Purely robotic ileocystoplasty in children: why not? First case in Spain

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ABSTRACT

Introduction. We present the first case of pediatric ileocystoplasty using a purely robotic approach in Spain.

Case report. 12-year-old male with neurogenic bladder of low capacity and high pressures. After failure of conservative treatment, bladder augmentation with ileum patch was decided upon. Surgery was carried out using a purely robotic approach with 4 robotic and 2 accessory ports. Surgery duration was 380 minutes in total, without intraoperative complications. He was discharged 2 weeks after cystographic control. During 32-months follow-up, he has remained continent.

Discussion. The minimal invasion, surgical precision and ergonomics made the robotic approach an optimal option for complex surgical techniques. Given the little availability of the robot and the low pediatric volume, its standardization is a challenge. Our accumulated experience is consistent with the current literature and shows promising surgical and esthetic results. We hope this case report will contribute to the divulgation and progressive introduction of robotic surgery in our daily lives.

KEY WORDS: Urinary bladder, neurogenic; Bladder augmentation; Ileocystoplasty; Robotic surgical procedures.

AMPLIACIÓN VESICAL PEDIÁTRICA MEDIANTE ABORDAJE ROBÓTICO PURO: ¿POR QUÉ NO? PRIMER CASO EN ESPAÑA

RESUMEN

Introducción. Presentamos el primer caso de abordaje robótico pediátrico puro en España.

Caso clínico. Varón de 12 años con vejiga neurógena de escasa capacidad y altas presiones sin respuesta al tratamiento conservador, abogando por una ileocistoplastia de aumento. Se lleva a cabo un abordaje robótico puro con 4 puertos robóticos y 2 accesorios, de 380 minutos de duración total sin complicaciones intraoperatorias. Es dado de alta a las 2 semanas previo control cistográfico. Tras 32 meses de seguimiento continúa continente.

Comentarios. La mínima invasión, mayor precisión y ergonomía del abordaje robótico, hacen de éste una opción óptima para técnicas quirúrgicas complejas. Dada la difícil disponibilidad del robot y el escaso volumen pediátrico, resulta un reto su normalización en este campo. Nuestra experiencia coincide con la literatura, mostrando resultados quirúrgicos y estéticos prometedores. Esperamos este reporte contribuya a la difusión e introducción progresiva de la cirugía robótica en nuestra rutina.

PALABRAS CLAVE: Vejiga neurógena; Ileocistoplastia de aumento; Cirugía robótica.

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INTRODUCTION

Robotic surgery is at a time of progressive expansion. Although the first robotic approach described in children occurred 10 years later than the first published in the adult population[(1)], by 2012[(2)] 2,393 pediatric robotic procedures had already been identified with promising results that continue to be valid in the current literature.

There are several hospitals in Spain with availability of surgical robots, but the pediatric surgery departments that perform robotic procedures are few. Our center opened a pediatric robotic surgery program in January 2019. Since then, 32 patients have been operated –56% were abdominal approaches and 35% were urological procedures. It has allowed us to experience its benefits and gain enough confidence and experience to be able to conduct the first case of purely robotic bladder augmentation in a child in Spain[(3)].

The objective of the study was to present the case, the technique performed, and the long- and short-term results in order to divulgate our experience by confronting different controversies with the current evidence.

CASE REPORT

We present the case of a 12-year-old male diagnosed with myelomeningocele since week 25, and operated on the first day of life. He was a diaper carrier due to urinary incontinence with lack of sphincter control and voiding sensation. The initial physical examination revealed hypotonia of the lower limbs, live osteotendinous reflexes, and negative Babinski sign. Cremasteric and umbilical reflexes were absent. In addition, normally configured male genitalia and normal anal sphincteric tone were observed.

