A New Technique for Continent Urinary Diversion: Initial Experience and Description of the Technique

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Purpose: Orthotopic neobladder is a well-established surgical solution for continent urinary diversion after radical cystectomy. Nevertheless, it still represents a challenging surgery. Some critical issues of orthotopic bladder substitution include relevant complication rates, renal function impairment, urinary incontinence and patient quality of life. We present a new ileal neobladder technique, Vesuvian Orthotopic Neobladder (VON), performed for the first time at our institution in 2020. The main purpose of this new surgical procedure is to simplify and speed up the reservoir reconstruction through a ten standardized technical steps and obtain an appropriate bladder capacity at the same time.

Methods: Inclusion criteria were muscle-invasive bladder carcinoma or non muscle-invasive high risk bladder cancer patients fit for bladder substitution. The exclusion criteria were locally advanced cancer, presence of hydronephrosis, renal or hepatic impairment. A chest-abdominal CT scan and urinary cytology were performed before the procedure. Patients received neoadjuvant chemotherapy, as required. Overall, operative time, bladder reconfiguration time, hospitalization time, catheterization time were recorded. All complications associated with the procedure were classified according to the Clavien Dindo score. The bladder volume was evaluated by ultrasound three months after the surgery.

Results: A total of six male patients diagnosed with non-metastatic muscle-invasive or high-risk non-muscle invasive bladder cancer who underwent radical cystectomy followed by VON reconfiguration were included in the study. Mean age was 62.8 (± 4.9) years; all selected patients enjoyed good health conditions (Charlson Comorbidity Index 4-6). One patient presented with high-risk non-muscle invasive bladder cancer. Four patients received neoadjuvant chemotherapy. Mean overall operative time was 273.3 (±18.6) minutes. Average time for neobladder reconstruction was 63.7 (± 16.1) minutes. There were no intraoperative complications. A single case of urethral anastomosis leakage occurred and was treated conservatively. Bladder volume on ultrasound evaluation ranged between 250 and 290 ml. Day time and nocturnal continence were observed in four and three patients, respectively.

Conclusion: The new VON technique is a good alternative to traditional orthotopic bladder procedures. VON reconstruction seems to offer the advantage of speeding up the procedure, reducing intestinal compromise with good storage capacity. The ten surgical steps can be considered a good starting point for further improvements in surgical technique. More robust data regarding the number of procedures and the duration of follow-up is required.

Keywords: neobladder; bladder cancer; urinary diversion; Vesuvian Orthotopic Neobladder

INTRODUCTION

Bladder cancer (BC) is the 11th most common cancer worldwide and the second most common urological malignancy[1,2]. Radical Cystectomy (RC) with urinary diversion is the standard treatment recommended for patients with non-metastatic muscle invasive bladder cancer (MIBC) and for selected patients with high-risk non-muscle-invasive bladder cancer (NMIBC). Urinary diversion is the second important step after RC. Over the past century, there has been an evolution of methods for lower urinary tract reconstruction following cystectomy, from being simple means of diverting urine to techniques allowing normal voiding pattern through the intact native urethra[3]. These innovations in urinary diversion should allow patients to lead a near-normal lifestyle, eliminating the need for a urostomy and maintaining urinary continence. Several techniques using ileum or colon for continent urinary diversion have been developed: Camey reservoir, Hautmann neobladder, Studer pouch, "T" pouch, Padua ileal neobladder, cecal, ileocecal and sigmoid reservoirs[4-10]. Despite extensive experience with these techniques, there is no consensus on the reservoir configuration that provides the best results. Moreover, orthotopic neobladder remains a challenging and time-consuming procedure, burdened with a considerable rate of complication. We describe a novel orthotopic neobladder technique in patients with bladder cancer and fit for

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Table 1. Patient characteristics

Patient	1	2	3	4	5	6
Age (years)	72.4	59.8	63.4	59.9	61.1	60.2
Smoker	30/day	No	Former	20/ day	No	20/ day
CCI	5	4	6	4	4	4
BMI	22.6	26.3	25.3	26.4	25.2	29.8
Comorbidities	COPD	HT	HT, DM, chronic hepatitis	Chronic hepatitis	HT	HT
ASA score	3	2	3	2	2	3
Clinical stage	cT2N0M0	cT2N0M0	cT1N0M0+CIS	cT2N0M0	cT2N0M0	cT2N0M0
Neoadjuvant CTx	no	yes	no	yes	yes	yes

