# Intraoperative Problems and Solutions in Pneumovesicum Laparoscopic Cross-trigonal Ureteral Reimplantation in Children by a Beginner Surgeon

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## ABSTRACT

**Objective:** Many beginner surgeons feel anxious when first doing the procedure. Some may encounter many intraoperative difficulties or problems, resulting in abandoning the technique. We will demonstrate our methods and the solutions to major intraoperative problems.

**Materials and Methods:** A beginner surgeon performed the operation on 13 children with VUR (20 ureters) who met the indications for surgery between October 2016 and August 2017. Age ranged from 2 to 7 years. Each operation comprised 2 main steps: anchoring the urinary bladder wall to the anterior abdominal wall under cystoscopic vision, followed by a cross-trigonal ureteral reimplantation under pneumovesicum laparoscopy. The intraoperative problems, postoperative care, and follow-up periods were recorded to identify surgical outcomes.

**Results:** Most significant, intraoperative problems were air leakage, bleeding, tear of the bladder mucosa above the tunnel, and inability to insert a tube into the ureter pre- and post-reimplantation. Most problems could be managed. Only one case had to be converted to open reimplantation due to uncontrolled air leakage. Postoperatively, 2 patients had hydroureteronephrosis at 4 weeks, but it eventually spontaneously regressed. One patient had cystitis, treated with oral antibiotics. Between the 1-year and 4-year follow-up, no patients had hydroureteronephrosis or urinary tract infections (UTI).

**Conclusion:** Pneumovesicum laparoscopic ureteral reimplantation is a feasible technique for beginner surgeons. Although many intraoperative problems may be encountered, most can be managed, resulting in the completion of the laparoscopic procedure.

**Keywords:** Vesicoureteral reflux; pneumovesicum laparoscopic ureteral reimplantation; vesicoscopic ureteral reimplantation; beginner surgeon (Siriraj Med J 2021; 73: 758-762)

## INTRODUCTION

Although many of the patients diagnosed with vesicoureteral reflux (VUR) may recover spontaneously with conservative treatment, a large number meet the indications for anti-reflux interventions. Injection therapy is now more popular because of its endoscopic approach that can be done in an outpatient setting and is more cost-effective than open ureteral reimplantation, especially for low-grade VURs.[1,2] In contrast, for high-grade VURs, ureteral reimplantation is considered a suitable option due to the lower success rate of injection therapy.[3] In many countries, including Thailand, no injection materials are

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used due to high cost. Consequently, ureteral reimplantation remains the option of choice for VUR treatment.

Like many other operations, ureteral reimplantation can be performed using open and/or laparoscopic methods. Based on our experience, laparoscopic surgery, in general, is associated with less pain, shorter lengths of hospital stay, rapid recovery, and better cosmesis than open approach. The same applies to the ureteral reimplantation procedure. Laparoscopic ureteral reimplantation employs 2 techniques: an extravesical and an intravesical approach. Because of concerns about postoperative voiding dysfunction, extravesical ureteral reimplantation is considered inferior to the intravesical technique, especially for bilateral reimplantation. A novel technique, transvesicoscopic Cohen ureteral reimplantation under carbon dioxide bladder insufflation, was first reported by Yeung et al. in 2005.[4] They demonstrated a high success rate for this method (96%), which is comparable with the conventional open intravesical Cohen cross-trigonal technique. This technique is currently in widespread use and is still employed to treat VUR.

For young pediatric urologists, laparoscopic procedures in children are hard to perform and require more learning than those for adults. This is not only because of the very small working space available in a little body, but also due to relatively few cases. Many beginner surgeons therefore face a steep learning curve. Compared to a pneumoperitoneum, a pneumovesicum has much less working space, resulting in more difficulty in performing a vesicoscopic ureteral reimplantation. This paper describes the experience gained in performing this operation by a beginner surgeon, the intraoperative problems encountered, and the solutions developed. The content should enable other beginner surgeons to undertake this operation with a degree of confidence and encourage them to perform further laparoscopic surgeries in children.

## MATERIALS AND METHODS

### Patients

From October 2016 to August 2017, a urologist, who recently finished his residency training in June 2016, carried out pneumovesicum laparoscopic ureteral reimplantation in 20 ureters of 13 patients with VUR. Their ages ranged from 2 to 7 years at the time of surgery. They all were followed until mid-2021.

### Surgical technique

***Cystoscopy.*** After general anesthesia was administered, each patient was placed in the lithotomy position. The abdomen and external genitalia were prepared and draped in a sterile fashion. Transurethral cystoscopy with a 30-degree lens and normal saline irrigation was performed. The bladder was carefully inspected, and both sides of the ureteral orifices were identified before the bladder capacity was measured. Normal saline was filled in the bladder again until maximum anesthetic capacity was reached.