At abdominal-renal ultrasonography, bladder wall thickening was observed, without dilation of the renal collective system or parenchyma alterations. Serial voiding cystourethrogram (VCUG) identified bladder pseudodiverticula and ruled out vesicoureteral reflux (Fig. 1). Tc-99m Dimercaptosuccinic Acid (DMSA) Renal Scintigraphy showed a homogeneous uptake of both kidneys, with a right renal function of 47.36% and a left renal function of 52.63%. At the urodynamic study, enhanced spontaneous detrusor contractions at scarce filling were observed, with a high-pressure bladder (>100 mm Hg) and a total bladder capacity of 167 ml. Anal sphincter electromyography was normal. In blood and urine tests, renal function was preserved, with normal urine sediment and no microalbuminuria.

Figure 1. Preoperative voiding cystourethrogram identified pseudodiverticula and ruled out vesicoureteral reflux.

Given the initial findings, intermittent bladder catheterization and anticholinergics –initially oxybutynin and subsequently solifenacin– were scheduled. In the first year of treatment, there was a slight improvement, but intermittent urinary leaks that required maximum doses of anticholinergics and bladder catheterization every 2 hours persisted. Unsuccessful pharmacological treatment led to endoscopic injection of botulinum toxin A into the bladder detrusor muscle up to three times every 2-3 months. Failure of conservative treatment forced to consider augmentation enterocystoplasty, opting for a purely robotic approach.

A Da Vinci Xi robotic system was used. At the beginning, cystoscopy was carried out by guiding both ureters with 3-Fr double-J catheters. Both of them were sutured to a 14-Fr Foley urethral catheter for subsequent easier removal. The patient was placed in a steep Trendelenburg position. To perform ileocystoplasty, four 8mm robotic ports and two accessory ports –a 12 mm one and a 5 mm one– were used (Fig. 2A). After robot docking, a 20 cm fragment of ileal loop was obtained 20 cm away from the ileocecal valve. The intestinal segment was resected with the robotic endostapler, and bowel continuity was restored by conducting a standard side-to-side mechanical anastomosis. The isolated bowel segment was irrigated with saline solution and then detubularized using the robotic scissors. Subsequently, side-to-side bladder opening was carried out with electrofulguration. The U-shaped ileal patch was fixed at 6 and 12 o'clock positions, and the ileal-bladder anastomosis was completed in quadrants with continuous 4/0 barbed suture. Patch suture tightness was verified by filling the neobladder with saline solution. A suprapubic cystostomy was carried out to improve urinary flow, and using counter-incision, a 10-Fr perivesical drain connected to suction was left in place. Finally, the ports were removed under endoscopic vision and closed by layers (Fig. 3).

Total operating time was 380 minutes, with port placement and docking lasting for 10 minutes, console for 355 minutes, and port closure for 15 minutes. The step-up phase was achieved during the anesthetic time. Estimated blood losses were less than 100 ml. There were no intraoperative complications. The immediate postoperative period was monitored at the Intensive Care Unit, and the patient was referred to the hospitalization ward 24 hours later. Postoperative pain control was managed using intravenous analgesia by alternating paracetamol and metamizole. Peritoneal drainage was removed 72 hours following surgery given the progressive flow reduction. Enteral tolerance was restored on postoperative day 5, and urethral-ureteral catheters were removed on day 7. Cystographic control two weeks later showed correct neobladder repletion, without contrast anastomotic leaks (Fig. 4A). Subsequently, cystostomy clamping was started and progressively up to every 4 hours, with tolerance being adequate. The patient was discharged on postoperative day 16 with solifenacin every 24 hours, antibiotic prophylaxis with trimethoprim/sulfamethoxazole and daily washings with 1 ampoule of acetylcysteine.

