Ileal pouch anal anastomosis in pediatric familial adenomatous polyposis: A 24-year review of operative technique and patient outcomes

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ABSTRACT

Background: Total proctocolectomy with ileal pouch anal anastomosis (IPAA) is the operative procedure of choice for familial adenomatous polyposis (FAP) patients. We review 24 years of operative experience and outcomes in pediatric patients with FAP.

Methods: Patients with FAP, age < 20 years, presenting to a single institution between 1987 and 2011 were included. Operative technique and outcomes were reviewed retrospectively. Primary outcomes included postoperative complications (30 days), long-term bowel function, and polyp recurrence at the anal anastomosis.

Results: 95 patients with FAP underwent IPAA. Mean age at IPAA was 15.5 years with a mean follow-up of 7.6 years. 29 patients underwent 1-stage IPAA, 65 patients had a two-stage IPAA, and 1 patient underwent a 3-stage procedure. 67 patients had an open procedure, 25 underwent a laparoscopic approach, and more recently 3 patients underwent single incision laparoscopic IPAA. Patients with 1-stage IPAA demonstrate better long term bowel control vs. 2-stage IPAA patients (10.7% vs. 36.0% occasional incontinence, p = 0.018). However, 1-stage IPAA patients suffered increased short-term complications, such as anastomotic leak (17.2% vs. 0%, p = 0.002) and reoperation (20.7% vs. 4.6%, p = 0.02) compared to 2-stage IPAA. Anal anastomosis polyp recurrence occurred in 22.7% of 1-stage patients and 10.0% of 2-stage patients. Short-term complications, polyp recurrence, or long-term continence were equivalent between open and laparoscopic cases.

Conclusion: Single-stage IPAA in children with FAP is associated with better bowel control but increased anastomotic leak, reoperative rate, and polyp recurrence. In experienced hands, laparoscopic IPAA is equivocal to open IPAA.

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Familial adenomatous polyposis (FAP) is an autosomal dominant syndrome characterized by mutation in the Adenomatous Polyposis Coli (APC) gene on chromosome 5 [1]. FAP leads to formation of numerous adenomatous polyps in the colorectum, beginning in the first and second decades of life. Progression to colorectal cancer (CRC) occurs in almost 100% of cases by 40 to 50 years of age [2]. Approximately 80% of patients have a documented family history of FAP, while 20% appear to be de novo mutations [1,2].

Prevention of colorectal cancer in FAP patients has long been managed by colectomy. Total proctocolectomy with ileal pouch anal anastomosis (IPAA) is a restorative procedure which effectively minimizes the risk of CRC by maximal removal of at-risk mucosa while maintaining bowel continence [3]. Abdominal colectomy with ileorectal anastomosis has been used for FAP patients with rectal sparing, however 30% of these patients will develop rectal cancer by age 60 years [4]. Therefore, our preferred approach has been and remains IPAA.

IPAA has been widely used since the early 1980s and can be performed with many technical variations. As with any surgical procedure over the past two decades, IPAA is now commonly performed laparoscopically in addition to the traditional open technique. It has also recently been described with a single site laparoscopic technique [5]. Furthermore, the procedure has been performed with and without diverting ileostomy [6]. Finally, the anal anastomosis may be performed with a circular stapler or involve a rectal mucosectomy with hand sewn anastomosis.

The purpose of this study was to review our experience with ileal pouch anal anastomosis in pediatric patients with familial...
adenomatous polyposis at a single institution, with emphasis on technical surgical variations and patient outcomes.

1. Materials and methods

Our institution is a tertiary care center which serves the local population of southeast Minnesota and a large referral population. This study was approved by the institutional review board. All patients with a diagnosis of FAP who underwent total proctocolectomy with ileal pouch anal anastomosis from 1987 to 2011 and were ≤20 years of age at the time of surgery were included. Patient medical records were retrospectively reviewed for diagnosis, operative technique, postoperative outcomes and complications.

Diagnosis of FAP was confirmed by either a positive genetic test in recent patients, or clinical presentation with pathologic confirmation of adenomatous polyps. Final surgical pathology reports were reviewed to confirm presence of adenomatous polyps. Final surgical pathology reports were reviewed to confirm extent of polyposis, degree of dysplasia and presence/absence of invasive cancer.

