CASE REPORT

pISSN 2234-778X • eISSN 2234-5248
J Minim Invasive Surg 2022;25(4):152-157

JMIS Journal of Minimally Invasive Surgery

Robotic-assisted resection of proximal jejunal ischemic stricture and intracorporeal robot-sewn anastomosis

Vishu Jain, Peeyush Varshney, Subhash Chandra Soni, Vaibhav Kumar Varshney, B Selvakumar

Department of Surgical Gastroenterology, All India Institute of Medical Sciences, Jodhpur, India

With the advent of robotic surgery as an effective means of minimally invasive surgery in the last decade, more and more surgeries are being performed robotically in today's world. Robotic surgery has several advantages over conventional laparoscopic surgery, such as three-dimensional vision with depth perception, magnified view, tremor filtration, and, more importantly, degrees of freedom of the articulating instruments. While the literature is abundant on robotic cholecystectomy and highly complex hepatobiliary surgeries, there is hardly any literature on robotic small bowel resection with intracorporeal anastomosis. We present a case of a 50-year-old male patient with a symptomatic proximal jejunal ischemic stricture who underwent robotic-assisted resection and robot-sewn intracorporeal anastomosis in two layers. He did well in the postoperative period and was discharged on postoperative day 4 with uneventful recovery. We hereby discuss the advantages and disadvantages of robotic surgery in such a scenario with a review of the literature.

Keywords: Robotic surgical procedures, Surgical anastomosis, Minimally invasive surgical procedures, Jejunal diseases

Received September 9, 2022
Revised 1st October 25, 2022
2nd November 27, 2022
3rd December 4, 2022
Accepted December 9, 2022

Corresponding author
Peeyush Varshney
Department of Surgical Gastroenterology, All India Institute of Medical Sciences, Marudhar HI Industrial Area, 2nd Phase, Basni, Jodhpur, Rajasthan 342005, India
Tel: +91-9929069007
Fax: +91-291-2831001
E-mail: varshneyp@aiimsjodhpur.edu.in
ORCID:
https://orcid.org/0000-0001-6276-1890

INTRODUCTION

Ischemic stricture is a known complication of chronic mesenteric ischemia, often requiring surgical resection in symptomatic cases. Minimally invasive surgery, either laparoscopic or robotic, has several advantages regarding short-term outcomes such as decreased postoperative pain, smaller scar size, early discharge, and return to work [1]. Although a laparoscopic or laparoscopic-assisted approach is routinely utilized for small bowel resection, there is limited data on robotic resection owing to cost constraints [2].

We present a case of symptomatic proximal jejunal ischemic stricture who underwent robotic-assisted resection and robot-sewn intracorporeal anastomosis. The advantages of robotic resection, particularly in this case, were the ease of performing a high-risk hand-sewn (robot-sewn) anastomosis when there was a significant luminal disparity between the proximal and distal bowel segments, an edematous and thickened proximal bowel, as well as proximity to the duodenojejunal flexure (DJF), which might have warranted a laparotomy with considerable morbidity.

CASE REPORT

A 50-year-old male patient with no prior comorbidities presented

Fig. 1. (A) Abdominal radiograph showing dilated small bowel loops with multiple air-fluid levels. (B–D) Axial, coronal, and sagittal sections of contrast-enhanced abdominal computed tomography showing a long segment jejunal stricture with proximal dilation.

with a 1-day history suggestive of acute intestinal obstruction on a background of intermittent colicky upper abdominal pain, bilious vomiting, and abdominal distention for the last 8 months. Physical examination revealed mild upper abdominal fullness, while routine laboratory investigations were within normal limits. Contrast-enhanced abdominal computed tomography was done, which showed a hypodense thrombus in the proximal superior mesenteric artery (SMA), causing 50% to 80% luminal occlusion and extending into distal SMA branches with poor opacification. Long segment (5–6 cm), smooth symmetrical circumferential bowel wall thickening was seen involving the proximal jejunal loops at the epigastric region, causing significant luminal occlusion and inflammatory stranding with proximal jejunal loop dilatation. Overall findings were suggestive of chronic mesenteric ischemia due to SMA thrombosis and proximal jejunal ischemic stricture (Fig. 1). He was planned to undergo surgery robotically as the patient desired a minimally invasive approach. After proper counseling and informed consent, he was taken up for surgery.

