AIM OF THE WORK

This is a feasibility study aiming at prospective evaluation of the safety and efficacy of extravesical transperitoneal laparoscopic ureteral re-implantation in cases with unilateral vesico ureteral reflux (VUR) and in cases with unilateral congenital obstructive megaureter.

PATIENTS AND METHODS

I. Study design

This is a prospective study. The data of 20 pediatric patients with unilateral ureteral pathology indicated for ureteral reimplantation and were admitted to Alexandria university hospitals was analyzed regarding preoperative evaluation, procedure, intraoperative complications, postoperative assessment and outcome of the management during follow up.

II. Outcomes

A. Preoperative evaluation as regards:

1- Informed consent signed by parents of all patients:

Patient condition, strategies for management, operative technique, possible risks, complications and the need for future follow up or interventions were explained to parents before the procedure. Also, it was essential for the parents to understand that with all laparoscopic procedures there is an inherent risk that the procedure may need to be converted to open surgery.

2- Thorough history taking and detailed clinical examination:

Meticulous history taking from parents and physical examination to the child was the initial step in evaluation. Demographic data included age, gender, weight, past history of previous abdominal or pelvic surgery, American Society of Anesthesiologists (ASA) score[54] and associated comorbidities.

3- Routine laboratory investigations:

Including complete blood count (CBC), blood urea, serum creatinine, fasting blood sugar, SGOT, SGPT and coagulation profile.

4- Complete urine analysis and urine culture and sensitivity test:

To exclude the presence of acute attack of urinary tract infection (UTI) "patients with acute attack of UTI were postponed till treatment and resolution of UTI"

5- Radiological investigations:

a) The following radiological investigations were done to all patients:

i- Urinary tract ultrasonography (US): to determine the degree of back pressure "if present", renal size, parenchymal thickness, urinary bladder (UB) capacity and post voiding urine residual (PVR).
ii- Voiding cystourethrogram (VCUG): to diagnose vesicoureteric reflux (VUR) and to determine its grade if present. Also, VCUG gave a rough idea about bladder capacity and the amount of PVR.

iii- Renal isotope study (Technetium Tc-99m Dimercaptosuccinic acid 'DMSA" scan): to document the base line renal function and determine the presence or absence of renal scaring.

b) The following radiological investigations were done to selected patients as follows:

i- Magnetic resonance urography (MRU): was done in cases with no VUR in VCUG and suspected to have obstructive megaureter.
ii- Technetium Tc-99m Diethylene triamine pentaacetic acid (DTPA) renal isotope scan: was done in cases with obstructive megaureter to demonstrate and document the presence of obstructive megaureter.

B. In all patients transperitoneal extravesical approach for ureteral reimplantation was used as follows

1- General anesthesia.
2- Nasogastric tube insertion: to decompress the stomach and bowel.
3- In one patient with obstructive megaureter retrograde insertion of guide wire in the obstructed ureter was done via bladder cystoscopy.

4- Urethral catheterization:

Sterile Foley catheter was inserted in the operative field to decompress the urinary bladder, to facilitate bladder filling when needed during the procedure and to determine urine output.

5- Patient positioning:

The patients were positioned in a supine position with elevated position of the pelvis 15 – 30 degrees from the horizontal plain (trendlenburg) to permit the bowel to move away from the operative field (figure 10).

Figure (10): Patient in supine position with elevated position of the pelvis (Trendelenburg).

6- Peritoneal access:

Open technique was used to access the peritoneum in all patients; that started with detection of the deepest point in the umbilical scar, the umbilicus was everted using atraumatic graspers while applying counter pressure on the abdominal wall to tent up the umbilical scar.

A 5 mm skin incision was made through the umbilicus. After dissecting the subcutaneous tissue and opening the ventral fascia, the posterior sheath and the peritoneum were pulled upwards and opened by scissors.

7- Insertion of the primary trocar:

A blunt tip 5 mm trocar was then introduced through the umbilical incision. The sheath "not the skin" was tightened around the trocar by 2\0 suture to prevent gas leak and \ or subcutaneous emphysema.

8- Establishment of the pneumoperitonium:

The insufflation system (i.e. insufflator, tubing, and chosen gas) is essential for the establishment of a pneumopertonium. The used gas for insufflation was carbon dioxide (CO2). To start, the insufflator pressure was set at 12 mmHg and the flow rate was adjusted at 2 – 3 Liters /minute.

9- Introduction of the endoscope:

After establishment of pneumopertonium the endoscope was introduced through the umbilical trocar. Inspection of the site of primary trocar insertion was the first step to be done. The length of the intracorporeal part of the trocar was adjusted and a rubber tube was placed around the extracorporeal part to prevent over introduction of the trocar.

