Review Article

The role of transanal total mesorectal excision in inflammatory bowel disease surgery

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Abstract: The transanal approach to rectal mobilization has gained considerable popularity and utilization continues to expand, fueled by the transanal total mesorectal excision for rectal cancer. The same principles and benefits of transanal pelvic dissection may apply to transanal proctectomy for benign indications such as in the setting of inflammatory bowel disease (IBD). Applications include restorative and non-restorative procedures for Crohn's disease (CD) and ulcerative colitis (UC). A transanal approach for restorative proctocolectomy with ileal pouch-anal anastomosis (IPAA) has particular advantages and its safety and feasibility has been demonstrated in small series. This paper examines the current literature exploring the use of transanal proctectomy using advanced transanal platforms for IBD.

Keywords: Inflammatory bowel disease (IBD); transanal total mesorectal excision (TaTME); transanal proctectomy; ulcerative colitis (UC)

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Introduction

Proctectomy for benign and malignant indications whether performed in an open or minimally invasive fashion represents a challenge with a steep learning curve for the surgeon. In the setting of rectal cancer, the popularization of total mesorectal excision (TME) has resulted in improved plane of dissection, nerve preservation, specimen quality and ultimately lower local recurrence rates. Unfortunately, in the presence of bulky tumors, a narrow male pelvis, or obesity, the procedure is more challenging with reported high morbidity rates and lower rates of clear surgical margins. The concept of an alternative, 'bottom–up' technique from the distal to the proximal mesorectal plane has evolved. Representing an evolution of direct target natural-orifice transluminal endoscopic surgery (1), initial cadaveric studies using transanal endoscopic microsurgery (2) led to the first human transanal TME (taTME) (3). TaTME enables direct visualization of the distal resection margin, may result in a more accurate distal complete excision of the mesorectum with wider resection margins, a lower rate of positive circumferential margins, and could increase the rate of sphincter-saving procedures (4). The availability of flexible, single use, transanal platforms under the umbrella term of transanal minimally invasive surgery further popularized this approach (5,6). After an initial phase of enthusiasm however, unique complications such as urethral injuries (7) and recent concern regarding oncologic outcome (8) has tempered dissemination of this technique.

Despite this, the principals and benefits of taTME also apply equally to transanal proctectomy for benign indications such as in the setting of inflammatory bowel disease (IBD). The uses for these conditions being in restorative and non-restorative procedures for Crohn's disease (CD) and ulcerative colitis (UC). A transanal approach for restorative proctocolectomy with ileal pouch-anal anastomosis (IPAA) has particular advantages and its safety and feasibility has been demonstrated in small series. This paper examines the current literature exploring the

use of transanal proctectomy using advanced transanal platforms for IBD.

Methods

A literature search of the PubMed and Embase databases was conducted using the search terms "transanal taTME", "transanal proctectomy" and "inflammatory bowel disease". Search results were screened to exclude duplicate and unrelated studies. Abstracts were reviewed to identify studies describing transanal approaches to the surgical management of IBD. Full text, English language articles were reviewed to identify the key roles for transanal surgery in IBD including completion proctectomy, restorative proctocolectomy, ileal pouch formation and revision surgery. Technical descriptions and clinical outcomes were extracted from relevant papers. A further database search was conducted using search terms related to identified key topics and a manual search of references lists from relevant articles was conducted.

The initial literature search yielded 657 articles. Following exclusion of unrelated, duplicate and non-English records 135 full text articles were reviewed to identify studies describing transanal proctectomy in IBD.

Results

Twenty studies were identified where a taTME approach was used in the surgical management of patients with IBD. Surgical technique, indications and patient characteristics are summarised in *Table 1*. Clinical outcomes related to the taTME approach in IBD surgery are summarised in *Table 2*.

Completion proctectomy

An initial role for taTME in IBD surgery included proctectomy for management of a residual rectal stump following subtotal colectomy in UC. Initial procedures utilising the approach were non-restorative. A video vignette published in 2013 by Atallah *et al.* illustrated the feasibility of the procedure (9). Further case reports and small case series from multiple centres demonstrated that taTME offered a minimally invasive option to avoid repeated abdominal surgery when managing a residual rectum (10-12). Authors described the use of a range of operating platforms and morbidity most frequently related to impaired healing of the perineal wound.

