Robotic Surgery for Inflammatory Bowel Diseases and Total Colectomy

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21.1 Minimally Invasive Surgery for Inflammatory Bowel Diseases

Surgery still represents the mainstay of treatment for inflammatory bowel diseases (IBD) and over the last decades a minimally invasive approach has been pursued, especially for uncomplicated cases. Compared to open surgery, laparoscopy has demonstrated better postoperative recovery, less postoperative pain, shorter hospitalization and quicker return to bowel function and, above all, prevention of abdominal adhesions, which is of paramount importance in this group of often immunocompromised patients potentially requiring repeated surgery [1–3].

For patients affected by chronic ulcerative colitis that is medically refractory or presenting with dysplasia or malignancy, the standard surgical procedure is restorative proctocolectomy with ileal pouch-anal anastomosis (IPAA). IPAA, described in 1978

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by A. Parks and J. Nicholls [4], is the best option for patients desiring intestinal continuity. Originally performed using a hand-sewn open approach, the technique was reproduced in a minimally invasive fashion with the advent of laparoscopy, although the complexity of the operation and the paucity of indications limited its diffusion. Despite the often young age of patients undergoing IPAA, there is a high rate (30–40%) of postoperative complications, such as surgical site infection, ileus, anastomotic leak and 30-day readmission, even in high-volume centers [5, 6]. The major risk factors are high BMI, state of malnutrition and chronic use of steroids/immunosuppressants. Studies investigating the outcomes and potential advantages of a minimally invasive approach over open surgery have revealed in particular a long-term decreased incidence of adhesive small bowel obstruction [7]. Robotic surgery allows lower conversion rates and its use for proctocolectomy and IPAA in ulcerative colitis has demonstrated less intraoperative blood loss and fewer complications [8] and a safe IPAA [9–12].

For Crohn's disease, which generally requires a limited ileocolic resection, the use of the robotic approach showed a quicker restoration of bowel function with lower conversion and complication rates, compared to open surgery and laparoscopy. A hybrid approach was occasionally recommended in cases of disease complicated by abscess or fistula [13]. The use of the robotic approach for stricturoplasty has also been reported [14], even though the improved nerve preservation [15] makes this technology mostly useful for rectal surgery and in selected cases of reoperation, especially in male patients.

The robotic treatment of IBD requires completion of an adequate learning curve and training in robotic surgery, as well as extensive experience in open and conventional minimally invasive surgery of IBD [16, 17]. The robotic approach usually involves a longer operative time compared to standard laparoscopy, but this aspect may be improved by the growing experience and training of the surgical team [18, 19]. However, comparative studies have been unable to detect any substantial advantage of robotic surgery in terms of complications, anastomotic leaks and return to normal life.

21.2 Technical Aspects of Robotic Total Colectomy and Proctocolectomy

A total colectomy or total proctocolectomy, with or without IPAA, represents the treatment of choice for patients affected by different diseases such as chronic ulcerative colitis, familial adenomatous polyposis, and synchronous colorectal tumors. Further indications include reoperations after previous colectomy, selected cases of transverse and left splenic flexure colon tumors, toxic megacolon and functional disorders such as colonic inertia.

The patient is placed in the supine position with legs apart to allow a lithotomy position at the end of the operation (Fig. 21.1). The latest generation da Vinci X or Xi platform (Intuitive Surgical Inc., Sunnyvale, CA, USA) allows rotation of the cart without robot repositioning, with an easier and quicker multiquadrant procedure [20]. Differently from the previous robotic carts, this model is generally placed