The patient was laid supine with the legs split posture. Pneumoperitoneum was created through a Veress needle, and an 8-mm infraumbilical port was placed in the midline. Three other 8-mm robotic ports were placed under vision, as shown in Fig. 2. A 12-mm assistant port was placed inferiorly between R1 and R2, forming a triangle. The da Vinci Xi Robotic system (Intuitive Surgical, Inc., Sunnyvale, CA, USA) was used, and the robot was docked from the right side of the patient (Fig. 2). Inflammatory adhesions between the omental and mesentery to the bowel were noted, along with significant dilation of the proximal jejunum. Careful adhesiolysis was done, and a stricture was noted around 30 cm distal to the DJF (Fig. 3). Around 5 to 8 cm of bowel was resected on either side of the stricture using an Echelon Flex Endopath stapler (Ethicon, Inc., Cincinnati, OH, USA) with a blue cartridge (triple row). As there was a significant disparity in the lumen size of the proximal and distal jejunum, with the proximal bowel being edematous and thickened, a side-to-side functional end-to-end anastomosis was performed in a two-layer continuous fashion using polydioxanone 3-0 sutures for the outer layer and barbed polyglyconate suture (V-loc; Medtronic, Minneapolis, MN, USA) 3-0 sutures for the inner layer (Fig. 4). The specimen was extracted through a 12-mm assistant port using an endo bag. The operating time, including docking time (15 minutes), was 150 minutes. The postoperative course was uneventful, and he was discharged on postoperative day 4. Histopathology confirmed ischemic changes in the jejunal mucosa with a stricture. At 4 months follow-up, the patient is doing well with no complaints.

