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The Role of Laparoscopic Surgery in the Management of Children and Adolescents With Inflammatory Bowel Disease

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Abstract: Although laparoscopic surgery is readily used in the management of inflammatory bowel disease (IBD) in adults, its role in the surgical treatment of IBD in the pediatric population is not well established. The aim of this narrative review was to analyze the published evidence comparing laparoscopic and open resection in the management of children and adolescents with IBD.

The Pubmed and Embase databases were searched using the terms ''inflammatory bowel disease,'' ''children,'' ''adolescents,'' ''laparoscopic,'' and ''colectomy.''

The review identified 10 appropriate studies. Even though laparoscopic surgery generally resulted in longer operating times (between a mean of 40 and 140 min), benefits included reduced postoperative pain (mean duration of opiate use 3 vs 6 days) and reduced length of stay (median length of stay 5–8 vs 10.5–19 days) compared with open surgery. Postoperative complication rates were similar following both approaches.

Due to the limited available data and the small sample size of the published series, definite recommendations are not able to be drawn. Nevertheless, current evidence indicates that laparoscopic colorectal resection is safe and feasible in the management of IBD in the paediatric population, with reductions in postoperative pain and length of hospital stay achievable.

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Abbreviations: CD = Crohn disease, IBD = inflammatory bowel disease, SBO = small bowel obstruction, UC = ulcerative colitis.

INTRODUCTION

Up to 25% of patients with inflammatory bowel disease (IBD) present with symptoms before the age of 18 years.[1–4] Data from a UK national prospective study indicate that the incidence of IBD is 5.2 per 100,000 in children ages 16 or younger.[5] The management of IBD is generally medical at initial presentation, with surgery being reserved for patients with disease refractory to medical management or complications that require emergency surgical intervention, such as bowel obstruction, perforation, or life-threatening haemorrhage.[2–4,6,7] It is estimated that up to 80% of patients with Crohn disease (CD) will require surgical intervention during their lifetime.[8]

Minimally invasive surgery is now increasingly used in the management of IBD in adults, with reduced morbidity and length of stay reported, as well as faster return to normal diet postoperatively.[9] A Cochrane review in 2011 compared two randomized control trials (n = 120) and demonstrated that there is no significant difference in morbidity and mortality between open and laparoscopic surgery in IBD, indicating that laparoscopic surgery is a feasible and safe option in the adult population.[10] In addition, the review reported improved cosmesis, reduced risk of adhesions, and lower incidence of postoperative abdominal wall hernia formation as additional advantages of minimally invasive surgery.[10] These potential benefits are reflected in the increasing use of the laparoscopic approach in the paediatric population. Nonetheless, the available data remain scarce and the literature supporting laparoscopic resection for the treatment of IBD in the paediatric population is limited.[7,11,12]

The aim of this narrative review was to analyze the published evidence comparing laparoscopic and open resectional surgery in the management of children and adolescents with IBD, determining the role and feasibility of minimally invasive surgery in this population.

METHODS

A literature search of the Pubmed and Embase databases was performed by 2 independent researchers (A.E.P. and S.G.S.) using the search terms ''inflammatory bowel disease,'' ''children,'' ''adolescents,'' ''laparoscopic,'' and ''colectomy.'' The search was confined to manuscripts published in the English language. As this is a narrative review, ethical approval was not required.

RESULTS

From the 22 studies identified during the search, 10 reported results on the laparoscopic surgical management of paediatric patients with IBD and were included in the analysis (Table 1). Outcomes following surgery, including operative time, technical difficulty, postoperative management (time to oral intake and length of opiate use), complications, and cosmesis, were compared for those children and adolescents with IBD undergoing laparoscopic and open resectional surgery.

Operative Time and Technical Difficulty

Often quoted disadvantages of a laparoscopic resection are the high degree of technical difficulty and potentially longer operative times associated with the procedures. This was suggested in one of the first series to report outcomes from laparoscopic surgery in the paediatric IBD population,

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TABLE 1. Results of Narrative Review

Author	Year	No. Patients	No. of Laparoscopic Patients	No. of Open Patients	Complication Rates (Lap Vs Open)	Operating time* (Lap vs Open - mins)	Length of stay* (Lap vs Open -days)	Length of opioid use* (Lap vs Open -days)	Time to oral intake* (Lap vs Open -days)
Tan[12]	2009	22	11	11	1 vs 4	443 vs 403	14 vs 19	–	–
Flores[13]	2010	32	13	19	11 vs 33	301–470 vs 197–330	5.3–8 vs 10–19	3–4 vs 4.6–6	2.5–3.5 vs 3.6–6.2
Diamond[2]	2010	136	154	–	65 vs -	125–299 vs -	6 vs -	3 vs -	5 vs -
Mattioli[7]	2011	16	25	–	6 vs -	160–250 vs -	5–7 vs -	2 vs -	–
Courtney[3]	2011	19	15	4	2 vs 1	172.5 vs 150	6 vs 8	–	–
Chatzizacharias[18]	2012	1	1	–	0 vs -	210 vs -	6 vs -	–	–
Linden[14]	2013	107	68	39	19 vs 27	328–517 vs 222-430	6–7 vs 6–7	–	–
McMullin[15]	2014	30	27	3	–	165 vs -	-	–	–
Sheth[11]	2014	82	45	37	15 vs 9	370–492 vs 390-530	15 vs 17	–	–
White[9]	2014	207 (including adults)	76	131	51 vs 61.5	208 vs. 285	6 vs. 8	–	–