Surgical reports were reviewed for operative technique. Variables recorded included use of laparoscopy, number of surgical stages employed (1-, 2-, and 3-stage procedures), and anal anastomosis technique (stapled vs. mucosectomy). One-stage procedures included total proctocolectomy with creation of IPAA with no diverting stoma. Two-stage procedures included total proctocolectomy with ileal pouch anal anastomosis and diverting ileostomy, where the diverting ileostomy was closed during the second-stage procedure. Three-stage procedures included total abdominal colectomy with end ileostomy, followed by a second stage with completion proctectomy, IPAA creation and diverting loop ileostomy, and then a final third stage with closure of the diverting ileostomy. Operative technique was determined by surgeon preference and local conditions at the time of surgery.

All postoperative complications were recorded with particular attention to anastomotic leak, abscess, wound infection, small bowel obstruction, and pouchitis. Anastomotic leak and bowel obstruction were confirmed with imaging (CT and/or X-ray). Wound infection and pouchitis diagnoses were made clinically. Short term complications were those occurring within 30 days after the final stage of the IPAA procedure, whereas long term complications were those encountered after 30 days. Reoperation for these complications was also tracked.

Bowel function was recorded as noted in last clinical follow-up documentation from the medical record. Polyp recurrence was monitored with annual or biannual pouchoscopy. Polyp recurrence was recorded as documented in follow-up pouchoscopy reports.

Statistical analysis was performed using T-tests for continuous variables. Chi square analysis and Fisher exact tests were employed for comparison of categorical variables. Logistic regression analysis was also performed where appropriate. Statistical significance was defined as p ≤ 0.05 for all of the above.

2. Results

Ninety-five patients ≤20 years with FAP underwent IPAA at our institution between 1987 and 2011. Average age at FAP diagnosis was 13.9 years (range 4–20 years). Mean age at surgery was 15.4 years (range 4–20 years) (Fig. 1). Mean follow-up was 7.6 years (range 0–24 years). Gender was equally distributed with 43 males (45%) and 52 females (55%). The indication for surgery was primary cancer prevention in 92 patients and treatment of active bleeding in the remaining 3 patients. All patients had greater than 50 colorectal polyps demonstrated by endoscopy preoperatively.

Median and mean postoperative length of stay was 9 days (range 3 to 48 days). Twenty-one short-term (30-day) postoperative complications occurred in 19 of 95 patients, where 9 (9.4%) patients required reoperation (Table 1). Fifty-two long term complications were documented in 35 of the 95 patients, with reoperative rate of 19.8% for these complications (19 patients) (Table 2).

Overall functional outcomes were positive, with 58 (72.5%) patients reporting no problems with incontinence. Nighttime soiling was occasional in 8 patients (10%) and occasional daytime leakage was reported by 13 (16%) patients. No patients reported complete incontinence. Fifteen patients had no documentation of bowel incontinence.

Ninety-four (98.9%) patients had a functional pouch at last follow-up, and only one has required pouch excision (secondary to early obstructive complications). Nine (9.4%) patients had documented recurrence of adenomatous polyps at the anal anastomosis, all of which were successfully managed with local transanal or endoscopic resection, and no patients had adenocarcinoma in these specimens.

Twenty-nine patients underwent 1-stage IPAA, 65 patients underwent 2-stage IPAA, and one patient had a 3-stage procedure.
Outcomes from the 1-stage and 2-stage patients were compared. Comparison of postoperative complications is available in Tables 1 and 2. Patients with the 1-stage IPAA demonstrate better long term bowel control compared to the 2-stage IPAA (10.7% vs. 36.0% occasional incontinence, p = 0.018). Patients in the 1-stage group suffered increased 30-day postoperative complications, such as anastomotic leak (17.2% vs. 0%, p = 0.002) and reoperation for complications more frequently than patients with 2-stage IPAA (20.7% vs. 4.6%, p = 0.02). All 1-stage procedures were performed by a single experienced pediatric surgeon. 2-stage procedures were performed by one of eight surgeons, with either pediatric surgical or colorectal surgical subspecialty training. Stapled anastomosis was performed in by one of eight surgeons, with either pediatric surgical or colorectal surgical subspecialty training. Stapled anastomosis was performed in 3 of 65 (4.6%) patients compared to 4/29 (13.8%) in the 1-stage group (p = 0.039). The mean length of hospital stay was longer in the laparoscopic group (10 days lap vs. 9 days open, p = 0.0001).

