



Robotic-assisted anorectal pull-through for anorectal malformations

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Abstract

Background/purpose: Many reports have addressed the feasibility and safety of using robotic surgery in children. To our knowledge, no published report has described the use of a surgical robot in the repair of anorectal malformations (ARMs).

Methods: Included children underwent robotic-assisted repair of ARMs with rectourethral fistula between April 2006 and March 2010 at King Khalid University Hospital, Riyadh, Saudi Arabia, using the da Vinci Surgical System. Their medical records were reviewed with respect to demographic data, associated anomalies, techniques and operative procedures, complications, outcomes, and follow-up.

Results: Five male infants (mean age, 6.6 months) underwent robotic-assisted repair of ARMs with rectourethral fistula using the Georgeson technique. The fistulae were divided and ligated in 4 patients and was left open in 1. All procedures were successfully completed without conversion to an open technique. One patient developed left-sided epididymo-orchitis postoperatively. All the patients had their colostomy closed. The follow-up ranged from 6 to 36 months. Fecal continence was difficult to assess in 2 patients. Two patients have voluntary bowel movements without soiling. One infant has fecal soiling and is on a laxative/enema for constipation.

Conclusions: Robotically assisted repair of ARMs with rectourethral fistula is feasible and safe. It offers a good alternative to the criterion standard, posterior sagittal anorectoplasty (PSARP), for repair of ARMs with rectourethral fistula. More patients and a longer follow-up period are needed for further evaluation of this novel approach.

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Since 1980, PSARP for the repair of high anorectal malformations (ARMs) has been the procedure of choice for most pediatric surgeons. Laparoscopic-assisted anorectoplasty (LAARP) was introduced in 2000 by Georgeson et al [1]. Robotic surgery is an emerging field in minimally invasive

surgery. Many reports have been published on the feasibility and safety of using this new technology in children [2,3]. Various pediatric surgical procedures have been performed successfully with an acceptable rate of complications and conversions to standard approach [2-5]. To the best of our knowledge, no report has been published describing the use of a robot in the repair of ARMs. The aim of this study is to report our early experience with using a robot in the repair

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of ARMs with emphasis on the feasibility, safety, and early functional outcomes.

1. Materials and methods

This is a retrospective review of all patients who underwent robotic-assisted repair of ARMs with rectourethral fistula by the senior author between April 2006 and March 2010 at King Khalid University Hospital, Riyadh, Saudi Arabia. Data were analyzed with respect to demographics, preoperative workup, associated anomalies, operative procedures, complications, outcomes, and follow-up.

1.1. Operative technique/procedure

The senior author was the sole operating surgeon in all of the cases, and he has wide experience with both laparoscopic and robotic surgery. At our institution, most patients of ARMs with rectourethral fistula are repaired by LAARP, as the ability to do a robotically assisted procedure depends on the availability of the surgical robot on that day.

The original da Vinci Surgical System (Intuitive Surgical, Inc, Sunnyvale, CA) was used in the first 4 patients, and the new da Vinci S HD was used in the last patient. A Foley catheter was placed into the bladder of each patient. The patient is placed in the supine position early on during trocar insertion and subsequently placed in the Trendelenburg position at the start of the procedure. Four trocars were used; these included a 5- or 8.5-mm supraumbilical trocar that accommodates a 5 (two-dimensional)- or 8.5 (3-dimensional [3D])-mm 30° robotic telescope. We used the 8.5-mm (3D) scope in 4 patients and the 5-mm (two-dimensional) scope in 1 patient, and 2 working 5-mm trocars to accommodate 5-mm robotic instruments inserted in the left side of the abdomen just above and medial to the colostomy site and in the right side of the abdomen at the anterior axillary line were used in all patients. The fourth trocar is an accessory 3-mm trocar placed at the right upper abdomen in the midclavicular line and is used to retract the bladder. The robotic arms approximated from the patient's foot, and the assistant surgeon stood on the right side of the patient facing the vision cart (Fig. 1). The same principle of the Georgeson technique was used in robotically operated patients. Most of the dissection was carried out with the help of a 5-mm robotic hook and bullet nose instruments. The rectum is mobilized by dividing the peritoneal folds on either side at the level of peritoneal reflection. As dissection is carried out distally, the rectourethral fistula is identified. It is divided and repaired robotically using 2/0 Ethicon suture (Ethicon, Somerville, NJ) (Fig. 2A, B). In the case of rectobulbar fistula, the dissection is carried out deep into the pelvis. This is done because the ligation is rather difficult because of the distal position and the broad base of these fistulae. This difficulty, however, is best overcome by the superior 3D vision of the