Abbreviations: CCI: Charlson Comorbidity Index; BMI: Body Mass Index; COPD: Chronic Obstructve Pulmonary Disease; HT: Hypertension; DM: Diabetes Mellitus; ASA score: American Society of Anesthesiology score; CTx: chemotherapy.

bladder substitution. Our primary aim is to simplify and speed up the reconstruction of the neobladder through a practical technique which can be reproduced easily.

MATERIALS AND METHODS

Patients with non-metastatic muscle-invasive or high-risk non-muscle invasive bladder cancer and fit for bladder substitution, based on age, life expectancy, comorbidities and patient's preferences, were included in the study. Exclusion criteria were locally advanced cancer, presence of hydronephrosis, renal or hepatic failure. All patients underwent a routine preoperative examination, consisting of chest-abdominal computed tomography and urinary cytology. All cases were discussed by a multidisciplinary team, and neoadjuvant chemotherapy was administered as required. Written informed consent was obtained from all patients following explanation of the surgical approach. Neobladder reconstructions were performed by the same surgical team to avoid bias due to differences in surgical skills. All data were entered prospectively into an institutional database. In particular, overall operative time, bladder reconfiguration time, hospitalization and catheterization time were analyzed. All complications associated with the procedure were recorded and categorized according to the Clavien-Dindo score[11]. Retrograde cystography was performed on day 7 and on day 15 prior to removal of urethral catheter if no urine leakage occurred (Figure 7). Bladder volume was evaluated by ultrasound three months after the surgery. Day and night time continence were defined as no pad use.

Surgical Technique

The Vesuvian neobladder was constructed with 36 cm of ileum, isolated about 15-20 cm from the ileocecal valve. The neobladder configuration takes shape through 10 steps as described below.

1. Selection of the intestinal loop, isolation of the loop and lateral-lateral anastomosis of the ileum with two 60/80 mm mechanical staplers (Figures 1 and 2).
2. On the loop obtained, two 1.5 cm incisions are made: they are perpendicular to the mesentery at 12 and 24 cm from the right apex of the loop (Figures 2 and 3).
3. The caudal horn is made by the introduction of a 60 mm stapler through the first incision (Figure 3).
4. The left horn is made by inserting a 60 mm stapler through the second incision (Figure 4a).
5. After removing the central part of the metal suture exceeding the intestinal resection (Figure 4b), the afferent and efferent stumps are sutured together with a 60 mm mechanical stapler forming the right lateral horn (**Figure 4c**).
6. A clover structure is obtained with three sym-