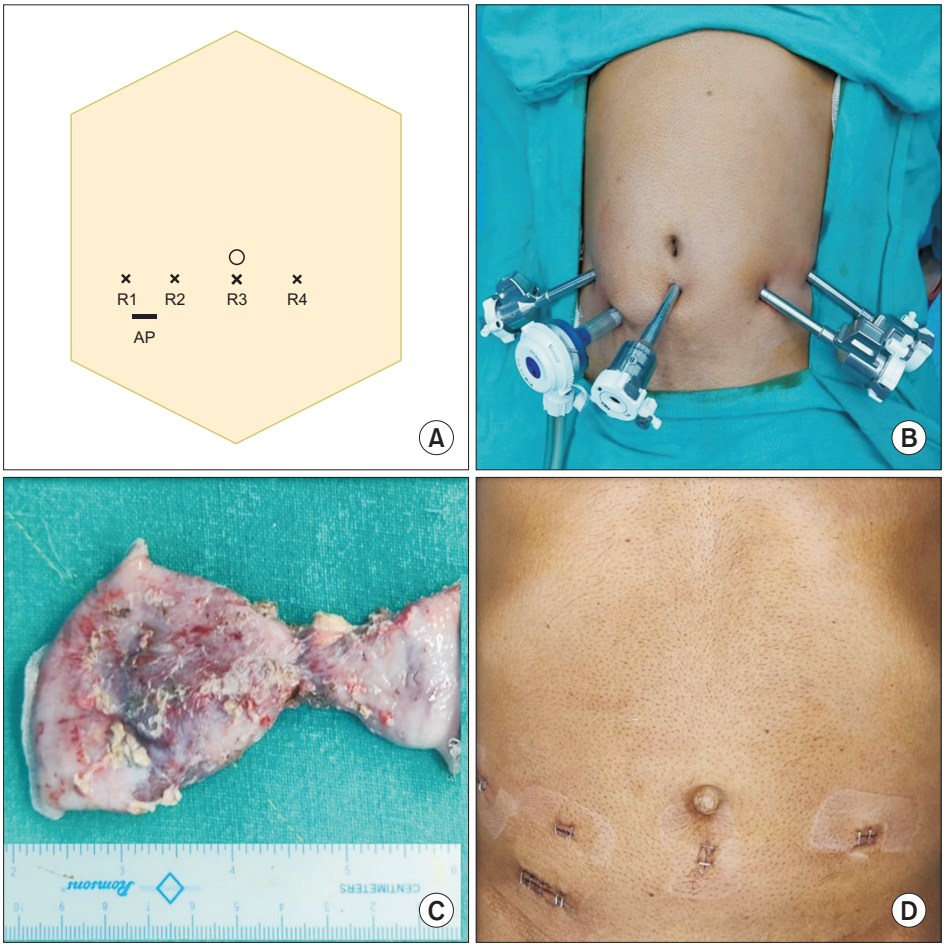

Fig. 2. (A) Schematic diagram of port position. (B) Port position in the patient after docking. (C) Resected jejunal stricture segment. (D) Postoperative image of the abdomen showing port scars. R1–R4, robotic ports; AP, assistant port.

DISCUSSION

Surgical resection of an ischemic stricture, causing small bowel obstruction, followed by anastomosis is the optimal treatment. The small bowel is a mobile organ, and a small midline laparotomy is usually sufficient in most cases. Minimally invasive surgery usually scores over open surgery due to its advantages [1], but in cases with dense adhesions, shortened mesentery, and proximity to the DJF, open surgery is preferred. This can result in a large incision, leading to considerable morbidity in terms of pain, delayed bowel movement, and wound-related complications. Robotic surgery has several advantages over conventional laparoscopic surgery in terms of magnified vision with depth perception, tremor filtration, improved dexterity, and wrist articulation [1]. All these advantages have translated into better surgical outcomes and have allowed the surgeon to perform more complex surgeries and reconstructions with technical ease and without fatigue [1]. Although the literature is abundant on various complex robotic surgeries, there is only one case report on robotic jejunal resection in an elective setting and none in an emergency setting [2]. A recent position paper on robotic surgery in the emergency setting included ten studies, none of which was related to the small bowel. It concluded that robotic surgery in the emergency setting might be done in highly selected cases, especially in challenging situations, which are foreseen as a reason for conversion to open surgery if operated by laparoscopy [3].

Gastrointestinal continuity after resection is restored either in stapled or hand-sewn manner. Numerous studies have proved that type of technique has no effect on the anastomotic leak rate in elective gastrointestinal surgeries [4]. However, in emergency gastrointestinal surgery, the intestinal physiology is altered. In an emergency setting, the bowel is edematous and friable due to one or more factors like an ongoing inflammatory process, hemorrhage, reperfusion injury, or resuscitation fluid. There is also often the presence of lumen disparity in the two cut ends of the bowel in cases of intestinal obstruction or when the small bowel is anastomosed with the large bowel. There might be preexisting enteropathy along with comorbid conditions like diabetes, atherosclerosis, and malnutrition, leading to poor or delayed wound healing [5,6]. Standard stapling devices are designed for normal bowel thickness. Individual staplers have a usual width of 3 mm and a length of 3.85 mm. After closing, the staple measures 1.5