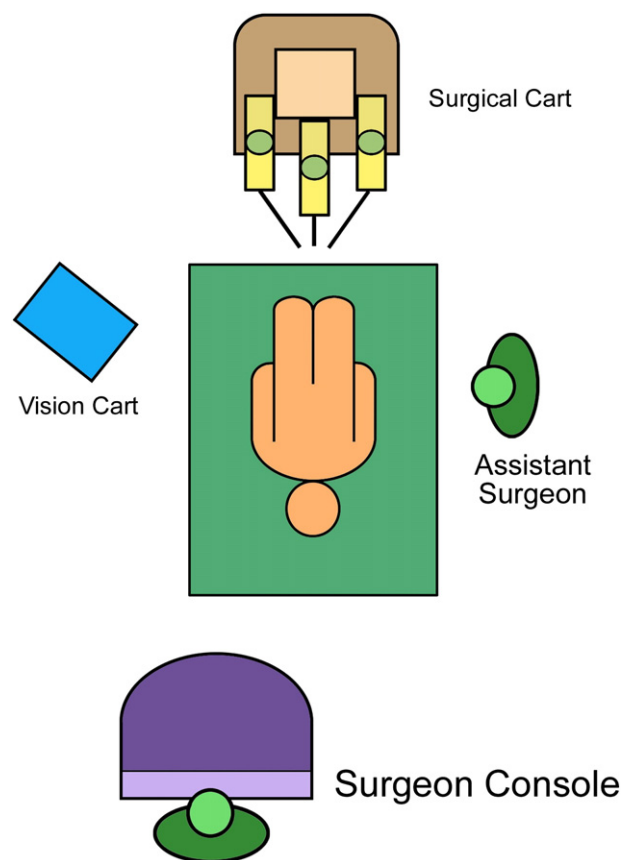


Fig. 1 Layout of the operating room for robotic-assisted anorectoplasty.

8.5-mm robotic scope and the fine manipulation of robotic instruments. Once the lower rectum is fully mobilized and the fistula is divided and repaired, the da Vinci robot is undocked; and anoplasty is carried out the same way as described by Georgeson et al [1].

2. Results

A total of 5 male infants underwent robotic-assisted repair of ARMs with rectourethral fistula. Their ages at surgery ranged from 4 to 11 months (mean, 6.6 months), and their body weights ranged from 6.2 to 9.9 kg (mean, 7.6 kg). Three patients had associated anomalies (Table 1). All patients had anterior-posterior and lateral sacral roentgenograms at birth. One patient had partial sacral agenesis. All patients had had a colostomy at birth. Preoperative distal colostograms documented rectourethral fistulas in all of them (rectoprostatic in 3 and rectobulbar in 2). All procedures were robotically completed without the need for conversion to an open technique. The fistula was divided and ligated in 4 patients and left open in 1. The operative time (robotic + anoplasty) ranged from 2.17 to 5.08 hours (mean, 3.56 hours). Postoperatively, the urethral catheter was left in place

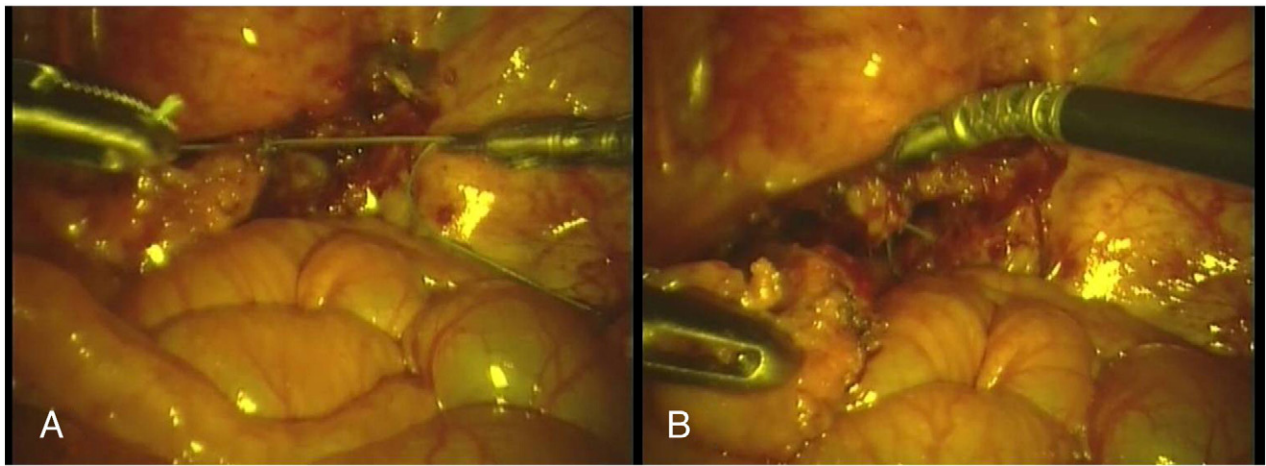


Fig. 2 This intraoperative view shows the robotic repair of a rectourethral fistula. A, Fistula ligation. B, Fistula divided and repaired.

