Original Article

Colorectal Injury during Pelvic Surgery: Is a Protective Diversion Stoma Necessary?

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Key Words
Colorectal injury;
Anastomotic leakage;
Primary repair;
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Purpose. This study assessed the surgical outcomes following intestinal restoration in patients who experienced iatrogenic colorectal injuries during gynecological surgery or genitourinary surgery, focusing on the efficacy of protective diversion stoma versus direct repair without stoma over the past decade.

Methods. We conducted a retrospective analysis of medical records from the Tri-Service General Hospital, Taipei, Taiwan. Among the 28,919 patients who underwent gynecological surgery or genitourinary surgery between April 2008 and September 2023, the review included 50 patients who underwent colon or rectal injury/resection. These patients were divided into two groups based on the surgical approach: 26 patients received a protective diversion stoma and 24 patients did not. We compared the incidence of post-operative complications, anastomotic leakage, and hospitalization duration between groups.

Results. The stoma group, which had a higher prevalence of malignant lesions (p = .035), had a longer operative time than the non-stoma group (318.1 mins vs. 219.8 mins; p = .008). Despite these differences, no significant variations were observed in the rate of complications (p = .146) or the length of hospital stay (p= .16). A history of surgery was significantly associated with major complications (p = .0451). Furthermore, surgeries requiring transfusions of four or more units of blood correlated with high leakage rates (p = .0362).

Conclusion. This study highlighted the importance of targeted risk management. Factors such as history of abdominal surgeries, significant blood loss ≥ 650 ml, and blood transfusions ≥ 4 units substantially elevate the risk of post-operative complications, particularly anastomotic leakage. These findings emphasize that careful surgical planning and post-operative care, especially in high blood loss or transfusion scenarios, protective stoma, and careful blood management are recommended to minimize leakage risks.

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Colorectal injury is recognized as one of the most dreaded complications of gynecologic/genitourinary surgery. While complete cytoreduction is an important factor in oncological outcomes, colorectal injuries/resection can at times be inevitable. If proper diagnosis and management after colorectal injury are delayed, enteric contents and intra-colonic bacteria spread into the abdominal cavity and result in perito-

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nitis, sepsis, or even death.[1,2]

Proper management of intra-operative colorectal injuries that occur during pelvic surgery is important to minimize patient morbidity. Different surgical options have been used to treat colorectal injury complications, including primary repair, resection with primary anastomosis, and Hartmann's procedure. Bowel repair and resection may be associated with complications, such as bowel leakage.

In recent decades, protective ileostomy or colostomy has been traditionally recommended as standard practice because of the possibility of bowel leakage. However, the benefits and necessity of stoma formation during pelvic surgery for colorectal injuries remain debatable. Colorectal surgeons are increasingly questioning the need for a protective stoma, with a shift towards using primary repair or resection with primary anastomosis during pelvic surgery.[3,4]

However, few comparative studies have been conducted on the efficacy of primary repair in the treatment of colorectal injuries during gynecologic surgery. This review aimed to assess the role and indications for primary repair of colorectal injuries during pelvic surgery.

Materials and Methods

Patient selection

A retrospective case review study of patients, the follow-up status of 28919 patients who underwent gynecological or genitourinary surgery of pelvic region in a single medical center (Tri-Service General Hospital, Taipei) was performed on 50 patients (0.17%) with iatrogenic colorectal injury perforation during gynecological or genitourinary surgery during the 15-year period from January 2008 to December 2023.

All surgeries were performed by gynecologic, genitourinary, and colorectal surgeons at our hospital. The patients were divided into two non-randomized groups: those who underwent surgery for colorectal resection with anastomosis or in whom colorectal injury was repaired primarily with interrupted absorbable sutures using a diversion stoma (DS group, n = 26), and those who underwent surgery without creating a stoma (NDS group, n = 24). Medical records were retrospectively reviewed and demographic data, operative procedures, operation times, postoperative complications, hospital courses, and morbidities were compared. The type of surgical approach and the procedure used were decided by a colorectal surgeon based on the intra-operative description of the colorectal injury situation and diagnosis and on the severity of intra-abdominal contamination.

Data were analyzed using descriptive statistics. All cases of colorectal injuries that occurred during gynecological/genitourinary surgery were included in this study. Patients with any of the following criteria were excluded: (1) other gastrointestinal injuries, such as those of the stomach or small intestine; (2) synchronous multiple colon cancer, colorectal cancer, or carcinomatosis; and (3) lack of an entire treatment course at our hospital. Fifty patients who experienced colorectal injuries during gynecological surgery were included in this retrospective analysis.

