Two-stage laparoscopic approaches for high anorectal malformation: Transumbilical colostomy and anorectoplasty

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A B S T R A C T

Background: Trans-umbilical colostomy (TUC) has been previously created in patients with Hirschsprung’s disease and intermediate anorectal malformation (ARM), but not in patients with high-ARM. The purposes of this study were to assess the feasibility, safety, complications and cosmetic results of TUC in a divided fashion, and subsequently stoma closure and laparoscopic assisted anorectoplasty (LAARP) were simultaneously completed by using the colostomy site for a laparoscopic port in high-ARM patients.

Methods: Twenty male patients with high-ARMs were chosen for this two-stage procedure. The first-stage consisted of creating the TUC in double-barreled fashion colostomy with a high chimney at the umbilicus, and the loop was divided at the same time, in such a way that the two diverting ends were located at the umbilical incision with the distal end half closed and slightly higher than proximal end. In the second-stage, 3 to 7 months later, the stoma was closed through a peristomal skin incision followed by end-to-end anastomosis and simultaneously LAARP was performed by placing a laparoscopic port at the umbilicus, which was previously the colostomy site. Umbilical wound closure was performed in a semi-opened fashion to create a deep umbilicus.

Results: TUC and LAARP were successfully performed in 20 patients. Four cases with bladder neck fistulas and 16 cases with prostatic urethra fistulas were found. Postoperative complications were rectal mucosal prolapsed in three cases, anal stricture in two cases and wound dehiscence in one case. Neither umbilical ring narrowing, para stomal hernia nor obstructive symptoms was observed. Neither umbilical nor perineal wound infection was observed. Stoma care was easily carried-out by attaching stoma bag. Healing of umbilical wounds after the second-stage was excellent. Early functional stooling outcome were satisfactory.

Conclusions: The umbilicus may be an alternative stoma site for double-barreled colostomy in high-ARM patients. The two-stage laparoscopic approaches for high-ARM, TUC and stoma closure with simultaneously LAARP are both technically feasible and safe with excellent cosmetic result.

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transumbilical colostomy (TUC), subsequently colostomy closure and laparoscopic anorectoplasty were done (age ranged from 3 to 7 months) at the Department of Pediatric Surgery, Wuhan Union Hospital of Tongji Medical College affiliated to Huazhong University of Science and Technology, China. The study was commenced after ethical approval was granted by the Local Ethics Committee of the hospital. A retrospective analysis was performed for 20 patients with high ARMs as shown in Table 1. The location of the fistula was diagnosed base on the clinical presentation and magnetic resonance imaging (MRI) study. TUC was created at the transverse colon in 15 patients and the sigmoid colon in 5 patients.

1.2. Surgical procedures

After induction of general anesthesia, a circumferential skin incision was made at the umbilical cord stump. The skin, subcutaneous tissue, and fascia were cored out vertically. The umbilical vessels and urachal remnant were individually ligated and divided (Fig. 1a). A loop of sigmoid colon was identified and exteriorized through the opening in the fascia and peritoneum under laparoscopy, and identification of transverse colon through the umbilicus directly. For severe distended colon we pre-punctured the stomal site to reduce contamination. A colostomy was created in double-barreled fashion with a high chimney more than 3 cm above the level of the skin, and the loop was divided completely at the same time. The two diverting ends both located in the umbilicus incision with the distal end half closed and slightly higher than proximal end. The interspaces between adjacent walls of two ends were closed and the bowel wall was fixed separately to the peritoneum. A polyactic acid anti-adhesive barrier film (Divine Medical technology Co. Ltd, Shanghai, China) was placed in a peristomal fashion to avoid peri-umbilical adhesions, and the deep fascia was closed with interrupted 5-0 absorbable seromuscular stitches (Fig. 1b and c).

Several months later, the stoma was closed through a peristomal skin incision followed by end-to-end anastomosis, and simultaneously laparoscopic-assisted anorectoplasty was performed by placing a 5 or 10-mm laparoscopic port in the previous colostomy site and two additional 3-mm trocars, one to the right and one to the left approximately 2 cm from the umbilicus (Fig. 2) for laparoscopic mobilization of the sigmoid colon and rectal pouch, fistula division and fistula repair. The muscle stimulator was used to contract the striated muscle complex (SMC) to detect the center of the anal sphincter. Under laparoscopic guidance, the pelvic floor channel was constructed by inserting a STEP trocar between the muscle contraction center and the pubococcygeus muscle. The distal rectal tissue was grasped and pulled down through the pelvic tunnel, and the rectum was sutured to the perineal skin (Fig. 3). The incision was washed repeatedly using 0.5% iodine and warm 0.9% normal saline while suturing. A tube was maintained in the new anus after operation. Umbilical wound was reconstructed with a subcutaneous purse string suture of 4-0 absorbable sutures leaving a central open area to create a deep circular scar resembling a normal umbilicus. Antibiotics were commenced at induction of anesthesia and continued for 72 h. Total parenteral nutrition (TPN) was used for 5 days postoperatively in all patients, and the perianal area was kept clean and dry carefully. Digital examination and serial anal dilatation were commenced 2 weeks after surgery. The follow-up protocol was bi-weekly visit for 3 months, monthly visit for 6 months to 1 year.