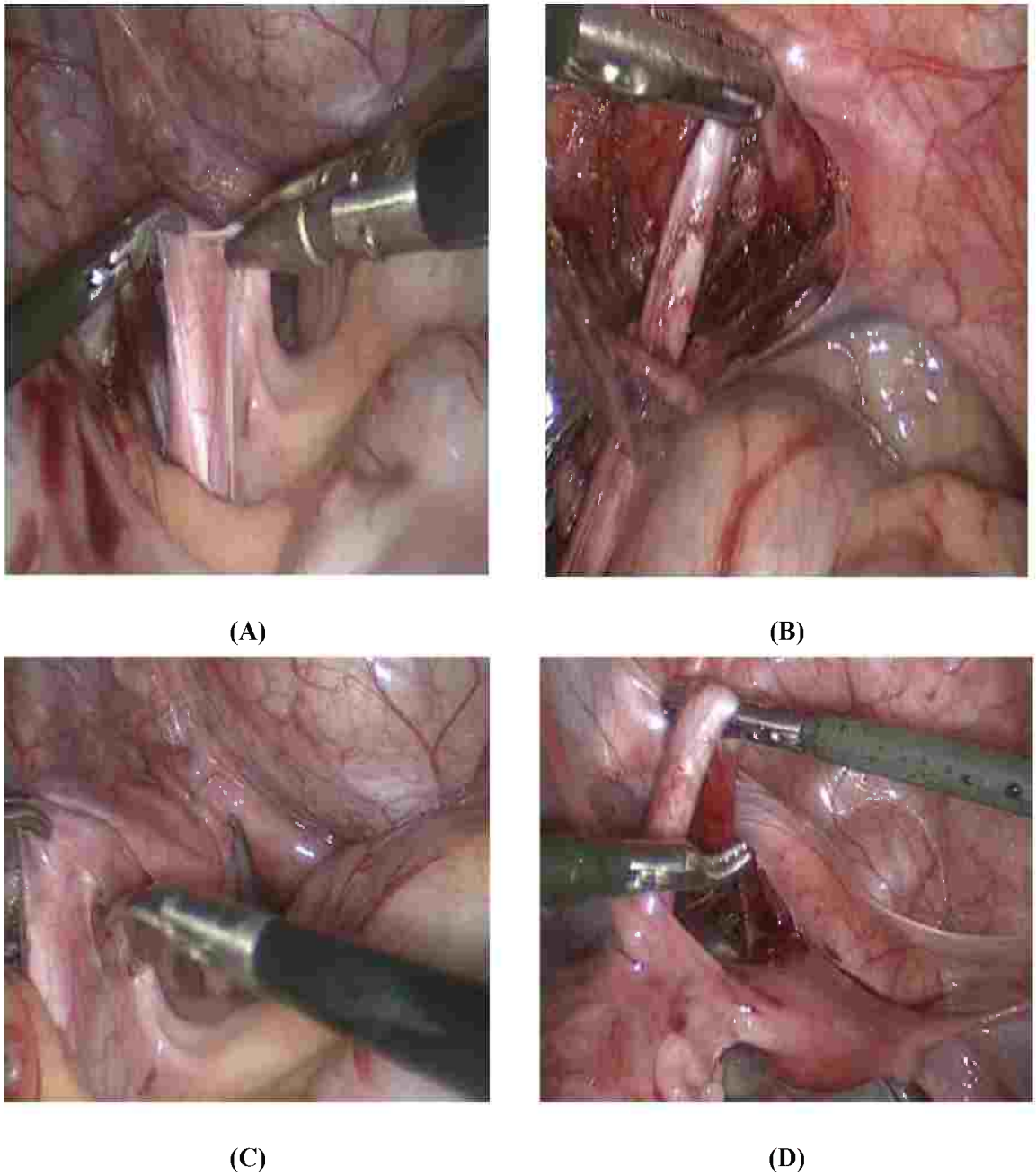
10- Insertion of secondary trocars:

One5 mm and another 3 mm trocars were inserted just lateral to rectus abdominus muscle slightly below the level of the umbilicus. The abdominal wall was trans-illuminated during insertion of secondary trocars to avoid injury to abdominal wall vessels .

Sometimes when a fourth instrument was needed especially during suturing direct introduction of a 3mm instrument without trocar insertion was done, but with the precaution not to remove the instrument or exchange it till the end of the procedure to prevent gas leak.

11- Ureteral dissection:

Deperitonization of the ureter at the side wall of the pelvis and dissection of the ureter; through the broad ligament in females and from behind the vas deference in male, till the ureterovesical junction were done in all cases (figure 11).



