CASE REPORT

Firearm injury and the Deloyers procedure: case report and literature review

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ABSTRACT

Following extended colon resections, it may not always be possible to perform colorectal anastomosis. The Deloyers procedure, which involves the transposition of the right colon, has been identified as a viable solution. This report aims to discuss the circumstances under which the Deloyers procedure was performed, as well as to evaluate the early and late postoperative outcomes, by reviewing cases conducted between 2010 and 2023. In a 22-year-old female patient who suffered major organ and tissue loss (with injuries to the sigmoid colon, descending colon, transverse colon, and mesentery) due to a firearm injury, the Deloyers procedure was applied during restorative surgery following initial damage control surgery. The procedure involved mobilizing the cecum and right colon, performing a cranio-caudal rotation over the ileocolic artery pedicle, followed by an appendectomy, and creating a colorectal anastomosis using circular staplers. There were no complications during the postoperative follow-ups. By the 14th postoperative day, the patient was discharged and experienced bowel movements four times a day, managed with 2.5 mg of diphenoxylate hydrochloride and 0.025 mg of atropine sulfate. At the 6-month follow-up, the frequency of bowel movements had decreased to twice daily without the need for medical treatment. Given the functional outcomes in patients after extended left colectomies, the Deloyers procedure, with its low associated morbidity, stands out as a viable option.

Keywords: Deloyers procedure; firearm injury; right colon transposition; right colon to rectal anastomosis.

INTRODUCTION

In cases involving pathologies of left-sided colon localizations (including the splenic flexure, descending colon, and sigmoid colon) that require extended resections, it may become technically unfeasible to perform colocolonic or colorectal anastomoses. In such instances, the Deloyers procedure has been identified as a viable alternative to ileorectal anastomosis.[1] This technique involves transposing the right colon to the origin of the ileocolic artery, enabling the safe achievement of tension-free colonic anastomosis. In addition to enhancing the quality of life of patients by ensuring colonic continuity and preserving the integrity of the ileocecal valve, this procedure also positively impacts their metabolic and immune systems.[2,3]

This study aims to evaluate the Deloyers procedure as performed during the restoration of a patient who underwent extensive colon resection and Hartmann's procedure due to firearm trauma, in conjunction with existing literature on the subject.

CASE REPORT

We report on the Deloyers procedure performed in the restorative surgery of a 22-year-old female patient with extensive tissue and organ loss due to a firearm injury, following damage control surgery. During damage control surgery for the patient in hypovolemic shock (arterial blood pressure 70/40 mmHg, pulse rate 138, hemoglobin (Hgb): 5.8 g/dL), extensive injuries to the transverse colon, descending colon, sigmoid colon, and colon mesentery necessitated an extend-

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Table 1. Results of studies on the Deloyers procedure conducted between 2010 and 2023, as identified through a literature review

