Primary Laparoscopic Pull-Through for Hirschsprung's Disease in Infants and Children

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● **Between November 1993 and September 1994, 12 primary laparoscopic colon pull-through procedures were performed in infants and children. The patients' ages ranged from 3 days to 6 years. The primary diagnosis in all 12 patients was Hirschsprung's disease. All children had their operations without construction of preoperative or postoperative colostomy. Three 5-mm abdominal wall ports were used for access to the peritoneal cavity. The sigmoid colon and proximal rectum were mobilized laparoscopically. A submucosal sleeve was developed transanally to meet the dissection from above. The colon was then pulled down in continuity, divided above the transition zone, and secured to the anal mucosa 5 to 10 mm above the pectinate line. Mean postoperative stay was 4 days. Laparoscopic visualization provides clear delineation of pelvic structures even in small infants. Laparoscopic pull-through requires no more time than similar open procedures, averaging just over 2 hours. The morbidities associated with colostomy formation and closure and the inconvenience of colostomy care are avoided with a one-stage technique. These benefits combined with the advantages of minimally invasive surgery make primary laparoscopic pull-through a potential advance in the surgical treatment of Hirschsprung's disease.**

INDEX WORDS: Hirschsprung's disease, aganglionosis, pull-through, laparoscopy.

THE TREATMENT of biopsy-proven colonic aganglionosis (Hirschsprung's disease) has traditionally consisted of preliminary diverting colostomy and later resection of the aganglionic segment accompanied by a pull-through of normally innervated colon down to the perineum. Colostomy closure is performed at the time of the pull-through or subsequently as a third-stage procedure. This approach entails two or three general anesthetics and hospitalizations with the attendant complications and inconvenience of a colostomy. Staged operative correction also delays colonic continuity for at least several months. A definitive, single-stage operative repair has many advantages and has been shown to be feasible not only in children but also in neonates. To date, primary pull-through has involved a laparotomy. Advancements in laparoscopic techniques and instrumentation now permit mobilization of the colon and a pull-through to be performed using a minimally invasive technique. The principal advantages offered by laparoscopic operations are avoidance of a painful abdominal incision, a more rapid return of bowel function, a shorter postoperative recovery, and an improved cosmetic appearance.

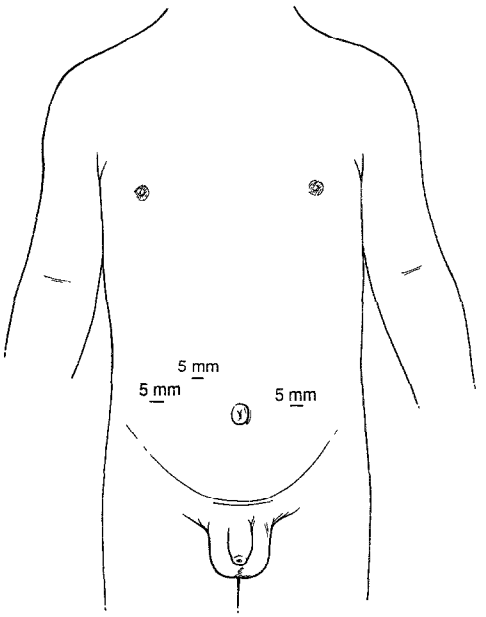

Fig 1. Sites of insertion of 5-mm trocars.

MATERIALS AND METHODS

Between November 1993 and September 1994, we performed primary laparoscopic colonic pull-through procedures in 12 children (10 boys, 2 girls). The patients' age ranged from 3 days to 6 years (5 neonates, 4 infants, 3 children) with weights from 2.3 kg to 20 kg. In each case, the diagnosis of Hirschsprung's disease was suggested by barium enema. A definitive diagnosis was made preoperatively by permanent section rectal suction biopsies and acetylcholinesterase studies. The transition zone between normal and noninnervated bowel was determined by intraoperative biopsies analyzed by frozen section. The level of aganglionic colon was rectosigmoid in 9 patients and descending colon in 3.

