

## Vesicoscopy In Children: A Potential Gold Standard Procedure With Good Outcome

**Marte A\***

Department of Pediatric Surgery, Second University of Naples, Italy

**\*Corresponding author:** Antonio Marte, Associate Professor, Pediatric Surgery Second University of Naples. Largo Madonna delle Grazie, 1. 80138, Naples, Italy, Email: antonio.marte@yahoo.it

**Published Date:** April 02, 2016

### SUMMARY

#### Aim

We report our experience on the use of vesicoscopy in children for treating Vesicoureteral Reflux (VUR), Refluxing Megaureter (RM) and Primary Symptomatic Bladder Diverticula (BD).

#### Material and Methods

63 patients aged 3 to 12 years have been operated at our Institution from January 2007 to December 2015. There were 45 VUR, 3<sup>rd</sup> to 5<sup>th</sup> degree, 2 refluxing megaureter, 16 Primary Bladder Diverticula.

All the procedures have been performed with three-trocar technique. Under cystoscopic control, a first midline 5-mm trocar was introduced for a 0° telescope at the dome of the bladder, and 2 left and right 3- or 5-mm trocars were inserted through the anterolateral wall. The refluxing ureter have been treated with Cohen's technique while Megaureter were tailored before the reimplantation. Primary bladder diverticula were excised by endovesical technique inverting the sac in the bladder en bloc or progressively. The detrusor was sutured in one of two layers.

## Results

Mean operative time ranged from 80 to 240 min. (mean 150 min.) in cases of Ureteral Cohen's reimplantation and 120-220 min. in Refluxing Megaureters respectively; In BD operative time ranged from 50 to 140 min, (mean time 90 min). No major perioperative complication (hemorrhage, urinoma) occurred nor conversion to open surgery was necessary. Operative complications have been:

- 1 fracture of the needle for suspension of the bladder removed with the aid of the image intensifier;
- 9 displacement of the trocars which resulted in the leakage of gas in the perivesical space compromising the space and the intravesical endoscopic vision. In this case the trocars were replaced or relocated in a more lateral position.
- 3 subcutaneous emphysemas
- Two VUR recurred and were treated the first with endoscopic injection while the other resolved with antibiotic prophylaxis. No recurrence occurred in the two girls with RM. One diverticulum recurred at VCUG control in a case of bilateral huge congenital diverticula

## Conclusion

Our experience seems to confirm that vesicoscopy can be performed safely and effectively in children.

## INTRODUCTION

Last in order of time but of growing interest, vesicoscopy has been added to the repertoire of minimally invasive procedures in pediatric surgery after the first reports by Valla and CK Yeung [1-4]. Actually to describe this technique, in the literature there is not yet a unique terminology and so in the main search engines this procedure is described as "pneumovesicum", "pneumovesicoscopy", "bladder laparoscopy", "transvesical laparoscopy" [5-9]. In our opinion the term "Vesicoscopy" would be more correct because it describes the minimally invasive technique in relation to the district in which the procedure is performed as happens for "Laparoscopy" and "Thoracoscopy".

Traditionally the treatment of the bladder pathologies of the bladder and the urethra, the working space was obtained with the instillation of a liquid medium (Saline, Mannitol, etc). Cystostomic approach also was often used by urologists from indefinite time to introduce an

operative cystoscope suprapubic to carry out infiltration of the bladder neck, hemostasis, foreign body removal, incision of proximal stenosis, retrograde catheterization utilizing a liquid medium.

The development of minimally invasive surgery, especially in children, allowed to use the pneumovesicum for some intravesical procedures utilizing laparoscopic technique and instruments in the 90's.

Recently Vesicoscopy has become a safe and useful alternative option to traditional open surgery in the treatment of some congenital or acquired pathologies in children such as Vesicoureteral reflux (VUR)), Symptomatic bladder diverticula (BD), Obstructive Megaureter (OM). There are then other minor indication as bladder stones removal or bladder neck injection. More recently the technique has been also used in adults for the removal of tumors of the upper urinary tract with remarkable effectiveness [10-12].

The use of this minimally invasive approach comes from the need to reduce morbidity typical of traditional surgery which are: prolonged hospitalization, postoperative bladder spasm, pain at the incision, prolonged catheterization, bladder dysfunction, intravesical clots.

The first attempts to treat vesicoureteral reflux by a sort of vesicoscopy dates back to Okamura et al. [13] when they reported the first results of endoscopic trigonoplasty as an alternative to ureteral reimplantation. However, this procedure was associated with a success rate of 70% in children 3 months after treatment but was associated with a high rate of secondary failure to "trigonal splitting" (regression of the urethral orifice to their original position) in 38% of patients ureteral and retraction (distance between the ureteral orifices less than 2 cm) in 23% of patients undergoing cystoscopy [13-15].