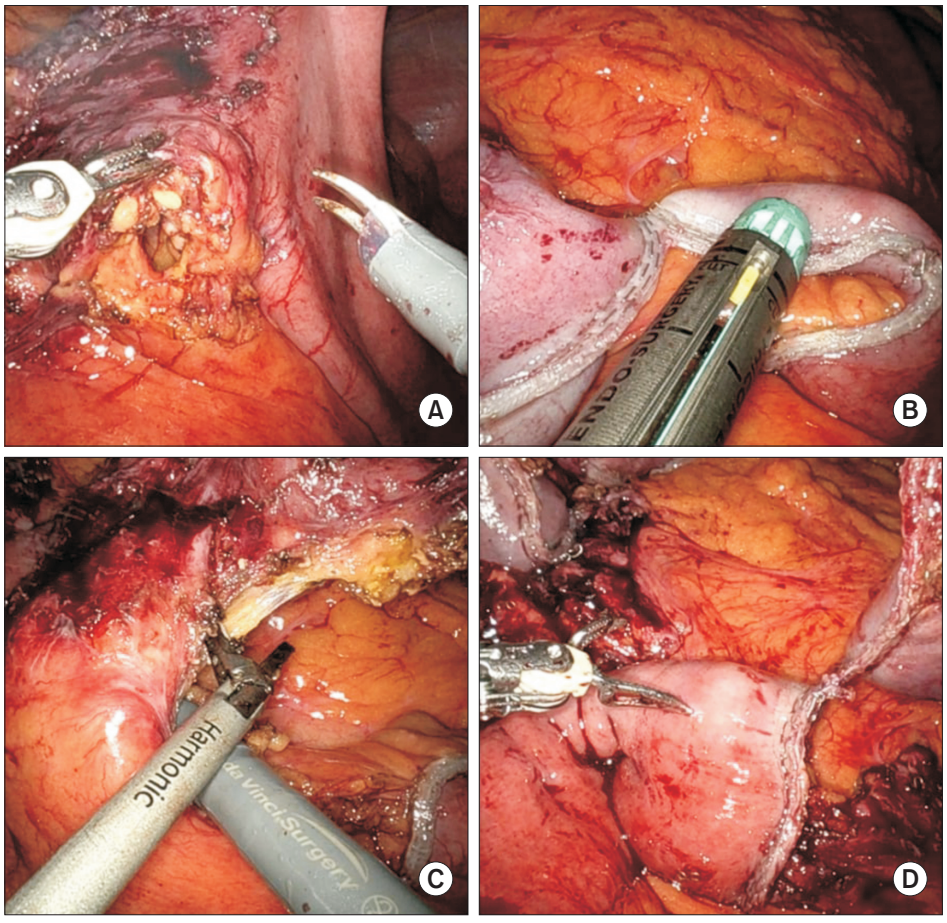

Fig. 3. (A) Creation of a mesenteric window for dividing the bowel proximal to the stricture. (B) Division of the proximal segment using an endo gastrointestinal anastomotic (GIA) stapler via the assistant port. (C) Division of the mesentery using the harmonic scalpel. (D) Division of the distal end using the GIA stapler.

mm. In an edematous bowel, this closure is dubious, and proper tissue sealing is doubtful. It can lead to either the formation of a local abscess or the development of a full-thickness breakdown, causing an anastomotic leak if edema is severe enough [5].

In a study by the University of Washington Harborview Medical Center, an analysis of 118 anastomoses in 84 patients, done in emergency setting, showed a significant association between stapled anastomosis with an anastomotic leak ($p = 0.037$) [6]. In the Western trauma multicenter study of 289 bowel anastomoses in 199 patients in emergency trauma patients, seven of the 175 stapled anastomoses and none of the 114 hand-sewn anastomoses had a clinically significant leak requiring reoperation ($p = 0.040$) [7]. Another retrospective review by Farrah et al. [5], consisting of 100 hand-sewn (43%) and 133 (57%) stapled anastomoses in 231 patients, showed higher anastomotic failure rates in the stapling group as compared to the hand-sewn group (15% vs. 6.1%, $p = 0.003$).

