Is mesenteric defect closure needed in urologic surgery using ileum?

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Introduction: *Classic surgical teaching advocates for closure of the mesenteric defect (MD) after bowel anastomosis but the necessity is controversial. We sought to evaluate the necessity of MD closure at the time of harvest of ileum for genitourinary reconstructive surgery (GURS) by analyzing the incidence of early and late gastrointestinal adverse events (GIAE) in patients with and without MD closure.*

Materials and methods: *A retrospective review was conducted on patients undergoing urologic reconstruction with ileum to identify incidence of ileus, small bowel obstruction (SBO), gastrointestinal (GI) fistula and stoma complications. Patient and procedure variables were analyzed to identify risk factors for GIAE.*

Results: *A total of 288 patients met inclusion criteria and 93% of GURS was for urinary diversion following cystectomy. MD was closed in 194 cases (67%). Median follow up was 19 months. Early (< 30 day) GIAE rates were 16.5% (n = 32) and 21.3% (n = 20) in the closure and non-closure groups, respectively (p = 0.22). The rate of early ileus/SBO requiring nasogastric tube decompression or laparotomy were similar after closure (15.0%) and non-closure (21.3%) (p = .18). The late GIAE rates were 5.7% (n = 11) and 6.4% (n = 6) in the closure and non-closure cohorts, respectively (p = 0.56). The rate of late SBO were similar and no cases of early or late SBO in either cohort were due to internal herniation. On multivariate analysis, increasing BMI was associated with both early and late GIAE.*

Conclusions: *After harvesting ileum for urologic reconstruction, the MD can safely be left open as we found no association between non-closure and early or late GIAE.*

Key Words: mesenteric defect, urinary diversion, urinary tract reconstruction

Introduction

In urologic surgery, ileum can be utilized to reconstruct the urinary tract as a urinary diversion, bladder augmentation or ureteral substitution. When bowel is harvested, a defect is created from division of the corresponding mesentery. Conventional surgical teaching advocates for closure of the mesenteric defect following reestablishment of bowel continuity to prevent internal herniation and high grade bowel obstruction.[1] Internal herniation has an overall incidence of less than 1% but constitutes up to 6% of all small bowel obstructions.[2] Routine mesenteric defect closure (MDC), however, may result in complications including bowel or anastomotic ischemia due to

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inadvertent mesenteric vessel ligation, development of a mesenteric hematoma or kinking of the bowel anastomosis with obstruction.[3,4] MDC may also impair mobility of the harvested segment which creates limitations for use in reconstructive surgery. The bariatric and colorectal surgery literature is inconclusive regarding the necessity of MDC.[3,5-7] To date, no studies have reported the need for MDC after harvesting ileum for urologic reconstructive surgery. Due to the lack of proven benefit of MDC and the potential harms of this practice, we stopped routinely closing the mesenteric defect in 2012 when harvesting ileum for reconstructive surgery. The purpose of this study is to determine if mesenteric defect non-closure (MDNC) is associated with higher incidence of early and late gastrointestinal adverse events (GIAE) compared to MDC when harvesting ileum for urologic reconstructive surgery. Patient and procedure variables were also analyzed to identify risk factors for GIAE.

Materials and methods

After institutional review board approval, a single institution retrospective chart review was conducted on patients (aged 16 years or older) undergoing reconstructive urologic surgery with ileum from 2005-2012 by two fellowship trained reconstructive urologists. Patients with a history of prior bowel anastomosis, inflammatory bowel disease or concomitant non-urologic bowel surgery at the time of urologic reconstruction were excluded. Billing records were utilized to identify 288 patients who met these criteria. The data collected included patient age, sex, body mass index (BMI), Charlson Co-morbidity Index (CCI), prior intraperitoneal surgery, prior pelvic radiotherapy, indication for surgery, operation(s) performed, closure status of the mesenteric defect, estimated blood loss (EBL), length of hospitalization (LOH), occurrence of early and late GIAE and total follow up duration. GIAE were identified and categorized by review of clinical assessment, radiographic and intraoperative findings.

The primary endpoint of the study was determination of overall GIAE for MDC and MDNC cohorts for the early (30 day) and late postoperative periods. Secondary outcomes included patient and procedure variables associated with early and late GIAE. The subtypes of GIAE in the analysis included small bowel obstruction (SBO) or ileus severe enough to warrant nasogastric tube decompression or laparotomy, gastrointestinal fistula, enteroanastomotic complications and stoma necrosis or stenosis.