In order to reduce the incidence rate of "trigonal splitting", Lakshmanan et al. [16] described in 1999 an experimental model of pigs for changes in the technique of intravesical trigonoplasty which provided for the mobilization of the ureters. This technique beyond the failures in the resolution of reflux and in preventing "trigonal splitting", showed the potential feasibility of an intravesical endoscopic mobilization of the ureters. In 2001, Gill et al. [17] described an endoscopic transvesical cross - trigonal Cohen's reimplantation in three patients with a complete resolution of vesicoureteral reflux in 2 out of 3 patients and a downgrading in 1. The Authors also emphasize how this approach has reduced the time of hospitalization, bladder spasm, the need for postoperative analgesia, all with a good aesthetic result.

The aim of this article is to report our experience of vesicoscopic treatment of VUR, Obstructive Megaureter and Primary Symptomatic Bladder Diverticula (BD) in children who underwent vesicoscopy between January 2007 and December 2015 at our Institution.

## **SURGICAL TECHNIQUE**

The specific surgical instruments required for this procedure are the following :

- Pediatric cystoscope
- 0°, 5mm optic
- Two 3-5mm reusable trocars
- One 5mm standard or self- blocking trocar
- Monopolar 3-5mm hook
- Monopolar 3-5mm scissors
- 3-5mm needle holder
- Suction device
- 3-5 mm grasper
- 3-5mm dissector Maryland

The procedure requires the following steps: the patients is placed in the lithotomy position with abducted thighs and the pelvis tilted with a cushion placed below the buttocks.

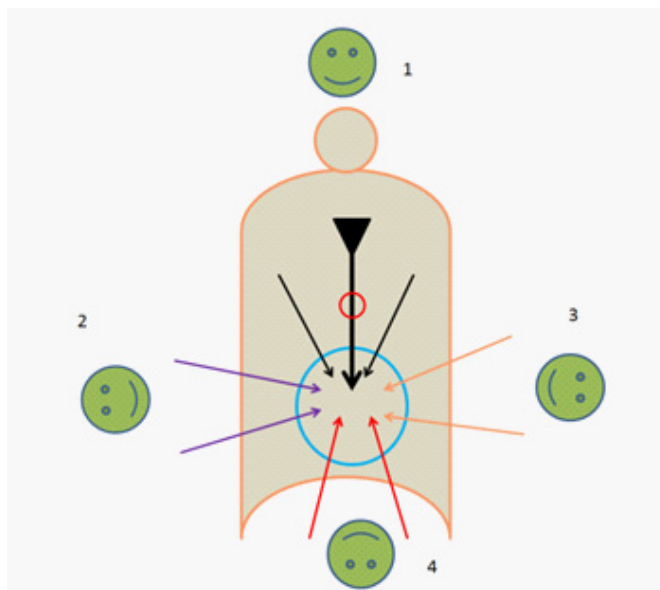
In infants, the surgeon may stand at the patient's head, with the column or a screen between the legs of the patient at the end of the operating table. In older children, the surgeon usually is positioned to its left or right side and on the contralateral side of the BD. The modern setting of operating rooms with multiple screens facilitates freedom of movement of the surgeon.

The pelvis of the patient is raised with a small cushion applied under the buttocks. The patient is then placed in mild Trendelenburg position.