Restorative Proctocolectomy and IPAA

The application of taTME in IBD has further expanded to include restorative surgery for UC. Coffey *et al.* and Hanke *et al.* described case reports of proctectomy and IPAA performed successfully using the taTME approach (13,14). Further case series and a small number of cohort studies have followed as multiple centres gained experience in the use of taTME for IPAA (15-21). Four published case series described 100 patients who underwent transanal proctectomy in the course of multi-stage panproctocolectomy and IPAA formation for UC (17-19,21). A prospective cohort study described outcomes from 16 selected patients undergoing a planned three stage approach to restorative panproctocolectomy and IPAA formation (20). Increased numbers of cases of taTME in IBD have facilitated the publication of two large retrospective studies comparing outcomes between 197 cases of transanal proctectomy with IPAA and 393 cases of transabdominal proctectomy with IPAA formation in UC (15,16).

A high degree of patient selection is reflected in these studies with patients predominantly male, non-obese and aged with a median of 30-40 years. The GelPOINT® platform (Applied Medical, Rancho Santa Margarita, CA, USA) was widely used and AirSeal® insufflation (CONMED, Utica, NY, USA) utilised in preference to standard high flow gas insufflation. Authors reported initial use of handsewn techniques for anastomosis formation but as experience increased authors predominantly reported a double purse string single circular stapled technique.

Transabdominal assistance during transanal proctectomy and IPAA was most commonly provided laparoscopically with many reducing abdominal incisions by employing a single incision laparoscopic port at the planned or existing ileostomy site. Open incision was reported less frequently and Pfannenstiel incisions were used predominantly. Formation of the ileal pouch was most commonly performed through the abdominal ileostomy site and less frequently at the open Pfannenstiel incision. In order to facilite pouch delivery to the pelvis authors reported using a range of drains or catheters placed on the stapler anvil to guide the pouch from the abdominal to perineal surgeon. Diversion ileostomy was used routinely by some surgeons while others performed a variety of one, two or three stage procedures.

Anastomotic leak rates reported varied from 6.2% to 9.1%. Surgical morbidity largely related to postoperative ileus, wound complications and high output ileostomy.

Table 1 Study characteristics

Study	Country	Design	Sample	Surgery	Indication	Gender (n)	Age (years)	BMI (kg/m^2)	Platform	Surgery duration (min)
Atallah 2013	USA	Video case report	1	Proctectomy	UC	ns	ns	ns	ns	ns
Serra-Aracil 2019	Spain	Case reports	3	Proctectomy	UC 2; FAP 1	M 1; F 2	25; 52; 70	ns	Operating proctoscope	–
Liyanage 2013	UK	Case series	12	Proctectomy	IBD (UC or CD) 9 Neoplasia 2 Radiation proctitis 1	M 7; F 5	Mean 66±13	ns	WOLF Proctoscope	253
Al Furajii 2017	Ireland	Case series	10	Proctectomy	UC	M 5; F 5	Median 52.2 [40–62]	Median 28.5 [23–34]	GelPOINT® Path	Median 190 [140–250]
Coffey 2016	Ireland	Case report	1	Proctectomy and IPAA (Prior total colectomy)	UC	F	32	ns	GelPOINT® Path	ns
Hanke 2017	Germany	Case report	1	Proctectomy and IPAA (Initial subtotal colectomy)	UC and neoplasia of ascending colon	F	47	41.8	GelPOINT® Path	ns
Leo 2016	UK	Case series	16	Proctectomy and IPAA	UC	M 10; F 6	Median 46 [26–70]	Males: median 27; females: median 21	GelPOINT® Path	Median 247
de Buck van Overstraeten 2016	Belgium	Case series	11	Proctectomy and IPAA	UC	M 3; F 8	Median 34 [22–66]	nr	GelPOINT® Path	Median 160 [133–209]
Zaghiyan 2018	Multicentre	Case series	62	Proctectomy and IPAA	UC 60; IBDu 2	M 43; F 19	Median 38 [16–68]	Median 21.8 [14–27.8]	GelPOINT® Path	Median 266 [180–576]
Levic Souzani 2019	Denmark	Case series	11	Proctectomy and IPAA	UC	M 7; F 4	Median 30 [13–51]	nr	GelPOINT® Path	Median 285 [190–375]
Tasende 2015	Spain	Single cohort	16	Proctectomy and IPAA	UC	M 13 F 5	40.5±15.7	26.4±11.1	GelPOINT® Path	Median 170 [90–300]
de Buck van Overstraeten 2017	Multicentre	Cohort study	TA: 97; ABD: 119	Proctectomy and IPAA	UC; IBDu	TA: M 50, F 47; ABD: M 63, F 56	TA: median 35; ABD: median 39	TA: 23.4; ABD: 23.3	ns	TA: 211; ABD: 223
Chandrasinghe 2019	Multicentre	Cohort study	TA: 100; ABD: 274	Proctectomy and IPAA	UC	TA: M 55, F 45; ABD: M 152, F 122	TA: mean 38.7; ABD: mean 39.2	ns	GelPOINT® Path	ns
Otero-Piñeiro 2018	Spain	Case report	1	Revision of transanal proctectomy and IPAA	Dysplasia at IPAA	Female	31	ns	ns	120
Caycedo-Marulanda 2018	Canada	Case report	1	Revision of laparoscopic IPAA	Recurrent pelvic sepsis	Female	ns	ns	ns	ns