for 5 to 20 days (mean, 7 days); and antibiotics were administered for 5 days. In 1 patient, the fistula was left open; and he had to be discharged earlier than expected for social reasons and came back on the 20th postoperative day for a follow-up when the Foley catheter was removed. Interestingly enough, a cystourethrogram showed no leak and no urethral diverticulum. The mean of the postoperative stay is 6 days (range, 5-7). Anal dilatation was started 3 weeks postoperatively according to the Peña recommendation. No mortality and no intraoperative complications occurred in this series. One patient developed left-sided epididymo-orchitis at 3 and 6 months postoperatively. Cystoscopy revealed a urethral diverticulum at the site of the repaired rectourethral fistula. This complication has occurred early in our experience, and it was in a patient with rectobulbar fistula. The patient has been maintained under conservative treatment, as he has shown no symptoms for the last 2 years. Should he become symptomatic, the diverticulum will be excised; and we prefer the perineal approach. All patients had their colostomies closed. In 2 patients, it was difficult to assess their fecal continence, as they were younger than 2 years of age. Two 4-year-old patients have voluntary bowel movement with no soiling. One 3-year-old patient has fecal soiling and is receiving laxatives and enema treatment of constipation. As for the anoplasty, there were no stenoses;

and the anal opening remained in a good position. One patient has partial mucosal prolapse but did not require any surgical intervention. All patients were followed up from 6 to 36 months (median, 12 months).

3. Discussion

Pediatric surgeons have long been challenged regarding the best way to restore anorectal function in infants born with ARMs. For the last 3 decades, PSARP popularized by De Vries and Peña [6] has been considered the procedure of choice for the repair of ARMs with rectourethral fistula by most pediatric surgeons. However, the results of performing PSARP for these ARMs are less than ideal. In a recent review by Rintala and Pakarinen [7] on the long- and short-term outcomes of imperforate anus treated with PSARP for ARMs with rectourinary fistula, the authors found that only 35% of patients have long-term total fecal continence. In the current era of minimally invasive surgery, most pediatric surgical procedures are performed by this approach. In 2000, Georgeson and associates [1] reported a new technique: LAARP; this technique aims for the precise placement of the rectum inside the muscle complex without dividing and

Table 1 Patients' characteristics

Patient	Age at surgery (mo)	Body weight (kg)	Associated anomalies	Type of fistula	Operative time: robotic + anoplasty (h)
1	4	6.2	Esophageal atresia and distal tracheoesophageal fistula	Rectobulbar	5
2	8	8.2		Rectoprostatic	2.1
3	6	7.5		Rectoprostatic	4.5
4	11	9.9	VSD, ASD	Rectobulbar	2.6
5	4	6.3	Absence of left kidney and grade IV VUR of the right kidney	Rectoprostatic	3.5

VSD indicates ventricular septal defect; ASD, atrial septal defect; VUR, vesicoureteral reflux.

weakening the muscles and eventually improving the functional outcome. Laparoscopic-assisted anorectoplasty is gaining popularity and currently is the technique that most pediatric surgeons use to repair ARMs with rectourinary fistula. Since its introduction by Georgeson et al, it has received wide acceptance among pediatric surgeons; and the literature is witnessing very favorable reports about the procedure [8-11]. Laparoscopic-assisted anorectoplasty has the advantages of being minimally invasive with minimal abdominal and perianal wounds and also being anatomically sound. However, few studies have documented a satisfactory rate of fecal continence after LAARP at the midterm follow-up [12,13]. Comparison studies between LAARP and PSARP are lacking. Yang et al [14] compared the clinical outcomes and anorectal manometry results between 11 patients who underwent LAARP and 12 patients who underwent PSARP. There appears to be no significant differences in clinical scoring between groups, but the results of anorectal manometry indicate that LAARP can significantly improve anal canal resting pressure. It is clear from the available data that LAARP is a good alternative to the criterion standard, PSARP; early results are encouraging and suggest that LAARP is at least equal if not superior to PSARP. Laparoscopic-assisted anorectoplasty is associated with some technical difficulties and complications. These include a residual posterior urethral diverticulum, stool leakage from the distal rectum during the procedure, rectal prolapse, and anal stenosis [15,16]. In addition, laparoscope dissection in a narrow operative space like the pelvis of a small infant can be a very challenging proposition. The surgical robot is considered the second revolution in general surgery after laparoscopy during the last 2 decades. The experience with use of robots in pediatric surgery is new and limited. The surgical robot provides the surgeon with more dexterity owing to the 3D vision and ease with tissue dissection, placing sutures, and knot tying, thus enabling surgeons to perform more complex procedures. Several reports have shown that robotic surgery is safe and appropriate for children and that a wide variety of procedures can be carried out [2,3]. In using the robot, we followed the same principle as that of the Georgeson technique for LAARP. The use of a robotic system makes working in a small space less intimidating for the surgeon by enhancing visualization, precision, and dexterity. Our experience indicates that robots are very helpful in performing the anorectal pull-through in small infants. We have no doubt that the robotic-assisted approach offers advantages over the conventional methods and would in time have an impact in the management of ARMs. But before that can take place, the limitations of the current robotic surgical system have to be addressed. Instruments will have to be redesigned with infants in mind for one to comfortably use them in the narrow intraabdominal space of a newborn baby. The way we went about it to overcome this problem was by inserting the robotic ports at a higher level in the abdominal wall. In addition, the enhanced vision of 8-mm 3D scope and the superior dexterity allowed