***Bladder wall anchoring and ports placement.*** The next step was to anchor the bladder wall to the anterior abdominal wall. This procedure prevented bladder collapse during the operation. Under cystoscopic vision, two, 24-gauge, Medi-Cut needles were passed into the bladder at the midline of the suprapubic site, which corresponded to the most anterior part of the bladder wall that had been observed from the cystoscopy. In this step, there is a need to be aware of the peritoneal recess, which may go down to cover the superior part of the anterior bladder wall. Number 1 nylon was first inserted into one Medi-Cut needle. Grasping forceps for cystoscopy were subsequently inserted into the other needle in order to grasp the end of the nylon, pull it up, and tie both ends of the nylon together, thereby anchoring the bladder wall. Using the same technique, two other anchoring stitches were sequentially placed on the Langer's at Langer line, just lateral to the site where the working ports would be placed. A 5-mm camera port was placed below the midline anchoring stitch using an open technique. Another two, 5-mm working ports were placed under laparoscopic vision on the Langer line (Fig 1). Placing the working ports on the Langer's line facilitated the later dissection of the ureter and creation of the submucosal tunnel. The bladder was then drained and insufflated with carbon dioxide at a pressure of 10–12 mmHg via a camera port at the bladder dome.

***Ureteral dissection and tunnel creation.*** A size 5 to 6 Fr feeding tube was inserted into the ureteral orifice. This tube facilitated the visualization of the ureter's contour and its serosa. The medial side of the ureteral orifice was hung with 4–0 chromic catgut or Vicryl. Dissection of the ureter was performed with the hook. Blood vessels on the serosa of the ureter were clearly visualized under the laparoscope. When the ureter was freely dissected, a cross-trigonal submucosal tunnel was created with sharp scissors. The ureter was mobilized through the tunnel and fixed into position with 4–0 Vicryl. The gap of the muscular layer at the ureteral hiatus was sutured to prevent the future formation of a diverticulum. The ureter serosa was fixed to the hiatus before the bladder mucosa was closed. The feeding tube was placed in the

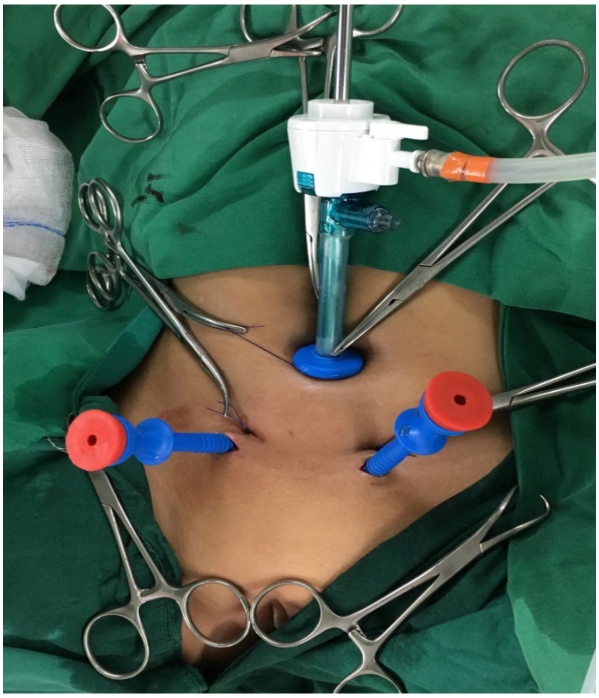

**Fig 1.** Position of all ports

ureter to enable splinting via the working port. The working port was removed, but the feeding tube was left and fixed to the skin with Number 3 nylon. A Foley catheter was placed. The camera port was removed, and cystoplasty was performed using an absorbable suture. The anchoring stitches were removed, and the abdominal sheath and skin were closed.

***Postoperative care and follow-up.*** General routine postoperative care was conducted. A ureteral stent was used for about 6 to 7 days, and the Foley catheter was removed 1 day after the ureteral stent removal. Without any catheter, the patient could then be discharged from the hospital. The patient was scheduled for a urinalysis and kidney-bladder sonography at 4 weeks postoperatively. If no abnormal symptoms or findings were found at that time, the patient was rescheduled to see us every 3 months postoperatively in the first year and every year with ultrasound afterwards. Voiding cystourethrography would be repeated in case of persistent hydronephrosis or febrile UTI. Prophylactic antibiotics was discontinued at 6 months after surgery if the patient had improved hydronephrosis and no febrile UTI.

