



What are the benefits of laparoscopic-assisted right colectomy with extracorporeal ileocolic anastomosis as compared to open thru minilaparotomy?

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Abstract: The benefits of laparoscopic colorectal surgery are apparent. However, laparoscopy generally requires special instruments, longer operation time, and a steep learning curve. Some studies reported that minilaparotomy using conventional surgical techniques and tools offers similar favorable outcomes. This review aimed to compare laparoscopic-assisted right colectomy with extracorporeal anastomosis and open right colectomy using minilaparotomy. Based on the analysis of recent literature, the proofs supported right colectomy via minilaparotomy are limited. There is no evidence for superiority for open right colectomy thru minilaparotomy in terms of more favorable postoperative course or better long-term results. The short-term outcomes for right colectomies using minilaparotomy were similar to laparoscopy in selected cases only. Currently, there is no reliable reason to start right colectomy using minilaparotomy.

Keywords: Laparoscopic colectomy; minilaparotomy; right colectomy

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Introduction

Laparoscopic colectomy was first described in 1991 by Moises Jacobs (1). In a short time, this technique has become an acceptable alternative to open colon resection. A laparoscopic approach was confirmed to be associated with a reduction in operation-induced stress, more favorable postoperative course, and the same degree of oncological radicality (2-6).

More laparoscopic techniques have been described for right colon surgery: totally laparoscopic right colectomy (laparoscopic intracorporeal anastomosis) (7), laparoscopic-assisted right colectomy (laparoscopic vessel ligation and bowel mobilization, extracorporeal anastomosis) (8), laparoscopic facilitated right colectomy (laparoscopic bowel mobilization, extracorporeal vessel ligation and anastomosis) (9), hand-assisted right colectomy (laparoscopic technique with hand assistance through a minilaparotomy) (10), and more recently single incision right colectomy (completely laparoscopic procedure with intracorporeal anastomosis through multichannel single trocar or trocars inserted

through one short incision) (11). Laparoscopic-assisted right colectomy with extracorporeal anastomosis represents one of the most commonly used procedures.

However, laparoscopy requires special instruments, longer operation time, and challenging learning curve. In this context, some studies reported that minilaparotomy using conventional surgical techniques and standard devices offers a promising approach for colon resection, including right colectomy. This technique can be associated with similar favorable postoperative recovery (12-17). Also, the operating time might be shorter, and the learning curve should be less steep.

Based on these facts, we present the literature state of the art to compare laparoscopic-assisted right colectomy with extracorporeal anastomosis and open right colectomy using minilaparotomy.

Indication

Generally, right colectomy (laparoscopic-assisted or

open thru minilaparotomy) is performed for benign and malignant pathologies affecting the bowel between the ileocecal junction and hepatic flexure. There are not any contraindications for laparoscopic-assisted technique concerning tumor stage or patient status, including age or previous abdominal surgery. Regarding the minilaparotomy method, the data about contra/indications are rather sparse. Patients are usually selected, and cases after previous abdominal surgeries, obese and advanced tumors have been excluded.

Technique

The main steps of right colectomy regardless of approach are division of the vascular pedicle, mobilization of the terminal ileum and right colon, division of the relevant part of the mesentery, transection of the distal and proximal bowel ends, and safe anastomosis. If right colon cancer is confirmed both techniques must respect the same oncologic criteria, including “non-touch isolation technique”, vessel ligation at their origin, complete mesocolic excision, adequate lymphadenectomy, and clear resection margins.

Minilaparotomy

Standard instruments and conventional open surgical technique via a small abdominal incision are used. Supine position and the right transrectal skin incision are preferred. According to the literature, 7 cm was the limit of incision length. Retractor system was usually used to assure an adequate surgeon's view and to protect the minilaparotomy (15,18). Several gauze swabs also retain small bowel and omentum out of the operative field, and the optimal view was facilitated by moving the minilaparotomy wound (19). The following steps were performed via minilaparotomy: mobilizing the relevant segment of bowel loop, division of central vessels (ileocolic, right colic, right branch of middle colic), removal of the entire lymph node-bearing mesentery, bowel resection and reestablishment of bowel continuity using hand-sewn or stapled anastomosis. The mesenteric window is usually closed.