Eighty-five patients had a mucosectomy with hand sewn anastomosis, while only 11 had a stapled anal anastomosis. The low volume of stapled anastomoses precludes meaningful statistical comparison of these two groups.

Of note, our youngest patient was 4 years old and presented with rectal bleeding. Subsequent endoscopy revealed extensive polyposis and the patient underwent subsequent IPAA because of the severe presentation despite young age.

Polyp recurrence at the anal anastomosis occurred in 22.7% of 1-stage patients and 10.0% of 2-stage patients (p = 0.21). Surgical pathology revealed low grade dysplasia in 90% of protocolectomy specimens at the time of IPAA. However, 5 patients (5%) had high grade dysplasia (ages 13, 16, 17 and two 20 years). More concerning however, 4 children were found to have invasive cancer at the time of surgery (ages 18, 19 and two 17 years). Using the TMN staging system, tumor stage ranged from T2 to T4 in these patients. One patient had 2 synchronous adenocarcinomas in the sigmoid. Secondary to our routine use of intraoperative frozen pathology, all patients with confirmed adenocarcinoma underwent appropriate oncologic lymphadenectomy at the time of surgery. Three patients had no lymph nodal involvement, while the remaining patient had a single lymph node involved by adenocarcinoma. Patients with invasive adenocarcinoma were referred to a medical oncologist for appropriate adjuvant treatment and as indicated by stage of disease. All IPAA patients were alive at last follow-up with no documented occurrence (or recurrence) of colorectal cancer.

3. Discussion

FAP is a rare genetic condition with few pediatric studies available examining surgical outcomes. We present the largest series to date of pediatric FAP patients undergoing IPAA (n = 95). Recently, Booij et al. reported their overall operative experience with pediatric FAP patients [7]. Their study includes 43 patients, 9 of whom underwent IPAA and 34 with ileorectal anastomosis. This differs from our practice where the majority of FAP patients undergo IPAA. During our study interval, only 13 patients underwent ileorectal anastomosis at our institution (data not available). Results of the Booij study showed that 7/34 (20.5%) of ileorectostomy patients eventually required completion proctectomy, and 2 patients died from metastatic colorectal cancer at ages 39 and 40 years. We have no documented cases of cancer after IPAA to date.

A 50-year review from the Cleveland Clinic showed that with selective screening of adult FAP patients with rectal sparing, ileorectostomy can be safely performed with minimal risk (0%) of subsequent rectal cancer development. However, prior to this selective management, 12.9% of patients developed rectal cancer following ileorectostomy [8]. Rectal sparing is more often associated with attenuated FAP and an older onset, thus not commonly seen among the pediatric population. Ileorectal anastomosis can be selectively considered for the few children who present with rectal sparing, although IPAA remains a more appropriate choice for most children who will have rectal polyposis involvement.

Our data indicate that laparoscopic-assisted IPAA can be performed safely and with equivocal results to open IPAA when performed by experienced surgeons. We saw no difference in overall complications or bowel function between the lap and open groups. This has been well documented in adults [9] and a few pediatric

### Table 1

<table>
<thead>
<tr>
<th>Complication</th>
<th>1-Stage IPAA (n = 29)</th>
<th>2-Stage IPAA (n = 65)</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anal Stricture</td>
<td>4 (13.8)</td>
<td>3 (4.6)</td>
<td>0.19</td>
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<tr>
<td>Wound Infection</td>
<td>0 (0)</td>
<td>2 (3.1)</td>
<td>1.0</td>
</tr>
<tr>
<td>SBO</td>
<td>6 (6.9)</td>
<td>3 (4.6)</td>
<td>0.64</td>
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<tr>
<td>Anastomotic Leak</td>
<td>5 (17.2)</td>
<td>0 (0)</td>
<td>0.002</td>
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<tr>
<td>Abscess</td>
<td>1 (3.4)</td>
<td>1 (1.5)</td>
<td>0.51</td>
</tr>
<tr>
<td>Hospital Readmission</td>
<td>1 (3.4)</td>
<td>2 (3.1)</td>
<td>1.0</td>
</tr>
<tr>
<td>Reoperation</td>
<td>6 (6.9)</td>
<td>3 (4.6)</td>
<td>0.019</td>
</tr>
</tbody>
</table>

Values are provided in n (%).