Technique

Preoperative decompression was performed either by finger dilatation of the rectum or by irrigation of the colon with saline. All patients were readily

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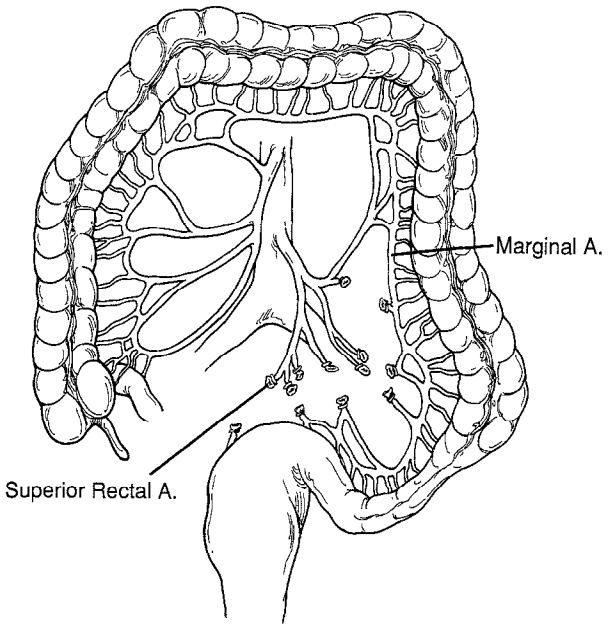

Fig 2. Division of colon and rectal mesentery.

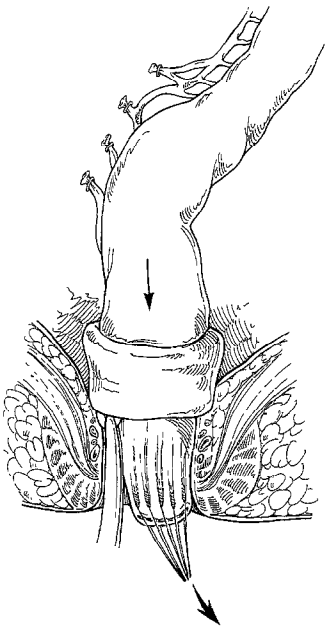

Fig 4. Placement of silk traction sutures into rectal mucosa and development of submucosal plane with blunt dissection.

decompressed with these measures. The patients were fasted preoperatively or were given an oral electrolyte solution (Pedialyte; Abbott, Ross Labs, Chicago, IL), 15 mL/kg every 3 hours. Two doses of an oral antibiotic regimen of erythromycin base and neomycin were given 14 and 8 hours preoperatively. An intravenous dose of ampicillin and gentamicin was administered on call to the operating room. With the patient positioned transversely at the end of the operating table, CO_2 insufflation of the peritoneal cavity was performed using a Varess needle inserted

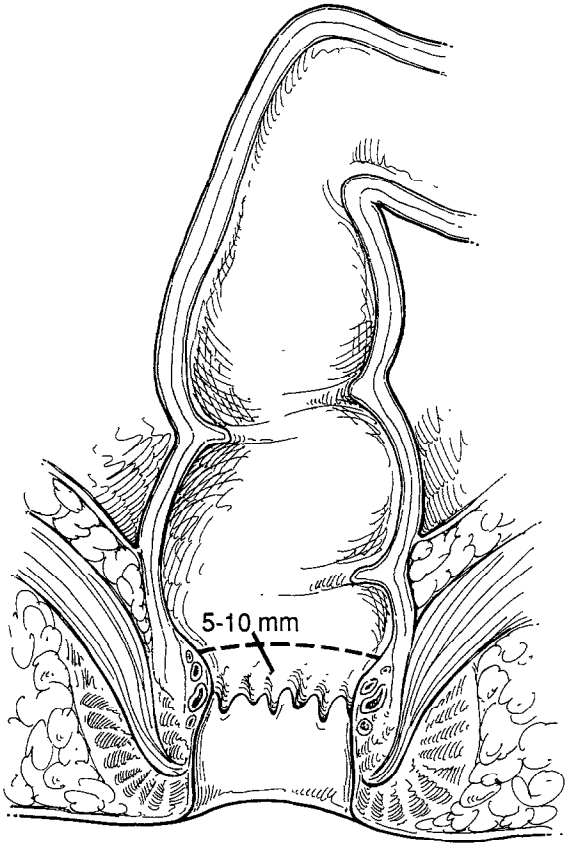

Fig 3. Mucosal incision 5 to 10 mm above pectinate line.