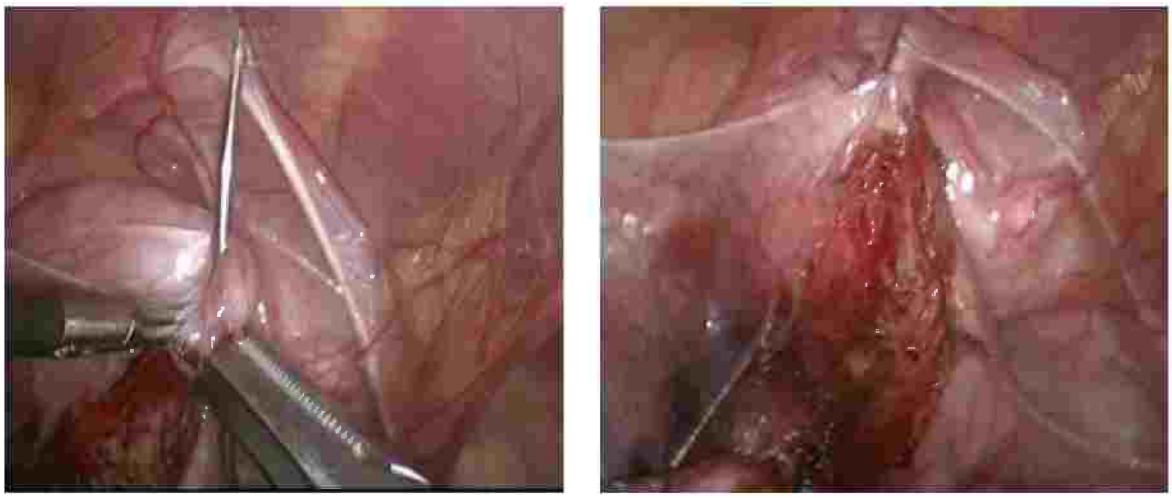
(A) **(B)**

(C) **(D)**

Figure (11): Ureteral dissection. **A)** Deperitonization of the ureter. **B)** Dissection of ureter from behind the vas deference. **C)** Making an opening through the broad ligament. **D)** Dissection of the ureter through the broad ligament.

12- Exposure of posterior bladder wall:

Hitch stitch through the anterior abdominal wall and the posterior bladder wall facilitated exposure of posterior bladder wall without the need for continuous traction on bladder by an extra instrument (figure 12).

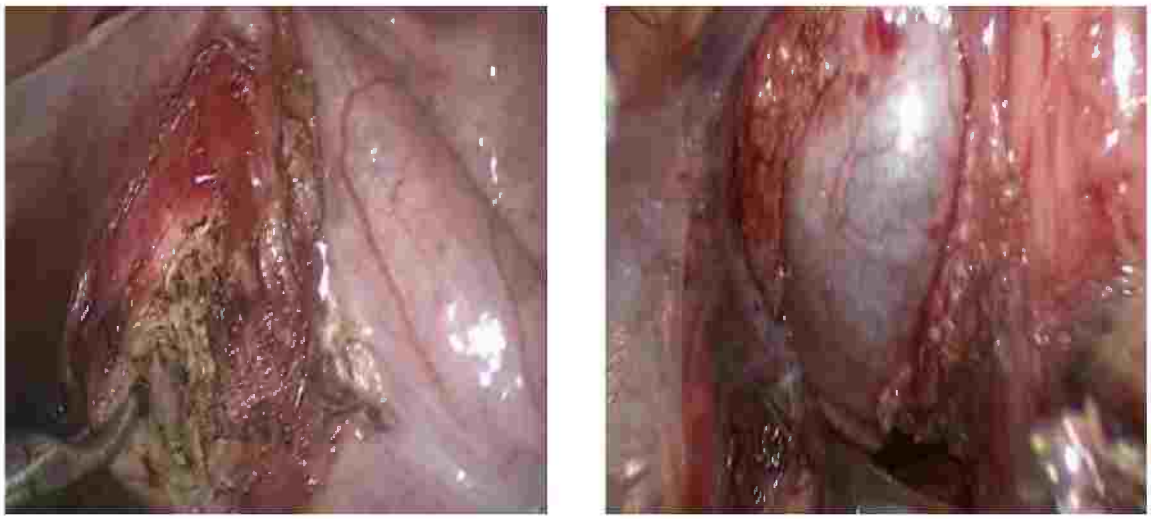


(A) **(B)**

Figure (12): A) Hitch stitch through anterior abdominal wall. **B)** Posterior bladder wall exposed.

13- Creation of bladder trough:

After bladder filling, creation of a seromuscular trough through the posterior bladder wall using electro-cautary and leaving the mucosa intact was done (figure 13).



(A) **(B)**

Figure (13): A) Creation of bladder seromuscular trough using electro-cautary. **B)** Seromuscular tunnel opened with intact mucosa.

14- Tailoring of the ureter:

In cases of obstructed megaureter or high grades of VUR with hugely dilated ureter, excision of the obstructed segment and ureteral tailoring in the former or tailoring only in the later were done intra corporeally (figure 14).

(A) **(B)**

Figure (14) :A) Dilated ureter before tailoring. **B)** Ureter after intracorporeal tailoring.

15- uretero neocystostomy:

In cases of obstructive megaureter where excision of the obstructed segment was done re-anastomosis of the ureter to the bladder was done using 4\0 absorbable sutures with subsequent closure of bladder rent. A double J ureteric stent was inserted into the ureter through the bladder rent before its closure, to be removed 6 weeks after surgery (figure 15).