*Median or mean.

including 32 children that underwent surgery for UC during an 18-year period.[13] The cohort included 25 patients who had a subtotal colectomy and end ileostomy and the outcomes of laparoscopic (n = 10) and open surgery (n = 15) were compared. The remaining 7 children had either laparoscopic (n = 3) or open (n = 4) proctectomy and ileoanal pouch or single-stage proctocolectomy and ileoanal pouch formation. Laparoscopic surgery was deemed a more technically demanding approach, particularly in the presence of thickened mesentery and friable bowel in these patients. Consequently, the duration of some of the laparoscopic procedures was significantly longer than that of the open ones. More specifically, operation time was longer for a mean of 104 minutes for laparoscopic subtotal colectomy and for a mean of 140 minutes for single-stage proctocolectomy with ileoanal pouch formation. No significant difference was identified in the operative time between open and laparoscopic proctectomy and ileoanal pouch, although the numbers in these groups were small. Over the course of the study, however, surgical times for laparoscopic procedures improved significantly and were comparable to those of open surgery.[13] This was not the patient in the largest reported series (n = 136), in which no reduction in laparoscopic operating times was observed (median time 258 minutes).[2] Linden et al reported longer operating times with a laparoscopic approach (median time 517 minutes vs 430 minutes),[14] whereas in one series no significant difference in operating time was identified between laparoscopic and open restorative proctocolectomies (mean total operating time of 443 vs 403 minutes, respectively).[11] In general, laparoscopic resections resulted in longer operating times between a mean of 40 and 140 minutes.

With regards to conversion to an open operation, Diamond et al[2] reported a 7.1% conversion rate. The primary reasons identified were poor visibility and inability to complete the sigmoid transaction via the minimally invasive approach. A similar conversion rate was reported by Courtney et al (6.7%).[3] Even though 0% conversion rates have also been reported,[7,13,15] a rate around 7% is considered acceptable and seems comparable with the adult population (7.9%).[10]

Postoperative Management

Introduction of oral intake is an important parameter in the management of patients after surgery. Laparoscopic surgery in adults is considered a less invasive approach, with reduced incidence of ileus in the postoperative period and consequently earlier introduction of oral feeding.[16] This observation was also reported in the surgical management of paediatric patients with IBD.[3,17] Two studies have reported introduction of oral fluids in these patients after laparoscopic surgery after an average of 3 days, which compares with 6 days following an open resection.[2,13] In 1 cohort, clear fluids were introduced at 4 days after laparoscopic colorectal surgery and regular diet at day 5.[2] Data published from adult studies show that there is no significant difference in length of opiate use between the 2 groups.[10] However, it is predicted that pain management and early mobilization are more readily feasible after laparoscopic surgery. This concurs with the data reported in the paediatric population with opiate analgesia being required for 2–3 days postoperatively in the laparoscopic group, versus up to 6 days in the open surgery group.[2,7,13]

Postoperative Complications

In the adult population with IBD, the Cochrane review of 2011 concluded that there is no difference in morbidity and

mortality between the 2 approaches.[10] Similar evidence has been reported in the paediatric population.[3,13] Of note, the overall incidence of complications was higher in the open subgroup in only 1 study (0% vs 7%), mainly due to the increased rate of infective complications.[13] Conversely, in 1 series a higher incidence of complications was identified in the laparoscopic group (12.5% vs 0%).[3] However, the size of the series is small and the only complication reported was a urine infection. Different series reported overall complication rates between 20 and 62.8% after laparoscopic colorectal procedures.[2,7,15] However, in these series, no open group sample was included for comparison. In addition, if laparoscopic surgery is compared between the adult and paediatric population, there is no difference in the complication rates (23% vs 20%, respectively).[15] The higher complication rate observed in 1 of the series can most likely be attributed to the fact that most of the patients were on active medical treatment for their IBD at the time of the operation, with 59% being on steroids.[2]

Small bowel obstruction (SBO) was the most common postoperative complication, with incidence ranging between 3% and 23%.[2,7,11,13] No clear association was identified between SBO rates and surgical approach, even though a trend toward increased rates was seen with open colorectal procedures. Small bowel obstruction was more common after open procedures in 1 series and occurred in 23% of patients (vs 5% of laparoscopic patients).[14] However, some series reported conflicting data, with SBO seen in 3–13% of patients after laparoscopic surgery.[11,13] In 1 cohort the reason hypothesized for SBO in laparoscopic surgery was the formation of an internal hernia caused by a tight window between the fixed terminal ileum and the abdominal wall. When this was accounted for using a number of different surgical techniques, SBO rates dropped significantly from 37.5% to 12.5%.[7]