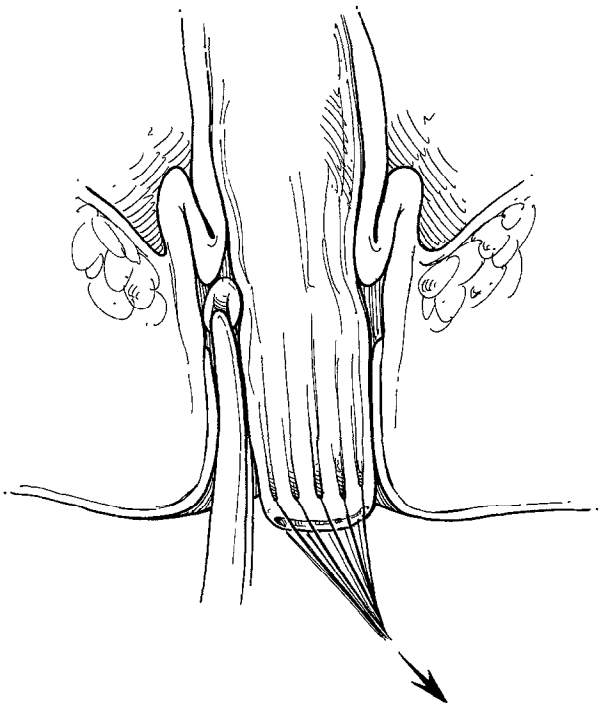

Fig 5. Extending submucosal plane to meet peritoneal dissection.

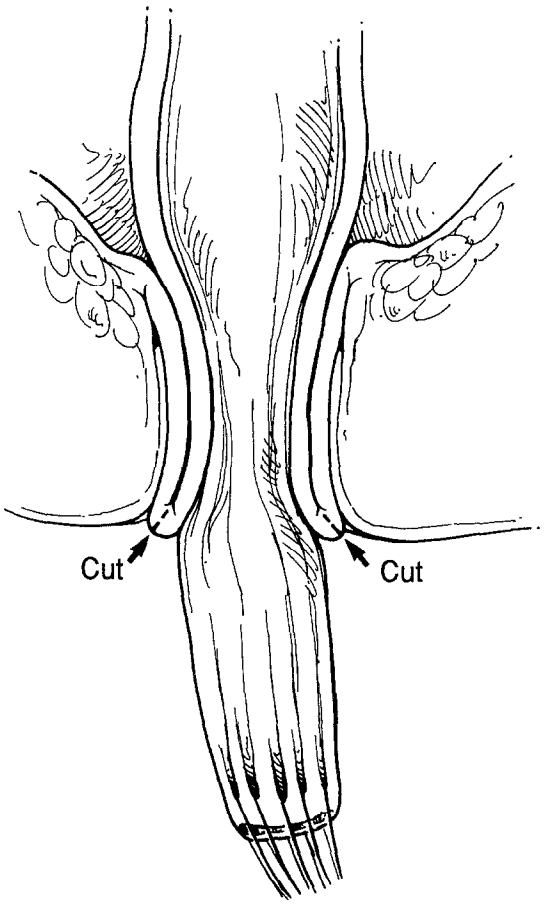

Fig 6. Transection of smooth muscle of rectum to join peritoneal dissection. Transection should begin posteriorly.