Trial	Gender	Age, years	BMI, kg/m²	Etiology	Postoperative Complication	Bowel Movements
Dux et al. 2021[8]	3 patients (2 male)	71 (67-76)	24 (23-29)	Diverticulitis, Synchronous, Hartmann reversal	Superficial SSI: 1 (33.3%)	5 per day
Choi et al. 2020[5]	6 patients (3 male)	74 (67-83)	23.5 (21.9-28.9)	Sigmoid colon cancer with left colon ischemic colitis: 2 (33.3%) Left colon necrotizing ischemic colitis: 3 (50%) Rectosigmoid cancer: 1 (16.7%)	Paralytic ileus: 2 (33.3%) Acute urinary retention: 1 (16.7%)	2-3 per day
Lin 2021[10]	1 patient (male)	70	N/A	Synchronous malignancy	None	N/A
Sciuto et al. 2016[4]	10 patients (8 male)	59 (36-71)	24.3 (17.5-28.2)	Synchronous malignancy: 5 (50%) Diverticular disease: 1 (10%) Anastomotic stricture after previous surgery: 2 (20%) Intraoperative left colon ischemia after IMA ligation: 2 (20%)	None	2-3 per day
Law et al. 2019[15]	1 patient (male)	27	N/A	Hirschsprung's disease	Rectal prolapse (long term)	N/A
Okamoto et al. 2020[9]	1 patient (male)	50	35.7	Synchronous malignancy	None	N/A
Antona et al. 2016[11]	1 patient (male)	36	N/A	Intraoperative left colon ischemia after IMA ligation	None	2 per day
Otani et al. 2017[12]	1 patient (male)	74	N/A	Synchronous malignancy	None	2 per day
Di Saverio et al. 2021[13]	1 patient (female)	67	21.2	Extended left colectomy	None	N/A
Chen et al. 2020[14]	4 patients (2 male)	60 (43-80)	N/A	Recurrent colon cancer: 1 (25%) Extended left colectomy: 1 (25%) Previous rectal surgery: 1 (25%) Intraoperative left colon ischemia after IMA ligation: 1 (25%)	Intraabdominal abscess Intraoperative presacral bleeding	N/A
Grasso et al. 2018[2]	1 patient (male)	63	N/A	Malignancy	N/A	N/A
Manceau et al. 2012[6]	48 patients (38 male)	67 (38-83.5)	24 (17.5-42)	Hartmann reversal: 17 (35%) Failed previous colorectal anastomosis: 11 (23%) Diverticular disease: 6 (12%) Left colon cancer: 6 (12%) Ischemic colitis: 3 (6%) Iterative colectomy for cancer: 3 (6%) Local rectal cancer recurrence: 1 (2%) Synchronous malignancy: 1 (2%)	Postoperative mortality: 1 (2%) Severe complications (Dindo 3): 3 (6%) Intra-abdominal hemorrhage: 2 (4%) Wound infection: 2 (4%) Persistent ileus: 3 (6%) Pneumonia: 2 (4%) Acute renal failure: 1 (2%) Acute urinary retention: 1 (2%)	3 (1-7) per day
Kontovounisios et al. 2014[7]	14 patients (9 male)	58.7 (45-75)	28 (22-34)	Diverticular disease: 7 (50%) Previous anterior resection: 3 (21.4%) Synchronous malignancy 3 (21.4%) Intraoperative left colon ischemia after IMA ligation 1 (7.14%)	Mild complications (Dindo 1-2): 3 (21.4%) Severe complications (Dindo 3-4): 0	2 (1-3)

BMI: Body mass index; IMA: Inferior mesenteric artery.

ed colon resection and Hartmann's procedure. After the patient's physiological status stabilized, the Deloyers procedure was planned for colostomy closure in the restorative surgery. The mobilized portion, including the cecum and ascending colon, was rotated 180° craniocaudally around the axis of the ileocolic pedicle. An appendectomy was performed due to the altered position of the appendix. Colorectal anastomosis was achieved using circular staplers between the transected ascending colon and rectum. Oral intake was initiated on postoperative day 1. The patient, who tolerated oral intake but experienced up to six bowel movements per day, was closely monitored for vital signs. In the absence of postoperative complications, treatment with 2.5 mg of diphenoxylate hydrochloride and 0.025 mg of atropine sulfate was initiated. By the 14th postoperative day, bowel movements had decreased to four times a day, and the patient was discharged. At the 6-month follow-up, the patient had bowel movements twice a day without the need for medical treatment. Additionally, no strictures were detected in the anastomosis during colonoscopy.

DISCUSSION

In extended left-sided colon resections, ischemia in the left colon can occur due to inadequate collateral circulation, a result of the high ligation of the inferior mesenteric artery, even in cases without pathology other than for mandatory reasons such as synchronous malignancies.[4-14] This ischemia necessitates extended resections. Firearm trauma can also lead to extensive tissue and organ loss, making the preservation of remaining tissues and organs crucial for patient quality of life. The Deloyers procedure contributes to preserving the ileocecal valve and the remaining colonic segment. Although there were no prior instances in the literature of this procedure being performed on patients with such trauma, we demonstrated its applicability in our patient without any morbidity.

