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Single-incision laparoscopic versus conventional laparoscopic surgery for Hirschsprung's disease: A comparison of medium-term outcomes

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ABSTRACT

Introduction: This study aims to report medium-term outcomes of single-incision laparoscopic surgery (SILS) and compare its results with conventional laparoscopic surgery (CLS).
Patients and Methods: Seventy-five patients with Hirschsprung's disease (HD) underwent operations from January 2009 to December 2012 in our institution (SILS, $n = 40$; CLS, $n = 35$). SILS procedure is similar to CLS, but uses a single, 1.5-cm horizontal skin incision in the umbilicus for laparoscopic access. Operative characteristics and medium-term outcomes were assessed.
Results: On average, patients in the SILS group had shorter operative times (mean ± standard deviation, 226 ± 69.4 min) than those in the CLS group (268.9 ± 83.6 min) ($P = 0.01$). Fourteen cases (35%) in the SILS group and ten cases (28.6%) in the CLS group had extended HD. Medium-term outcomes did not significantly differ between the groups, and the SILS group had better cosmetic results.
Conclusions: SILS could be safely performed in HD patients with good medium-term outcomes. Although SILS and CLS procedures had similar medium-term outcomes, SILS has advantages such as better cosmetic results and shorter operative times.

Hirschsprung's disease (HD) is characterized by the absence of ganglion cells in the distal bowel. This condition is confined to the rectosigmoid colon in 75% of affected patients. The rectosigmoid variant is the most frequent presentation, but an extended form has also been seen. In 17% of cases, the aganglionic segment was observed extending from the rectum, sigmoid colon and colon up to the part of the transverse colon. The rarest form of the disease with the most severe clinical course was total colonic aganglionosis (TCA), which was observed in 8% of patients [1,2]. Surgery to correct an aganglionic bowel segment could be performed by a laparoscopic-assisted endorectal pull-through operation [2]. Conventional laparoscopic surgery (CLS) for HD was described in detail by Georgeson and Robertson [3], and has been widely adopted for treating HD. This surgery is usually accomplished through a total of three small incisions in the abdomen to accommodate laparoscopic trocars [3].

Recently, single-incision laparoscopic surgery (SILS) has gained momentum and popularity as a method to reduce visible scars on the abdomen [4,5], and was found to be safe and feasible for HD [6–8]. However, results in using this approach have been limited only to three studies with relatively short follow-ups. Long-term outcomes and gastrointestinal functions are not available. This study aims to report medium-term outcomes of SILS procedure, and compare results with an age-matched group of children that underwent the CLS procedure.

1. Patients and methods

A total of 150 patients with HD underwent an operation at our institution from January 2009 to December 2012. Specific inclusion criteria were: histologically proven HD and laparoscopic surgery. Among these, we excluded cases with ileostomy ($n = 15$), colostomy ($n = 22$), laparotomy ($n = 24$), transanal pull-through ($n = 11$) and Down syndrome ($n = 3$); thus, 75 cases were enrolled in this study. Patients with constipation were diagnosed with HD by anorectal manometry, suction rectal biopsy and barium enema. Patients were divided into two groups based on the surgical technique used: 40 patients in the SILS group (32 boys and 8 girls), and 35 patients in the CLS group (28 boys and 7 girls). Five cases in the SILS group and two cases in the CLS group previously underwent transanal surgery at other surgery departments. However, in all seven children, constipation had recurred after a short time.

Before surgery, patients were randomized into two groups. The purpose of this study and the potential risks associated with these two procedures were fully explained to each subject, and informed written consent was obtained. All procedures were performed by a single surgeon at the Pediatric Surgery Department of Tongji Hospital at the Huazhong Science and Technology University (Wuhan, China). This

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study was approved by the Tongji Medical College review board. Diagnosis was confirmed by intraoperative frozen biopsy and reconfirmed by postoperative conventional histopathological study. Colon preparation was performed by colonic irrigation with normal saline for seven days. An oral antibiotic regimen of metronidazole was given for three days preoperatively.

Demographic data, perioperative events and postoperative outcomes of all patients were recorded. Cosmetic results were subjectively assessed as to whether scars were visible or not according to a patient's or parent's judgment. Follow-ups were scheduled three weeks after the date of operation and at regular 1–3 month intervals. Follow-up information was obtained from outpatient visits and detailed telephone interviews. All data were entered in an electronic spreadsheet (Microsoft Excel) specially designed for the study.

For patients three years of age or older (62 of 75 cases; SILS, $n = 33$; CLS, $n = 29$), questionnaires were completed during outpatient visits and detailed telephone interviews with the children's parents to assess long-term outcomes after SILS or CLS. Families were interviewed by using a 15-item, postoperation, long-term outcome questionnaire reported by El-Sawaf et al. [9–11]. This questionnaire examined the following outcome measures of stooling: frequency of defecation, stool consistency, stool odor, continence, soiling, urgency period, sense of fullness and evacuation after defecation, need for medical treatment to control stooling, and recurrent attacks of enterocolitis. Total scoring ranged from 0 to 40: 0 to 10, excellent; 11 to 20, good; 21 to 30, fair; and 31 to 40, poor. Soiling was defined as voluntary bowel movements with more than one involuntary bowel movement between two voluntary bowel movements with small quantities and small liquid stools. Incontinence was defined as involuntary bowel movements.