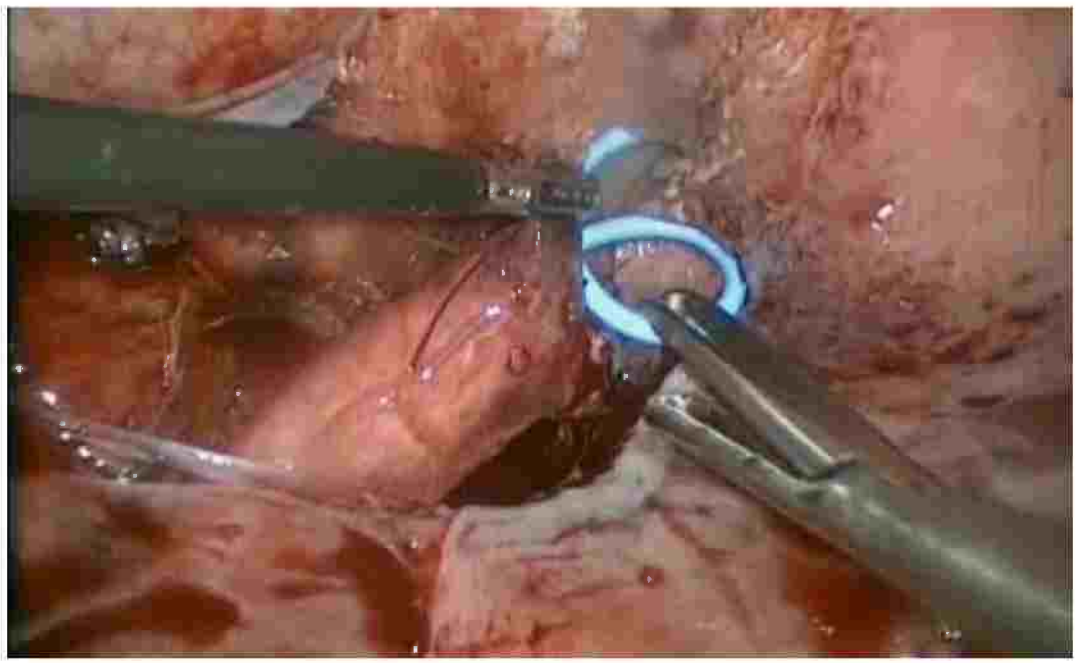
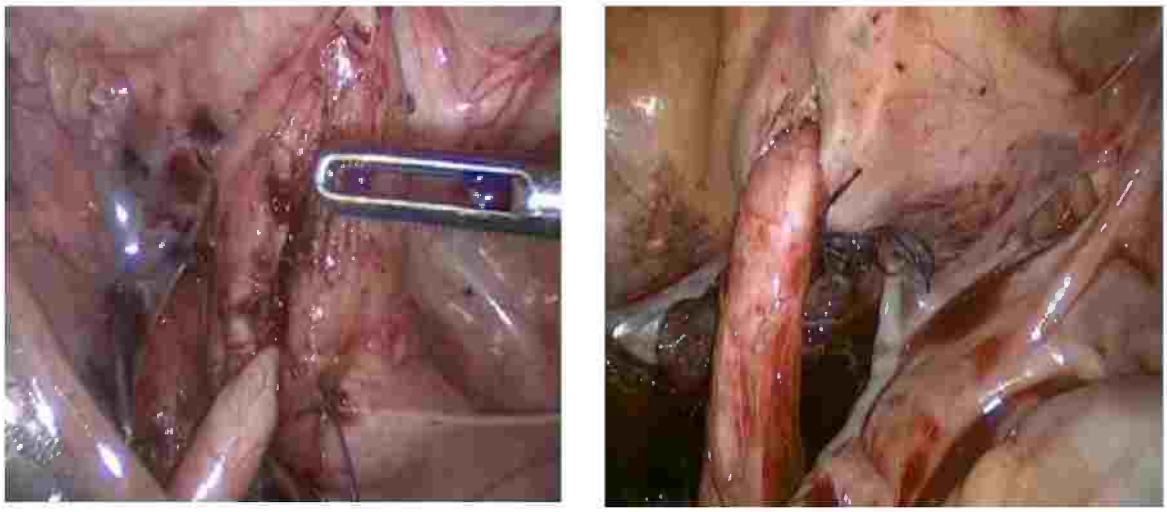


Figure (15): DJ stent inserted into ureter through bladder rent before its closure.

16- Re-implantation of the ureter:

Implantation of the ureter extravesically into the seromuscular tunnel with closure of the tunnel over the ureter with three to four 4\0 absorbable sutures (following the modified Lich Gregoir technique), making sure not to make the new ureteral hiatus so tight in order to prevent ureteral obstruction (figure 16).



(A) **(B)**

Figure (16): **A)** Closure of the bladder tunnel around the ureter. **B)** Ureter after complete reimplantation.

17- Release of the trans-abdominal hitch stitch.
18- A tube drain was left in situ.
19- Desufflation of the abdomen and removal of trocars under vision.
20- Closure of all port sites.

C- Intraoperative evaluation as regards:

1- Operative time (min).
2- Estimated blood loss.
3- Intraoperative complications.
4- Additional port placement.
5- Conversion to open surgery .

D- Postoperative evaluation as regards:

1- Postoperative pain and analgesic requirements.

Pain may be localized or diffuse. If postoperative pain was limited to a port site, it might be secondary to herniation (immediate or late) or infection (late). Localized pain combined with a subcutaneous bulge might indicate a rectus sheath hematoma, bleeding and hematoma formation at a port site.

Immediate severe diffuse abdominal pain might be related to bowel injury. Immediate postoperative scapular discomfort might be a result of the CO2 pneumoperitoneum itself causing some irritation of the diaphragm. Delayed diffuse abdominal discomfort and the development of peritoneal signs or simply ongoing abdominal discomfort accompanied by a low grade fever might be due to an unsuspected bowel injury.

In our study The Faces Legs Activity Cry Consolability (FLACC) Scale[55] has been used to assess the efficacy of pain management regimens in patients with postoperative pain, FLACC is an easy and practical scale to use in evaluating and measuring pain in children from 2 months to 7 years. It includes five indicators (face, legs, activity, cry, and consolability) with each item ranking on a three point scale (0–2) for severity by behavioral descriptions resulting in a total score between 0–10 (table 3).