UC, ulcerative colitis; FAP, familial adenomatous polyposis; ns, not specified; IBDu, IBD unclassified; TA, transanal; ABD, transabdominal; CD, Crohn's disease; F, female; M, male; IPAA, ileal pouch anal anastomosis.

Table 2 Clinical outcomes in taTME

Study	Dissection	Anastomosis	Conversion	Early complications	Late complications	Leak	LOS (days)	Diverting ileostomy	Stoma closure (months)	Mortality
Serra-Aracil 2019	CRD	No	No	No	No	N/A	Median 6.6	Existing stoma in all	N/A	No
Liyanage 2013	CRD	No	33%	Delayed wound healing 4	Colocutaneous fistula 1	N/A	Mean 5.5	End colostomy or existing ileostomy in all.	N/A	No
Al Furajii 2017	TME	No	0 perineal conversion	Bleeding 1; perineal wound infection 1	Perineal wound sinus 1	N/A	Median 7 [4–11]	End colostomy or existing ileostomy in all	N/A	No
Coffey 2016	TME	Handsewn	No	Raised inflammatory markers with pneumoretroperitoneum on CT	No	No	8	Diverting ileostomy	nr	No
Hanke 2017	CRD	Handsewn	No	No	No	No	nr	No (risk of recurrent parastomal hernia)	N/A	No
Leo 2016	TME	Handsewn 2; Circular stapler 14	Perineal: 1 (6.2%); abdominal: 2 (12.5%)	Minor 5 (pneumonia, ileus)	Major 1 (leak)	1 (6.2%)	Median 6 [2–30]	16 (100%)	Median 6 [5–12]	
de Buck van Overstraeten 2016	CRD	Double purse string single stapled	No	Major 2 (Presacral haematoma drained)	No	No	6 [4–12]	No	N/A	No
Zaghiyan 2018	CRD 13; TME 49	Double purse string single stapled or Handsewn	nr	Minor 14 (Ileus, SSI); Major 4 (Leak)		5 (8%)	6 [2–24]	61 (98%)	TA: 43 (44%); ABD: 99 (45%)	No
Levic Souzani 2019	CRD	Double purse string single stapled	No	High output ileostomy 5; wound breakdown 1		1 (9.1%)	7 [5–37]	11 (100%)	5 (45%)	No
Tasende 2015	CRD	Double purse string single stapled 14; Handsewn 2	No	Minor 6 (pouch bleed, ileus, high stoma output)	Pouchitis 1 Anastomotic stenosis 2	No	7.25 ±3.87	16 (100%)	12 (75%)	No
de Buck van Overstraeten 2017	CRD or TME	TA: Handsewn or single stapled ABD: handsewn or double stapled	TA: 5 (5.2%) ABD: 28 (23.5%)	Comprehensive complication index; TA: mean 13.1; ABD: mean 18.25		16 (7.4%)	TA: mean 7.3; ABD: mean 9.1		ns	No
Chandrasinghe 2019	TA: CRD 56; TME 40	TA: Double purse string single stapled; ABD: double stapled	ns	TA: 33%; ABD: 41%		TA: 6%; ABD: 13%	ns	TA 46 (46%); ABD: 130(47%)	ns	No
Otero-Piñeiro 2018	Close dissection of pouch	Handsewn	No	No	No	No	3	No	N/A	No
Caycedo-Marulanda 2018	Close dissection of pouch	Handsewn	No	No	No	No	3	Diverting ileostomy	8 weeks	No