The reconstructive portion of each case was performed in an open fashion. Prior to ileal segment harvest the corresponding mesentery was transilluminated to identify adequate vascular arcades for both the bowel anastomosis and ileal segment. A LigaSure Impact vessel sealing device (Medtronic, Minneapolis, MN, USA) was then used to widely divide the mesentery (to its root) distally and for several centimeters at the proximal end of the segment to allow for both mobility of the harvested segment and a tension free bowel anastomosis. All bowel anastomoses were performed in the standard side-to-side, functional end-to-end fashion with gastrointestinal anastomotic (GIA) and throacoabdominal (TA) linear stapling devices (Ethicon, Somerville, NJ, USA).[1] Ileal conduits were constructed in a standard fashion with either Bricker or Wallace ureteroenteric anastomoses and ileal neobladders were constructed using the techniques described by Studer and Hautmann.[8,9] Routine postoperative management entailed 24 hours of perioperative antibiotics, advancing diet with return of bowel function and initiation of irrigation of continent urinary diversions or enterocystoplasties within 12 hours of surgery.

Patient-procedure baseline characteristics and outcomes were compared between MDC and MDNC cohorts using chi-square tests for categorical variables and Man Whitney U Test or t-tests for continuous variables. Outcomes of each group were evaluated for collective GIAE as well as for each individual complication separately. In cases of early and late SBO, operative dictations and imaging studies were reviewed to identify obstruction etiology to determine if internal herniation involving the mesenteric defect was causative. Multivariable logistic regression evaluating the effect of patient and procedure characteristics was used to model each binary outcome (early and late GIAE) separately. All analyses were performed in SAS 9.4 (SAS Institute, Cary, NC, USA) and $p < 0.05$ was considered statistically significant.

Results

During the study period, 288 patients underwent reconstructive surgery with ileum, including 94 with MDNC. Baseline patient demographics and indications for surgery are summarized in Table 1. BMI was significantly higher in the MDNC cohort but age, CCI, history of prior surgery, prior pelvic radiotherapy and indications for surgery were similar. Urinary diversion after cystectomy comprised 93% of cases with 76% of diversions being ileal conduits. There was a greater utilization of robotic assisted laparoscopy for the cystectomy portion of these procedures in the

TABLE 1. **Patient and procedure characteristics**

	Mesenteric defect closure (n = 194)	Mesenteric defect non-closure (n = 94)	p value
Mean age ± SD	64 ± 13	64 ± 14	0.238
Mean body mass index ± SD‡	28.9 ± 5.4	31.2 ± 6.1	0.002
Mean Charlson comorbidity index ± SD	4.8 ± 2.1	4.9 ± 1.9	0.758
Prior intraperitoneal surgery (%)	90 (46.4)	37 (39.4)	0.26
Prior pelvic radiotherapy (%)	26 (13.4)	7 (7.4)	0.137
Indication for surgery (%)			0.731
Bladder cancer	153 (78.8)	76 (80.9)	
Neurogenic bladder	18 (9.3)	10 (10.6)	
Radiation cystitis	5 (2.6)	2 (2.1)	
Ureteral stricture	1 (0.5)	1 (1.1)	
Other	17 (8.8)	5 (5.3)	
Surgery type (%)			
Radical cystectomy, ileal conduit	109 (56.2)	54 (57.4)	
Radical cystectomy, ileal neobladder	49 (25.3)	20 (21.3)	
Simple cystectomy, ileal conduit	22 (11.3)	14 (14.9)	
Enterocystoplasty	6 (3.1)	3 (3.2)	
Ileal conduit urinary diversion	6 (3.1)	0 (0)	
Ileal ureteral replacement	2 (1.0)	2 (2.1)	
Ileovesicostomy	0 (0)	1 (1.1)	
Robotic assisted cystectomy (%)‡	76 (39.2)	61 (64.9)	< .001
Continent urinary diversion (%)	49 (26.3)	21 (23.6)	0.624
Mean estimated blood loss mL	424	496	0.222
Median length of hospitalization in days	7	7	0.873
Median duration of follow up in months	20.9	16.8	0.200