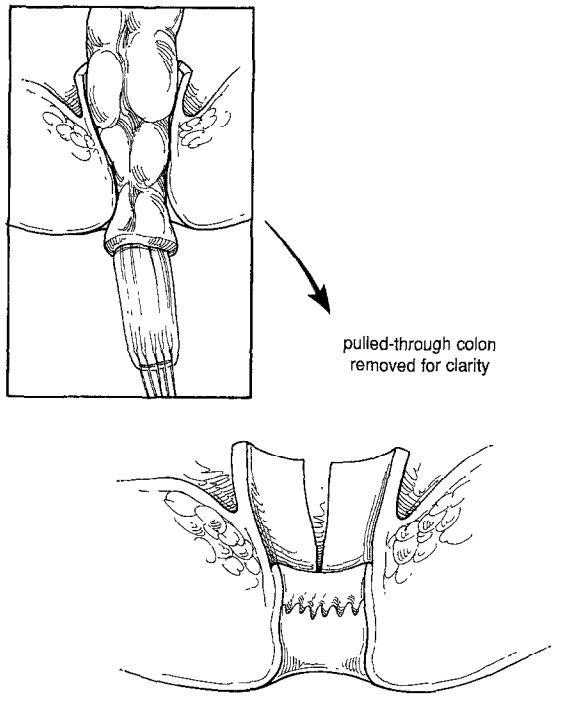

Fig 7. Splitting muscle sleeve posteriorly down to the level of the proposed anastomosis.

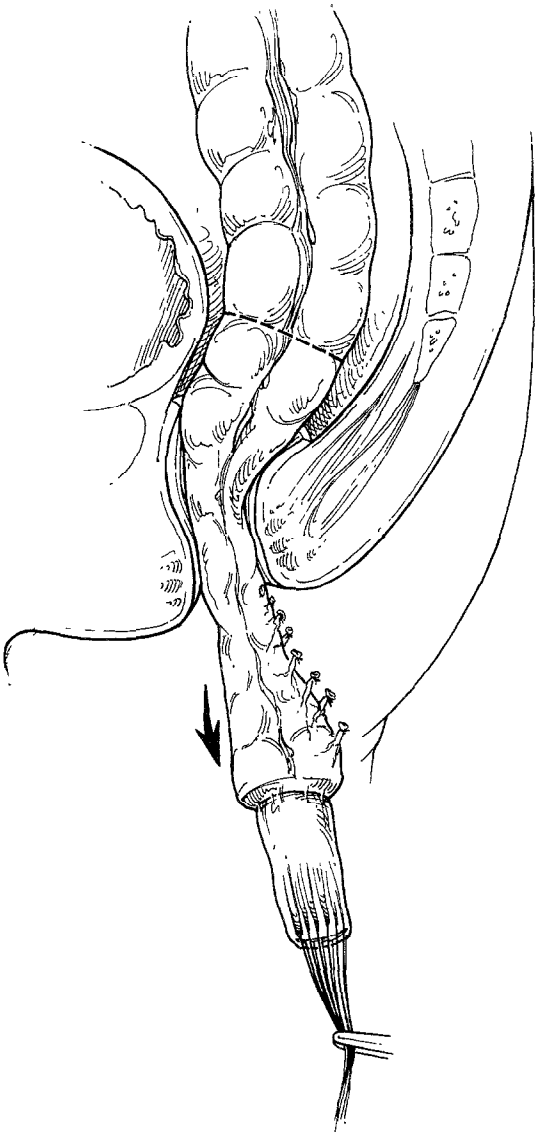

Fig 8. Rectum and colon pulled down in continuity, bringing transition zone through the anus.

through the abdominal wall. Three 5-mm trocars were inserted as shown in Fig 1. Using a 5-mm laparoscopic camera and standard laparoscopic grasping and dissecting instruments, the superior rectal vessels were divided with bipolar cautery or the ultrasonic scalpel (Fig 2). The mesentery was mobilized up to the level of the inferior mesenteric artery, which was also divided in patients with high transition zones. The colon fusion fascia was sharply incised. The mesocolon was divided up to a point that allowed adequate mobilization of the colon for the pull-through procedure. Pelvic dissection was extended circumferentially just outside the rectal wall distally to the level of the prostate or cervix anteriorly, and to the level of the coccyx posteriorly. The middle rectal arteries were divided using the ultrasonic scalpel or