A recent meta-analysis by Naumann et al. [8] showed no differences in anastomotic failure rates between hand-sewn and stapled techniques. However, the data were at a high risk of bias as the majority of the included studies were retrospective (five out of seven), with a high level of heterogeneity. In these and other non-randomized studies [9], surgeons usually opt for hand-sewn techniques in patients with high-risk anastomoses (greater disease burden, more bowel edema). The meta-analysis concluded that the available evidence is sparse and at a high risk of bias, and neither stapling nor hand sewing is justifiably favored in emergency laparotomy. Hence, it can be concluded that, in the absence of strong evidence favoring stapled anastomosis, surgeons may continue to prefer the hand-sewn technique in high-risk and emergency cases due to fear of an anastomotic leak. Thus, robot-sewn anastomosis may be the answer in these situations, giving the benefit of both hand-sewn and minimally invasive techniques and translating into better patient outcomes. Further, during robotic surgery, the Cadiere Forceps (Intuitive Surgical, Inc.) is particularly useful during manipulation and holding of the edematous small bowel. It has a low grasping force due to a fenestrated and small size jaw with less traumatic serrations, which leave a minimum closing footprint on the bowel after grasping.

However, robotic surgery has its own disadvantages, mainly in the form of cost constraints. Robotic or robotic-assisted surgery is more expensive than laparoscopy [10]. Factors that contribute to a higher economic burden are the cost of purchasing the robot

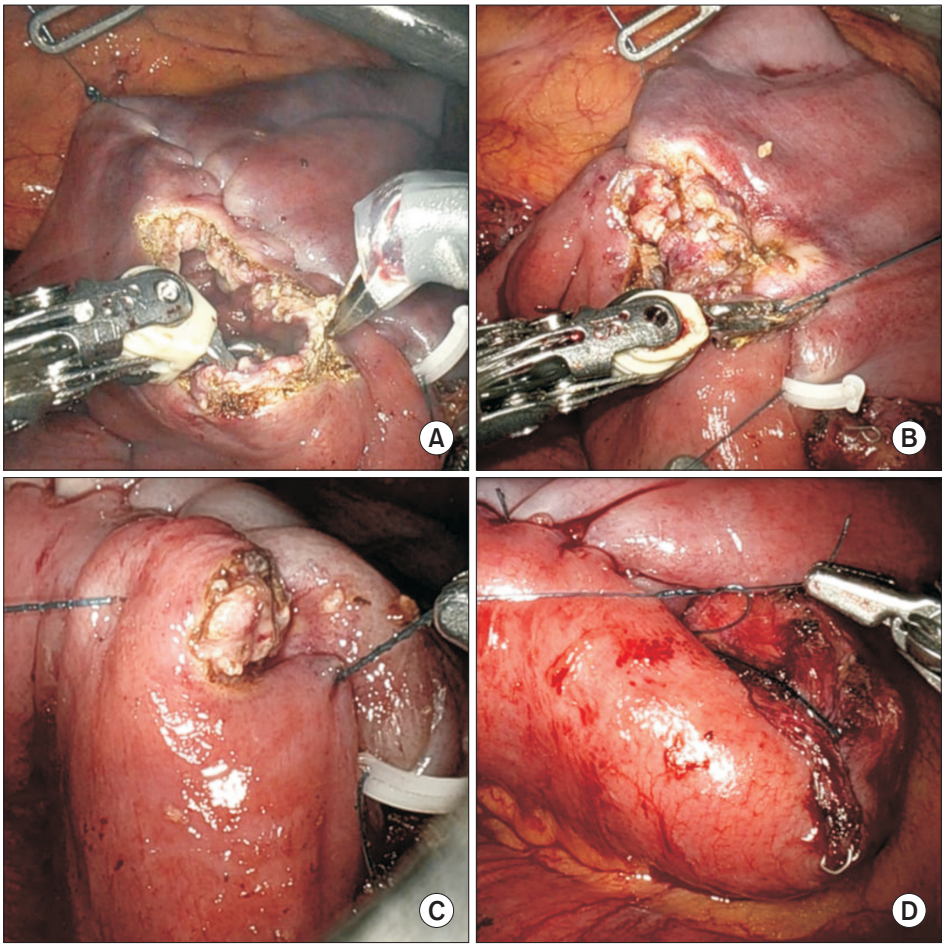

Fig. 4. (A) Creation of a jejunal enterotomy after completion of the first layer of anastomoses (seromuscular). (B) Completion of the second layer of anastomoses. (C) Completion of the third layer of anastomoses. (D) Completion of the fourth layer of anastomoses (seromuscular).

by the institution, its maintenance, the cost of disposable items, and the longer surgical duration. However, for overall cost-effectiveness, the costs associated with rehabilitation, days out of work after surgery, and the impact on quality of life should also be included. These parameters are difficult to calculate, and more scientific ways of measuring these aspects need to be devised.