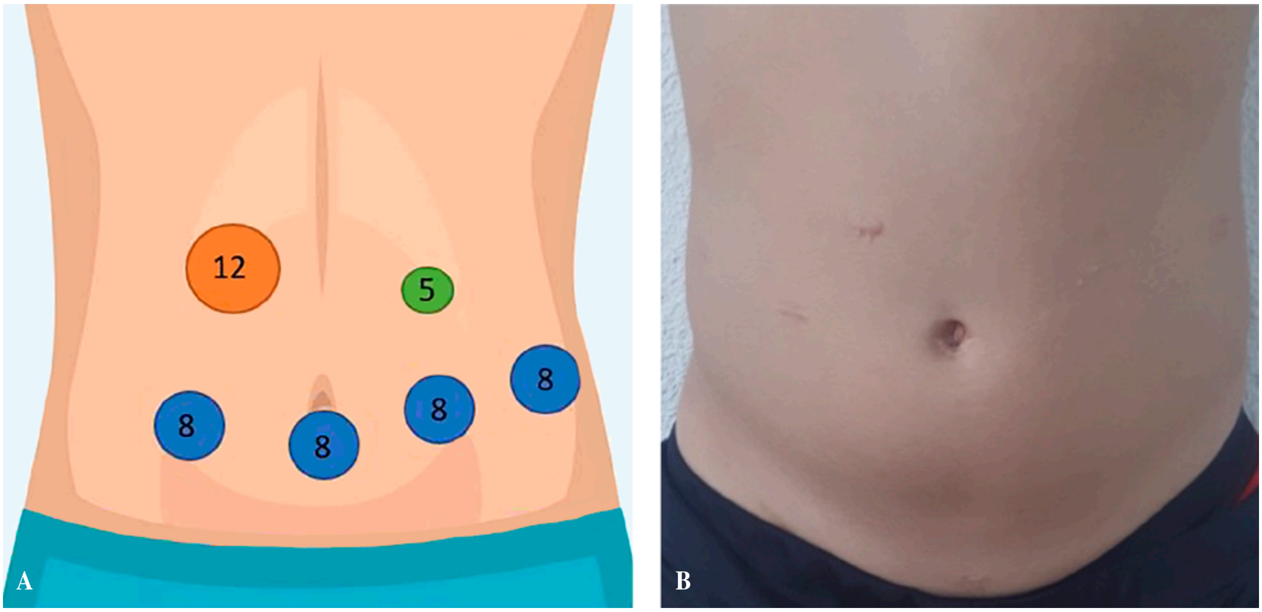

Figure 2. A) Port location for robotic ileocytoplasty using 4 robotic ports and two accessory ports of 12 mm and 5 mm. B) Esthetic final result after 32-month follow-up.