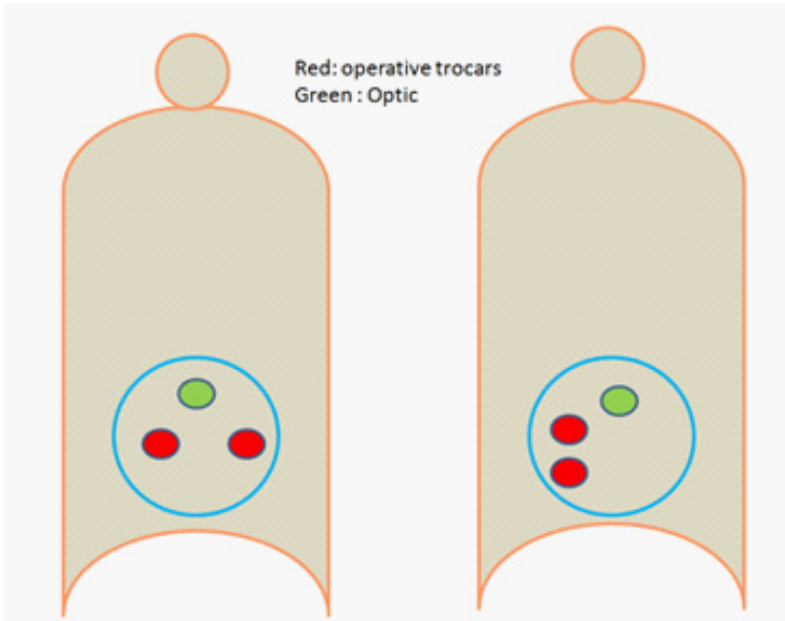
A cystoscopy recognition is performed to verify the condition of the urethra and the ureteric orifices, or the position and the number of diverticula. A ureteral sund is introduced in refluxing ureters or at side of diverticulum. The bladder is then filled at 2/3 of its capacity and two percutaneous transfixing sutures (no.1 or no.2 polyglactin stitches) are placed laterally to allow keeping the bladder wall close to the abdominal wall and stabilize the bladder during the manoevers. Under visual control the first 5 mm trocar is introduced for a 0° telescope at the bladder dome and two operative lateral 3 or 5 mm trocars are then inserted at level of midclavicular line. Once settled the trocars, pneumovesicum is established at a pressure of 10-12 mmHg cm H<sub>2</sub>O and a volume of 2L/min, and simultaneously the irrigation fluid is aspirated. A Foley catheter is kept in side serving as a system of suction / irrigation during dissection and ureteral reimplantation.

To perform the reimplantation we utilize a 3 or a 5mm needle holder, a grasper, a pair of scissors, a monopolar hook and a peanut. The ureteral orifice(s) is fastened to the probe by means of a transfixed stitch and then attracted into the bladder (Figures 1-3). The bladder mucosa around the orifices is then incised by scissors and hook and the ureter is freed obtaining a sharp plane between the detrusor muscle and the ureteral wall. To work in a limited working space,

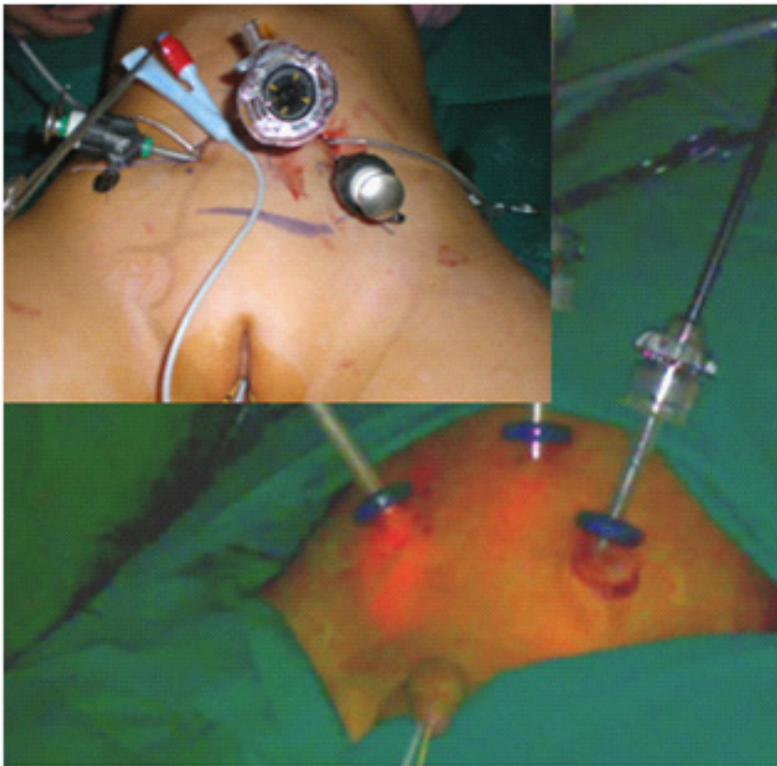
the “spaghetti manoever”, rolling the ureter around the needle holder or the grasper [5,6], makes easier the ureteral isolation. In case of megaureter, the ureter can be brought out the bladder and tailored according to Hendren’s technique, outside the bladder, through the urethra in girls or through the hole of the ipsilateral lateral port in boys [4]. A medium dilatation of the ureter can be also sutured intravesically. Reimplantation is carried out by creating the submucosal tunnel with the scissors and the graspers by lifting the bladder mucosa and through a combination of blunt and sharp dissection. The detrusor below the ureter is repaired with one or two absorbable stitches as in the open technique to stabilize the tunnel and prevent retroperitoneal gas leakage. The ureter is then passed through the tunnel spatulating its distal portion and the ureter is anastomized to neomeatus with three/four three-four 5-6/0 absorbable sutures according to Cohen’s technique.