The database included (1) patient demographic information, including their age, hemoglobin level, history of previous surgery (abdominal surgery or pelvic surgery), body mass index (BMI), prepare of colon and American Society of Anesthesiologists (ASA) grade; (2) characteristics of the tumor, including the primary tumor location, and prognostic characteristics; and (3) Surgery and post-operative condition, including the surgery time, type of surgery approach (laparoscopy or laparotomy), use of emergent or elective surgery, blood loss, blood transfusion, colorectal injury site, post-op hemoglobumin and post-op hospitalization course.

Statistical analysis

IBM SPSS statistics software version 22 (IBM® SPSS® statistics 22) was used for data entry and statistical analysis. Each variable factor of the 5-year OS and DFS rates were estimated using the Kaplan–Meier method. The significance of the differences between the subgroups was calculated using the log-rank test. Variables that reached statistical significance ($p < 0.05$) were entered into multivariate analysis using the

Cox proportional hazard model. All statistical tests were two-tailed, and a p value < 0.05 was considered statistically significant.

Results

Clinical characteristics

Over 15 years period, 50 patients (0.17%) with a median age of 51.7 years (range, 20 years-83 years) experienced colorectal injuries during pelvic surgery. Of these, 24 patients underwent primary repair or resection with primary anastomosis using interrupted absorbable sutures without a protective diversion stoma, whereas 26 patients underwent colorectal repair or resection with a stoma, including Hartmann's procedure. Notably, 92% of all colorectal injuries occurred during gynecological surgeries and 6% occurred during genitourinary surgeries. Following the diagnosis of colorectal injury, a colorectal surgeon performed repair in all cases. Emergency surgeries were performed in two patients.

Furthermore, 48% of patients had a history of abdominal and pelvic surgeries. The rectum was the most frequent site of perforation in both treatment groups, occurring in 19 patients (70%) in the DS group and in 13 patients (54%) in the NDS group. A comparative analysis of the two treatment groups, one with a stoma (n = 26) and the other without (n = 24), revealed no significant differences in hemoglobin levels, age, site of injury, surgical approach, surgical status (emergency or elective), history of previous abdominal operations, colon preparation, body mass index (BMI), or American Society of Anesthesiologists (ASA) grade.

Operative results and post-operative outcome

The most common surgical approach for colorectal injury was primary repair, which was performed in 31 patients (62%). Of these patients, 10 underwent a protective ostomy procedure (either ileostomy or colostomy), whereas 21 underwent only primary repair. We compared the post-operative courses across groups and noted one case of post-operative death. Most patients were successfully followed-up and discharged without complications.

The total complication rates were 69% and 41% in the DS and NDS groups, respectively (p = 0.146). However, when focusing on major complications (Clavien-Dindo Scale ≥ 3), the incidence was 15% in the DS group versus 16% in the NDS group. The baseline post-operative hospital stay, total blood loss, and total blood transfusion were similar between the two groups (Table 1).

A significant difference was observed in the prevalence of benign and malignant lesions, with a higher proportion of malignant lesions in the DS group than in the NDS group (p =.035). Furthermore, there was a significant difference in surgery duration; the NDS group having a mean surgery time of 219.8 minutes (SD 94.2 minutes) and a median of 210.0 minutes (152.8-269.5 minutes), compared to the DS group's mean of 318.1 minutes (SD 148.3 minutes) and median of 289.0 minutes (235.3-373.0 minutes, p = .008). This variation in the surgical duration could be attributed to the inherent complexities in surgery for malignant lesions, which are typically more challenging and time-consuming. The necessity for longer operative times in these cases ensures thoroughness and precision, particularly when a protective stoma is part of the surgical plan.

Post-op complication rate and leakage rate

In our study, 7 out of 50 patients experienced major complications (Clavien Dindo Scale ≥ 4). The perioperative variables included in this study encompass post-surgery hospital stay, age, body mass index (BMI), ASA grade, injury site (rectum, sigmoid), history of previous surgery, colon preparation, emergent surgery, surgical approach (exploratory laparotomy, laparoscopy or robotic), surgery time (≥ 300 minutes, < 300 minutes), blood loss (≥ 650 ml, < 650 ml), blood transfusion (≥ 4 units, < 4 units), and benign/malignant status (Table 2).