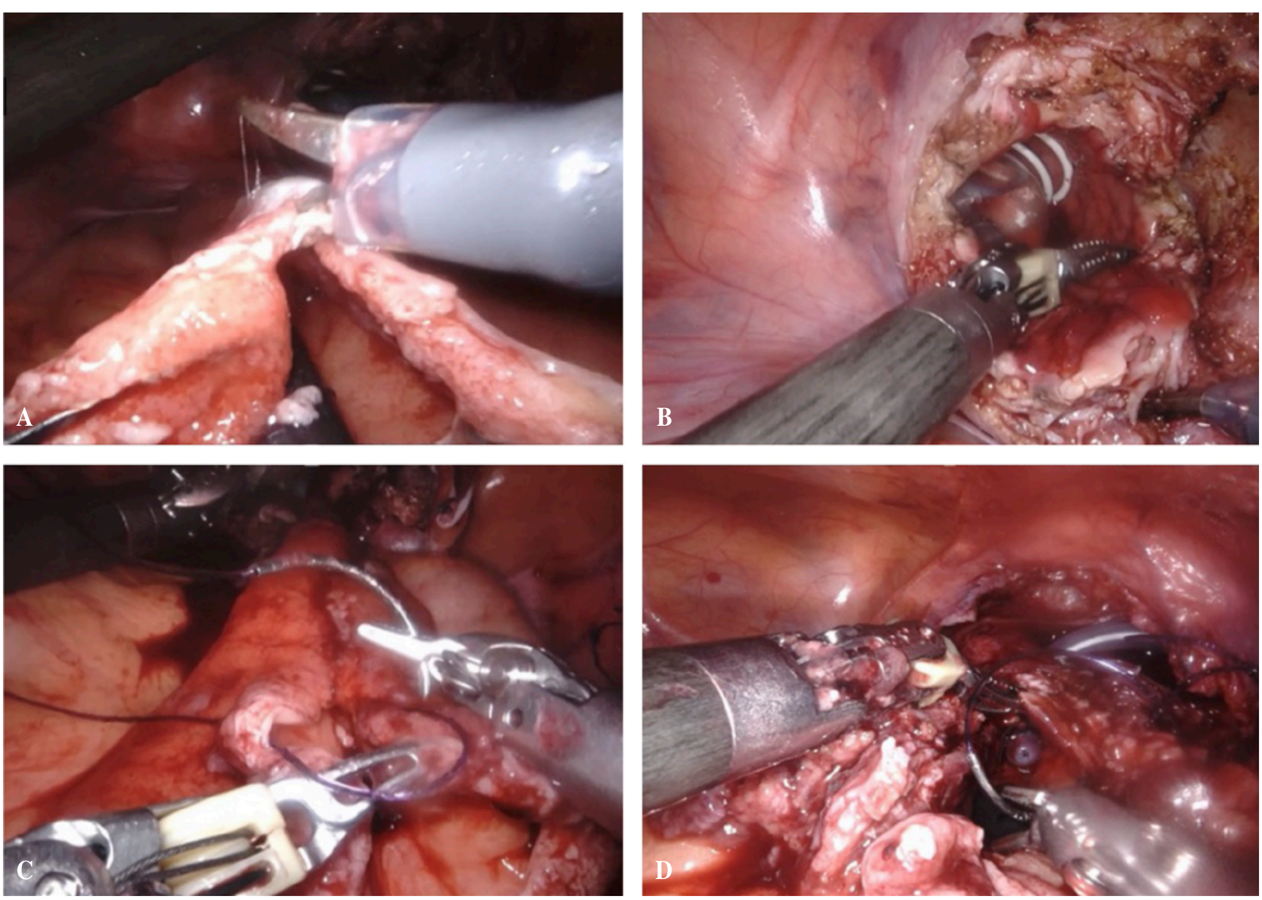

Figure 3. Operative steps. A) Ileum patch design. B) Side-to-side bladder opening. Ureteral guiding with double-J stent and urethral Foley catheter is to be noted. C) Creation of U-shaped ileal patch. D) Ileal-bladder anastomosis.

