JOURNAL OF LAPAROENDOSCOPIC & ADVANCED SURGICAL TECHNIQUES
Volume 21, Number 9, 2011

DOI: 10.1089/lap.2011.0107

Outcome Comparison Among Laparoscopic Duhamel, Laparotomic Duhamel, and Transanal Endorectal Pull-Through: A Single-Center, 18-Year Experience

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Abstract

Purpose: Transanal endorectal pull-through has changed the treatment of Hirschsprung's disease (HD) in the past decade. The aim of the study was to compare outcomes, obtained in a single center, with laparotomic Duhamel (LTD), laparoscopic Duhamel (LSD), and laparoscopic-assisted transanal endorectal pull-through (LTEPT).

Materials and Methods: We retrospectively reviewed the charts of all patients operated on for HD since 1992. Preoperative, operative, and postoperative data were collected to compare short- and long-term outcomes among the three groups.

Results: From 1992 to 2010, 70 children were treated for HD. Patients were divided into three groups based on the surgical technique used: 14 LTEPT, 32 LSD, and 24 LTD. Mean ages at surgery were 4.67, 14.61, and 13.28 months, respectively. Patients in the LTEPT group had significant shorter operating times (195 versus 257 versus 291 minutes, $P = .03$), earlier start of feeding (1.2 versus 3.1 versus 4.7 days, $P < .01$), and shorter length of hospital stay (4.4 versus 6.8 versus 9.7 days, $P < .011$). Overall complications rate was lower in the LTEPT (14%) than in the LSD (31.2%) and LTD (29.7%) groups. Postoperative enterocolitis incidence was 3%–4% in the Duhamel groups and none in LTEPT. Long-term outcome showed less constipation and better continence for age in the LTEPT group at the 1-year follow-up ($P = .033$).

Conclusions: This study further supports technical advantages, lighter impact of the surgical procedure on infants, lower incidence of complications, and better long-term outcome of the transanal pull-through compared to the Duhamel approaches.

Introduction

Hirschsprung's disease (HD) was described more than one century ago but the effective treatment was established only half a century later, and a variety of surgical procedures have evolved with time. In the late 1940s, Swenson first described definitive surgical management of neonates and infants with HD: preliminary colostomy (due to common severe presentation with malnutrition or enterocolitis), followed by a laparotomic pull-through procedure.[1,2] In the 80s, earlier diagnosis and better understanding of pathogenesis, together with improved surgical technique, allowed the operation to become less extensive, and a single-stage laparotomic pull-through (Swenson, Duhamel and Soave) replaced the classical three-staged procedure, even in small infants.[3,4] Next step was in the 1990s, when Georgeson, Duhamel, and Swenson techniques were adapted to laparoscopic-assisted approaches with all the known benefits.[5] Since 1998 the transanal endorectal pull through (TERP), proposed by De La Torre and Ortega-Salgado, became the most popular technique for the treatment of HD.[6] It offers the safety and efficacy of the previous techniques plus all the advantages of a minimally invasive technique (minimizing scars, abdominal contamination, and adhesions) with excellent short-term results reported: better pain control, faster discharge from hospital, and unquestionable better aesthetic results.

The aim of the study was to compare short- and long-term outcomes obtained, in our center, with three surgical techniques: laparotomic Duhamel (LTD), laparoscopic Duhamel

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(LSD), and laparoscopic-assisted transanal endorectal pull-through (LTEPT).

Materials and Methods

We retrospectively reviewed the charts of all the patients operated for HD, in a single institution, over the past 18 years. Three different techniques were used: from 1992 to 1999, the classic LTD; from 2000 to 2005, the LSD; and from about 2003 until now, the LTEPT. Preoperative, operative, and postoperative data were collected to compare short- and long-term outcomes among the three groups of patients. In particular, we analyzed the following demographic features: age at diagnosis, sex, comorbidities, and length of aganglionic bowel (ultra-short, classic recto-sigmoid, descending, transverse ascending). We compared the age at surgery, surgical operative time, length of hospital stay, postoperative start of oral feeding, return to first normal bowel movement, necessity for postoperative intensive care monitoring, and early complications for the three groups. For the long-term outcome evaluation, we considered the mean follow-up period, number of episodes of postoperative enterocolitis, incidence of severe constipation, or incontinence. Diagnosis of HD-associated enterocolitis (HAEC) was based on clinical presentation of diarrhea, abdominal distension, and fever. Severe constipation was defined as less than two spontaneous bowel movements per week or palpable abdominal fecal mass. All the patients with constipation needed laxatives and/or enemas.