Table (III): The Faces Legs Activity Cry Consolability (FLACC) Scale[55]

	Scoring		
Categories	**0**	**1**	**2**
Faces	No particular expression or smile	Occasional grimace or frown, withdrawn, disinterested	Frequent to constant frown, quivering chin, clenched jaw
Legs	Normal position or relaxed	Uneasy, restless, tense	Kicking or legs drawn up
Activity	Lying quietly, normal position, moves easily	Squirming, shifting back and forth, tense	Arched, rigid, or jerking
Cry	No cry (awake or sleep)	Moans or whimpers; occasional complaint	Crying steadily, screams or sobs, frequent complaints
Consolability	Content, relaxed	Reassured by occasional touching, hugging, or being talked to; distractible	Difficult to console or comfort

For children older than 7 years the visual analog scale (VAS)[56] has been used to assess the efficacy of pain management regimens in patients with postoperative pain. We instructed the patient to point on the line to indicate how much pain they are currently feeling. The far left end indicated "no pain" and the far right end indicated "worst possible pain" (Figure 17).

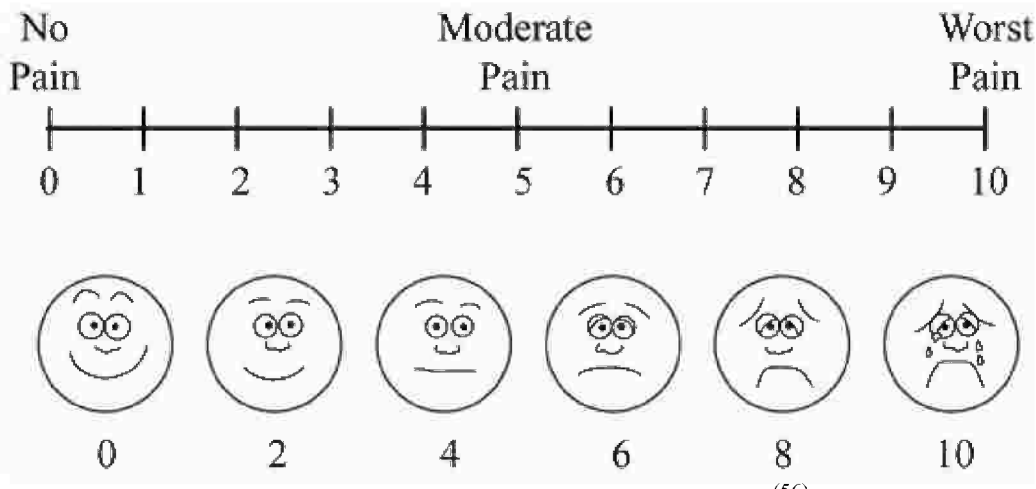


Figure (17): Visual analogue scale (VAS)[56]

2- Postoperative hospital stay length (days).
3- Postoperative complications.

Postoperative complications were scored according to the standardized Clavien-Dindo system (table 4).[57]

Table (IV): Clavien et al classification of surgical complications.[57]

Grade	Definition
Grade I	Any deviation from the normal postoperative course without the need for pharmacological treatment or surgical, endoscopic, and radiological interventions. Allowed therapeutic regimens are: drugs as antipyretics, analgesics, diuretics, electrolytes, and physiotherapy. This grade also includes wound infections opened at bed side.
Grade II	Requiring pharmacological treatment with drugs other than such allowed for grade I complications. Blood transfusion and total parenteral nutrition are also included.
Grade III	Requiring surgical, endoscopic or radiological interventions.
Grade IIIa	Intervention not under general anesthesia.
Grade IIIb	Intervention under general anesthesia.
Grade IV	Life threatening complication requiring ICU management.
Grade IVa	Single organ dysfunction (including dialysis)
Grade IVb	Multi-organ dysfunction
Grade V	Death of a patient

E. Outcome of the management:

As regarding functional and symptomatic outcome by:

1- History taking.
2- Clinical examination.
3- Laboratory investigations including complete urine analysis and urine culture.
4- Radiological investigations including:

   a- US abdomen and pelvis 1 month after surgery.
   b- VCUG 3 months after surgery and in cases with persistent VUR or de novo contralateral VUR another VCUG was done 6 months after surgery.

Success was defined as complete resolution of patient's symptoms and the ureteral pathology either VUR or obstruction, where failure was defined as persistence of patient's complaint and ureteral pathology.

III. Statistical analysis

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0.

Qualitative data were described using number and percentage while quantitative data were described using median, minimum and maximum.

RESULTS

Data of twenty children admitted to Alexandria University Hospitals who were diagnosed to have either unilateral VUR or obstructive megaureter and were managed by transperitoneal laparoscopic reimplantation from January 2013 to September 2014 was analyzed as regarding preoperative evaluation, intraoperative date, postoperative assessment and outcome of the management during follow up.

I. Patients' demographics:

Tables (V and VI) show the perioperative demographic data of the studied patients. The median age was 57 months (range from 24 – 120 months), 75% of patients were girls and 25% were boys. 19 patients (95%) presented with recurrent febrile UTIs that did not respond to CAP, where only one case presented to emergency room (ER) after falling from height as a case of renal trauma with urine extravasation. Out of the 20 children 13 patients (65%) had painful micturition.

Table (V): Distribution of studied patients according to demographic data (n = 20).