## RESULTS

The mean age of the patients was 4 years 6 months (range: 1 year 10 months to 6 years 5 months). Six patients had unilateral VUR, while seven had bilateral VUR; a total of 20 ureters were reimplanted without tapering of the ureters. The mean bladder anesthetic capacity was 302 mL (range: 200 to 450 mL). The mean operative time (from cystoscopy to wound closure) was 176 minutes (range: 140 to 205 minutes) for the unilateral reimplantations and 240 minutes (range: 180 to 371 minutes) for the bilateral reimplantations. Table 1 details the demographic data and operative times of all 13 cases. In our experience, the intraoperative problems were air leakage (4 cases), bleeding (3 cases), tear of the bladder mucosa over the tunnel (2 cases), and inability to insert the ureteral stent (1 case). The whole operation managed to be performed for almost all of the patients. The procedure for only one patient (who was the youngest, aged 1 year and 10 months) had to be converted to an open reimplantation because of uncontrolled air leakage into the extravesical space and severe bladder collapse.

No patient had significant postoperative complications. They occasionally had gross hematuria for only a few days. They could start ambulating on postoperative day 1. Bladder spasm was minimal with no anti-muscarinic administration. The ureteral stent was left in the reimplanted ureter for 7 days. The urethral catheter was removed one day after the ureteral catheter removal, following which the patients were discharged home. A follow-up was conducted 4 weeks later. A urinalysis and kidney ultrasonography were carried out on all patients. If both tests were normal and the patients had no abnormal symptoms, they were scheduled for a further follow-up 3 months postoperatively. One patient was found to have dysuria, frequent urination, and pyuria at the initial two follow-ups. She received oral antibiotics and recovered fully during the following 2 weeks. Two patients with grade 5 VUR were found to have hydronephrosis in the first follow-up. However, the degree of hydronephrosis had improved by the next 4-week follow-up. Between the 1-year and 4-year follow-up visits, none of the 13 patients exhibited a dilated ureter or hydronephrosis in an ultrasound examination, and there were no signs or symptoms of urinary tract infections.

## DISCUSSION

A minimally invasive technique for intravesical cross-trigonal ureteral reimplantation was reported by Gill et al. in 2001.[5] They used a transurethral endoscope, and 2 working balloon-ports were placed at the suprapubic area. However, this technique had some limitations, such as not being suitable for bilateral reimplantations and problems with the original ureteral hiatus. In 2005, Yeung et al. reported the first series of transvesicoscopic Cohen ureteral reimplantations; these had a high success rate that was comparable with that achieved with open cross-trigonal ureteral reimplantations.[4] They placed

**TABLE 1.** Demographic data and operative times.

| Gender | Age | Side | Grade of VUR (Lt/Rt) | Bladder capacity (mL) (mL) | Operative-time (minutes) |
|---|---|---|---|---|---|
| Male | 5 yr. 2 mo. | Left | 4 | 350 | 193 |
| Female | 5 yr. 10 mo. | Both | 3/3 | 350 | 190 |
| Female | 5 yr. 3 mo. | Both | 5/1 | 260 | 371 |
| Male | 2 yr. 4 mo. | Left | 4 | 200 | 205 |
| Male | 6 yr. 1 mo. | Left | 4 | 350 | 140 |
| Female | 5 yr. 7 mo. | Left | 3 | 320 | 180 |
| Female | 6 yr. 5 mo. | Left | 3 | 300 | 180 |
| Male | 4 yr. 3 mo. | Both | 5 | 300 | 270 |
| Male | 3 yr. 1 mo. | Both | 5/4 | 250 | 205 |
| Female | 4 yr. 5 mo. | Left | 3 | 450 | 160 |
| Female | 3 yr. 9 mo. | Both | 3/4 | 300 | 275 |
| Male | 4 yr. 11 mo. | Both | 4/5 | 300 | 180 |
| Male | 1 yr. 10 mo. | Both | 4/4 | 200 | 190 |

a camera port at the dome of the bladder instead of using transurethral endoscopy, resulting in a better forward intravesical view. Moreover, they used carbon dioxide to distend the bladder instead of glycine, which resulted in much better intravesical vision. The largest series of this technique was reported by Valla et al. in 2009.[6] Their success rate was 92%–95%, and the conversion rate was 6%. The cause of the conversions was an inability to maintain pneumovesicum, which mostly occurred in patients aged under 2 years.

From our series and experience, there are four main problems which occur during the operation. The methods to solve or to prevent those problems are described below.