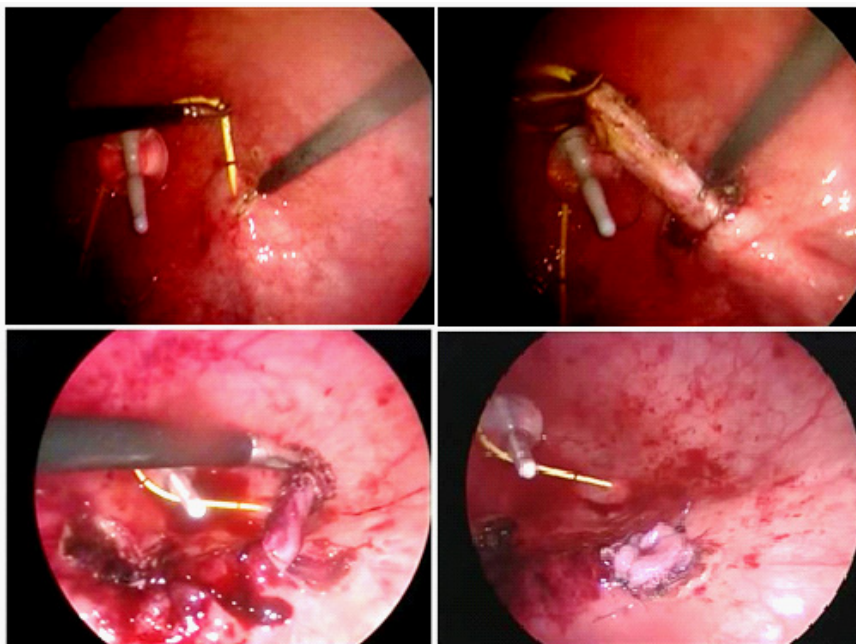
**Figure 1A:** The various position of the surgeon according to the age of the patient (head, feet, side) to perform vesicostomy.



**Figure 1B:** Two possible disposition of the operative trocars (red).



**Figure 2:** Operative field and trocar disposition.



**Figure 3:** The main steps of Cohen's reimplantation: The ureter is secured to the suture and then attracted into the bladder. Isolation by spaghetti manoeuvre, tunneling.

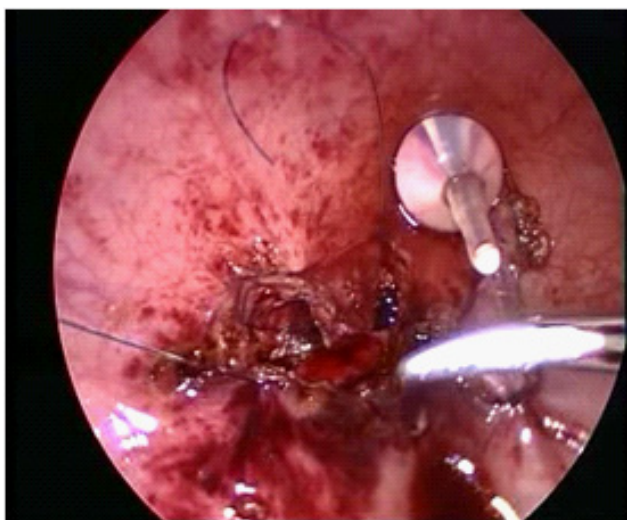
Some Author prefer Politano reimplantation even if the procedure implies a longer operative time, because of the higher surgical complexity [16].

A useful tool to facilitate the tunnelling is to reduce the CO<sub>2</sub> pressure to 5-6 mmHg during the dissection in order to obtain a better angulation of the instruments during the creation of the tunnel. In case of double reimplantation we prefer to obtain two separate tunnels.

The fact that some patients had previously undergone endoscopic single or multiple dextranomer/hyaluronic acid injections does not represent a problem. At the end of the procedure, in some cases a ureteral double J stent is left in place for 3 to 4 weeks if the dilated ureter needed a long tailoring.

Regarding Bladder diverticula, the procedure followed the same initial and final steps of VUR and Megaureter treatment. In older children the operative trocars can be placed both on the contralateral side of the diverticulum to realize a better ergonomics. The smallest diverticula can be inverted and the mucosa around the neck is incised and freed by creating a plane between the detrusor and the mucous membrane and removed using the hook and the scissors. The bigger ones instead need to be gradually inverted into the bladder and removed in small pieces gaining gradually the whole diverticulum. When the dissection is completed, the closure of the wall is performed by a double or a single layer watertight closure with interrupted absorbable sutures. The specimens are removed under visual control, either entirely or divided into small pieces.