	No.	%
Age (months)		
≤50	9	45.0
51 – 60	6	30.0
>60	5	25.0
Min. – Max.	24.0 – 120.0	
Median	57.0	
Sex		
Male	5	25.0
Female	15	75.0
Presentation		
Recurrent febrile UTI not responding to antibiotic treatment	19	95.0
Falling from height → Renal trauma and urine extravasation	1	5.0

Table (VI): Distribution of studied patients according to presence of fever and painful maturation (n = 20)

	No.	%
Fever only	6	30.0
Painful micturition only	0	0.0
Fever and Painful micturition	13	65.0

II. Ureteral pathology:

Table (VII) shows distribution of studied patients according to type of mega ureter, side and grade of VUR.

For the 20 patients, 15% were diagnosed to have obstructive megaureter; whereas 85% were diagnosed to have VUR where 82.4% of them were grade III. In 60% of patients the pathology was in the left ureter.

Table (VII): Distribution of studied patients according to type of mega ureter, side and grade of refluxing cases (n = 20)

	No.	%
Type of mega ureter		
Obstructed	3	15.0
Refluxing	17	85.0
Side		
Right	8	40.0
Left	12	60.0
Grade of reflux (in cases with VUR) (n = 17)		
II	2	11.8
III	14	82.4
IV	1	5.9

III. Technique and instrumentation:

Table (VIII) shows the distribution of patients according to the number of trocars used and the need for ureteral tailoring.

In the first two cases (10%) 4 trocars were used from the start of the procedure; and with rising of the learning curve 3 trocars were used in 85% of cases. In only one case (5%) laparoendoscopic single-site surgery (LESS) was used as a pilot study and was not repeated.

In two cases (10%) an additional port was installed during the procedure to help in traction, these two cases were also in the beginning of the learning curve.

Tailoring was done intracorporeal in two cases (10%) with obstructive megaureter.

Table (VIII): Distribution of studied patients according to number of trocars used, additional port insertion and need for tailoring (n = 20)

	No.	%
No. of trocars		
Single port	1	5.0
3	17	85.0
4	2	10.0
Need for additional port	2	10.0
Tailoring		
No	18	90.0
Done intracorporeal	2	10.0

IV. Perioperative outcomes:

Table (IX) shows the perioperative outcomes of transperitoneal laparoscopic unilateral ureteral reimplantation for our study cases. The median operative time was 90 minutes (range from 80 – 180 minutes). Urethral catheter was removed in a median of 1 day (range from 1 – 10 days) and drain was removed in a median of 2 days (range from 2 – 7 days). The median hospital stay was 2 days (range from 2 – 7 days).

Table (IX): Distribution of studied patients according to perioperative outcomes (n = 20)

	Min. – Max.	**Median**
Operative time (min.)	80.0 – 180.0	90.0
	No.	**%**
Urethral catheter removed in		
Day 1	14	70.0
Day 4	5	25.0
Day 10	1	5.0
Min. – Max.	1.0 – 10.0	
Median	1.0	
Drain removed in		
Day 2	13	65.0
Day 5	5	25.0
Day 7	2	10.0
Min. – Max.	2.0 – 7.0	
Median	2.0	
Hospital stay (days)		
2 days	13	65.0
5 days	5	25.0
7 days	2	10.0
Min. – Max.	2.0 – 7.0	
Median	2.0	

V. Complications:

Tables (X and XI) show the complications in the present study. Out of the 20 cases, 5 (25%) cases suffered from intraoperative complications, where 4 cases (20%) had minute accidental mucosal bladder injury; one case (5%) had accidental minute thermal serosal colonic injury (blanching).

Post-operative complications occurred in 7 patients (35%), where two of them (10%) were grade IIIb who had pyogenic granuloma at trocar site that was excised surgically (figure 18). Five cases were grade I and included one case in which the tube drain was obstructed resulting in intraperitoneal urine collection, abdominal distention, ileus and increase in serum creatinine; the patient's condition was improved after restoration of drain patency. Two cases had persistent leakage per drain and high grade fever that was managed by proper antibiotic treatment, antipyretics, gradual withdrawal of drain and follow up U/S to preclude the presence of any collection. After stoppage of leakage the drain was removed. Two cases had high grade fever that was managed by proper antibiotic treatment and antipyretics. No grade IV or V complications were reported.

Table (X): Distribution of studied patients according to intra-operative complications (n = 20)

	No.	%
Intra-operative complications		
None	15	75.0
Accidental minute bladder tear	4	20.0
Accidental minute serosal thermal colonic injury	1	5.0

Table (XI): Distribution of studied patients according to post-operative complications (n = 20)

	No.	%
post-operative complications		
No	13	65.0
Pyogenic granuloma	2	10.0
Obstructed drain → urine collection, ileus, distension and ↑cr.	1	5.0
Persistent leakage / drain	2	10.0
High grade fever	4	20.0
Clavien-Dindo grade		
I	5	25%
IIIb	2	10%

Figure (18): Pyogenic granuloma at trocar site.

VI. Follow up outcomes:

The data of the follow up outcomes are shown in tables (XII and XIII). The median length of follow up was 6 months (range from 3-21 months).