Laparoscopic-assisted right colectomy with extracorporeal anastomosis

There were various techniques reported for laparoscopic-assisted right colectomy. These techniques were differing mainly in trocars positions, the sequence of steps, and

anastomotic method (isoperistaltic, anisoperistaltic, end to end, end to side, side to side, hand sewn, stapled). The patient is placed in the supine position, tilted to the left. The feet are elevated slightly above the head (Trendelenburg position). This position is changed during surgery as needed. From three to five trocars are usually used. Recently the medial to lateral approach is preferred (20,21). Commonly the avascular plane between the right mesocolon and retroperitoneal structures is found and dissect from medial to lateral, duodenum, and vascular anatomy is exposed. Ileocolic vessels dissection and ligation at the root of the superior mesenteric vein and the superior mesenteric artery is emphasized as an essential step. The right colic vessels, if present, are transected. The root of the middle colic artery is found, right branch of middle colic artery and vein are identified and ligated. The gastrocolic trunk (Henle) due to several anatomical variations sometimes represents a problematic area. If possible, the gastric and pancreatic branches should be preserved. The right part of gastrocolic ligament along the right gastroepiploic artery is divided. The dissection of the right side of the greater omentum, division of lateral peritoneum of the hepatic flexure and ascending colon, and terminal ileum mobilization is completed. After that, the transrectal minilaparotomy is performed. The division of the ileal and colonic mesentery is finished extracorporeally, the right colon with terminal ileum is resected, and extracorporeal ileocolic stapled or hand-sewn anastomosis is performed. In some cases, the closure of the mesentery window due to technical difficulties is avoided.

Critical appraisal of the literature

The advantages of laparoscopic colorectal surgery have been strongly confirmed (2-6). However, laparoscopic colorectal surgery has still not reached similar acceptance as cholecystectomy or laparoscopic fundoplication. Improvements in conventional open surgery, including minilaparotomy approach, offered concurrently the same alternative possibilities (19).

There are several studies comparing colon resection via conventional laparotomy and minilaparotomy (15,19,22,23). Fürstenberg *et al.* in 1998 (24) reported prospective study included 47 right colectomies using minilaparotomy. Authors recommended minilaparotomy as a safe alternative to conventional surgery. Retrospective comparison published by Nakagoe *et al.* in 2001 (13) included 21 right colectomies via minilaparotomy and 28 open right

colectomies respectively. Operating time was similar; the length of incision was shorter in the minilaparotomy group, blood loss in the open group was significantly higher. The postoperative course was substantially significantly more favorable in the minilaparotomy group. These results were supported by a paper published by Nakagoe in 2003 (25). The authors reported reduced inflammatory responses after minilaparotomy for colorectal resections. Takegami *et al.* in 2003 published a retrospective comparison of colon resection via minilaparotomy and by conventional laparotomy including right colectomies (22). Minilaparotomy approach offers the same curative resection, more lymph node harvesting, earlier recovery, and earlier hospital discharge than conventional surgery. Similarly, Ishida's retrospective comparison colon resection via minilaparotomy and by traditional laparotomy found minilaparotomy as an attractive alternative to traditional laparotomy for selected patients (15).

The comparisons between minilaparotomy and laparoscopic-assisted approach for colectomy are rare. The paper published by Fleshman *et al.* in 1996 (12) was the first article issued to compare minilaparotomy and laparoscopic-assisted methods for colorectal resections. They reported a statistically significant difference between incision lengths (10 *vs.* 6 cm) but comparable postoperative short-term outcomes. However, the minilaparotomy group of patients was small, including 14 right colectomies only. A retrospective study published in 2001 by Nakagoe *et al.* (26) included 18 right colectomies thru minilaparotomy and only six laparoscopic-assisted right colectomies in the group of 47 resp. 30 colectomies. The results were similar in terms of early return of bowel function and discharge for both techniques. The numbers lymph nodes removed, and resection margins evaluation were comparable for both approaches. These oncological surrogates were confirmed by other authors (12,17,27). Hsu *et al.* in 2004 (14) presented the prospective study included 81 right colectomies. The midline vertical incision less than 7 cm was used, which was a similar length to the minilaparotomy and multiple incisions for trocars for laparoscopic colectomy. Ishida *et al.* in 2010 published paper including 93 right colectomies, supported a minilaparotomy approach without utilizing specific instruments (retractor system) as an alternative to laparoscopy (23). The short- and long-term results were reported by Liu *et al.* in 2018 (16). Their retrospective analysis included 63 right colectomies via minilaparotomy and 70 laparoscopic-assisted respectively. The choice of surgical technique (minilaparotomy or