***Air leakage and port problem***. This is an important problem that forces surgeons to convert to open surgery. Air from the inflated bladder may leak through to the urethra, the ureteral hiatus, or the port sites. The Foley catheter placement and traction can prevent air leakage through the urethra. Air leakage through the hiatus after the ureteral dissection can be solved by the immediate suturing of the defect after the ureteral dissection, and by the subsequent insertion of a small feeding tube into the prevesical space beside the ports to release the air. From the series of Mohan et al., another method to solve air leakage from the hiatus is to reduce the pressure.[7] They reduced the intravesical pressure from 14 to 8 mmHg, and air leakage did not recur. Air leakage through the port sites into the extravesical space can be prevented by anchoring the bladder to the abdominal wall and by assuring the stability of the working ports by fixing them the skin with suture material or using a balloon port instead. We observed that younger patients had a port problem more than older patients. Port displacement is also an important problem that is associated with air leakage. One patient in our series had to be converted because of severe bladder collapse from uncontrolled air leakage into the extravesical space. According to the series from Yeung et al.,[3] out of 16 patients had this problem, and 1 patient had to be converted to open surgery.[4] Canon et al. also reported a port problem.[8] One out of 52 patients in their series had to be converted to open surgery due to poor port placement and an equipment malfunction. They also reported air leakage into the peritoneal cavity, which caused pneumoperitoneum. However, transumbilical Veress needle placement was used to release the air in the abdominal cavity. In our series, no pneumoperitoneum occurred. This may be the result of using a different technique for the placement of the camera port at the dome of bladder. We used the open technique, whereas Canon et al. placed the camera port under cystoscopy. Port placement with the open technique can definitely avoid entering the peritoneum via the peritoneal recess. In Valla's study, 4 out of 72 patients had to be converted owing to a port placement problem, and 6 patients had pneumoperitoneum, which could be corrected using a Veress needle.[6]

***Bleeding***. The laparoscopic approach resulted in a higher chance of serosal blood vessel preservation than the open reimplantation technique because of better visualization. However, it is possible to have a bleeding from the detrusor muscle or the serosa of the ureter during a ureteral dissection. Although bleeding in this operation is usually minimal, it will cause difficulty with the visualization of the plane between the ureter and the bladder muscle. This problem can be solved by careful electrocoagulation at the bleeding point. However, extensive electrocoagulation may cause long term complications, such as ureteral stricture due to ischemia or heat effect.

***Tear of bladder mucosa over the tunnel.*** If this problem occurs, it can be easily corrected by suturing the tear mucosa. This problem mainly stems from an inappropriate scissor curve and working-port angle. The working ports should be placed on the Langer's line. We observed that the ureteral orifices and the interureteric bar are usually underneath the Langer's line. Consequently, we can create a submucosal tunnel in a direction that will not cause a mucosal tear. In addition, we recommend placing the working ports laterally as far as possible to make the angle of the port more parallel with the posterior bladder wall. However, one should be aware of the injury to the iliac and inferior epigastric vessels. To prevent inferior epigastric vessel injury during the working-port placement, which may result in abdominal wall bleeding or hematoma, the light from the cystoscopy shining through the abdominal wall greatly facilitates the identification of the position of these vessels.

***Inability to insert the feeding tube.*** The feeding tube in the ureter allows us to clearly identify the contour of the ureter and the plane between the ureter and the detrusor muscle. An inability to insert the feeding tube may be caused by 2 factors: either the tube is too big, or the angulation of the ureterovesical junction is difficult. The later can be solved by inserting the guidewire first, followed by railroading the feeding tube over the guidewire. Alternatively, a smaller tube can be chosen for insertion into the ureter.

From our series, the average operative time was longer than the series of Yeung et al., Canon et al., and Valla for both the unilateral and bilateral ureteral reimplantations.[4,6,8] This may reflect the level of experience of the surgeon with laparoscopic surgery. Moreover, we found that the operative time is inversely associated with bladder capacity, with no statistical significance (Pearson correlation coefficient: -0.347; p-value: 0.25). Therefore, it would be easier for beginner surgeons to perform this operation on patients with a large bladder capacity.

## CONCLUSION

Ureteral reimplantation is still a crucial operation for pediatric urologists. Pneumovesicum laparoscopic cross-trigonal ureteral reimplantation is a better option than open technique for reducing postoperative pain, the incidence of bladder spasms, and the lengths of hospital stay, and for achieving better cosmesis. Because of the many problems that may occur during the operation, this procedure may be hard to perform, but it is not impossible to learn and acquire the necessary skills. Despite there being a steep learning curve, we firmly believe that every beginner surgeon is able to carry it out effectively and safely with good outcomes.

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