After 3 months

As regard functional outcome:

For cases with VUR (85%), complete resolution of VUR was achieved in (75%) proved by absence of VUR in follow up VCUG (figure 19), where VUR was downgraded in two cases (10%) and 3 cases (15%) developed de novo contralateral low grade VUR. While for cases with obstructive megaureter (15%), the obstructed ureters were converted to refluxing ones (figure 20).

As regard symptomatic outcome:

16 patients (80%) had neither fever nor dysuria (asymptomatic), while 4 patients (20%) developed febrile UTIs manifested as fever and dysuria that were managed conservatively.

After 6 months

All refluxing cases (85%) showed complete resolution. Cases who showed previous downgrading of VUR (figure 21) and those who developed contralateral reflux (figure 22) spontaneously resolved. By 6 months all patients were symptom free without CAP.

By 6 moths, patients who previously had obstructive megaureter became symptom free despite conversion to refluxing ureters.

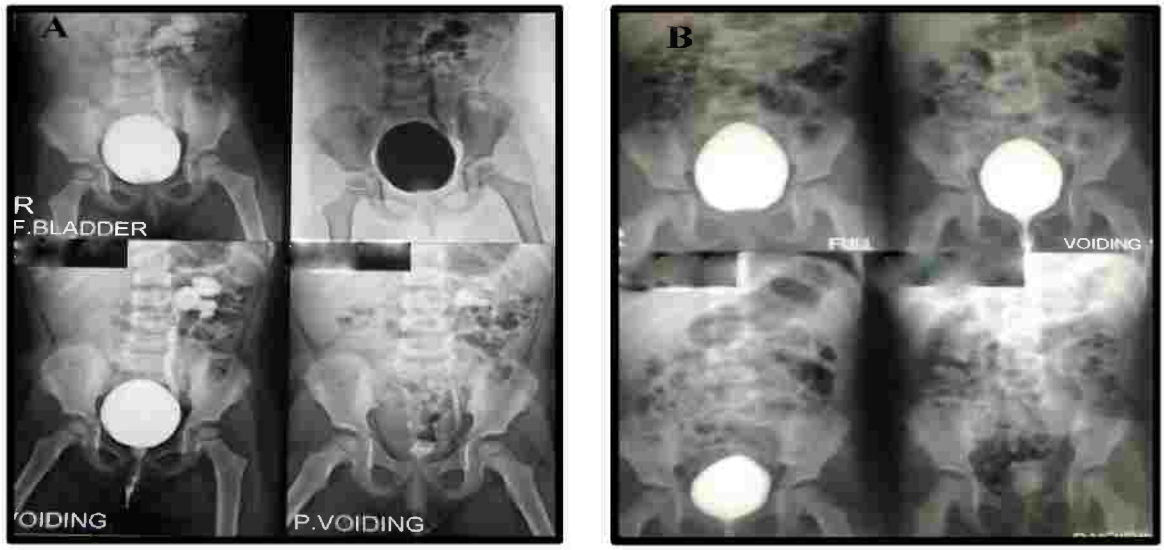


Figure (19): Patient with VUR. **A)** Preoperative VCUG with left grade III VUR. **B)** VCUG 3 months after surgery with complete resolution of VUR.

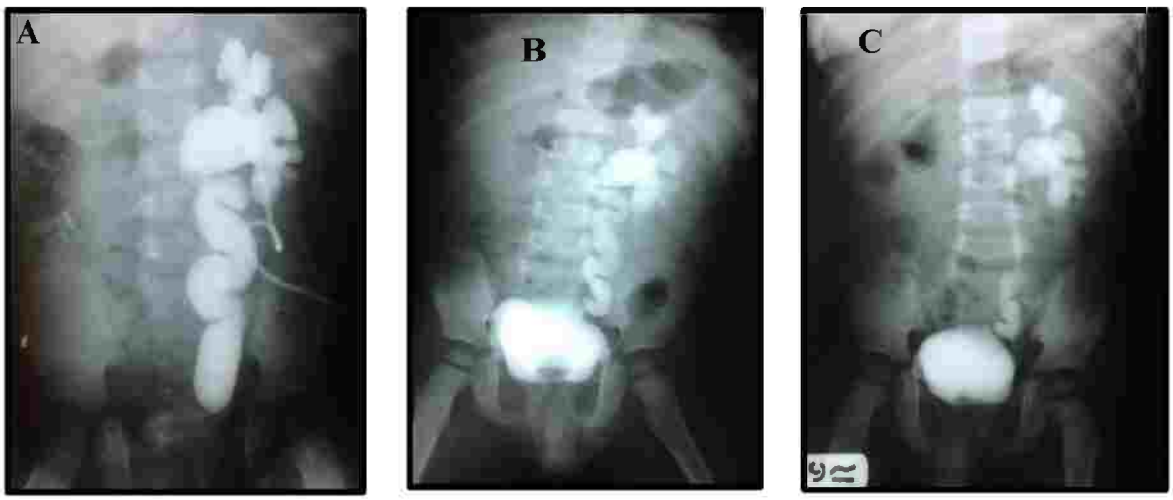


Figure (20): Patient with obstructive megaureter. **A)** Preoperative left descending nephrostogram showing left obstructive megaureter. **B)** VCUG 3 months after surgery. **C)** VCUG 6 months after surgery.