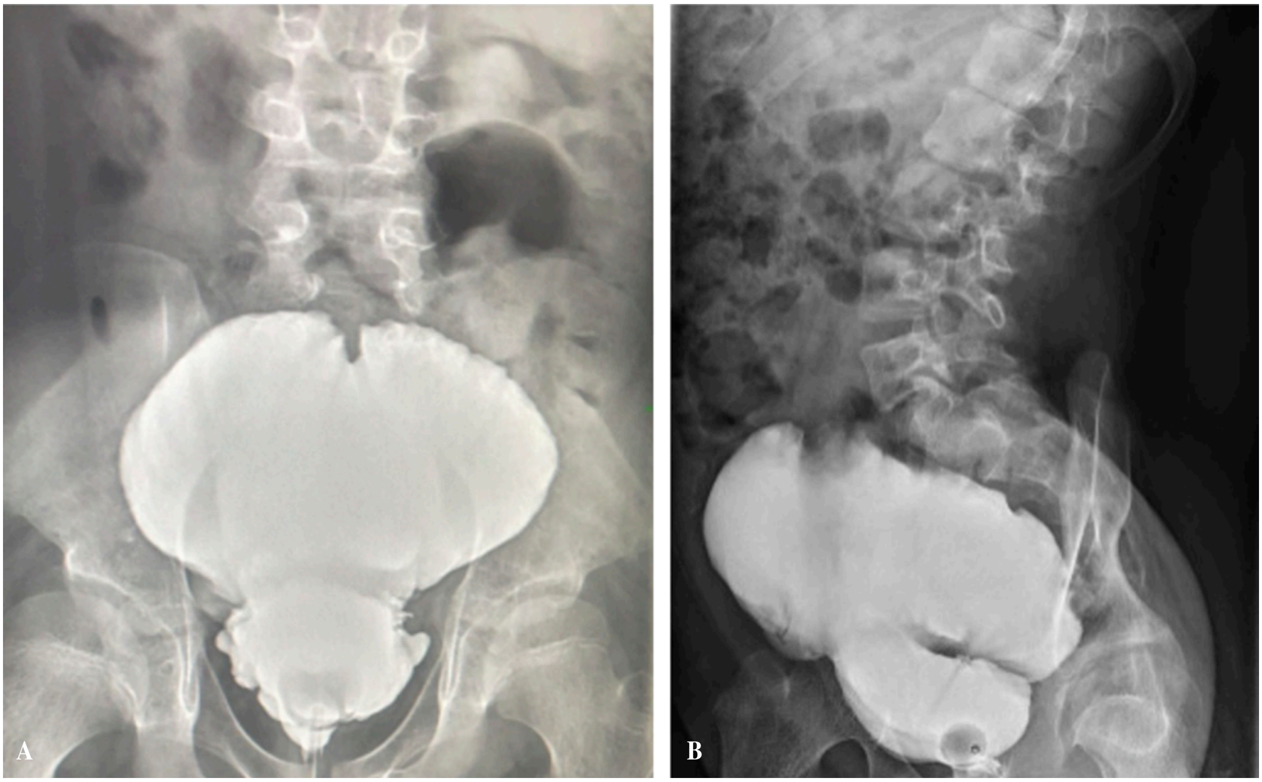

Figure 4. A) Two-week postoperative voiding cystourethrogram showed previous bladder diverticula and augmented bladder capacity without anastomotic leaks. B) No significant changes were observed at three-month postoperative voiding cystourethrogram.

At home, the patient remained with cystostomy clamping up to urethral catheterization every 4 hours was possible, without urinary leaks between them. Postoperative clinical control was carried out at 1 week, 1 month, 3 months, 6 months, and a year following surgery by a pediatric surgeon and a pediatric nephrologist. Three months postoperatively, a new VCUG was performed, which revealed an intact intestinal patch at the bladder dome, with no vesicoureteral reflux (Fig. 4B). Subsequently, imaging control was conducted with abdominal ultrasonography, showing no complications. In the serial blood analysis renal function was preserved. No urodynamic studies were required, since the patient remained asymptomatic.

During the 32-month follow-up, the patient remained dry between catheterizations every 3-4 hours. Esthetic results were highly satisfactory (Fig. 2B).

DISCUSSION

The current trend towards minimally invasive surgery is a virtually global phenomenon. In robotics, the well-known advantages of laparoscopic surgery seem to be added to other remarkable benefits. At first, robotic arms allow greater angulation (7 degrees compared to 4 in conventional laparoscopy), improving handling and ergonomics[4]. In addition, they reduce the surgeon's movements on a scale of 5 to 1, providing greater precision. These two aspects become important in small cavities where triangulation is a challenge, such as the pelvis[2,4]. On the other hand, robotic optics are capable of magnifying images 10 to 15 times and presenting them in 3D. This safeguards depth perception, especially limiting in conventional laparoscopy[4,5]. Furthermore, the optics remain fixed and filter possible tremors, facilitating continuous and precise visualization. Likewise, the rest of the robotic arms suply fixed and tireless help, making it the optimal assistant surgeon[6]. This, along with the relaxed position of the main surgeon in the control console, provides with greater comfort during surgery, which is important in complex surgical techniques such as this one.

Robotic surgery also has limitations that can be magnified in pediatric patients. So far, the only robotic system accepted for pediatric use has been the Da Vinci surgical system (Intuitive Medical, Sunnyvale, CA, USA). This system is available for 5mm and 8mm instruments, so its use may be controversial in younger children and neonates[2,7]. Although limitations in this regard could be solved with the development of adapted material, our institution has still been able to successfully operate on up to 6 patients under 5 years of age –the youngest one being 7 months old– and with a good esthetic result[3].