Among these, the duration of hospital stay after surgery and a history of previous surgery were significantly associated with major complications (p < 0.05).

Table 1. Demographics of 50 patients underwent protective diversion stoma (PDS), or non-stoma (NS) following iatrogenic colorectal injury during gynecologic surgery

Variable	NS (n = 24)	PDS (n = 26)	*p* value
Hospital course after surgery, mean (SD), medium (Q1-Q3)	10.5 (7.0), 7.5 (6.0-15.8)	14.4 (11.8), 10.0 (8.0-18.3)	0.160
Complication rate	19 (41.7)	18 (69.2)	0.146
Clavien Dindo Scale of complication			0.287
1	14 (58.3)	8 (30.8)	
2	1 (4.2)	3 (11.5)	
3	6 (25.0)	11 (42.3)	
4	3 (12.5)	3 (11.5)	
5	0 (0)	1 (3.8)	
Age, mean (SD)	51.7 (15.0)	58.8 (14.6)	0.094
Conversion	0(0)	2 (7.7)	0.491
Injury site			0.423
Rectum	14 (58.3)	19 (73.1)	
Sigmoid	10 (41.7)	7 (26.9)	
Surgical approach			0.087
Exp. Lap	13 (54.2)	21 (80.8)	
Laparoscopy or robotic	11 (45.8)	5 (19.2)	
Emergent surgery	1 (4.2)	1 (3.8)	1.000
Surgery time, mean(SD), medium (Q1-Q3)	219.8 (94.2), 210.0 (152.8-269.5)	318.1 (148.3), 289.0 (235.3-373.0)	0.008
Post-op HgB, mean (SD), medium (Q1-Q3)	10.7 (1.9), 10.7 (8.9-12.5)	9.9 (2.0), 9.6 (8.3-10.9)	0.147
Blood loss, mean (SD), medium (Q1-Q3)	488.3 (412.3), 425.0 (162.5-637.5)	982.7 (1489.2), 650.0 (275.0-1050.0)	0.123
Blood transfusion, mean (SD), medium (Q1-Q3)	2.1 (2.9), 2.0 (0-2.0)	2.9 (4.8), 2 (0-2.5)	0.461
Previous Hx of abdominal OP	10 (41.7)	14 (53.8)	0.563
Prepare colon	7 (29.2)	7 (26.9)	1.000
BMI, mean (SD)	22.8 (3.1)	24.0 (4.4)	0.258
ASA grade			0.569
1	15 (62.5)	13 (50.0)	
2	9 (37.5)	12 (46.2)	
3	0 (0)	1 (3.8)	
Benign/malignent			0.035
Benign	10 (41.7)	3 (11.5)	
Malignent	14 (58.3)	23 (88.5)	

M ± SD: Mean ± standard deviation, BMI = Weight [Kg] / Height^2 [m^2].

A long post-operative hospital stay (p = .000029) indicates slow recovery and presence of severe complications, with a significant statistical link to major complications, highlighting the necessity for early detection and management of potential issues to enhance patient recovery and outcomes.

Similarly, a history of previous surgeries (p = .0451) shows a significant correlation with major complications, suggesting that past surgical interventions could adversely affect the current health status of patients through scarring or anatomical changes, thereby increasing the difficulty of subsequent surgeries and the risk of complications.

In the NDS group, 2 of the 24 patients experienced post-operative anastomotic leakage, necessitating reoperation with exploratory laparotomy and stoma creation. We analyzed variables including post-operative hospital stay, age, BMI, ASA grade, injury site (rectum or sigmoid), history of previous surgery, colon preparation, emergent surgery, surgical approach (exploratory laparotomy, laparoscopy, or robotic), surgery time (minutes), blood loss (mL), blood transfusion (units), and benign or malignant status (Table 3).

Table 2. Operative results and post-operative outcome following iatrogenic colorectal injury during plevic surgery

Variable	Major complication (n = 7)	No complication or minor complication (n = 43)	*p* value
Hospital course (after surgery)	28.8	9.9	0.000029
Age	64.1	53.7	0.2613
BMI	22.33	23.6	0.3976
ASA grade	1.44	1.57	0.5036
Protective stoma	4	22	0.936
Injury site			0.6768
Rectum	4	29	
Sigmoid	3	14	
Previous surgery history	6	18	0.0451
Prepare colon	4	10	0.0853
Emergent surgery	0	2	0
Surgical approach			0.4149
Exp. Lap	4	31	
Laparoscopy or robotic	3	12	
Surgery time (minute)	336.4	260.2	0.2738
≥ 300	4	13	0.2098
< 300	3	30	
Blood loss	1635.7	600.4	0.2431
≥ 650	5	14	0.0894
< 650	2	29	
Blood transfusion (unit)	5.14	2.09	0.3515
≥ 4	3	8	0.1697
< 4	4	35	
Benign/malignent			0.6596
Benign	1	12	
Malignent	6	31	

Clavien Dindo Scale ≤ 3, Clavien Dindo Scale ≥ 4.