<table>
<thead>
<tr>
<th>No. of patient</th>
<th>Time at TUC (days)</th>
<th>Age at LAARP (months)</th>
<th>Type of recto-fistula</th>
<th>VACTERL</th>
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<td>Prostatic urethra</td>
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VSD—ventricular septal defect ASD—atrial septal defect. 0, the day at birth; 1, 1 day after birth.

Table 1. Patients’ characteristics.
2. Results

TUC was successfully performed in all 20 male patients with high ARMs. Sigmoid colonostomy was done in five patients but laparoscopic assistance was required to identify the sigmoid colon. The loop of transverse colon in 15 patients was safely brought out through the umbilical opening for transverse colonostomy. No umbilical ring narrowing, parastomal hernia, or obstructive symptoms were observed. No umbilical wound infection occurred. No fecal impaction and urinary tract infections were found. Stoma care could easily be performed by attaching stoma bag.

Laparoscopically assisted anorectal pull-through with stoma closure at same time was successfully performed in all patients, with no conversions to laparotomy. The mean age at laparoscopic anorectoplasty with stoma closure was 5.3 months (3–7 months). The mean operative time for patients was 136.7 ± 18.4 minutes. Intraoperative blood loss was 14.5 ± 5.5 ml. The mean length of hospital stay was 8.5 ± 2.0 days.

The appearance of the umbilical wound after colostomy closure and laparoscopic procedures resembled a normal umbilicus (Fig. 4). In this series, postoperative complications including superficial perianal surgical site infection occurred in one patient, minor anal stenosis in two patients and rectal mucosal prolapse in three patients, respectively, which responded to conservative treatment. Early functional stooling outcome were satisfactory.

3. Discussion

Laparoscopy has been used as a primary pull-through procedure for high ARM during the newborn period, avoiding a colostomy. This has been considered as evidence of less invasiveness and provides excellent cosmetic results of abdominal wall [1,2], but the risk in anesthesia and surgery, special with bowel distension as seen in newborns may be a serious disadvantage for a laparoscopic approach [7]. Currently, either the two-stage or the three-stage operation is recommended. With the three-stage approach, a temporary colostomy is initially created followed by LAARP in several months, and then the colostomy is closed several weeks to months later. Although a debate remains about whether LAARP has achieved better functional results as compared with PSARP, LAARP allows exact placement of the bowel through the muscle complex with minimal invasive abdominal and perineal wounds, and avoids division of sphincteric complex. It results in shorter hospital stay, faster recovery and potentially fewer wound complications than the conventional methods [2,8–10]. The real problem is that the scar on the abdominal wall after colostomy closure would have reduced cosmetic results of laparoscopic approach.

In 1982, Cameron et al. [3] created divided umbilical colostomies in patients of high ARMs with rectourethral fistula. The proximal stoma was brought out at the umbilicus, and the distal mucous fistula in the left lower abdomen. They are thus the first to create colostomies at the umbilicus in patients with ARMs. After colostomy closure, the resulting scar closely resembles a normal umbilicus, and is cosmetically superior to the scar of a colostomy placed elsewhere. In 2012, Hamada et al. [6] firstly reported temporary umbilical loop colostomy procedure for intermediate ARMs. The loop was divided 7 days...
postoperatively to stop fecal flow toward the distal rectal pouch and prevent fecal impaction. The colostomy was closed 2–3 months after posterior sagittal anorectoplasty (PSARP) through the peristomal skin incision followed by end-to-end anastomosis. Healing of umbilical wounds after stoma closure was excellent.