1.1. Surgical technique

SILS procedure is similar to CLS (Fig. 1), but uses a single 1.5-cm horizontal skin incision in the umbilicus for laparoscopic access [6–8]. This laparoscopic access is similar with the one described by Zhu et al. [6] (Fig. 2). Three or four seromuscular leveling biopsies of the colon were obtained and sent to pathology for rapid frozen section to determine the presence or absence of ganglion cells in the submucosal nerve plexus. Resection length was determined based on preoperative examination and biopsy results. Affected portions of the colon were mobilized 5-cm proximal to the most distal biopsy site showing ganglion cells by taking down the mesentery using an ultrasonic scalpel. Dissection was continued to the peritoneal reflection of the rectum. Subsequently, Soave or Swenson anastomosis was performed based on the child's condition. Finally, after confirming the appropriate position and laxity of the remaining colon, instruments and trocars were removed. The umbilical fascia was closed using a 3-0 vicryl suture, and the skin was approximated using biological glue. Final length of resection ranged from 25 to 90 cm.

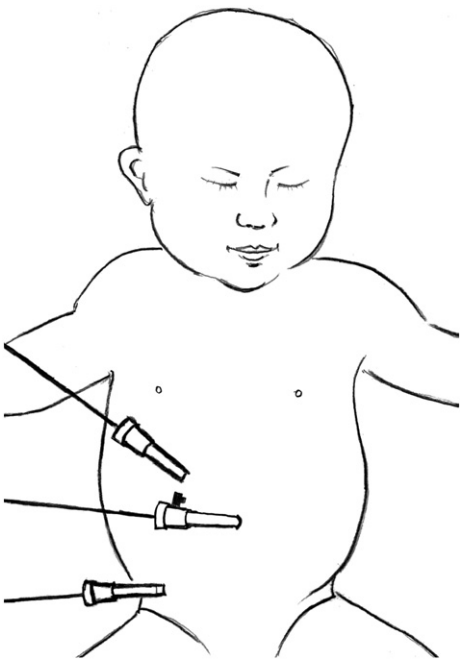

Fig. 1. Trocar placement for conventional laparoscopic surgery. The first trocar is placed through the umbilicus. A second trocar is placed subcostally in the right upper quadrant, and a third trocar is placed in the right lower quadrant.

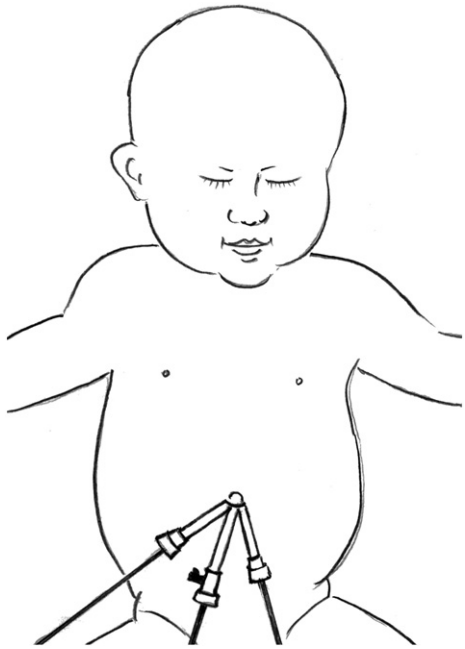

Fig. 2. Trocar placement for single-incision laparoscopic surgery. A 1.5-cm skin incision is made below the umbilicus. The first trocar is placed centrally and the other two trocars are inserted laterally to form a triangle.

Postoperatively, an anal tube was placed and maintained for 7–14 days to promote defecation and prevent anastomotic dehiscence in the immediate postoperative period. Subsequently, a dilation program was started between postoperative days 15–20, and parents were taught to continue this program at home for 3–6 months to avoid anastomotic stenosis and enterocolitis.

1.2. Statistical analysis

Statistics for all variables were calculated using SPSS Version 20.0. χ^2 Test was used to analyze dichotomous variables and Student's t-test was used to analyze continuous parameters. All statistical tests were two-sided, and a P value <0.05 was considered statistically significant.

2. Results

In total, 40 patients underwent SILS (Soave procedure, $n = 39$; Swenson procedure, $n = 1$) and 35 patients underwent CLS (Soave procedure, $n = 23$; Swenson procedure, $n = 12$). All patients underwent laparoscopic surgery. No conversion to laparotomy was necessary in either group. Fourteen cases (35%) in the SILS group and ten cases (28.6%) in the CLS group had extended aganglionosis. Aganglionic segments were observed extending to the descending colon (SILS, $n = 10$; CLS, $n = 8$) or transverse colon (SILS, $n = 4$; CLS, $n = 2$). Dilated segments were observed extending to the ascending colon (SILS, $n = 14$; CLS, $n = 10$). For these patients, most of the colon was removed, and