Patients with total colonic aganglionosis (4 patients) and redo patients (2 patients) operated in other hospitals before were excluded from the study.

Data are quoted as a mean or percentage. Ranges and comparison tables use nonparametric statistical tests. *t*-Test was used to inter-group comparison. Significance was assumed at the level of $P \leq .05$.

The operative techniques for the LTD and LSD have been previously presented by our group.[7] Briefly, the LTEPT technique started with the patient in the lithotomy position to perform the preliminary laparoscopic leveling biopsies, to subsequently mobilize the left colon or splenic flexure, and in the rare case of total colonic aganglionosis to perform an ileostomy. In the lithotomy position, a Lonestar retractor was placed to demonstrate the dentate line; a circumferential mucosal dissection was started 0.5 cm above it with cautery, to prevent damage to the transitional epithelium and loss of sensation, affecting the continence in the long-term. Fine silk traction sutures were placed on the mucosal-submucosal tube, and dissection was carried out proximally with blunt technique. After reaching the peritoneal reflection, the muscular layer was entered, and the dissection became full thickness. A key point was to split the muscular tube, posteriorly, down to the internal sphincter to avoid a relative obstruction in the postoperative period. With the laparoscopic-assisted approach, the mesenteric vessels were dissected at the beginning of the procedure, so, at this point, the bowel was easily pulled down until the normal colon biopsy was found. Then, after resection of the aganglionic tract, the anastomosis was performed with interrupted absorbable sutures.

After surgery, all patients received oral antibiotic prophylaxis with Metronidazole (20 mg/kg/day, 5 days every month, for a total of 6 months) to prevent enterocolitis. This was an intestinal decontamination protocol, created in collaboration with the infectious disease team, to decrease the postoperative enterocolitis rate.

Almost all the patients, starting 3 weeks after LTEPT, received daily anal dilation with appropriate size Hegar for at least 3 months.

Results

Seventy children (58 boys and 12 girls) were treated in the past 18 years. In term of length of the aganglionic tract, the patient distribution was as follows: 53 with classic recto-sigmoidal, 7 with left colon, 3 with transverse colon, and 7 with ultra-short disease. Associated comorbidities were as follows: Trisomy 21 (3), hyperthyroidism (1), and plurimalformative syndrome (1). Demographic details are reported in Table 1.

Patients were divided in three groups according to the surgical technique used for the repair: 14 LTEPT, 32 LSD, and 24 LTD. Mean age at surgery in months was 4.67, 14.61, and 13.28, respectively.

Patients of the LTEPT group had significant shorter operative times (195 versus 257 versus 291 minutes, $P = .03$), earlier start of oral feeding (1.2 versus 3.1 versus 4.7 days, $P < .01$), faster first bowel movement (1.4 versus 1.68 versus 2.05 days, $P = .03$), and shorter length of hospital stay (4.4 versus 6.8 versus 9.7 days, $P < .011$). Rate of conversion from laparoscopy to laparotomy was none in LTEPT group compared with 6% in LSD group (technical issues or poor vision). Colostomy was performed only in 1 case (7%), for a severe neonatal obstruction/enterocolitis, in the LTEPT group. Differently, 10 cases (42%) required a colostomy in the LTD group. (Table 2)

Total complication rate was significantly lower in the LTEPT group (1/14 patients, 14%) compared to LSD (10/32 patients, 31.2%) and LTD (7/24 patients, 29.16%) groups (Table 3). Early postoperative complications were one intestinal obstruction, one anastomosis dehiscence, and one ureter transection in the LSD group; one case of intrabdominal bleeding and one ileo-ileal intussusception requiring a new laparotomy in LTD group; and none in the LTEPT group.