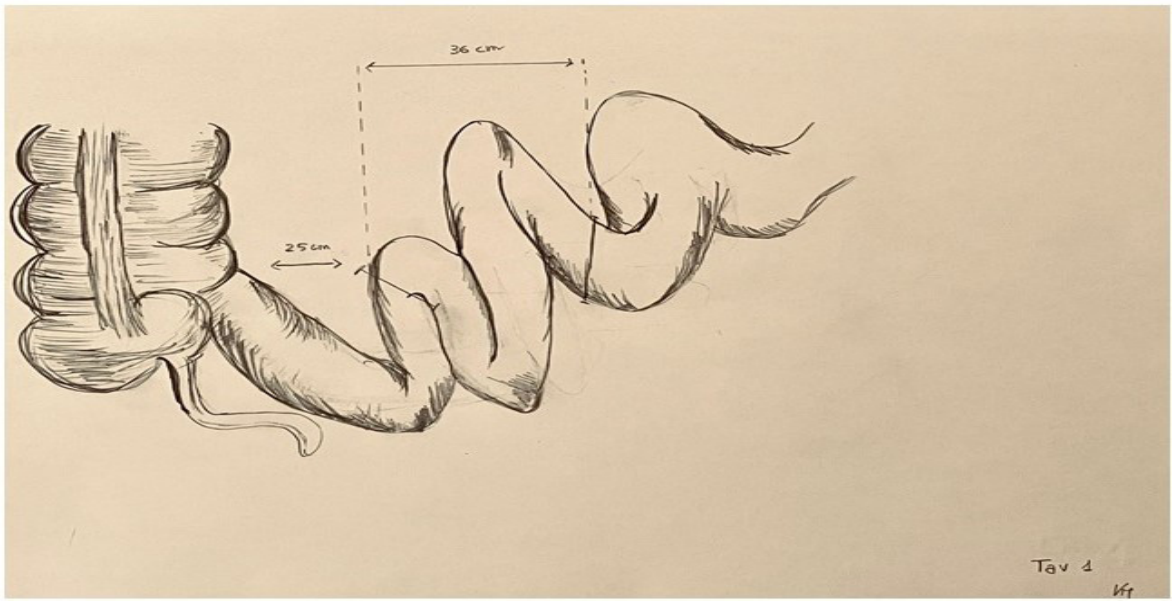

Figure 1. Selection of the intestinal loop, isolation of the loop and lateral-lateral anastomosis of the ileum with 2 mechanical staplers of 60/80 mm.

Table 2. Operative outcomes.

Patient	1	2	3	4	5	6
Estimated blood loss (ml)	320	240	210	250	190	210
Intraoperative transfusion rate (%)	0	0	0	0	0	0
Operative Time (min)	260	300	270	290	270	250
Reconstruction time (min)	80	75	70	53	56	48
Hospitalization (days)	15	17	14	13	15	20
Catheterization time (days)	21	22	21	18	19	30
Pathological stage	pT3aN0	pT1N0	pT1N0+CIS	pT3aN0	pT2bN0	pT3bN0

metrical horns.

7. The ureters are cannulated with 8Fr ureteral catheters. The ureters are placed ipsilaterally to the horns and the uretero-neovesical anastomosis is performed in detached 3-0 monofilament stitches with anti-reflux technique. Then, ureteral catheters are passed contralaterally through the anterior wall of the neobladder(**Figure 5**).

8. The right ureter is anastomized at the level of the right lateral horn. The left ureter is anastomized similarly at the level of the apex of the left horn, at the site of the incision used for stapler's introduction. After removing part of the suture made by the stapler on the right lateral horn, an opening of about 2-cm in diameter is obtained which is used to make the anastomosis of the ureter with anti-reflux technique: the ureter is spatulated dorsally and fixed to the anterior edge of the opening with three detached 3-0 monofilament stitches. In this way, the length of the ureter is sufficient to cover the entire area. The posterior margin of the opening is fixed to the ureter and the lateral margins are brought together to embrace the ureter with two 3-0 monofilament stitches passing through the anterior wall of the ureter (**Figures 6a and 6b**). The same procedure is repeated on the left side.

9. The anastomosis with the urethra is performed with five detached 2-0 monofilament stitches at the apex of the caudal horn, at the site of the incision used for the stapler using 22 Ch neobladder catheter with 15 cc in the balloon (Figure 6c).

10. Ureteral catheters are passed contralaterally through the abdominal wall to which they are fixed with 2-0 silk stitches.

This concludes the packaging for the Vesuvian Orthotopic Neobladder.

RESULTS

We performed Vesuvian Orthotopic Neobladder from December 2020 to July 2021 in 6 male patients with ages ranging from 59.9 to 72.4 years. All selected patients enjoyed good health conditions (Charlson comorbidity index 4-6) and none had previously undergone abdominal surgery. One patient presented with T1HG (high grade) and CIS (carcinoma insitu), refractory to intravesical BCG (Bacillus Calmette-Guerin) therapy. Preoperative patient characteristics are listed in Table 1. The mean overall operative time was 273.3 (±18.6) minutes. Neobladder reconstruction time ranged from 48 to 80 minutes (average 63.7, ±16.1) [Table 2]. No intraoperative complications occurred. We also did not encounter any complications in the early postoperative period, such as infection or urinary retention. One patient reported urethral anastomosis urine leakage on cystography and he was treated conservatively. After 30 days from surgery, the cystography was negative for leakage and then the bladder catheter was removed.