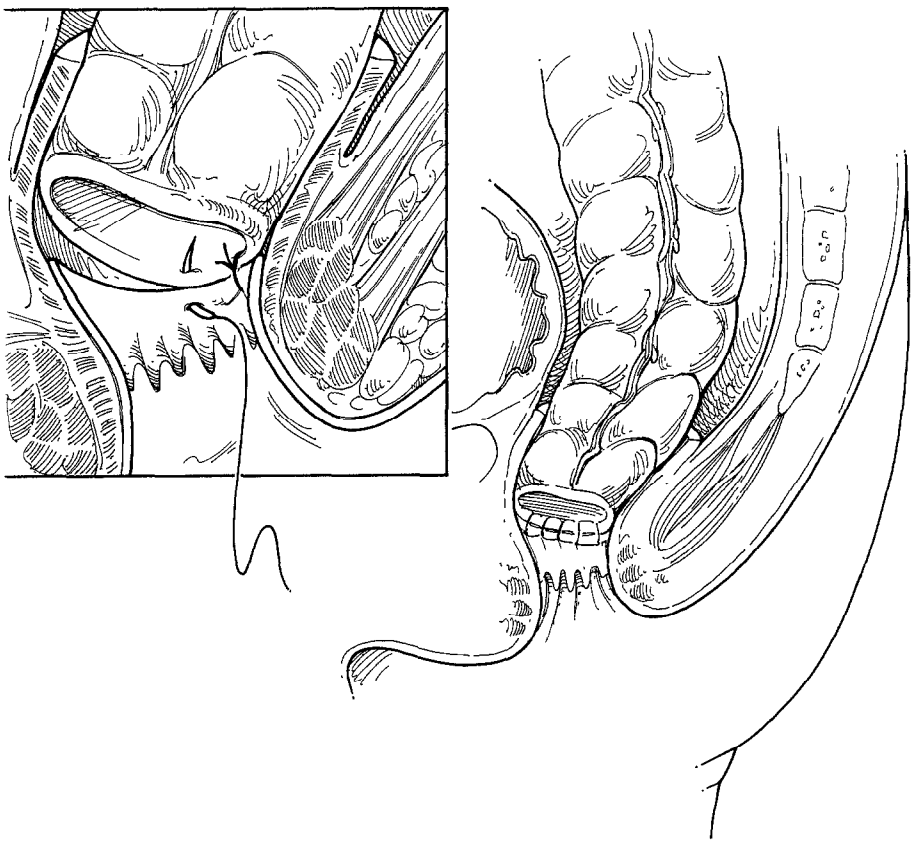

Fig 9. Securing neorectum to short anorectal cuff.

bipolar electrocautery. Transanal dissection was then begun. Normal saline containing 1:200,000 parts per million of epinephrine was injected submucosally to aid in the dissection. A circumferential incision was made in the mucosa 5 to 10 mm above the pectinate line (Fig 3). Fine silk traction sutures were placed through the mucosa to facilitate separation of the muscular wall (Fig 4). The transanal submucosal dissection was extended above the extramuscular plane (Fig 5). An incision was then made in the rectal muscle posteriorly to join the dissection from above. The smooth muscle fibers of the rectal sleeve were then divided circumferentially at this level (Fig 6). This muscle was also split posteriorly down to the proposed anastomotic line to accommodate the ganglionated colon to be pulled through the sleeve (Fig 7). The rectum and sigmoid colon were then pulled down through the rectal sleeve in continuity (Fig 8). The mesenteric vessels of the colon were divided between clamps outside the anus and ligated, freeing the colon to the level of ganglion cells. A full-thickness biopsy was sent to the pathologist for frozen-section confirmation of the presence of ganglion cells. The colon was then transected above this point and sutured to the transitional rectal mucosa using absorbable sutures placed circumferentially (Fig 9).

The peritoneal cavity was again inspected laparoscopically. The pelvis and divided mesocolon were observed for possible bleeding. The floor of the pelvis was reperitonealized laparoscopically in a few patients who appeared to be at risk for pararectal herniation of the small bowel. After experience was gained in the initial three operations, total operative time for the laparoscopic procedures did not differ significantly from historical controls who underwent pull-through operations by the standard open technique, averaging about 2 hours.

RESULTS

Oral feeding was resumed 1 to 3 days postoperatively (mean = 2) with discharge home on days 3 to 6 (mean = 4). Rectal dilatations were begun in all patients 3 weeks postoperatively and continued daily by the parents for 6 to 8 weeks. Initially a No. 7 or No. 8 Hagar dilator was used with incremental increases to a No. 14 Hagar dilator. No laparoscopic procedure required conversion to open laparotomy. One patient required a blood transfusion as a result of bleeding from the inferior mesenteric artery during dissection.

