). There was one readmission in TEM-P group. This patient returned with abdominal pain post-operative day 2 with no significant findings on abdominal/pelvis CT scan. The patient was kept for 2 days in hospital and treated with 5 days of amoxicillin-clavulin antibiotic. One patient developed two intra-abdominal pelvic abscesses found on post-operative day 5 from resection of a 4-cm adenocarcinoma and endoscopic repair of peritoneal perforation. Their length of hospital stay was 14 days and treatment included antibiotics for 10 days with ultrasound-guided drain for one of the abscesses.

Discussion

TEM is becoming the standard of care for transanal excision of selected rectal lesions. To our knowledge, our experience in 39 patients with peritoneal perforation is one of the largest single-center TEM studies in the published literature. Overall, the peritoneal perforation rate for our single-hospital study was 6%, which is comparable with previous studies [15, 17, 18]. We note an association between peritoneal perforation and proximal and anterior lesion location.

Multiple studies have demonstrated significant variability in the distance between the anal verge and the peritoneal reflection [20–22]. However, most series suggest that the peritoneal reflection is at least 9 cm away from the anal

verge. Najarian et al. demonstrated the mean lengths of the peritoneal reflection differ between anterior, posterior, and lateral locations with the peritoneal reflection being the lowest anteriorly. This would agree with our study as 56% of TEM-P patients had anterior lesions. Even though it has been suggested that women have a deep anterior peritoneal reflection, we did not find a significant difference in perforation rates between genders [23]. Despite the surgical complexity with larger rectal lesions and unlike other studies, we did not find that larger lesions were more likely to have peritoneal perforations [15, 24, 25].

This group has previously published on open vs. closed management of extraperitoneal surgical defect after TEM, showing that open management can lead to more post-operative complications and readmission to hospital [26]. The same surgical technique described in the publication was used during this study to close intraperitoneal defects.

In our study, only 31% of the TEM-P patients were discharged the same day. Day surgery is associated with higher patient satisfaction and low morbidity and mortality rates [27–30]. This can improve health care centers' issues with bed shortage and may be a financial benefit from fewer patient admissions and shorter length of stay in hospital [31, 32]. Even though TEM-P patients were more likely to be admitted post-operatively, they still have a mean hospital stay of only 2 days. Of note, the hospital stay for both TEM-N and TEM-P patients were shorter than most published studies [15, 16, 18].

Studies show that increased surgeon experience with TEM has been linked to improve outcomes such as decreased complication rates, hospital stay, blood loss, and duration of surgery [14, 33, 34]. Increased experience has also been shown to decrease conversion rate to laparotomy during TEM for complications such as peritoneal perforation [15, 35]. In Morino et al., their review found conversion to laparotomy was reported in 50–100% of TEM peritoneal perforation cases when the surgeon performed fewer than 100 procedures, whereas larger series had conversion rates between 0 and 40%. Therefore, case volume along with the learning curve for TEM are factors that impact patient outcomes and management during peritoneal perforations. In our study, two patients were converted to an open procedure. Laparotomy was favored over laparoscopy in one circumstance due to the large proximal defect that would be more amenable to open suture repair in that surgeon's experience. The other patient had a 9-cm circumferential lesion associated with the perforation. The surgeon felt it would be difficult to conduct the procedure laparoscopically while preventing significant contamination of the pelvis. Laparoscopic approach was considered at the time of abdominal conversion in both cases.

Our study showed that patients with peritoneal perforations did not suffer worse post-operative outcomes compared to patients without peritoneal perforation. There was a similar readmission and post-operative morbidity rate for both groups. Other studies investigating peritoneal perforation in TEM have found comparable post-operative complication rates to our study [15, 25]. In addition, both groups had similar outcomes in terms of margin status.

One of the limitations of this study is the lack of a standard protocol for post-operative care. While our institution has day care surgery discharge criteria, hospital admissions for patients with peritoneal perforation can still be based on surgeon bias and not medical need. Due to the nature of this study, there is no opportunity for a randomized trial comparing patients with peritoneal perforation with patients who have no compromise of the abdominal cavity. We acknowledge that the lack of long-term outcomes and our small sample size for the peritoneal perforation group are limitations in understanding the full impact of this intraoperative issue on outcomes.

In conclusion, peritoneal breach during TEM can be safely managed with outcomes similar to patients without peritoneal entry. These findings provide a large center study to further support findings in smaller, previous studies [15, 17–19, 25]. Proximal, anterior lesions were at highest risk of peritoneal perforation. We found that selected TEM patients with peritoneal perforation can be managed with transanal approach and with day surgery. Future studies may be able to delineate other risk factors and help investigate short-term and long-term outcomes of patients with peritoneal perforation after TEM.

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Compliance with ethical standards

Disclosures Drs. Jonathan Ramkumar, Ahmer A. Karimuddin, P. Terry Phang, Manoj J. Raval, and Carl J. Brown have no conflicts of interest or financial ties to disclose.

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