In conclusion, robotic small bowel resection and anastomosis can be a feasible option, especially with the technical advantages of robotic systems in selected cases. Robot-sewn anastomosis replicates hand-sewn anastomosis and can be a good alternative to laparoscopic surgery, especially in cases of emergency, edematous bowel, significant disparity in the proximal and distal lumen, and proximity of the DJF. For it to gain acceptance, further studies are needed to define specific measures to quantify the equipment benefits to the surgeon and the outcome in patients.

NOTES

Ethical statements

Since this study is a retrospective study that reviewed electronic charts and computed tomography readings, and personal information protection measures are well established, the study approval was waived from Institute Ethics Committee. Informed consent was taken from the patient.

Authors' contributions

Conceptualization, Project administration: PV
Data curation, Visualization: PV, VJ
Formal analysis: PV, SCS, VJ
Investigation: All authors
Methodology: PV, VKV, BS
Writing–original draft: PV, VJ
Writing–review & editing: SCS, VKV, BS
All authors read and approved the final manuscript.

Conflict of interest

All authors have no conflicts of interest to declare.

Funding/support

None.

ORCID

Vishu Jain, https://orcid.org/0000-0002-2261-4236
Peeyush Varshney, https://orcid.org/0000-0001-6276-1890
Subhash Chandra Soni, https://orcid.org/0000-0001-9972-8920
Vaibhav Kumar Varshney, https://orcid.org/0000-0003-1771-2787
B Selvakumar, https://orcid.org/0000-0002-2280-3862

REFERENCES

1. Rudiman R. Minimally invasive gastrointestinal surgery: from past to the future. Ann Med Surg (Lond) 2021;71:102922.
2. Oh MH, Lee BC. Robot-assisted resection of GIST in the proximal jejunum. J Surg Case Rep 2020;2020:rjaa301.
3. de'Angelis N, Khan J, Marchegiani F, et al. Robotic surgery in emergency setting: 2021 WSES position paper. World J Emerg Surg 2022;17:4.
4. Neutzling CB, Lustosa SA, Proenca IM, da Silva EM, Matos D. Stapled versus handsewn methods for colorectal anastomosis surgery. Cochrane Database Syst Rev 2012;(2):CD003144.
5. Farrah JP, Lauer CW, Bray MS, et al. Stapled versus hand-sewn anastomoses in emergency general surgery: a retrospective review of outcomes in a unique patient population. J Trauma Acute Care Surg 2013;74:1187-1194.
6. Brundage SI, Jurkovich GJ, Hoyt DB, et al. Stapled versus sutured gastrointestinal anastomoses in the trauma patient: a multicenter trial. J Trauma 2001;51:1054-1061.
7. Brundage SI, Jurkovich GJ, Grossman DC, Tong WC, Mack CD, Maier RV. Stapled versus sutured gastrointestinal anastomoses in the trauma patient. J Trauma 1999;47:500-508.
8. Naumann DN, Bhangu A, Kelly M, Bowley DM. Stapled versus handsewn intestinal anastomosis in emergency laparotomy: a systemic review and meta-analysis. Surgery 2015;157:609-618.
9. Bruns BR, Morris DS, Zielinski M, et al. Stapled versus hand-sewn: a prospective emergency surgery study: an American Association for the Surgery of Trauma multi-institutional study. J Trauma Acute Care Surg 2017;82:435-443.
10. Jeon Y, Park EJ, Baik SH. Robotic surgery for rectal cancer and cost-effectiveness. J Minim Invasive Surg 2019;22:139-149.