There were no other major intraoperative or early postoperative complications. Follow-up has ranged from 2 months to 1 year (mean = 6 months) and is too short to fully assess bowel function and continence. No patient has developed enterocolitis or anal stricture.

DISCUSSION

Colonic aganglionosis is being diagnosed at an increasingly younger age. Rectal biopsies are routinely performed as a bedside or outpatient procedure, and histochemical staining usually provides the definitive diagnosis of Hirschsprung's disease. Barium enema often helps to identify the transition zone, especially in the 24-hour follow-up film.

The traditional surgical approach has been to perform a laparotomy and diverting colostomy above the transition zone for ganglion cells.[1-3] Several months later, the patient returns for an open anorectal pull-through procedure with concurrent or subsequently staged colostomy closure. Single definitive procedures for the surgical treatment of Hirschsprung's disease and have been reported and have many important advantages[4-8] (personal communication, Coran AG, May 10, 1993). Among these are avoidance of additional hospital admissions, a shorter total hospital stay, a single anesthetic and operative procedure, and immediate colon continuity. Another benefit of the procedure described in this article is that the bowel is never opened intraperitoneally. The morbidities and psychological effects of colostomy formation, care, and closure are avoided with a one-stage procedure. In addition, more efficient use is made of hospital resources.

Experience in laparoscopic surgery as well as refinements in instrumentation have made possible the performance of increasingly complex intra-abdominal surgical procedures in infants and children. Laparoscopic visualization provides clear delineation of pelvic structures even in small infants. We have used this technique to safely perform one-stage pull-through procedures in children with Hirschsprung's disease with good early results. The apparent benefits of using a minimally invasive laparoscopic pull-through technique include clear delineation of pelvic structures, less postoperative pain,[9] a more rapid return of bowel function,[10] earlier discharge from the hospital, decreased adhesion formation,[11] and a better cosmetic result. As with any surgical procedure, and especially those performed laparoscopically, adequate experience and assistance is of utmost importance.[12]

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Discussion

G. Holcomb (Nashville, TN): Keith, I enjoyed your presentation very much. I would like to ask three general questions.

In the manuscript you state the principal advantages of the laparoscopic approach include a less painful abdominal incision, a more rapid return of bowel function, shorter recovery, and improved cosmosis.

Have you had the opportunity to assess for these advantages comparing the laparoscopic approach

with the open approach? Have you looked at the pain medicine requirements in both groups of patients, the time to initiation of feedings in each group, the length of postoperative hospitalization, and any comparative charges between patients undergoing an open operation and a laparoscopic approach at your institution?

The second question is how would you approach a patient with a previously performed colostomy? Is this a suitable patient for a laparoscopic approach? Or is it a better operation if the colostomy has not been previously performed?

The final question is do you believe the laparoscopic approach is ideally suited only for the soave procedure for correction of Hirschsprung's disease or can the laparoscopic approach be used with either the Duhamel or Swenson technique?

K.E. Georgeson (response): We have looked at the advantages of laparoscopic surgery in terms of length of stay and how long it takes to feed the patient with fundoplication. These parameters are improved with the laparoscopic approach. We have not comparatively accessed these parameters for the colon pull-through. Dr Lobe, in Memphis, has discharged a patient after this procedure on the first postoperative day, which is unheard of with a standard surgical incision.

In regard to using a laparoscopic approach on patients with colostomies, I have laparoscopically treated 12 of these patients primarily and 13 with a colostomy. In assessing the differences between the two, it seems to be a better operation if you perform a primary procedure. The patients can almost all eat the next day and do very well. Notice that there is no division of the colon inside the peritoneal cavity with this technique. You do not even run a suture line across the colon inside the peritoneal cavity. Another advantage is that only 5-mm trocars are used in the primary technique, whereas a 12-mm trocar is needed to pass the stapler if you perform a two-stage procedure.

However, I think that if you have a patient with a colostomy, it is better to perform the two-stage procedure laparoscopically than open. A two-stage laparoscopic procedure is similar to a single-stage procedure after takedown of the colostomy. I have performed several laparoscopic Duhamel operations. But I prefer the primary technique, which is not really a Soave procedure in the sense that it is an extramuscular dissection from above, and a mucosectomy from below.