Minor complications, Clavien Dindo Grade 1–2; Major complications, Clavien Dindo Grade 3–5. TaTME, transanal total mesorectal excision; CRD, close rectal dissection; TME, total mesorectal excision; TA, transanal; ABD, transabdominal.

The median length of stay ranged from 6 to 7.3 days across reported series and cohorts. Prolonged length of stay predominantly related to anastomotic complications. Late complications were reported by Tasende *et al.* and included pouchitis and anastomotic stricture which were managed with antibiotics and dilatation respectively (20). Conversion from the taTME approach was reported in three studies (11,16,18). Conversion to laparotomy or laparoscopy was reported for management of small bowel adhesions during the transabdominal phase while loss of dissection plane prompted conversion of the perineal phase.

taTME versus transabdominal TME in IBD

Comparative study of transanal and transabdominal surgery for restorative proctectomy in UC was described in two large multicentre cohort studies (15,16). de Buck van Overstraeten *et al.* described 216 patients with UC or unspecified IBD with 97 (44.9%) undergoing transanal surgery (16). Similar proportions of male patients and similar body mass index (BMI) were reported in both treatment groups while the transanal group were slightly younger (transanal median 35 years versus transabdominal median 39 years). The mean duration of surgery which controlled for ileostomy formation was similar between the surgical approaches (211 minutes transanal versus 223 minutes transabdominal). The primary outcome reported was a comprehensive complication index (CCI) which was considered to reflect the probability of developing a complication and the complication severity. The mean CCI was lower in the transanal group. Anastomotic leak was observed in 16 patients (7.4%). Major complications were reported in 17.5% and 17.6% patients in the transanal and transabdominal groups respectively. Length of stay was shorter in the transanal group (7.3 *vs.* 9.1 days, P=0.001).

Chandrasinghe *et al.* analysed outcomes from 274 patients undergoing transabdominal surgery and 100 patients undergoing transanal surgery in variety of one, two or three stage procedures (15). Transabdominal surgery included both open and laparoscopic approaches to proctectomy and IPAA with study centres employing a double stapled technique. Lower rates of early complication and anastomotic leak were reported in the transanal group (complications: transanal 33% *vs.* transabdominal 41%; leak: transanal 6% *vs.* transabdominal 13%) although the difference was not statistically significant.

Revision IPAA

Further application of the taTME technique was described by authors using a transanal approach to perform revision IPAA surgery in UC. Caycedo-Marulanda *et al.* reported briefly upon a case of recurrent pelvic sepsis post IPAA managed surgically by incorporation of a transanal component to access a difficult pelvis (22). Authors described the use of a transanal minimally invasive surgery platform to deconstruct the pouch anal anastomosis and commence proximal dissection of the pouch from the pelvis. Completion of dissection was achieved by transabdominal laparoscopic assistance and the pouch delivered through a Pfannenstiel incision. A revised pouch was repositioned into the pelvis and a handsewn pouch anal anastomosis performed transanally. Otero-Piñeiro *et al.* reported a case of dysplastic polyp diagnosed at the anastomosis of an IPAA in a patient with UC (23). The authors reported performing transanal full thickness resection of the rectal remnant and careful mobilisation of the pouch with transabdominal assistance followed by transanal pouch anal handsewn anastomosis.