for a higher degree of freedom of movements of 5-mm robotic instruments. Taking advantage of these features helped us work within such a small space. Although our study has the limitations of a small number of cases and short-term follow-up, the outcome of the first 5 patients was comparable to those who were done by LAARP in terms of operative time, perioperative complications, and short- and midterm functional outcome.

In conclusion, robotically assisted repair of ARMs with rectourethral fistula is feasible and safe. It offers a good alternative to the criterion standard PSARP for repair of ARMs with rectourethral fistula. Early results are encouraging, although a larger number and long-term follow-up are needed to further evaluate the outcomes.

References

- [1] Georgeson KE, Inge TH, Albanese CT. Laparoscopically-assisted anorectal pull-through for high imperforate anus—a new technique. *J Pediatr Surg* 2000;35:927-30.
- [2] Sinha CK, Haddad M. Robot-assisted surgery in children: current status. *J Robotic Surg* 2008;1:243-6.
- [3] Meehan JJ, Sandler A. Pediatric robotic surgery: a single-institutional review of the first 100 consecutive cases. *Surg Endosc* 2007;22:177-82.
- [4] Woo R, Le D, Krummel TM, et al. Robot-assisted pediatric surgery. *Am J Surg* 2004;188:27S-37S.
- [5] Albassam A. Robotic-assisted surgery in children: advantages and limitations. *J Robotic Surg* 2010;4:19-22.
- [6] De Vries PA, Peña A. Posterior sagittal anorectoplasty. *J Pediatr Surg* 1982;17:638-43.
- [7] Rintala RJ, Pakarinen MP. Imperforate anus: long and short-term outcome. *Semin Pediatr Surg* 2008;17:79-89.
- [8] Lima M, Tursini S, Ruggeri G, et al. Laparoscopically assisted anorectal pull-through for high imperforate anus: three years' experience. *J Laparoendosc Adv Surg Tech A* 2006;16:63-6.
- [9] Kubota A, Kawahara H, Okuyama H, et al. Laparoscopically assisted anorectoplasty using perineal ultrasonographic guide. A preliminary report. *J Pediatr Surg* 2005;40:1535-8.
- [10] Srimurthy K, Ramesh S, Shankar G, et al. Technical modifications of laparoscopically assisted anorectal pull-through for anorectal malformations. *J Laparoendosc Adv Surg Tech A* 2008;18:340-3.
- [11] Bailez M, Cuenca ES, Benedetto VD, et al. Laparoscopic treatment of rectovaginal fistula. Feasibility, technical details, and functional results of a rare anorectal malformation. *J Pediatr Surg* 2010;45:1837-42.
- [12] Kudon S, Iwanaka T, Kawashima H, et al. Midterm follow-up of high-type imperforate anus after laparoscopically assisted anorectoplasty. *J Pediatr Surg* 2005;40:1923-6.
- [13] El-Debeiky MS, Safan HA, Shafei IA, et al. Long-term functional evaluation of fecal continence after laparoscopic-assisted pull-through for high anorectal malformations. *J Laparoendosc Adv Surg Tech A* 2009;19:S51-4.
- [14] Yang J, Zhang W, Feng J, et al. Comparison of clinical outcomes and anorectal manometry in patients with congenital anorectal malformations treated with posterior sagittal anorectoplasty and laparoscopically assisted anorectal pull-through. *J Pediatr Surg* 2009;44:2380-3.
- [15] Uchida H, Iwanaka T, Kifamo Y, et al. Residual fistula after laparoscopically assisted anorectoplasty: is it a rare problem? *J Pediatr Surg* 2009;44:278-81.
- [16] Poderin G, Petit T, Mure PY, et al. Minimally invasive surgery for anorectal malformation in boys: a multicenter study. *J Laparoendosc Adv Surg Tech A* 2009;19:S233-5.