‡statistically significant

TABLE 2. **Univariate analysis**

	Mesenteric defect closure (n = 194)	Mesenteric defect non-closure (n = 94)	p value
Early (%)			
Combined gastrointestinal adverse events	32 (16.5)	20 (21.3)	0.222
Small bowel obstruction or ileus	29 (15.0)	20 (21.3)	0.18
Gastrointestinal fistula	1 (0.5)	0 (0)	0.486
Enteroanastomotic leak	1 (0.5)	0 (0)	0.486
Stoma necrosis	1 (0.5)	0 (0)	0.486
Late (%)			
Combined gastrointestinal adverse events	11 (5.7)	6 (6.4)	0.559
Small bowel obstruction	10 (5.2)	3 (3.2)	0.719
Gastrointestinal fistula‡	0 (0)	3 (3.2)	0.013
Stomal stenosis	1 (0.5)	0 (0)	0.31

‡statistically significant

TABLE 3. **Case details for bowel obstruction**

Early small bowel obstruction requiring exploratory laparotomy		
	Intraoperative findings	n
Mesenteric defect closure (n = 2)	Small bowel adhesions	1
	Kinking of bowel anastomosis	1
Mesenteric defect non-closure (n = 2)	Small bowel adhesions	1
	Incarcerated hernia at lap port site	1
Late small bowel obstruction		
	Etiology	n
Mesenteric defect closure (n = 10)	Partial bowel obstruction managed conservatively	3
	Malignant bowel obstruction	3
	Bowel obstruction following subsequent surgery	2
	High grade obstruction, adhesions found during laparotomy	1
	High grade obstruction resulting in sepsis and death	1
Mesenteric defect non-closure (n = 3)	Incarceration in parastomal hernia	3

MDNC cohort but the proportion of continent urinary diversions, EBL, LOH and median follow up were similar in both groups.

The rates of early and late GIAE are reported in Table 2. There was no difference in the rate of early GIAE between the two cohorts. Specifically, there was no difference in the rate of early SBO or ileus requiring NG tube decompression or laparotomy. Similarly, the incidence of late GIAE was similar in both cohorts.

The etiologies of each case of early and late SBO are reported in Table 3. There were no cases of early or late SBO due to incarceration in the MD.

There was a higher incidence of late gastrointestinal fistula in the MDNC cohort (3.2% versus 0%, p = 0.013). Two of the three patients who developed late fistulae had precipitating factors. One patient developed an enterocutaneous fistula 4 months postoperatively after a prolonged hospitalization due to urinary ascites, pneumonia, sepsis and acute kidney injury. Another patient developed a small bowel to neobladder fistula following neobladder rupture approximately 1 year after cystectomy. The third patient developed a small bowel to neobladder fistula after cystectomy. The two cases of small bowel to neobladder fistulae were successfully managed with robotic assisted laparoscopic fistula repair. None of these cases was thought to be related to the lack of MDC.

Multivariate regression analysis identified increasing BMI as a risk factor for both early and late GIAE. MDC status, prior pelvic radiation therapy, prior intraperitoneal surgery and CCI were not associated with increased risk of early or late GIAE. When ileal conduit urinary diversions were compared to ileal neobladders, there was a higher risk of late GIAE with ileal conduit (OR 2.5, p = 0.02) but no difference for early GIAE (OR 1.51, p = 0.31).

Discussion

The need for MDC is inconclusive with the most robust data coming from the colorectal and bariatric surgery literature. Closure of all mesenteric defects during laparoscopic Roux-en-Y gastric bypass was noted to have the lowest risk of internal herniation in a meta-analysis of over 31,000 patients.[6] Conversely, a multi-institution randomized control trial combined with outcomes from a national surgical registry found no differences in severe complications within 30 days of surgery or re-operations for SBO after MDNC during laparoscopic gastric bypass surgery.[5] Furthermore, despite MDC significant potential for the defect to reopen has been reported in a series of gastric bypass undergoing reoperation for various reasons. Interestingly, reopening of the mesenteric window did not contribute to any cases of internal herniation.[10] MDNC is an accepted practice in the colorectal surgical literature, with the rate of internal herniation reported to be 0.3%-1% during laparoscopic colon resection.[3,7] Internal herniation is reported more commonly with left compared to right colon resection which has been attributed to the anchoring of the small bowel mesentery resulting in a natural tendency of the small bowel to lie on the left iliac fossa.[3,11] The segment of ileum utilized for urologic reconstructive surgery is generally harvested 15 cm-20 cm proximal to the ileocecal valve. Thus, the reported outcomes from MDNC during right

colectomy are potentially generalizable to urologic reconstruction with ileum.