A foley catheter is left in place for one to three days. Only the sites of the 5 mm lateral ports are sutured with 3/0 polyglactin stitches passed around the trocars with a Reverdin needle. The urethral and suprapubic catheters are removed 3-4 days after the procedure. A 12Ch Foley catheter filled with 3-4 ml sterile water can be also introduced at the site of the 5 mm dome-port through the trocar channel or with the help of a guide-wire if a suprapubic derivation is considered necessary . The two sites of the 3 mm trocars does not require closure. Postoperative follow-up consisted of clinical examination, reno-bladder US and in selected cases VCUG, MAG3 radionuclide scan and urodynamics from 3 to 6 postoperative months . A clinical control and reno-bladder US was then repeated yearly (Figures 1 -9).

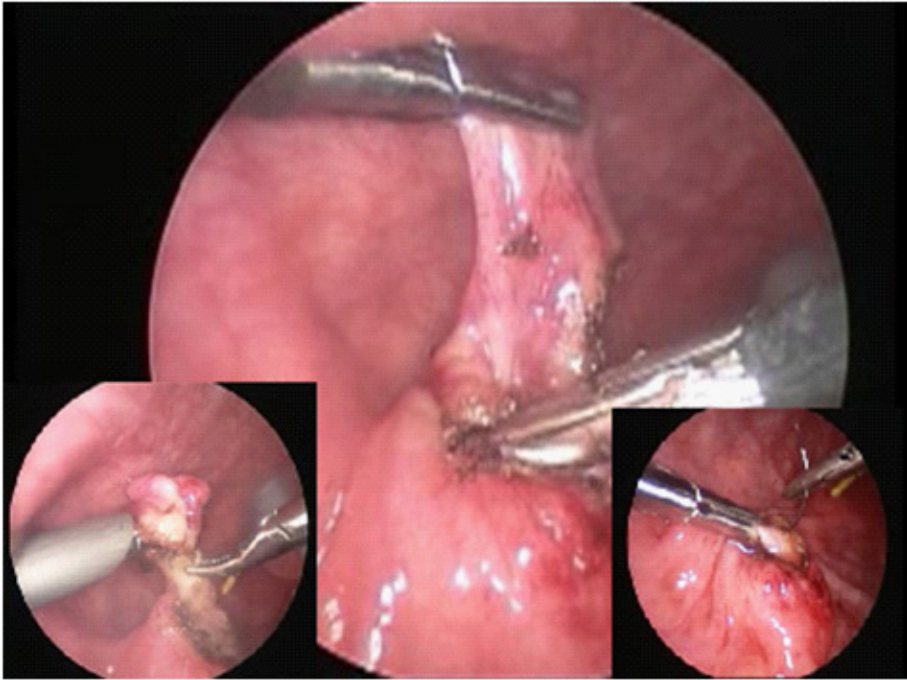


**Figure 4:** Repair of the ureteric hiatus.

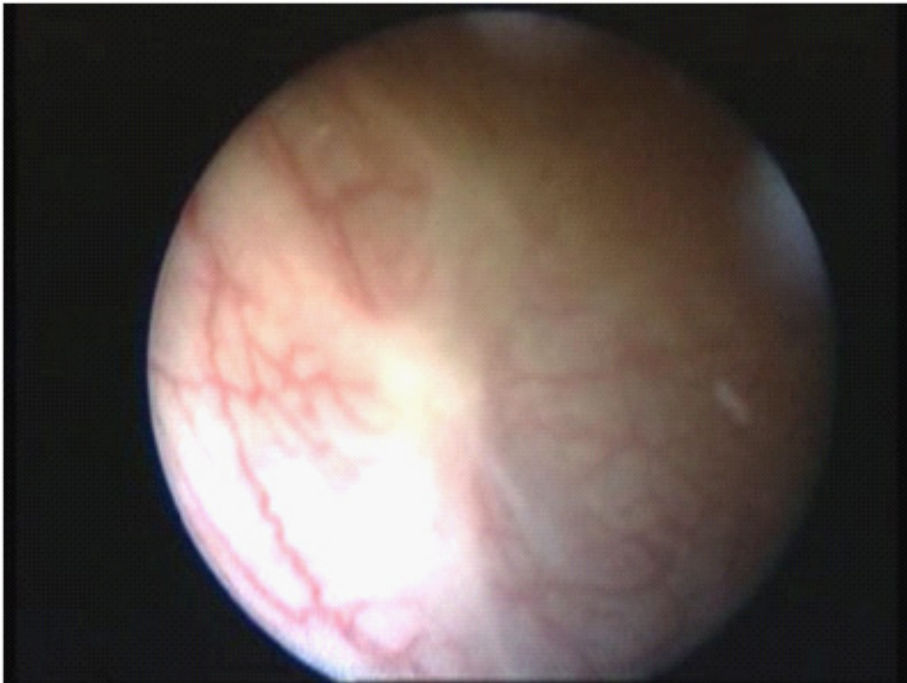


**Figure 5:** Extravesical tailoring of dilated ureter attracted through the urethra in a girl.

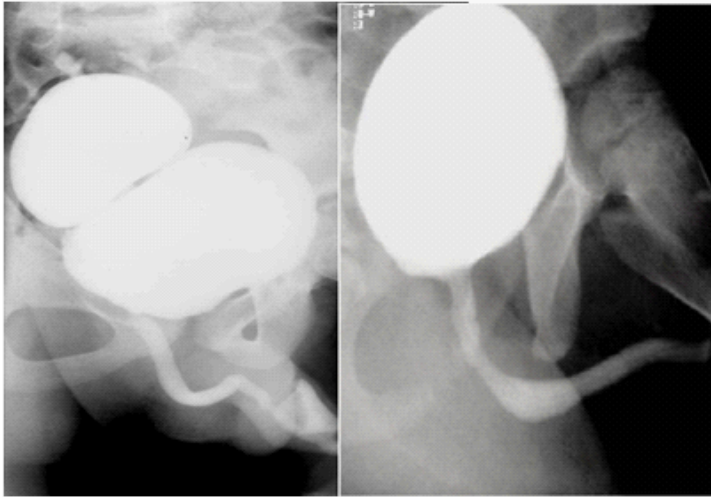




**Figure 6:** Main steps of bladder diverticulectomy.



**Figure 7:** Endoscopic postoperative view of bladder diverticulectomy: the whitish area corresponds to the diverticulum removed.



**Figure 8:** Preoperative and postoperative VCUG in huge posterolateral BD.



**Figure 9:** Postoperative cosmetic results after vesicoscopy.