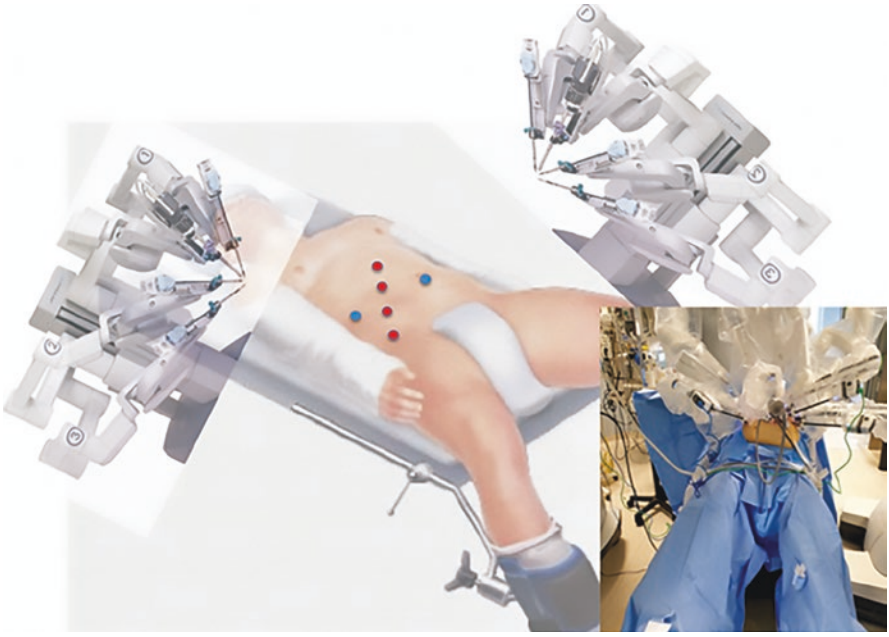

Fig. 21.1 Patient and trocar positioning for robotic total colectomy. In the inset, the patient cart location for double docking is shown

between the patient's legs for the whole procedure. Sometimes single docking is possible using the recent Xi da Vinci system, otherwise double or even triple docking is required during the main surgical steps. The rotation of the boom depends on the side of the colon to be started on and the operational steps. Four robotic ports (placed along a diagonal line as in Fig. 21.1) and one or two laparoscopic accessory ports are generally used. With the new da Vinci Xi system, two different boom positions are required. If we start from the right side, the right colon, transverse colon and splenic flexure are mobilized using the same docking with the robotic boom rotated to the right side of the patient, who is placed in a Trendelenburg position tilted to the left (20°). The second docking requires a rotation of the boom to the left side of the patient, who remains in Trendelenburg position but with a slight tilt to the right; this docking is used to complete the left colectomy, rectal resection and IPAA. A medial-to-lateral approach for the mesocolic vessels is generally performed. Lymph node harvesting up to the vessel origins as well as complete mesocolic excision and total mesorectal excision (TME) are reserved for oncologic diseases. Rectal resection may be performed using a conventional laparoscopic or robotic EndoWrist stapler. The specimen is generally extracted via a 4–5 cm suprapubic Pfannenstiel incision (Fig. 21.2) or transanally or by enlarging a paraumbilical incision. A 20-cm ileal J pouch is generally created extracorporeally with hand-sewn or stapled technique; a circular 29-mm stapler is used to fashion a transanal end-to-end ileoanal anastomosis. A protective diverting loop ileostomy is generally placed on the right iliac fossa [21–23].