Other significant complications reported following resectional surgery in IBD included anastomotic leak (2.2%),[11] haemorrhage (4.3%),[12,13] anastomotic stricture (13% after laparoscopic vs 28% after open surgery),[7,14] rectal stump dehiscence (6.3%),[7] intraabdominal fistulae (2.4%), and abscesses (7.1%).[2,13] Infective complications were more prevalent in the open group, with intraabdominal fistulae, pouchitis, and sepsis occurring more frequently.[7,13] It is important to note that half way through 1 of the 2 studies, open procedures were no longer performed electively; hence, the open group included only patients requiring an emergency procedure, who have an acknowledged higher risk of developing complications.[13] Intraoperative blood loss was lower during laparoscopic colorectal procedures and this was attributed to the good haemostatic control achieved by the use of laparoscopic energy sealing devices, as well as meticulous surgical technique and attention to fine detail.[11]

Length of Hospital Stay

The early introduction of oral diet and less analgesia requirements associated with laparoscopic surgery, with no increase in the complication rate compared with open surgery, may translate to shorter hospital stay. Not surprisingly, this has been demonstrated in most series. The median reported length of stay varied between 5 and 8 days,[2,3,7,13] whereas only 1 study reported similar length of stay at a median of 7 days in both their study groups.[14] Flores et al reported a significantly shorter length of stay with laparoscopic surgery, with a mean of 8 days in hospital versus 19 days following open surgery.[13] Similar data were reported by Courtney et al (6.7 days with laparoscopic vs 10.5 days with open surgery).[3] Sheth and Jaffray noted longer lengths of stay postoperatively compared with other series, but again patients after minimally invasive surgery were discharged 2 days earlier (15 days for laparoscopic surgery vs 17 days for open surgery).[11]

Cosmesis

Although laparoscopic surgery is considered to be preferable to open surgery in terms of improved cosmesis, there are no current published data to support this. Interestingly, in 1 series 40% of children were unsatisfied with the cosmetic results following laparoscopic surgery.[7]

DISCUSSION

Laparoscopic surgery is widely practised in the management of IBD in the adult population. The benefits of a minimally invasive approach include reduced postoperative pain and morbidity and a shorter hospital stay. Nonetheless, it is a more technically demanding operation and careful patient selection is warranted.[10] Patients with no previous abdominal surgery, low body mass index, and favourable body habitus are the ideal candidates.[18] In addition, technical difficulty is increased in patients of IBD because of the fact that the bowel may be friable resulting in challenging handling and mobilization.

With regards to the paediatric population, data remain limited. Furthermore, many reports on the utilization of minimally invasive techniques in colorectal surgery in this population include patients with non-IBD-related problems, such as polyposis syndromes, constipation, and Hirschsprung disease. Even in those studies that report outcomes following IBD surgery, the data are heterogeneous due to the inclusion of adult patients and patients needing surgery for CD and UC. In addition, these studies generally have a small sample size, while no randomized trials of laparoscopic versus open surgery in the paediatric IBD population have been published. Because of all these limitations, any conclusions should be considered with caution. Nonetheless, the published literature supports the feasibility of minimally invasive surgery for IBD in children and adolescents. The increased technical difficulties and the generally small experience in this population may result in longer operative times.[2,13] However, with increasing experience, operative time may be reduced.[13] Complication rates and length of stay are generally reported as either comparable or reduced in the laparoscopic group.[2,3,7,11–14] This may translate into a quicker return to educational activities and the patient's psychosocial health being less affected. Furthermore, the economic burden to the overall healthcare system may be reduced.

It is thought that with laparoscopic surgery, superior cosmesis may improve body image after surgery. However, only 1 study has quantifiable data showing results on cosmesis in the paediatric population, reporting a 40% rate of patient-reported dissatisfaction with the cosmetic results.[7] Further data in the paediatric population are needed in this area. More recently, case reports have advocated the potential role of single incision minimally invasive surgery in the management of children and adolescents with IBD.[18–21] Single incision laparoscopic surgery carries the theoretical advantage of reduced hospital stay and improved cosmesis, with less chance for wound infection and incisional hernias. The technique has considerable technical challenges however, and further data are needed to clarify the role of this approach in the paediatric population.

It becomes clear that despite some potential advantages, the laparoscopic approach increases the complexity of the surgery in these patients. In addition to a dedicated paediatric gastroenterology team, a specialized colorectal surgical team with significant experience and technical expertise in minimally invasive surgery is required. The role and contribution of all the members of the multidisciplinary team, including nursing staff on the ward and in theatres, IBD specialist nurses, play specialists, and psychologists, is paramount in the different aspects and phases of care. Furthermore, the use of specialized and potentially costly, disposable laparoscopic surgical equipment should also be considered. Therefore, minimally invasive surgery for the management of children and adolescents with IBD should be practised in the tertiary hospital setting, in which appropriate clinical pathways can be instituted by appropriate teams.

Notwithstanding the small numbers and poor quality of the published data, current evidence suggests that laparoscopic colorectal surgery is safe and feasible for the management of IBD in the paediatric population and should be considered a management option. Key factors for successful outcome are careful patient selection by an experienced IBD surgical team within a paediatric gastroenterology multidisciplinary IBD team.

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