SBO = Small bowel obstruction.

* Statistically significant.

### Table 2

<table>
<thead>
<tr>
<th>Complication</th>
<th>1-Stage IPAA (n = 29)</th>
<th>2-Stage IPAA (n = 65)</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anal Stricture</td>
<td>7 (24.1)</td>
<td>15 (23.1)</td>
<td>1.0</td>
</tr>
<tr>
<td>Wound Infection</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>1.0</td>
</tr>
<tr>
<td>SBO</td>
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<td>0.27</td>
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<tr>
<td>Anastomotic Leak</td>
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<td>3 (4.6)</td>
<td>0.55</td>
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<tr>
<td>Abscess</td>
<td>0 (0)</td>
<td>1 (1.5)</td>
<td>1.0</td>
</tr>
<tr>
<td>Pouchitis</td>
<td>5 (17.2)</td>
<td>6 (9.2)</td>
<td>0.30</td>
</tr>
<tr>
<td>Hospital Readmission</td>
<td>2 (6.9)</td>
<td>8 (12.3)</td>
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<tr>
<td>Reoperation</td>
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<td>9 (13.8)</td>
<td>0.79</td>
</tr>
</tbody>
</table>

Values are provided in n (%).

SBO = Small bowel obstruction.

* Statistically significant.
studies have also confirmed equivalency of lap vs. open colectomy in pediatric patients with a variety of underlying diagnoses [10–12]. More recently, single site laparoscopic colon resection and IPAA has been performed. From the few cases documented, this technique appears safe in experienced hands although further research is required before recommendation to broadly adopt this practice [5]. The length of stay in our laparoscopic group is reflective of the long study duration. Our current hospital stays after laparoscopic IPAA now average 3–5 days.

The need for diverting ileostomy and a staged procedure remains a topic of debate. Previous report by Ryan and Doody showed equivalence of restorative proctocolectomy with and without diverting ostomy [6]. However, our results conflict with that. The current study shows a statistically significant increased risk of anastomotic leak (17.2% vs 0%, p = 0.002) and reoperation (20.7% vs 4.6%, p = 0.02) in 1-stage patients compared to 2-stage patients. Furthermore, previous report from our institution indicates that pelvic sepsis is a critical determinant of pouch failure [13]. Thus, our current recommendation is for a highly selective approach to 1-stage reconstruction. We would consider no diverting ileostomy in patients that undergo a technically straightforward resection and ileoanal anastomosis with minimal tension. Additionally, we tend to use diversion in stapled ileoanal procedures.

Patients with the 1-stage IPAA demonstrated better long term bowel control compared to the 2-stage IPAA (10.7% vs. 36.0% occasional incontinence, p = 0.018). However, this data reflects only what bowel function was subjectively documented at last follow-up and was not available for 15 patients, therefore should be interpreted with caution. Despite multivariate analysis (including age, gender, method of anal anastomosis, postoperative complications, or use of laparoscopy) only the number of stages appears significantly correlated with continence. We are uncertain why 1-stage vs 2-stage IPAA would result in better bowel continence and more detailed research is required to clarify this. Of note, a single surgeon performed the 1-stage procedures, whereas several surgeons performed the 2-stage procedures. The better functional outcomes may be related to a subtle operative technique or variation that we are unable to fully evaluate with retrospective chart reviews.

A strength of our study is the large sample size (95 patients) and the variety of patients seen at our institution secondary to a wide referral base. The retrospective nature of our data is a weakness. The variety of patients seen at our institution secondary to a wide referral base. The retrospective nature of our data is a weakness. The long study duration. Our current hospital stays after laparoscopic IPAA now average 3–5 days.

In conclusion, total proctocolectomy with IPAA is a safe procedure for children with FAP and effectively minimizes the risk of colorectal cancer. IPAA may be performed either laparoscopically or open with equivalent results in experienced hands. We commonly perform 2-stage IPAA with diverting ileostomy to minimize anastomotic leaks and reserve 1-stage procedures for well selected patients. Further research is required to define optimal technique to maximize bowel continence.

Acknowledgments
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References