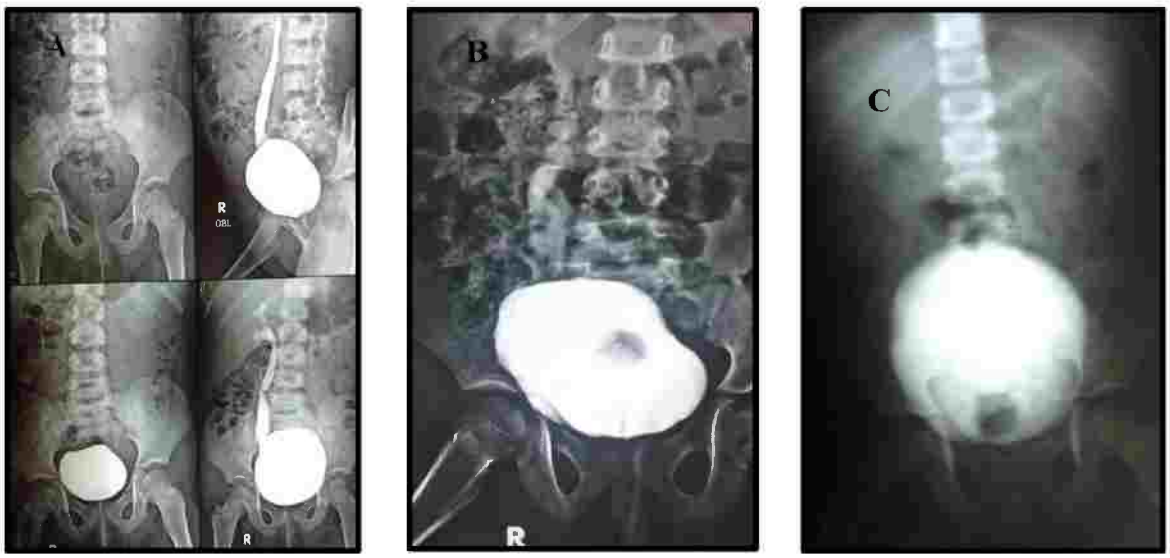


Figure (21): Patient with VUR. **A)** Preoperative VCUG with right grade III VUR. **B)** VCUG 3 months after surgery showing downgrading of VUR. **C)** VCUG 6 months after surgery showing completer resolution of VUR.

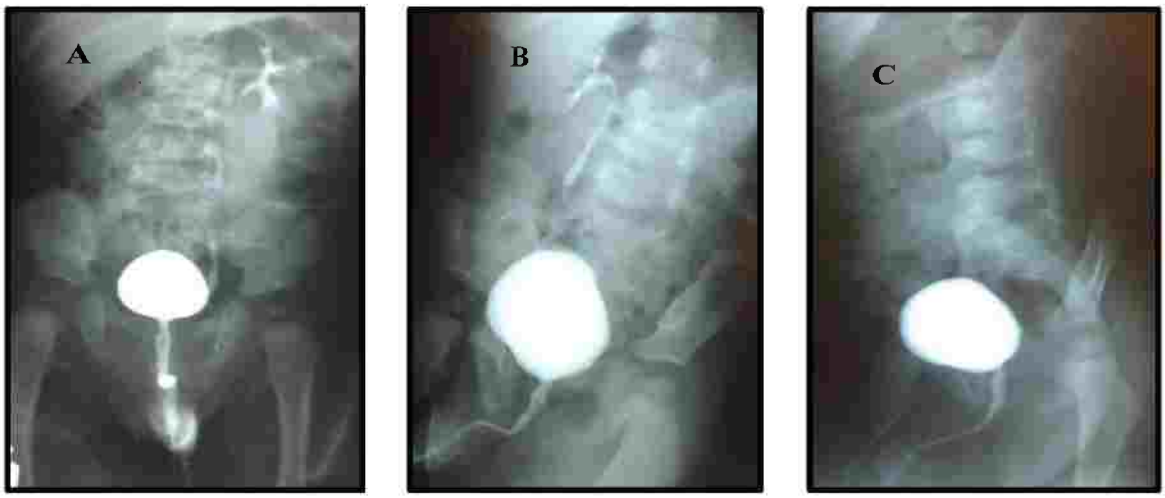


Figure (22): Patient with VUR. **A)** Preoperative VCUG with left VUR. **B)** VCUG 3 months after surgery showing resolution of left VUR and de novo right VUR. **C)** VCUG 6 months after surgery showing bilateral complete resolution.

Table (XII): Distribution of studied patients according to functional outcome (n = 20)

	VCUG after 3 months		VCUG after 6 months	
	No.	**%**	**No.**	**%**
Type of mega ureter				
Obstructed	**3**	**15.0**	**3**	**15.0**
Complete resolution	0	0.0	0	0.0
Converted to refluxing megaureter	3	15.0	3	15.0
Refluxing	**17**	**85.0**	**17**	**85.0**
Complete resolution	15	75.0	17	85.0
Down grading	2	10.0	0	0.0
Contra lateral reflux	3	15.0	0	0.0
Failed	0	0.0	0	0.0
Total resolution rate	**15**	**75.0**	**17**	**85.0**

Table (XIII): Distribution of studied patients according to Symptomatic outcome (n = 20)

	After 3 months		After 6 months	
	No.	**%**	**No.**	**%**
Symptomatic outcome				
Asymptomatic	16	80.0	20	100.0
Fever and dysuria	4	20.0	0	0.0