Preserving the right colon, ileocecal valve, and terminal ileum has been shown to maintain regular stool consistency and restore normal transit times, unlike in cases of total colectomy. In one of the most extensive case series reported in the literature, Manceau et al. documented a median daily bowel movement count of 3 (1-7), whereas Kontovounisios et al. reported a median of 2 (ranging from 1 to 3).[6,7] A study comparing ileorectal anastomosis with the Deloyers procedure after extended resections favored the latter in terms of bowel movement frequency (p=0.01).[3]

Developed as an alternative to ileorectal anastomosis, the Deloyers procedure has shown satisfying results concerning anastomotic leakage. Moreover, mild complications such as paralytic ileus, urinary retention, and surgical site infection (Clavien-Dindo grade 1-2) were observed in the early postoperative period (Table 1).[5-8] Regarding long-term complications, rectal prolapse was noted during the follow-up of a patient operated on for Hirschsprung's disease.[15] The morbidities associated with the procedure can be considered minor in light of the functional benefits it offers to patients.

During the Deloyers procedure, ligating the right colic and middle colic arteries is crucial, with the primary goal of preserving the ileocecal valve. Therefore, it is important to monitor the ischemic colon segment following the ligation of these arteries closely. Indocyanine green can be utilized for testing if necessary.[9] In our case, colonic vascular perfusion was assessed through inspection, confirming the presence of a pulsatile flow.

In the procedure, although a routine diversion ileostomy could not be included, Chen and colleagues have previously established diversion ileostomies for patients who had undergone rectal surgery, as well as for those requiring resection of the rectum.[14] We recommend against creating a diversion ileostomy in patients where dissection and resection are performed above the peritoneal reflection.

CONCLUSION

While randomized prospective studies may be limited, the Deloyers procedure can be safely applied with a lower incidence of morbidity. Moreover, by preserving functional intestinal integrity and reducing the frequency of bowel movements, it significantly enhances the patient's quality of life.

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OLGU SUNUMU - *ÖZ*

Ateşli silah yaralanması ve Deloyers prosedürü: vaka raporu ve literatür derlemesi

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Geniş kolon rezeksiyonları sonrasında kolorektal anastomoz yapmak mümkün olmayabilir. Bu nedenle, sağ kolon transpozisyonu ile yapılan Deloyers prosedürü tanımlanmıştır. 2010-2023 yılları arasında yapılan Deloyers prosedürlerini inceleyerek, prosedürün hangi durumlarda uygulandığını ve erken ile geç dönem sonuçlarını tartışmayı amaçladık. Ateşli silah yaralanması sonucu sigmoid kolon, inen kolon, transvers kolon ve mezenterde büyük organ ve doku kaybı yaşayan 22 yaşındaki bir kadın hastada, hasar kontrol cerrahisini takiben restoratif cerrahide Deloyers prosedürü uygulandı. Çekum ve sağ kolonun mobilizasyonu sonrasında, ileokolik arter pedikülü üzerinde kraniokaudal yönde rotasyon yapıldı, ardından appendektomi gerçekleştirildi. Kolorektal anastomoz ise sirküler stapler ile oluşturuldu. Postoperatif takiplerde herhangi bir komplikasyon gelişmedi. Postoperatif 14. günde hasta taburcu edilen hastanın barsak hareketleri 2.5 mg difenoksilat hidroklorür ve 0.025 mg atropin sülfat tedavisi ile günde 4 kezdi. 6 aylık izlemde, medikal tedaviye ihtiyaç duymaksızın barsak hareketleri günde 2'ye düştü. Geniş sol kolektomileri takiben hastaların fonksiyonel sonuçlarını düşünerek, düşük morbiditesi olan Deloyers prosedürü güvenle uygulanabilir.

Anahtar sözcükler: Ateşli silah yaralanması; deloyers prosedürü; sağ kolon transpozisyonu; sağ kolon-rektal anastomoz.

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