CD

The majority of literature related to taTME in IBD is focused upon the surgical management of UC. Proctectomy may occasionally be indicated in extensive perianal CD or rectal involvement with failed attempts at best medical management (24). Adoption of transanal principles for proctectomy in the surgical management of CD was outlined by Gardenbroek *et al.* (25). The authors reported their institutional experience with intersphincteric proctectomy with dissection in the "close" plane at the bowel wall to preserve the rectal mesentery. Authors advocated the preservation of mesentery and vacuum closure devices to reduce dead space and reduce the risk of poor wound healing or persistent presacral sinus. These findings are in contrast to recent data showing increased perineal complications in CD after close rectal dissection than after total mesorectal excision (59.5% *vs.* 17.6%) with lower healing rates (51.4% *vs.* 88.2%) (26).

Dissection plane

Increasing experience with the surgical approach has seen the technique for transanal proctectomy dissection modified from the standard TME approach employed for rectal

Table 3 Functional outcomes in taTME

Study	Surgery	Indication	Gender	Age (years)	Dissection	Anastomosis	Function	QOL	Urinary/sexual dysfunction
Tasende 2015	Proctectomy and IPAA	UC	Male 13; Female 5	Mean 40.5	CRD	Double purse string single stapled 14; Handsewn 2	3 months post op; Mean Wexner score: 1.4±2.9; Mean Oresland score: 4.7 ±3.7	ns	None reported
Leo 2016	Proctectomy	Low/mid rectal cancer	Male 12; Female 8	Mean 60 (32–80)	TME	ns	1 year follow up: major LARS: 10%; minor LARS: 40%; Mean Wexner score: 2.8	FIQOL Baseline mean: 4.1 FIQOL 1 year follow up: mean 3.9	ns
Chandrasinghe 2019	Proctectomy and IPAA in 1,2 or 3 stage procedure	UC	TA: M 55, F 45; ABD: M 152, F 122	TA: mean 38.7±12.7; ABD: mean 39.2±13.2	TA: CRD 56; TME 40	TA: double purse string single stapled; ABD: double stapled	Stool <10/24 h: TA 78%; ABD 79% Pouch failure: TA 1%; ABD 3%	1 year follow up: Mean CQCL; TA 0.75; ABD 0.71	1 year follow up: Mean IEFS: TA 19.69; ABD 20.84 Mean FSFI: TA 18.86; ABD 17.12

TaTME, transanal total mesorectal excision; UC, ulcerative colitis; CRD, close rectal dissection; TME, total mesorectal excision; TA, transanal; ABD, transabdominal; FIQoL, faecal incontinence quality of life; CGQL, Cleveland global quality of life; IEFS, international erectile function score; FSFI, female sexual function index.

cancer to the close rectal dissection plane (27). Close rectal dissection is expected to reduce the volume of deadspace remaining in the pelvis (28), providing a "cushion" to support the newly formed pouch and may reduce risk of injury to urological and nerve structures particularly during anterior dissection (29). A lower rate of severe complications is reported in taTME using the close rectal dissection rather than TME plane (29) and this approach is supported by the European Crohn's and Colitis Organization (ECCO) Evidence-Based Consensus on Surgery for UC (29,30).

Outcomes related to the dissection plane were reported by Chandrasinghe *et al.* (15). Similar quality of life and major incontinence rates were described while stool frequency > 10/24 hours occurred in 15% of TME patients versus 27% receiving close rectal dissection. Urological or sexual function was not compared between the dissection planes. Zaghiyan *et al.* reported a case series from three institutions where one centre employed close rectal dissection as a routine while the remaining sites adhered to the TME plane (21). No anastomotic complications were observed in the close rectal dissection group of patients or in those who received fluorescein angiography; although the difference in such complications was not statistically significant.