laparoscopic) based on surgeons' and patients' decision. There was the early return of bowel function, shorter hospital stay, but longer operation time and higher costs in the laparoscopic group. Morbidity, mortality, recurrence rate, 5-year overall survival, and 5-year disease-free survival were without significant difference. The similar results were published in a prospective study by Chen *et al.* in 2018 (17). The authors compared the laparoscopic-assisted approach, minilaparotomy, and open colectomy for colorectal cancer stage I-III. Data of 40 laparoscopic-assisted, 62 minilaparotomies, and 51 open right colectomies were analyzed. Laparoscopic-assisted procedures had significantly less blood loss (but no difference in transfusion requirements), earlier first flatus and earlier resumption of a healthy standard diet. The postoperative complication rates were higher in patients undergoing laparotomy than those undergoing minilaparotomy. The long-term oncological results—recurrence rate, disease-free survival, and overall survival—were equivalent. They concluded, that laparoscopic-assisted surgery and minilaparotomy—both may be safe alternatives to conventional open laparotomy for colorectal cancer.

To be complete, the studies comparing laparoscopic-assisted right colectomy *vs.* open right colectomy via transverse incision must be shortly mentioned. In the study published by Tanis *et al.* in 2012 (27) laparoscopic-assisted and open right colectomy via transverse incision was identical and significantly better than open midline approach. However, the choice of an approach based on surgeons' and patients' preference again.

Discussion

There are several meta-analyses which provided evidence that supported the better outcomes for laparoscopy comparing with open colorectal surgery (2-4). The same results were reporting analyzing exclusively right-sided colectomies. The benefits are dominantly less surgical trauma, more favorably post-operative course, shorter hospitalization, and improved cosmesis. However, laparoscopic colectomy requires capnoperitoneum, special instruments and complicated techniques, longer operating time, higher costs, and surgical skill.

The smaller incision has been confirmed as one of the reasons for faster postoperative recovery after laparoscopic colorectal procedures (6,28). Laparoscopy to a midline laparotomy have been compared in the majority of studies focused on right colectomies, the open colectomy via

transverse incision has been evaluated less often. However, two meta-analyses confirmed better short- and long-term outcomes for the transverse approach in comparison to a midline laparotomy (29,30). Moreover, some authors compared laparoscopic right colectomy to open right colectomy via transverse laparotomy could not find a significant difference in postoperative outcomes. They concluded, there is no clear superiority for laparoscopy over a transverse incision (31,32).

Fleshman *et al.* first suggested that small incisions regardless of surgical technique (open through minilaparotomy or laparoscopic-assisted) resulted in the more favorably postoperative course (12). Since this report, other authors have supported this conclusion (8,15,22,24,26). They proposed that the minilaparotomy approach could be an acceptable alternative to laparoscopic surgery. Avoidance of exposure of the bowel to the operating room environment and reduced small bowel manipulation were the most frequently emphasized factors (13,22,24).

The most cited advantages for the minilaparotomy approach are faster and less cumbersome completion of the procedure, lower costs, reduced bulkiness of the equipment, and avoidance of potential danger caused by capnoperitoneum (12,13,15,22,23). Colectomy via minilaparotomy is simple to learn and does not require highly trained laparoscopic skills. Procedures are performed without loss of tactile sensation.

What we should call minilaparotomy is a matter of personal opinion. Fleshman *et al.* enclosed patient with 18-cm incision (12), Fürstenberg *et al.* reported maximal length 10 cm (24). Seven centimeters was commonly published as an upper limit, which allowed the insertion of the surgeon's hand through minilaparotomy to check for liver metastases and peritoneal dissemination and to assist and provide prompt control for unexpected bleeding (13,15,16,22).