Table 3. Post-operative anastomotic leakage in NS group

Variable	No stoma, anastomosis leak (n = 2)	No stoma (n = 22)	*p* value
Hospital course (after surgery)	19.5	9.6	0.771
Age	44	52.41	0.4423
BMI	22.1	22.85	0.7441
ASA grade	1	1.41	0.2901
Injury site			0.163
Rectum	0	14	
Sigmoid	2	8	
Previous surgery history	2	8	0.163
Prepare colon	1	6	0.507
Emergent surgery	0	1	1.0
Surgical approach			0.163
Exp. Lap	0	14	
Laparoscopy or robotic	2	8	
Surgery time (minute)	238	218.18	0.7719
= 300	1	3	0.3116
<300	1	19	
Blood loss	950	446.36	0.0669
≥ 650	2	4	0.0543
< 650	0	18	
Blood transfusion (unit)	4	1.91	0.0503
≥ 4	2	3	0.0362
< 4	0	19	
Benign/malignent			1.0
Benign	1	9	
Malignent	1	13	

Among these variables, only blood transfusion showed a marginally significant correlation with leakage, with a *p*-value of 0.0503, which was very close to the statistical significance threshold of 0.05. Although this result does not strictly surpass the conventional threshold for statistical significance, its proximity suggests a potential association between blood transfusions and the risk of post-operative leakage.

Quantity of blood transfusions and rate of anastomotic leak

Further subgroup analysis of the relationship between the amount of intra-operative blood loss and the quantity of intra-operative blood transfusion with leakage was performed. In group of blood loss ≥ 650 mL, the *p* value of .0543 suggests that the correlation between blood loss exceeding 650 mL and leakage is very close to reaching statistical significance ($p < .05$). In the group receiving blood transfusions ≥ 4 units, the *p* value was .0362, the only variable to reach statistical significance. These results imply that patients with a high volume of blood loss or who receive a high quantity of blood transfusion during surgery have a high risk of leakage.

Discussion

Iatrogenic colorectal injury is a rare but serious complication that occurs during pelvic surgery. Gynecologists and urologists should acquire basic knowledge regarding the prevention and management of intestinal injuries. Adherence to standard surgical techniques during gynecological/genitourinary operations and the anticipation of bowel injury in high-risk patients will minimize the occurrence of such injuries.

Some risk factors for colorectal injury have been identified, including surgeon experience, meticulous dissection, and adequate familiarity with the physical properties of various instruments and cutting modalities.[5] Forty-eight percent of patients had a history of pelvic or abdominal surgery.[6] Patients with a history of abdominal surgery scars are at a high risk of intestinal injuries,[7] and treatment of such patients demand vigilance & skills. The above-mentioned risks may be due to intestinal adhesions that occur after pelvic or abdominal surgery.[8] However, all obstetric and gynecological specialists must be trained in the prevention and management of these injuries.[6] Approximately one-third of bowel injuries may be recognized at the time of the initial surgery.[9,10] Fifty-two percent of patients had a history of pelvic or abdominal surgery.[6]

In this study, we explored the impact of various factors on the occurrence of post-surgical complications, with particular focus on leakage in patients undergoing significant surgeries. Our findings elucidate the intricate relationships between surgical history, blood loss, blood transfusions, and the risk of developing major post-operative complications.

The presence of a history of previous surgeries demonstrated a significant correlation with major complications, as indicated by a *p* value of .0451. This correlation may reflect the cumulative impact of past surgeries on a patient's current health status, potentially through scarring or anatomical changes, which can complicate subsequent surgeries and increase the risk of post-surgical complications.

Our analysis revealed that blood loss exceeding 650 mL closely approached statistical significance with leakage, as suggested by the *p* value of .0543. Although this does not confirm a statistically significant correlation, it unveils a possible trend towards increased leakage risk with substantial blood loss, meriting further investigation in future research endeavors.