## RESULTS

The results are summarized in Table 1, which shows that the outcome of this technique attains reasonable results. With this technique 63 patients aged 3 to 12 years have been operated at our Institution in about 8 years (January 2007-December 2015). There were 45 VUR 3<sup>rd</sup> to 5<sup>th</sup> degree, 2 refluxing megaureter, 16 Primary Bladder Diverticula. Mean operative time ranged from 80 to 240 min (mean 150 min.) in cases of Ureteral Cohen's reimplantation and 120-220 min. in RM respectively; In BD operative time ranged from 50 to 140 min, (mean time 90 min). No major perioperative complication (hemorrhage, urinoma) occurred nor conversion to open surgery was necessary. Overall operative complications have been:

- 1 fracture of the needle for suspension of the bladder removed with the aid of the image intensifier;
- 9 displacement of the trocars which resulted in the leakage of gas in the perivesical space compromising the space and the intravesical endoscopic vision. In this case the trocars were replaced or relocated in a more lateral position.
- 3 subcutaneous emphysemas.

**Table 1: Results.**

63 Patients (Age, sex)	Pathology	Side	Operative time	Outcome Mean f-up (4.7 yrs)
45 32 F, 13M Age 3-7 (m 4.5)	VUR 3rd -5th Grade	Unilateral n=29 Bilateral n=16	80- 240 m' Mean 150 m'	All cured (1 needed Deflux, 1 resolved spontaneously)
2 F (3,6 yrs)	Refluxing Megaureter	Unilateral=2	120-220 m'	cured
16 M Age 4-12 (m 6.8)	Bladder diverticula	Unilateral n=13 Bilateral n=3	50-140 m' Mean 90'	1 recurrence (bilateral huge diverticula)