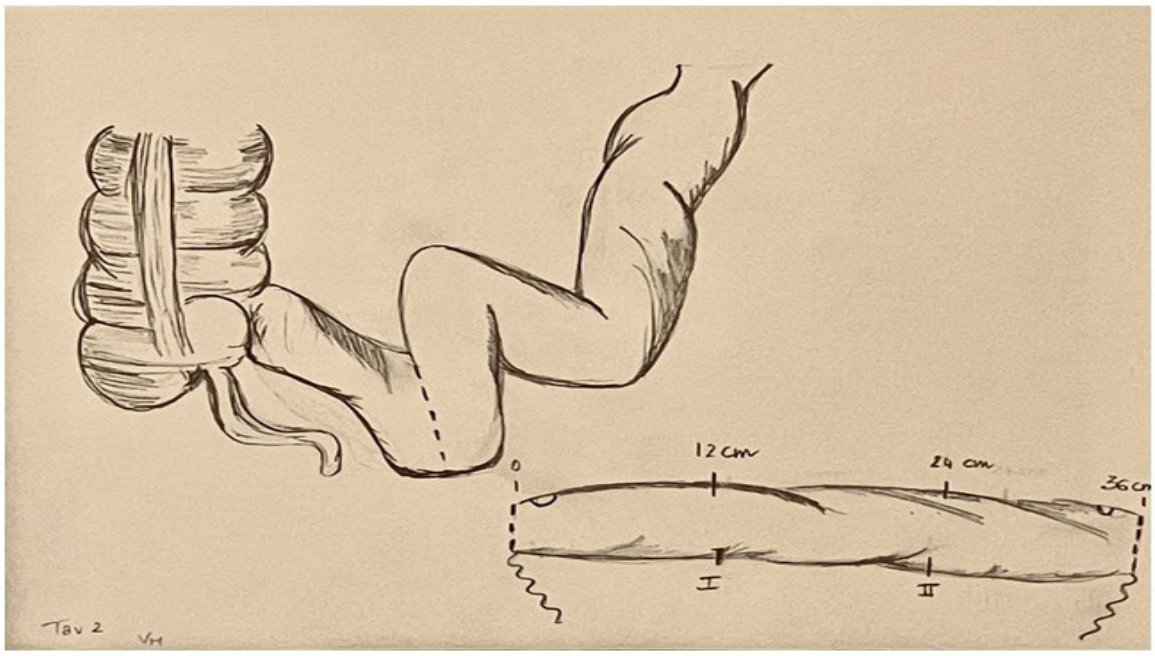

Figure 2. Selection of the intestinal loop, isolation of the loop and lateral-lateral anastomosis of the ileum with 2 mechanical staplers of 60/80 mm.

Table 3. Functional outcomes.

Patient	1	2	3	4	5	6
Day time continence	No	Yes	Yes	Yes	Yes	No
Night time incontinence	No	No	Yes	Yes	Yes	No
Neobladder volume (ml)	N/A	270	290	280	250	N/A

Abbreviations: N/A: Not Applicable.

The bladder volume measured by ultrasound 3 months after the surgery ranged between 250 and 290 ml (mean 272.5, SD 17.1). No significant differences were found between preoperative and postoperative 3rd month serum creatinine and eGFR values (data not shown). All patients, with the exception of two, reported full daytime urinary continence. Nocturnal continence was reported by three patients (**Table 3**).