The number of blood transfusion units showed a marginally significant correlation with the incidence of leakage, as underscored by a *p* value of .0503. This finding suggests a potential association between the extent of blood transfusion and leakage risk, and that the volume of blood transfused during surgery might play a role in the development of post-surgical leakage.[11,12]

Notably, receiving more than 4 units of blood transfusion was the only variable that demonstrated a statistically significant correlation with leakage, as evidenced by a *p* value of .0362. This pivotal result underscores the increased risk of leakage among patients subjected to high volumes of blood transfusion during surgical procedures.

In summary, our study highlights the importance of considering a patient's surgical history and extent of intra-operative blood loss and transfusion when assessing the risk of post-surgical complications such as leakage. The significant correlation between receiving substantial blood transfusions and increased leakage risk warrants particular attention, suggesting the need for cautious blood management strategies during surgery. These insights pave the way for more nuanced approaches to patient care that aim to mitigate the risk of complications and improve surgical outcomes.

A protective stoma is primarily used to reduce the risk of anastomotic leaks by temporarily diverting fecal flow away from the surgical site, thereby allowing the anastomosis a better chance to heal. Although this approach can mitigate the risk of leaks to some extent, it may introduce additional complications and affect the patient's quality of life. Therefore, the decision to perform a protective stoma should be individualized, requiring the surgeon to perform a comprehensive assessment based on the patient's specific situation and surgical details.

Conclusions

In conclusion, our investigation of iatrogenic colorectal injuries during pelvic surgery underscores the importance of focused prevention and risk management strategies. These strategies should particularly address the history of past surgeries, significant blood loss, and the role of transfusions in elevating the risk of post-operative complications such as leakage. A critical observation from our study is that receiving more than four units of blood transfusion significantly increases the risk of leakage in patients without a stoma. Based on these findings, meticulous surgical planning and post-operative care, especially in high blood loss or transfusion scenarios, protective stomas, and careful blood management are recommended to lower leakage risks.

Limitations

The present study has some limitations. First, it was conducted at a single center, had a retrospective design, and lacked randomization. The decision to perform protective ostomy was based on the clinical judgment of the attending physicians. Additional randomized studies are necessary to clarify the role of risk management in colorectal injuries that occur during pelvic surgery.

Author Contribution

Chao-Yang Chen, Shu-Wen Jao, Pi-Kai Chang, Chia-Cheng Wen, Yi-Chiao Cheng, Je-Ming Hu, Po-Hsien Wu provided and cared for study patients.

Ethics Approval

This retrospective study was approved by the Institutional Review Board (IRB) of Tri-Service General Hospital (Taiwan).

Consent to Participate

All patient-related info was de-identified so patient consent was waived.

Disclaimers

The authors declare no conflict of interests.

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原　著

盆腔手術中結直腸損傷：是否需要保護性分流造口？

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目的　本研究評估了在婦科手術或泌尿生殖手術期間經歷醫源性結直腸損傷的患者腸道修復後的手術結果，重點關注過去十年中保護性改道造口與無造口直接修復的療效。

方法　我們對台灣台北三軍總醫院的病歷進行回溯性分析。在 2008 年 4 月至 2023 年 9 月期間接受婦科手術或泌尿生殖手術的 28,919 名患者中，此評估包括 50 名接受結腸或直腸損傷/切除的患者。根據手術方法將這些患者分為兩組：26 名患者接受了保護性改道造口，24 名患者沒有接受。我們比較了各組之間術後併發症、吻合口瘺管和住院時間的發生率。

結果　造口組的惡性病變發生率較高 (p = .035)，其手術時間比非造口組更長 (318.1 分鐘 vs. 219.8 分鐘；p = .008)。儘管存在這些差異，但在併發症發生率 (p = .146) 或住院時間 (p = .16) 方面沒有觀察到顯著差異。手術史與主要併發症顯著相關 (p = .0451)。此外，需要輸註四個或更多單位血液的手術與高滲漏率相關 (p = .0362)。

結論　這項研究強調了有針對性的風險管理的重要性。腹部手術史、大量失血量 ≥ 650 ml、輸血量 ≥ 4 單位等因素大大增加了術後併發症的風險，特別是吻合口瘺管。這些發現強調，建議仔細的手術計劃和術後護理，特別是在高失血或輸血情況下，保護性造口和仔細的血液管理，以盡量減少滲漏風險。

關鍵詞　結直腸損傷、吻合洩漏、原位修復、保護性造口。