Regarding the patients treated for VUR, operating time ranged from 80 to 240 minutes. No major perioperative or postoperative complications were recorded. No patient was converted to open surgery or required additional trocars. Blood loss was very minimal in all cases. After a mean follow-up of 4.5 years 31 out of 33 patients are doing well and free of symptoms and renal function at Mag 3 scan is stable. All patients were kept on oral antibiotic prophylaxis for three months. Renal scan with MAG3, VCUg and ultrasound performed in all patients 3 to 6 months after surgery showed the disappearance of reflux in 31 out of 33 patients: one girl who had been treated for monolateral 4<sup>th</sup> grade reflux, and one boy with refluxing megaureter. Three patients presented a transient, asymptomatic ureteral dilatation observed at follow-up ultrasound. In patients with VUR recurrence, the reflux was resolved by continuing antibiotic-prophylaxis in the boy, while the girl underwent successful endoscopic treatment with Deflux. The two girls with Refluxing Megaureteres are well and symptoms-free after a mean follow-up of 2 years. Patients with BD presented full resolution in 15 out of 16 patients where 1 monolateral recurrence occurred ( a case of bilateral huge diverticula). The resolution was confirmed by US and VCUg. Mean operative time ranged from 50 to 140 minute (mean 90 minutes). US and VCUg were performed 6 months after the operation and showed the disappearance of the diverticulum/a. The patient with recurrence is still on clinical surveillance with anticholinergics. Patients with voiding disorders presented a gradual improvement of their urgency, which was also confirmed by the urodynamics. In five cases a cystoscopy recognition was performed from 8 to 12 months: the site of operation resulted easily recognizable thanks to some whitish scars arranged radially at the site of the diverticulum.

## COMMENT

Vesicoscopy in the treatment of bladder diseases, congenital or acquired in childhood is a procedure still to be confirmed as a valid alternative to the open technique.

The potential benefits compared to the open technique include reduction of postoperative bladder spasm, reduction / elimination of pain, early removal of the catheter, a significant reduction in hospitalization time and better aesthetics.

Technically, the procedure requires an excellent experience in laparoscopy by the surgeon.

The first experiences of intravesical reimplantation have seen the use of glycine to distend the bladder so as to create sufficient working space [17,18]. CK Yeung et al. [1] in 2002, proposed the use of CO<sub>2</sub> for bladder distension. According to the Authors the pneumovesicum allows to get a better view than the use of a liquid medium as the light is transmitted better in the gas. Also in case of bleeding, if it occurs utilizing liquid medium, the surgical field can be completely fogged up while with pneumovesicum this is gathered at the base of the bladder and can be easily removed by suction. One of the limitations of Vesicoscopy still remains the limited working space which can be worsened by the gas leakage or by bleeding but never to the extent that this can occur with a liquid medium.

Kutikov et al. [6] reported failure and complications in 4/32 (12.5%) patients. The authors point out that the highest rate of failure that is marked in patients with a cystometric capacity <130 cc. While in patients with cystometric capacity exceeding 130 cc, the results are similar to those reported by other authors as well as, in older patients at high capacities, the results are superimposable to those of open surgery.

Finally, but not of little importance, some doubts still remain on the safety of pneumovesicum on urinary tract : while pneumovesicum is deemed not to have systemic effects [17], potential physiological effects of pneumovesicum on the bladder and upper-tract function need to be evaluated further because some Authors, in experimental studies , raised the doubt that CO<sub>2</sub> causes significant histopathological and biochemical changes in the early period and long-term results are required to determine whether permanent renal injury occurs even if according to Others, CO<sub>2</sub> pneumovesicum at a pressure of 10 mm Hg for 2 hours did not result in any demonstrable deleterious effect [19,20].

## CONCLUSION

In conclusion the review of our experience can be considered largely positive. Actually this technique meets the requirements of minimally invasive surgery: does not change the rationale of surgery nor alters the technique, but changes only the way of the approach to the bladder. Finally we can mention the considerable advantage at any step of the procedure of conversion to open surgery without any difficult. Moreover the indications of Vesicoscopy are being extended also to the pathologies of the adult with promising results with the use of single port access [21-23] The only technical drawback of this surgery, can be represented by a rather long learning curve and longer operating time.