Another limitation of robotic surgery lies in the high cost of purchase and maintenance. In our experience, the cost of surgical robotic instruments ranged from $986.56 to $2,328.21, consistent with the results published by other groups[8]. A recent financial analysis[9] by Intuitive Surgical Inc from 1999 to 2017 found that the average cost per robotic procedure is $3,568, of which 52% comes from instruments and accessories, 29% from the robotic system, and 19% from the service contract. However, the analysis of other direct costs derived from the results is equally necessary. Rodrigues Martin's group[10] linear regression cost analysis of robotic-assisted radical prostatectomy, showed that one added hour in operating time meant a 4.4% increase in costs ($p<0.001$), and one more day of admission meant a 3.7% increase ($p<0.001$). It was also observed that the main surgeon's previous experience (15 or more cases performed) was associated with a 6.9% cost reduction ($p<0.001$), while the use of four instead of five robotic instruments represented a 13.9% decrease ($p<0.001$). Regarding pediatric experience, a multicenter comparative analysis[11] of the most frequent urological procedures conducted using the robotic vs. the laparotomic approach revealed a significant reduction in hospital stay and higher hospitalization costs ($p<0.001$), which is consistent with other previous multicenter analyses[12].

A clear barrier to the implementation of robotic surgery in pediatric institutions is the low volume, which leads to a loss of profitability. According to Palmer et al.[13], 3 to 5 cases per week are needed to demonstrate a net gain with the use of the surgical robot, which is difficult to achieve in most centers. In our opinion, this may be cause and consequence of the non-incorporation of the robotic approach to pediatric surgery.

As for the learning curve, it seems to be shorter than in conventional laparoscopy training thanks to the movement of the robotic arms. However, having previous laparoscopic experience contributes to reducing operating times[14]. A review[15] of the robotic fundoplication learning curve revealed a 50% drop-in operating time after 5 procedures. In our experience, after 5 procedures, the same surgeon managed to reduce operating times in ureteroplasty from 220 minutes to 145 minutes[3], which is close to the times published by other groups[16,17]. However, as expressed by Pio et al.'s group[18], surgical time per se does not completely define the learning curve or the surgical success, advocating a multivariate analysis that includes surgical outcomes – which we broadly agree with. Besides, we consider specialized training of the remaining operating-room staff to be essential for good surgical dynamics.

Ileocystoplasty is a complex technique that is difficult to completely execute laparoscopically, so the open technique is still considered the gold standard[19-21]. Robotic ileocystoplasty has proven to be feasible, safe, and efficient since the first case published in 2008[22], and subsequent case series[20]. A comparative study in 2015[21] of robotic vs. open approach results showed that the robotic group had a significantly longer operating time (623 vs. 287 min; $p<0.01$) but significantly shorter mean hospital stay (6 vs. 8 days; $p=0.01$), and no differences in terms of postoperative opioid use, increase in bladder capacity, and type or incidence of postoperative complications. None of the patients in the robotic group required epidural anesthesia vs. 3 in the open-label group. This is remarkable in patients with spinal dysraphism, since they usually cannot opt for this type of analgesia. In our patient's case, conventional intravenous analgesia was sufficient to control postoperative pain.

The minimally invasive approach is undoubtedly an important option but it is essential to strike a balance between risk and benefit[23]. Although robotic surgery has proven to be useful in adults and children[2], the low volume of pediatric candidates is an obstacle to the system's profitability and slows down the learning curve, separating it from the speed at which technology advances. In this regard, pathology centralization could be a possible solution[21,24]. Robotic ileocystoplasty yields positive surgical results without differences in terms of surgical complications, which should lead us to investigate its use as it was done at the early steps of laparoscopic surgery, which is currently widespread. The reporting of cases such as the one presented aims to demystify certain prejudices, contributes to the divulgation of new techniques, and hopefully will make us wonder 'why not?' approach it this way.

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