Postoperative recovery in Pediatric Intensive Care Unit (PICU) was needed in 5/14 patients of the LTEPT group, 16/32 of the LSD group, and 13/24 of the LTD group. Mean time in the PICU was 10.80, 13.63, and 34.46 hours, respectively. Bood transfusion was necessary in 4, 3, and 6 patients of each

Table 1. Clinical and Demographic Characteristics

	LTEPT	*LSD*	*LTD*	P *value*
Patients	14	32	24	
Male:female	8:1	9:1	7.5:1	NS
Age at surgery (months)	4.67	14.61	13.28	$P < .01$
Aganglionic segment				
Ultrashort	2	3	2	NS
Rectosigmoid	10	28	15	NS
Descending	1	1	5	NS
Transverse- ascending	1	0	2	NS
Comorbidities	2	2	1	NS

LTEPT, laparoscopic-assisted transanal endorectal pull-through; LSD, laparoscopic-assisted Duhamel; LTD, laparotomic Duhamel; NS, not significant.

Table 2. Operative Data and Results Comparison Among Groups

	LTEPT (14)	*LSD (32)*	*LTD (24)*	P *value*
Preoperative enterocolitis (pts)	2	4	4	NS
Colostomy (pts)	1	0	10	.041
Preoperative intestinal obstruction (pts)	2	1	2	NS
Operative time (minutes)	195	257	291	.03
Perioperative RBC transfusion (pts)	4	3	6	NS
Conversion to laparotomy (pts)	0	2	0	NS
Postoperative in PICU (pts)	5	16	13	.036
Mean PICU time (hours)	10.80	13.63	34.46	NS
Mean postoperative re-feeding (days)	1.28	3.15	4.75	< .01
Mean first bowel movement (days)	1.40	1.68	2.05	.03
Mean hospital stay (days)	4	7	10	< .01

PICU, pediatric intensive care unit; RBC, red blood cells; pts, number of patients.

group, respectively. Long-term complications were also lower in LTEPT group (1/14 patients, 14%) compared to LSD (7/32 patients, 21%) and LTD (5/24 patients, 17%) groups. In the LTEPT group we had one anastomotic stricture at the beginning of our experience with this technique. It was successfully treated with progressive Hegar dilation for 3 months.

Long-term outcome results are reported in Table 3. Postoperative enterocolitis had an incidence of 0% in LTEPT group, 3% in LSD group, and 4% in LTD group. Postoperative constipation, at 1 year follow-up, was 0% in the LTEPT group, 6.1% in the LSD group, and 8.3% in the LTD group. The constipation rate was significantly higher in the LSD and LTD groups even after an intense enemas and laxative regimen. Painful defecation was observed only in the LSD group with an incidence of 4%. The mean follow-up period for the LTEPT group was 26 months, and all the children were normal in term of general health, growth, and development for age.

Table 3. Postoperative Complications and Follow-Up Comparison Among Groups

	LTEPT (14)	*LSD (32)*	*LTD (24)*	P *value*
Early postoperative complications	0	3	2	.035
Intestinal obstruction	0	1	0	
Dehiscence	0	1	0	
Other	0	1	2	
Late postoperative complications	1	7	5	.021
Anastomotic stricture	1	0	0	
Constipation	0	5	4	
Postoperative enterocolitis	0	1	1	
Other	0	1	0	
3-month follow-up				
Normal bowel pattern for age	13	29	22	NS
Constipation	1	3	2	.045
12-month follow-up				
Normal bowel pattern for age	14	30	22	NS
Constipation	0	2	2	.033

Discussion

The surgical management of HD has progressed from a two- or three-stage procedure to a primary operation over the past 25 years. Nowadays, the majority of surgeons around the world have opted for a single-stage approach in the repair of its classic form. In a recent article, Keckler et al. reported that 90% of the operations in the United States were performed using a minimally invasive technique, such as the LTEPT or the single-stage transanal endorectal pull-through (TEPT).[8]

At our institution the LTEPT was the preferred technique because, apart from the excellent cosmetic results, it allowed biopsies to be obtained as well as adequate mobilization of the bowel. In addition, the transanal endorectal coloanal anastomosis was simple and easy to perform, with minimal dissection, which resulted in less damage to the internal sphincter and pelvic nerves.[9] Moreover, LTEPT could be used even if the transitional zone was at or proximal to the splenic flexure. Starting with the laparoscopy was helpful in dividing the middle colic vessels, leaving a generous arcade of marginal vessels along the colon, plus avoiding the pull-through of ischemic bowel. In our experience, since we have used LTEPT, we have been able to perform all HD cases, no matter the length of the aganglionic tract.