## References

1. Yeung CK, Borzi PA. Pneumovesicoscopic Cohen ureteric reimplantation with carbon dioxide bladder insufflation for gross VUR. *Br J Urol Int.* 2002; 89: 15-86.
2. Yeung CK, Sihoe JD, Borzi PA. Endoscopic cross-trigonal ureteral reimplantation under carbon dioxide bladder insufflation: a novel technique. *J Endourol.* 2005; 19: 295-299.
3. Valla JS. Transvesicoscopic Cohen ureteric reimplantation for vesicoureteral reflux in children. In: Godbole PP (ed.) *Pediatric Endourology Techniques.* Springer-Verlag: London. 2007; 39-46.
4. Atul A, Thakre, B. Sreedhar, Yeung CK. Laparoscopy in the management of pediatric vesicoureteral reflux. *Indian J Urol.* 2007; 23: 414-419.
5. Kawauchi A, Naitoh Y, Soh J, Hirahara N, Okihara K, Miki T. Transvesical laparoscopic cross-trigonal ureteral reimplantation for correction of vesicoureteral reflux: initial experience and comparisons between adult and pediatric cases. *J Endourol.* 2009; 1875-1878.
6. Kutikov A, Guzzo TJ, Canter DJ, Casale P. Initial experience with laparoscopic transvesical ureteral reimplantation at the Children's Hospital of Philadelphia. *J Urol.* 2006; 176: 2225-2226.
7. Kim SW, Lim NL, Lee YS, Han SW, Im YJ. Laparoscopic Intravesical Detrusorrhaphy With Ureteral Plication for Megaureter: A Novel Technique. *Urology.* 2015; 86:187-191.
8. Emir H, Mammadov E, Elicevic M, Buyukunal C, Soylet Y. Transvesicoscopic cross-trigonal ureteroneocystostomy in children: a single-center experience. *J Pediatr Urol.* 2012; 8: 83-86.
9. Badawy H, Eid A, Hassouna M, Elkarim AA, Elsalmy S. Pneumovesicoscopic diverticulectomy in children and adolescents: is open surgery still indicated? *J Pediatr Urol.* 2008; 4: 146-149.
10. Lee DH, Oh CY, Jang HS, Hong CH. Bladder neck injection of a polydimethylsiloxane-bulking agent under pneumovesicum for treatment of children with urinary incontinence: report of 3 cases. *J Laparoendosc Adv Surg Tech A.* 2013; 23: 297-300.
11. NunezBragayrac LA, Machuca V, Saenz E, Cabrera M, de Andrade R, Sotelo RJ. Transvesical Laparoendoscopic Single-Site Management of Distal Ureter During Laparoscopic Radical Nephroureterectomy. *J Endourol.* 2014.
12. Giannakopoulos S, Toufas G, Dimitriadis C, Giannopoulos S, Kalaitzis C, Bantis A, et al. Laparoscopic transvesical resection of an en bloc bladder cuff and distal ureter during nephroureterectomy. *ScientificWorldJournal.* 2012; 2012: 658096.
13. Okamura K, Kato N, Tsuji Y, Ono Y, Ohshima S. A comparative study of endoscopic trigonoplasty for vesicoureteral reflux in children and adults. *J Urol.* 1999; 6: 562 – 566.
14. Okamura K, Kato N, Takamura S, Tanaka J, Nagai T, Watanabe H, et al. Trigonal splitting is a major complication of endoscopic trigonoplasty at 1-year follow up. *J Urol* 1997; 157, 1423 -1425.
15. Gil Vernet JM. A new technique for surgical correction of vesicoureteral reflux. *J Urol.* 1984; 131: 456-458.
16. Lakshmanan Y, Mathew RI, Cadeddu JA, Chen RN, Slaughenhaupt BL, Moore RG. Feasibility of total intravesical endoscopic surgery using mini-instruments in a porcine model. *J Endourol* 1999; 13: 14-15.
17. Gill IS, Ponsky LE, Desai M, Kay R, Ross JH. Laparoscopic cross-trigonal Cohen ureteroneocystostomy: Novel technique. *J Urol* 2001; 166: 1811 – 1814.
18. Soh S, Kobori Y, Shin T, Suzuki K, Iwahata T, Sadaoka Y, et al. Transvesicoscopic ureteral reimplantation: Politano-Leadbetter versus Cohen technique. *Int J Urol.* 2015; 22: 394-399.
19. Yeung CK. Endoscopic Cross-trigonal Ureteric Reimplantation under Carbon Dioxide Pneumovesicum. Springer-Verlag Berlin Heidelberg. 2008; 98: 729-735.
20. Kilincaslan H, Gundogdu G, Terzi EH, Ozturk H, Firat T, Tosun M. Carbon dioxide insufflation causes upper urinary tract injury in the early period of an experimental vesicoureteral reflux model. *Pediatr Surg Int.* 2013; 29: 1311-1320.
21. Xiang B, Liu JX, Sung HB, Yan B, Cheng W. The effect of CO<sub>2</sub> pneumovesicum on upper urinary tract. *J Pediatr Surg.* 2010; 45: 1863-1867.
22. Vicentini FC, Hisano M, Agresta TS, Murta CB, Claro JF. Single port transvesical prostatectomy. *Int Braz J Urol.* 2012; 38: 432.
23. Ko YH, Kang SG, Kang SH, Park HS, Lee JG, Kim JJ, et al. Removal of long, complex foreign bodies from bladder using single laparoscopic port underpneumovesicum. *J Laparoendosc Adv Surg Tech A.* 2010; 20: 639-642.