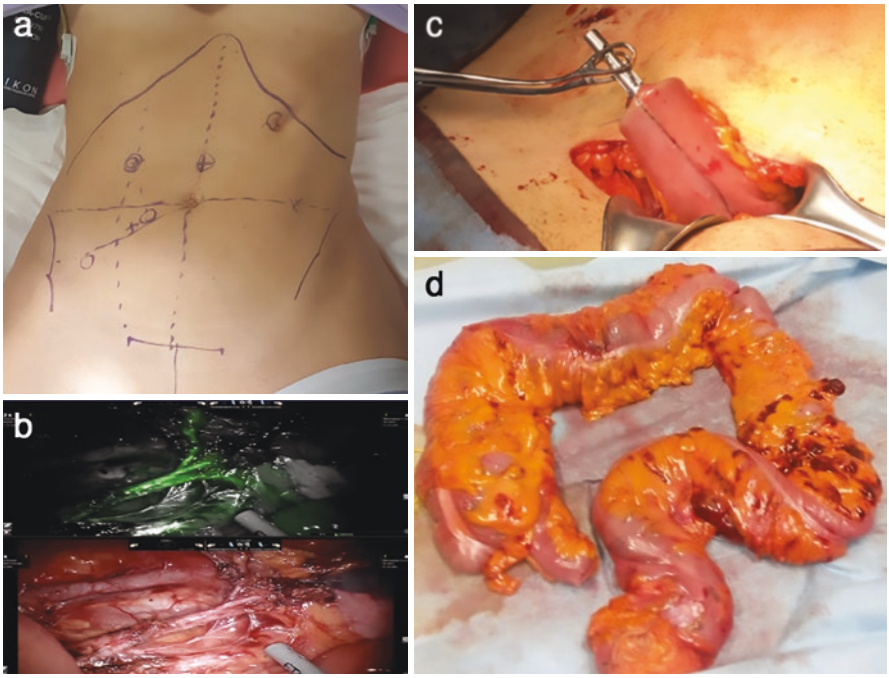

Fig. 21.2 (**a**) Pre-operative planning for trocar positioning. (**b**) Indocyanine green use for vessel identification. (**c**) Ileal-pouch packaging through Pfannenstiel incision. (**d**) Specimen of total proctocolectomy

21.3 Literature Review

The application of robotic surgery to IBD, compared to conventional laparoscopy, has shown an overall lower rate of conversion to open surgery, a shorter time to bowel function recovery especially after ileocolic resection for Crohn's disease, and an overall lower complication rate [17]. The advantages of robotic surgery for TME and nerve-sparing rectal resection have been widely demonstrated. When applied to proctocolectomy, extended colectomies and IPAA, the robotic approach has resulted in less estimated blood loss, fewer complications and lower readmission rates, compared to the laparoscopic approach [8, 15]. Hybrid approaches such as laparoscopic-open or laparoscopic-robotic have been described that may be useful when complications such as abscess, fistula, or phlegmon are present during surgery [13].

In 2016, Moghadamyeghaneh et al. published a series of 26,721 patients, from the U.S. Nationwide Inpatient Sample database, who underwent elective total colectomy during the period 2009–2012. Of these, 62.8% had open surgery, while 37.2% had a minimally invasive approach (9614 laparoscopy, 326 robotic). The most common indication was ulcerative colitis (31%). Patients who underwent open surgery had significantly higher mortality and morbidity compared to the minimally

invasive approach. There was no significant difference in mortality and morbidity between the laparoscopic and robotic approaches. The conversion rate in the laparoscopic series was significantly higher than in the robotic approach. Mean hospital stay (8 days) was similar for both laparoscopy and robotic surgery and significantly lower compared to the 11 days of open surgery. Laparoscopic surgery had significantly lower total hospital charges compared to open surgery ($p < 0.01$), and total hospital charges for robotic surgery were significantly higher than for laparoscopic surgery, with a mean difference of $15,595 [24].

A systematic review of perioperative outcomes and adverse events in robotic colorectal resections for IBD was published by Renshaw et al. in 2018. Of the studies evaluated, three were case-matched observational studies, four were case series and one was a case report, for a total of 150 patients. No mortality was reported; overall complications occurred in 54% of patients, with 20% Clavien-Dindo grade III–IV complications. Mean length of hospital stay was 8.6 days; the conversion rate was 7.3%, and 24.7% of patients treated were readmitted. A significantly longer operative time was observed for the robotic procedure; however, conversion, complication, length of stay and readmission rates were similar for the robotic, laparoscopic and open approaches. None of the evaluated studies compared cost-effectiveness between the robotic and traditional approaches [19].