The current study is the first evaluate MDNC after ileal harvest for urologic reconstructive surgery. It is well established that the reconstructive portion of these procedures contributes to infectious, urinary and gastrointestinal complications which are responsible for the majority of perioperative morbidity.[12,13] Gastrointestinal events account for 15% to 29% of early postoperative complications following ileal conduit, Studer and Hautmann ileal neobladders in recent series of radical cystectomy cases at high volume centers.[12,13] We sought to determine if MDNC impacts the incidence of GIAE and also to identify risk factors for GIAE. Our experience with MDNC suggests it has no impact on the occurrence of early or late GIAE. Specifically, we did not identify any cases (early or late) of internal herniation resulting in complications.

While there was no difference in overall GIAE between the MDC and MDNC cohorts in univariate analysis, there were differences in the incidence of individual types of complications that are worth noting. In the MDC cohort, we found more cases of fistula as well as bowel anastomosis and stomal complications in the early postoperative period. While these events may have been related to ischemia resulting from MDC, the low overall incidence of these complications did not demonstrate statistical significance. The rate of SBO or ileus requiring NG tube placement was similar in the two cohorts. Of the four cases of bowel obstruction that required laparotomy, the cause of obstruction was identified to be related to adhesions (n = 2), the bowel anastomosis (n = 1), and incarceration in a laparoscopic port site hernia (n = 1). Varkarakis et al reported similar findings during early re-operation for SBO in a series of radical cystectomy with the sources of obstruction being bowel adhesions and anastomotic malfunction.[14] One case of early SBO and one case of late SBO was related to internal hernia, but the authors did not comment on whether the hernia involved a MD.

The incidence of late GIAE in the two cohorts was similar but the types of complications differed between MDC and MDNC groups. Small bowel obstruction due to incarceration in a parastomal hernia occurred more frequently in the MDNC cohort. In the MDC cohort, malignant obstruction accounted for 33% of late SBO which is concordant with the 32%-38% reported in large radical cystectomy series.[14,15] We also found a statistically greater incidence of GI fistula in the MDNC cohort. However, these were not thought to be related to MDNC as one was due to neobladder rupture and another due to prolonged hospitalization with poor nutrition leading to impaired wound healing and breakdown of the bowel anastomosis. The remaining case of spontaneous fistula between the small bowel and neobladder had no identifiable predisposing factors.

Ileal conduit was associated with a greater risk of late GIAE when compared to ileal neobladder cases. The difference is likely related to the absence of stoma complications (e.g. stomal stenosis) and SBO due to incarceration in a parastomal hernia with continent orthotopic urinary diversions.

Our study is limited by its retrospective design and small sample size. Symptomatic internal herniation through a MD occurred in only 0.3% of patients from a series of 2909 laparoscopic low anterior resection cases. Thus, it is conceivable that this rare complication was not captured in our sample of patients. Furthermore, it is possible some patients did experience internal herniation without sequela and may have been missed with respect to the outcome of internal herniation. Longer follow up will be needed to determine if these results are durable. Lastly, even though all urinary diversions were performed in an open fashion, the greater use of robotic cystectomy for more recent study patients may have impacted short and long term GIAE rates.[16]

The decision to close the MD therefore remains the surgeon's choice. There is no data in urologic patients (apart from ours) and the general surgical literature is inconclusive. We did not find MDNC to be problematic in that there were no significant differences in early or late GIAEs compared to MDC. However, as noted, our sample size may be too small to identify differences (considering the incidence reported in the general surgical literature). We are reassured that at least so far, we have not found any significant problems by leaving the MD open. MDNC is one less step in an already complex surgery. Furthermore, we feel that given what seems to be a limited benefit of closure (the potential avoidance of internal herniation) at least based on the reported incidences (including ours) of adverse events, we don't believe the potential benefit outweighs the risks of mesenteric bleeding/hematoma/ischemia or a possible tethering effect on a urinary diversion that could occur with MDC.

Conclusion

Based on our experience, we do not believe routine mesenteric defect closure is necessary when harvesting ileum for urologic reconstructive surgery. We identified no cases of internal herniation and no difference in early or late gastrointestinal adverse event rates between MDC and MDNC cohorts. Increasing BMI, however, was associated with higher risk of early and late gastrointestinal adverse events. □

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