Not all right colon pathologies and patients are indicated for resection via minilaparotomy. The size of the specimen is one of the limiting factors. Resection for bulky tumor thru 7-cm minilaparotomy may not be possible. Tumors larger than 6–7 cm in size or infiltrating adjacent organs were commonly excluded by many authors (22,23,26). Sometimes, the extending of the minilaparotomy or conversion to laparoscopic-assisted surgery (or hand-assisted surgery) can be necessary. Generally, the reasons for that “failure” of the minilaparotomy procedure and conversion from laparoscopy were similar. Intra-abdominal adhesions, obesity, tumor size, or invasion into adjacent organ are reported most frequently. In the study published by

Nakagoe *et al.* (33) multivariate logistic regression analysis revealed gender (male), BMI (≥ 25.5 kg/m²), tumor location (splenic flexure, rectum), tumor adhesion/invasion on/into adjacent organs and maximum tumor diameter (≥ 7.0 cm) as a significant risk factor for minilaparotomy technique “failure”. Similar risks—obesity, adhesions—were published by Ishida *et al.* (23).

Many authors stressed the technical difficulties to perform right colectomy via minilaparotomy in obese patients due to abdominal wall thickness and thick mesentery (22,23). Ishida *et al.* excluded patients with BMI greater than 25 (23). Regarding the laparoscopic approach, obesity has been identified similarly as one of the factors associated with a higher conversion rate (34–36). However laparoscopic approach has definitive advantages for obese patients when compared to their open surgery counterparts (36) or minilaparotomy also (16). It is worth mentioning that the most experiences with minilaparotomy are mainly from Japan. The frequency of obesity in East Asia and Japan is much lower than in western countries. Therefore, the minilaparotomy approach may be in a different position for this part of the world (13,23). In this context should be mentioned, that foreshortened mesentery or thick abdominal wall constitutes a rationale for a pure laparoscopic approach with intracorporeal anastomoses for overweight patients with right colon pathologies (37). There is reliable data that laparoscopic right colectomy with intraabdominal anastomosis is a safe and efficient alternative to extracorporeal anastomosis (38).

The minilaparotomy could be insufficient in cases requiring full visualization. Any synchronous intra-abdominal pathology is less likely to miss. On the other hand, the entire working space is generally required for laparoscopy. Minilaparotomy approach involved a straightforward resection, usually without extensive adhesiolysis in obtaining a clear surgical field.

From a technical point of view, the principles of complete mesocolic excision for right colon cancer are recently accepted (39). Safe identification of the vascular anatomy, vessel ligation at their origin, meticulous dissection, and lymph nodes harvesting is often tricky using the mini-invasive technique (40) and especially using minilaparotomy. The closure of mesentery, especially in obese patients is more comfortable to perform laparoscopically (41). The above-presented review shows many weak points. The short- and long-term outcomes of laparoscopic-assisted right colectomies are robust. But the number of studies evaluating right colectomies using minilaparotomy and their quality is limited. The groups of

patients are small, study designs are different, and selection bias was undoubtedly challenging to avoid. Patients were not blinded to the surgical approach they were allocated to receive; nonrandomized assignment affected the outcome. It is almost impossible to compare studies with fundamental differences in inclusion and exclusion criteria, various endpoints, different surgical techniques, and different postoperative follow up. And finally, reliable long-term results for minilaparotomy are not available. In state of the art about the surgical approach to right colon cancer, published by Fabozzi *et al.* in 2016, the minilaparotomy technique is not mentioned at all (41).

Generally, the data supported minilaparotomy for right colectomy are limited to a small group of selected patients mainly from Japan and East Asia. The most common authors conclude that the minilaparotomy approach is an alternative to the laparoscopic approach in selected cases (15-17). The superiority of minilaparotomy was never confirmed. Moreover, currently pure laparoscopic right colectomy with intraabdominal anastomosis is more and more preferred technique compare to extra-abdominal anastomosis (42,43), but this topic will be discussed elsewhere. The question in the title of this article is “*What are the benefits of laparoscopic-assisted right colectomy with extracorporeal ileocolic anastomosis as compared to open thru minilaparotomy?*” The short answer is: “*The postoperative course is favorable without a selection of patients, oncological principles are entirely accepted, and adequate long-term results are confirmed.*”

Conclusions

The laparoscopic technique has become a standard approach. The outcomes for right colectomies using minilaparotomy method were similar to laparoscopy in selected cases only. There is no evidence of superiority. But there is increasing proof for laparoscopic-assisted right colectomy with intracorporeal anastomosis. Currently, we don't see any reason why started right colectomy via minilaparotomy.

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