In accordance with the literature, our results showed LTEPT being better than LSD or LTD in term of surgical learning curve, operative time (average for LTEPT was 195 minutes but for the past 5 cases it was down to 158 minutes), operative complications, postoperative oral feeding, return of bowel function, admission to ICU/analgesia, and length of hospital stay.[10–15] Historically, in our hospital we have admitted children to the postoperative ICU for administration of opioid analgesia. We proved that a significant smaller number of children were admitted to ICU if operated on with LTEPT; in addition, the last 7 cases performed with the transanal pull-through did not require any opioid, proving the technique was not particularly painful for the babies.

It has already been demonstrated that TERP in neonatal patients is as feasible and safe as in older children or in those with a leveling colostomy.[16] As noted by other authors, a postoperative stabilization period was required for a normal stooling pattern to develop.[17,18] The younger the patient operated upon and the shorter the aganglionic segment, the lower the frequency of stooling disorders.[19] As a consequence, the immediate postoperative period could be characterized by severe perianal excoriation, which needed to be prevented by application of zinc-based barrier cream. In our experience it takes about 6–8 weeks, following the pull-through, for them to normalize to less than four to five bowel movements per day.

The second most common postoperative complication after TERP is the anastomotic stricture.[16,20] We had only 1 case of anastomotic stricture at the beginning of our experience with LTEPT and, since then, we have used anal dilation starting from the 3rd postoperative week, for at least 6 months, to avoid stricture and to reduce constipation and risk of enterocolitis.

The reported incidence of HAEC ranges from 4.6% to 54%.[21] A recent meta-analysis, designed to evaluate postoperative incidence of HAEC following TEPT procedure, showed that it occurred in 10.2% of patients.[22] Recurrent episodes of HAEC were reported in 2% of patients. Conservative

treatment of HAEC was successful in 81.5% of cases, whereas in remaining 18.5% a further surgical treatment was required. This systematic review reveals that TEPT is a safe and less-invasive procedure with a low incidence of postoperative HAEC compared to previous surgical techniques. In our case series, we had an overall very low incidence of postoperative HAEC (3.5%), and in particular, in the LTEPT group we had no HAEC compared to a 3% and 4% incidence in the other groups. This could be explained by our postoperative enteric decontamination protocol, which was started early in the 90s, to reduce the postoperative HAEC rate. We strongly believe that, in particular for the first 6 months after any HD surgery, the following factors play an important role in the recurrence of HAEC: the relative postoperative dysmotility, the residual enteric dilation, and the postoperative constipation. Moreover, the decontamination protocol is cheap, easy to be delivered, and effective after all kind of HD surgery.

When the TERP was introduced, some authors have reported less continence capacity compared to the classic transabdominal approaches (TAA).[23] The initial argument was that the overstretching of the anal sphincter, during the transanal operation, could be a critical issue affecting continence. To address this matter, several studies have been published and, in particular, Kim et al. examined long-term stooling outcomes in a large, multicenter cohort of patients undergoing either TERP or the TAA. TERP was associated with fewer complications, fewer episodes of enterocolitis, and no higher incidence of incontinence. These results support the use of TERP as an excellent surgical approach for children with HD even for the long-term outcome.[24–26] Our article confirms an even better long-term outcome, with regard to stooling pattern, compared to any Duhamel approach. In our case series in the long-term follow-up we had more severe constipation in the LTD and LSTD compared to the LTEPT group. This can be explained by the shorter length of operation and the correct use of a Lonestar retractor, applying just the right amount of dilation. A recent article, comparing TEPT to Duhamel, presented a decreased incidence of complications and better long-term continence in the trans anal pull-through group.[13]

In conclusion, the endorectal dissection has become the dominant minimal access procedure in the treatment of HD because of the ease and reliability in performing this technique and the excellent results obtained. With our experience we strengthen the evidence that TERP has better outcome, not only in the short-term, but also in long-term follow-up. In particular, after a postoperative stabilization period, patients gain a normal stooling pattern with less constipation and soiling compared to the Duhamel procedure; no incontinence is experienced if the LTEPT technique is performed accurately. Although a TERP can be performed without laparoscopy, the LTEPT is a much more versatile technique and allows early biopsies to determine the extent of aganglionic and dysfunctional bowel before ablation of the rectum and mesocolon.

Acknowledgments

We want to thank Mr. Neil Featherstone for reviewing the article.

Disclosure Statement

No competing financial interests exist.

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