Functional outcomes

Functional outcomes following taTME are increasingly reported in the literature (*Table 3*). Tasende *et al.* provided a comprehensive report on their experience of transanal proctectomy as part of a three stage surgical management of UC (20). The authors collected data related to functional outcomes at an interval of three months following proctectomy in 12 patients. A mean defecatory frequency of 5.5 events in 24 hours was reported. A mean Oresland score of 4.7 and mean Wexner score of 1.4 was reported while patients denied urinary or sexual dysfunction.

Chandrasinghe *et al.* provided comparative data related to quality of life and functional outcomes following proctectomy and IPAA performed by transanal versus transabdominal approaches for UC (15). The primary outcome of the study was functional and quality of life metrics at one year postoperatively. Cleveland Global Quality of life score (CGQL), major incontinence, stool frequency, pouch failure, International Erectile Function Score (IEFS) and Female Sexual Function Index (FSFI) were compared at one year follow up. Similar CGQL scores, stool frequency, major incontinence, pouch failure

Table 4 Carbon dioxide embolism in taTME

Study	Design	Sample	Surgery	Indication	Device	Pneumorectum	Conversion	Completion
Ratcliffe 2017	Case report	1	TaTME	Rectal cancer	GelPOINT® Mini	AirSeal® (12mmHG)	No	Yes
Shiraishi 2018	Case report	2	TaTME	Rectal cancer	GelPOINT® Mini	AirSeal® (15 mmHg)	No	Yes
Harnsberger 2018	Case report	3	TaTME	Rectal cancer	ns	AirSeal®	Laparoscopy 1	Yes
Dickson 2019	Invited case report from database contributors	25	TaTME	Rectal cancer 20; UC 3; Revision AR 1; Revision TAMIS 1	GelPOINT® Path or Mini	AirSeal® 20; Hiflow gas 5 Median 15mmHg	Laparoscopy 13 Open 7; closure and reoperation 4	Same surgery 21; delayed 4

TaTME, transanal total mesorectal excision; UC, ulcerative colitis; AR, anterior resection; TAMIS, transanal minimally invasive surgery.

Table 5 Urological complications in taTME

Study	Design	Sample	Male	Surgery	Indication	Urethral injury
Rouanet 2013	Case series	30	30 (100%)	TaTME	Rectal cancer	2 (6.6%)
Burke 2016	Case series	50	30 (60%)	TaTME	Rectal cancer	1 (2%)
Penna 2017	Registry data	720	489 (67.9%)	TaTME	Rectal cancer 634; proctectomy and IPAA for UC 27	5 (0.7%)
Penna 2019	Registry data	1,594	1,080 (67.8%)	TaTME	Rectal cancer 1,540; proctectomy and IPAA for UC 43	12 (0.8%)
Sylla 2019	Invited case reports	39	38	TaTME	Rectal cancer 38; UC 1	39 (n/a)

TaTME, transanal total mesorectal excision; UC, ulcerative colitis; IPAA, ileal pouch anal anastomosis.

rates were reported for each approach. Similar IEFS and FSFI scores were reported.

Procedure specific complications

As the volume of taTME procedures performed internationally has increased, surgeons have noted the development of procedure specific complications including carbon dioxide embolism (*Table 4*) and urethral injury (*Table 5*). Due to limited reports in IBD surgery, interrogation of the taTME literature for both IBD and malignant indications is necessary to enhance our understanding. Carbon dioxide embolism is thought to be associated with transfer of pneumorectum carbon dioxide into the pelvic veins with subsequent desaturation, ventilatory and cardiovascular compromise (31). The occurrence of carbon dioxide embolism is frequently described to occur at the time of bleeding from periprostatic, paravaginal or pelvic venous plexuses during dissection. Patient positioning is hypothesised to contribute as prolonged Trendelenburg position creates low pressure within the elevated pelvic venous system permitting gas entry (32). Use of spinal anaesthesia may contribute to further reduction in venous pressure by vasodilation (33). Application of pressure to maintain a stable pneumorectum within the confined pelvic space is a further contributory factor, particularly as gas cannot decompress through the closed bowel lumen (34).