A systematic review by Flynn et al., including nine studies for a total of 640 patients treated with three different approaches (170 open, 174 laparoscopic, 286 robotic) for IPAA, concluded that the procedure can be performed safely, with equivalent rates of overall complications, anastomotic leaks and returns to theatre [8].

Opoku et al. analyzed, over a period of 4 years (2016–2019), 1067 open, 971 laparoscopic, and 341 robotic total colectomies with IPAA, where the most frequent indications were inflammatory bowel disease (64%), malignancy (18%), and familial adenomatous polyposis (7%). Overall morbidity was 26.8% for the entire cohort with 4% anastomotic leak, 6% reoperation, 21% ileus, and 21% readmission rate. In this series none of the techniques was associated with better short-term outcomes, including length of stay, overall morbidity, anastomotic leak, 30-day readmissions and reoperation. The traditional advantages of the minimally invasive approach (either laparoscopy or robotic) were less evident than for other operations, and the authors concluded that IPAA is associated with significant postoperative morbidity independently from the surgical approach [25].

In a recent paper, Bianchi et al. reported their personal experience of 16 consecutive patients treated with robotic total proctocolectomy and IPAA at the tertiary care center of Creteil Hospital (Henri Mondor University, France). Fourteen over 16 patients were affected by ulcerative colitis. No conversion, no readmission and no mortality were reported. Mean hospital stay was 8.2 days. The authors also performed a systematic literature review, including 23 retrospective studies with 736 robotic cases, showing that robotic surgery had a lower conversion rate compared to laparoscopy ($p = 0.03$), longer operative time ($p = 0.02$), and no difference in postoperative complications and hospital stay [26].

21.4 Conclusions

A growing interest and application of robotic surgery in IBD has been observed in the last decade. Challenging procedures, such as stricturoplasty in Crohn's disease or total colectomy or proctocolectomy for ulcerative colitis, may find in robotic technology an interesting alternative to conventional laparoscopy. However, high costs, longer operative time due to multiple docking and low availability represent the most important drawbacks of this technology. The shortage of literature on this surgery, which is performed in specialized high-volume centers in selected cases, is the reason for the lack of high-grade evidence. The lower conversion rate compared to laparoscopy is one of the main advantages reported. The new robotic devices have reduced the time required for the docking steps.

Finally, long-term outcomes, such bowel and genitourinary function, incisional hernias, quality of life, small bowel obstructions secondary to adhesions, have not been adequately investigated in this generally young population. Randomized controlled trials analyzing these outcomes and the cost-effectiveness of robotic surgery are needed to confirm the usefulness of this technology.

References

1. Crippa J, Carvello M, Kotze PG, Spinelli A. Robotic surgery in inflammatory bowel disease. Curr Drug Targets. 2021;22(1):112–6.
2. Wu XJ, He XS, Zhou XY, et al. The role of laparoscopic surgery for ulcerative colitis: systematic review with meta-analysis. Int J Color Dis. 2010;25(8):949–57.
3. Indar AA, Efron JE, Young-Fadok TM. Laparoscopic ileal pouch-anal anastomosis reduces abdominal and pelvic adhesions. Surg Endosc. 2009;23(1):174–7.
4. Parks AG, Nicholls RJ. Proctocolectomy without ileostomy for ulcerative colitis. Br Med J. 1978;2(6130):85–8.
5. Ahmed Ali U, Keus F, Heikens JT, et al. Open versus laparoscopic (assisted) ileo pouch anal anastomosis for ulcerative colitis and familial adenomatous polyposis. Cochrane Database Syst Rev. 2009;2009(1):CD006267.
6. White I, Jenkins JT, Coomber R, et al. Outcomes of laparoscopic and open restorative proctocolectomy. Br J Surg. 2014;101(9):1160–5.
7. Ng KS, Gonsalves SJ, Sagar PM. Ileal-anal pouches: a review of its history, indications, and complications. World J Gastroenterol. 2019;25(31):4320–42.
8. Flynn J, Larach JT, Kong JCH, et al. Robotic versus laparoscopic ileal pouch-anal anastomosis (IPAA): a systematic review and meta-analysis. Int J Color Dis. 2021;36(7):1345–56.
9. Haas EM, de Paula TR, Luna-Saracho R, LeFave JJ. Robotic total intracorporeal completion proctectomy with restorative IPAA: the NICE approach. Dis Colon Rectum. 2020;63(11):e550–1.
10. Lightner AL, Kelley SR, Larson DW. Robotic platform for an IPAA. Dis Colon Rectum. 2018;61(7):869–74.
11. Miller AT, Berian JR, Rubin M, et al. Robotic-assisted proctectomy for inflammatory bowel disease: a case-matched comparison of laparoscopic and robotic technique. J Gastrointest Surg. 2012;16(3):587–94.
12. Lightner AL, Grass F, McKenna NP, et al. Short-term postoperative outcomes following robotic versus laparoscopic ileal pouch-anal anastomosis are equivalent. Tech Coloproctol. 2019;23(3):259–66.