Our TUC procedure is the first to be reported for high ARMs. Similar to our open surgery experience, we used to choose sigmoid colostomy, but an additional 3 mm trocar was needed at right abdomen to facilitate the process. Even though, it was still difficult to pull out sigmoid colon via umbilicus for some patients with short sigmoid mesocolon or severe abdominal distention, so in these cases transverse colostomy was a better choice. For these patients, the distal blind pouch was washed out using warm normal saline after meconium was suctioned thoroughly out. Gently pressing left abdomen repeatedly by hand, might facilitate the evacuation of distal transverse and descending colon.

It was well aware that adhesion might cause injury during laparoscopic surgery. A polylactic acid anti-adhesion barrier film (Divine Medical technology Co. Ltd, Shanghai, China) was intraperitoneally placed in a peristoma fashion, which was able to decrease peri-umbilical adhesions prominently. In our procedures, firstly we freed the stoma and adhesion, and performed colonic end-to-end anastomosis. After returning the colonic anastomosis back to the abdomen, a trans-umbilical trocar for laparoscope was placed inside. Besides, intra-abdominal adhesion was much less in trans-umbilical or laparoscopic procedure, compared to open colostomy. Under the guidance of the camera, we inserted the rest trocars. Following these steps, injuries to the tissues inside the abdomen were avoided.

Some surgeons think that it may increase the risk of umbilical wound infection. However, using the technique of placing the two stomas in the incision of umbilicus, we did not experience this problem in any of our 20 cases. We did not encountered wound infection or enteritis but perianal temporary excoriation did occur in some cases, but it did not seemed to delay healing of the anastomosis. Laparoscopic anorectoplasty had smaller perianal incision than PSARP procedure, and it may be advantageous to reduce the incidence of wound infection.

We also like the fact that the colostomy closure left a single scar resembling a normal umbilicus, producing a better cosmetic result. Pena et al. [11] recommended that colostomy for patients with high ARMs should constitute the opening of a descending colostomy with separated stomas. The loop colostomies possibly allowed for passage of stool distally, which produced urinary tract infections and fecal impaction in the distal pouch of the colon, particularly if they were partially retracted. We believe that a divided colostomy entirely at the umbilicus may avoid these complications by creating a high chimney with the distal end half closed and slightly higher than proximal end, resulting in a small distal stoma and prevent prolapsed of the stoma. The umbilicus provided easy access to both the transverse and sigmoid colon. The transverse colon could be pulled out easily and safely with sufficient bowel length for the pull-through procedure. The intestinal contents in the distal pouch of the colon were sucked out and washed out using warm normal saline during surgery. It usually required laparoscopic assistance when the sigmoid colon was pulled out. We agree to the opinion, in accordance with Hamada et al. [6] that the umbilicus is located in the center and on the apex of the abdominal wall and is thus an advantageous stoma site. In procedure the application of colostomy bags is facilitated by the wide expanse of abdomen available around the centrally placed stoma [3–5]. This enables easy stoma care. From the cosmetic point of view, a scar is easily mistaken for a normal umbilicus. We thus think that the transumbilical modified colostomy suits well for high ARMs, as anoplasty can be performed via laparoscopic approach by placing a laparoscopic port at the colostomy site.

Over the past few decades, the surgical approach has changed gradually from three-stage procedures to one-stage pull-through without colostomy for most children with Hirschsprung disease. One-stage operations were considered safe, cost-effective whether in neonates or infants [12,13]. Similar to the treatment of Hirschsprung disease, one-stage or two-stage procedures for patients with ARM have turned out to be as favorable as the multistage procedures with benefits for the patients and reduction of treatment cost and stress for the patients and their parents. Most patients with ARM receive a protective colostomy before the main repair to avoid contamination of the perineal operation. However, during the last two decades, some pediatric surgeons advocate the repair of ARMs in a primary fashion without a colostomy [14–16]. Their outcomes showed that it was feasible for correction of ARM and there were not complications of the wound of the operative site. We need to underline that in our experience, we had treated two consecutive children with rectoprostatic urethral fistula from other institutions whose distal stoma was located at lower part of sigmoid colon and the distal colon was too short for pull-through. So we performed stoma closing and pull-through at the same stage. The recovery was quite well and no perineal infection was found. Later on we successfully performed this technique for some patients with frequent and unbearable prolapse of stoma. The satisfactory outcome provoked the idea of closing the colostomy at time of pull-through.

In conclusion, the transumbilical colostomy for high ARMs similarly as umbilical loop colostomy for intermediate ARMs in laparoscopic era is safe and feasible. The modified colostomy has many advantages including minimal surgical complications, excellent appearance of the umbilicus, and excellent cosmetic result of the abdomen. Staged colostomy and laparoscopic surgery achieved a similar effect of one-stage LAARP.

References