Ratcliffe *et al.* (33) and Shiraishi *et al.* (35) described cases of carbon dioxide embolism during taTME for a rectal cancer. Ratcliffe *et al.* reported that the GelPOINT Mini® and AirSeal® insufflation at maximum 12 mmHg were utilised. The event was diagnosed by sudden desaturation, reduced end tidal carbon dioxide and hypotension. Harnsberger *et al.* (36) report their experience of carbon dioxide embolism from a single institutions case series of taTME. Eight taTME performed with benign and malignant indications were reviewed from a four-year period and three cases (4%) of clinically significant intraoperative carbon dioxide embolism identified. Carbon dioxide embolism coincided with bleeding from periprostatic or paravaginal veins in all cases. The incidence of carbon dioxide embolism was examined by Dickson *et al.* (31) in a collection of case reports generated by contributors

to taTME registries. Seventeen centres from 10 countries reported experiencing carbon dioxide embolism intra-operatively. This represented an estimated incidence of 0.4% (25/6,375 cases from reporting centres). Three of the included patients underwent proctectomy for UC with two involving IPAA formation. In 24 of 25 cases the AirSeal® system was used while high pressure insufflation was used in the remaining case. Median transanal insufflation pressure was 15 mmHg (range 12–20 mmHg). The earliest clinical sign noted in most cases was a reduction in the end tidal CO_2. Echocardiography was performed in eight cases after carbon dioxide embolism and demonstrated gas bubbles within the heart chambers. Cardiovascular collapse necessitating CPR occurred in two patients while a third developed ventricular tachycardia and fibrillation. In 21 cases it was possible to continue the surgery after establishing cardiovascular stability, albeit converting to open surgery in seven and transabdominal laparoscopic surgery in 13. Visible bleeding was evident in 21 of 25 cases at the time of embolism with periprostatic venous bleeding reported most commonly.

Urethral injuries are rare complications but are reported increasingly in taTME cases (37). The incidence of urethral injury during taTME varied in prior series which predominantly included surgery for rectal cancer. Lacy *et al.* (38) reported no urethral injury in their series of 140 (63.6% males) patients. One urethral injury was noted by Burke *et al.* (39) in a series of 50 patients (60% males). Rouanet *et al.* (40) documented two urethral injuries in a series of 30 exclusively male patients. A large series from the International taTME Registry Collaborative (41) including a small number of taTME for UC documented a urethral injury rate of 0.7% in a series of 720 patients (67.9% males). A subsequent report from this collaborative (42) documented 12 urethral injuries (0.8%) during the transanal phase of 1594 taTME cases (67.8% male).

Sylla *et al.* (7) on behalf of the International taTME Urethral Injury Collaborative detailed the nature of 39 urethral injuries complicating taTME in a multicentre self reported study. Thirty-two centres in 20 countries self-reported urological injury occurring during taTME between April 2010 and September 2017 through an anonymous structured survey. Thirty-eight patients were male and the indication for surgery was rectal cancer in 38 cases versus one case of UC. Sixteen patients had a prior diagnosis of benign prostatic hyperplasia or had undergone urological surgery or prostatic radiotherapy. Thirty-six urethral injuries were recognised intraoperatively and were repaired transperineally in 26 with added insertion of a cystostomy in one case. Complications included four urethral strictures, one urethral dehiscence, three rectourethral fistulae and permanent catheterisation or cystostomy in five patients. Thirty-four patients had successful removal of catheters and 23 of this group reported normal urinary function at follow-up. One would hope due to the non-oncologic dissection of a proctectomy for IBD, the risk of urethral injury should be lower.

Conclusions

Review of the published literature demonstrates the safety and feasibility of taTME approaches for indications including completion proctectomy, restorative proctocolectomy and IPAA. Rare but important complications including urethral injury and carbon dioxide embolism require consideration when performing taTME surgery. Close rectal dissection may be advantageous in taTME for benign indications. Increased reporting of functional and patient reported outcomes is desirable to allow comprehensive assessment of the role of taTME in IBD surgery.

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Footnote

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