13. Aydinli HH, Anderson M, Hambrecht A, et al. Robotic ileocolic resection with intracorporeal anastomosis for Crohn's disease. J Robot Surg. 2021;15(3):465–72.
14. Tou S, Pavesi E, Nasser A, et al. Robotic-assisted strictureplasty for Crohn's disease. Tech Coloproctol. 2015;19(4):253–4.
15. Neumann PA, Rijcken E. Minimally invasive surgery for inflammatory bowel disease: review of current developments and future perspectives. World J Gastrointest Pharmacol Therapeut. 2016;7(2):217–26.
16. Diana M, Marescaux J. Robotic surgery. Br J Surg. 2015;102(2):e15–28.
17. Gul F, Kazmi SNH, Abbas K, et al. The future of robotic surgery for inflammatory bowel diseases. Ann Med Surg (Lond). 2022;25(81):104476.
18. Hota S, Parascandola S, Smith S, et al. Robotic and laparoscopic surgical techniques in patients with Crohn's disease. Surg Endosc. 2021;35(8):4602–8.
19. Renshaw S, Silva IL, Hotouras A, et al. Perioperative outcomes and adverse events of robotic colorectal resections for inflammatory bowel disease: a systematic literature review. Tech Coloproctol. 2018;22(3):161–77.
20. Jimenez-Rodriguez RM, Quezada-Diaz F, Tchack M, et al. Use of the xi robotic platform for total abdominal colectomy: a step forward in minimally invasive colorectal surgery. Surg Endosc. 2019;33(3):966–71.
21. Roviello F, Piagnerelli R, Ferrara F, et al. Robotic single docking total colectomy for ulcerative colitis: first experience with a novel technique. Int J Surg. 2015;21:63–7.
22. Morelli L, Guadagni S, Mariniello MD, et al. Hand-assisted hybrid laparoscopic-robotic total proctocolectomy with ileal pouch–anal anastomosis. Langenbeck's Arch Surg. 2015;400(6):741–8.
23. Pedraza R, Patel CB, Ramos-Valadez DI, Haas EM. Robotic-assisted laparoscopic surgery for restorative proctocolectomy with ileal J pouch-anal anastomosis. Minim Invasive Ther Allied Technol. 2011;20(4):234–9.
24. Moghadamyeghaneh Z, Hanna MH, Carmichael JC, et al. Comparison of open, laparoscopic, and robotic approaches for total abdominal colectomy. Surg Endosc. 2016;30(7):2792–8.
25. Opoku D, Hart A, Thompson DT, et al. Equivalency of short-term perioperative outcomes after open, laparoscopic, and robotic ileal pouch anal anastomosis. Does procedure complexity override operative approach? Surg Open Sci. 2022;9:86–90.
26. Bianchi G, Gavriilidis P, Martínez-Pérez A, et al. Robotic multiquadrant colorectal procedures: a single-center experience and a systematic review of the literature. Front Surg. 2022;9:991704.