DISCUSSION

Radical Cystectomy with urinary diversion is the standard treatment recommended for non-metastatic MIBC and an option for high-risk NMIBC. Orthotopic neobladder is the preferred option by patients undergoing RC, because it preserves quality of life better compared to other types of urinary diversions[12]. The long-term results are valid and therefore, more investment is being made in the training of surgeons in the operative procedure and the number of patients who get neobladder in recent years is steadily increasing[13,14]. The new techniques of the neobladder are able to achieve anatomical and physiological objectives, almost similar to the native bladder[15]. Nevertheless, it is very difficult for the surgeons to master the key step and the learning curve is very long[16]. The objective pursued in the Vesuvian Ortothopic Neobladder was to obtain an easy, fast and reproducible technique, at the same time ensuring an adequate neovesical volume. Moreover, another relevant issue concerns the non-antiperistaltic horn that avoids neovescicoureteral reflux and hydronephrosis that accompany other techniques[17,18,19]. Compared to a Y-shaped neobladder, our technique is just as easy to do and it optimizes the final volume achieved with the same length of ileal loop used, because the loop is completely detubulated contrary to the Y technique. In fact, in the Y technique, the right horn is present with active and contrary peristalsis to that of the ureter, while in our Vesuvian technique this problem is eliminated because both ureters are anastomized in two horns obtained from complete detubularization of the loop[20,21]. We believe that another advantage of our technique is that the ureters are anastomosed ipsilaterally to the neobladder horns. So, we don't have to cross the left ureter to the right side or vice versa. In this way, the ureters are left in their anatomical position with no kinking and less risk for ischemia. Laparoscopic and robotic approaches for radical cystectomy and intracorporeal neobladder have been described in recent years[14,22, 23,24]. Since laparoscopic and robotic suturing for the construction of the neobladder is a challenging procedure, the use of a stapler may facilitate the procedure, and thus reduce the operating time significantly. Compared to the Vesica Ileale Padovana technique, our approach offers the advantage of being completely done with the use of staplers[14,22]. We believe that our results will encourage the use of stapler more frequently for intracorporeal robotic neobladder approach[22,23]. The non-spherical configuration of our technique could be considered as a restric-

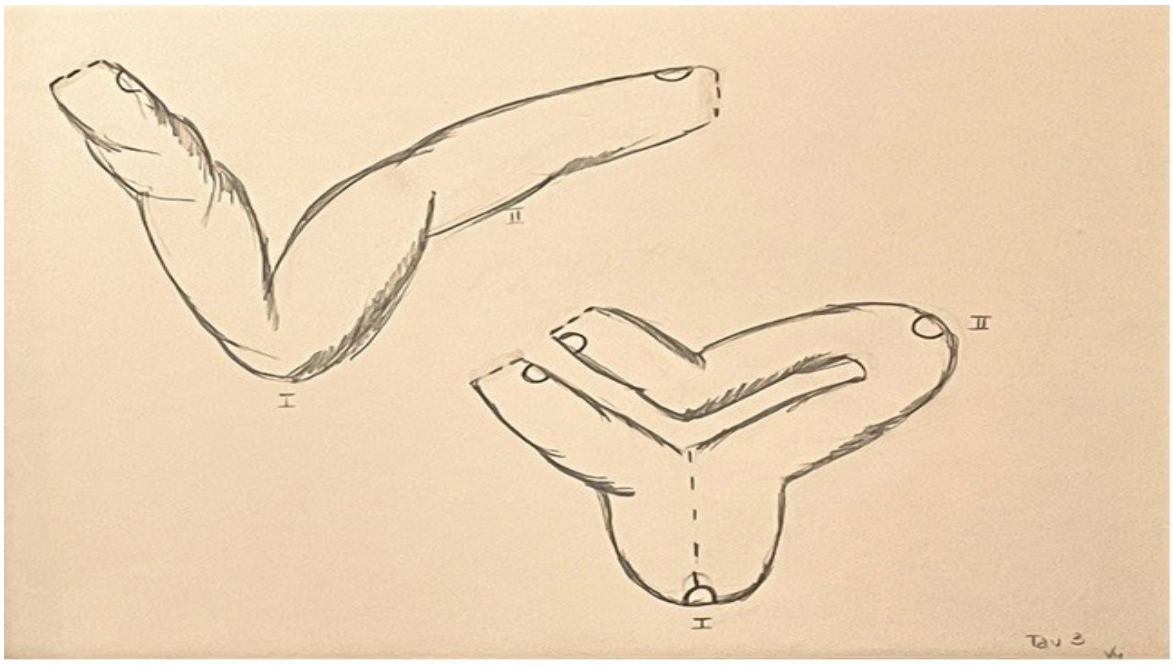

Figure 3. Two 1.5 cm incisions are made perpendicular to mesentery at 12 and 24 cm from the right apex of the loop.

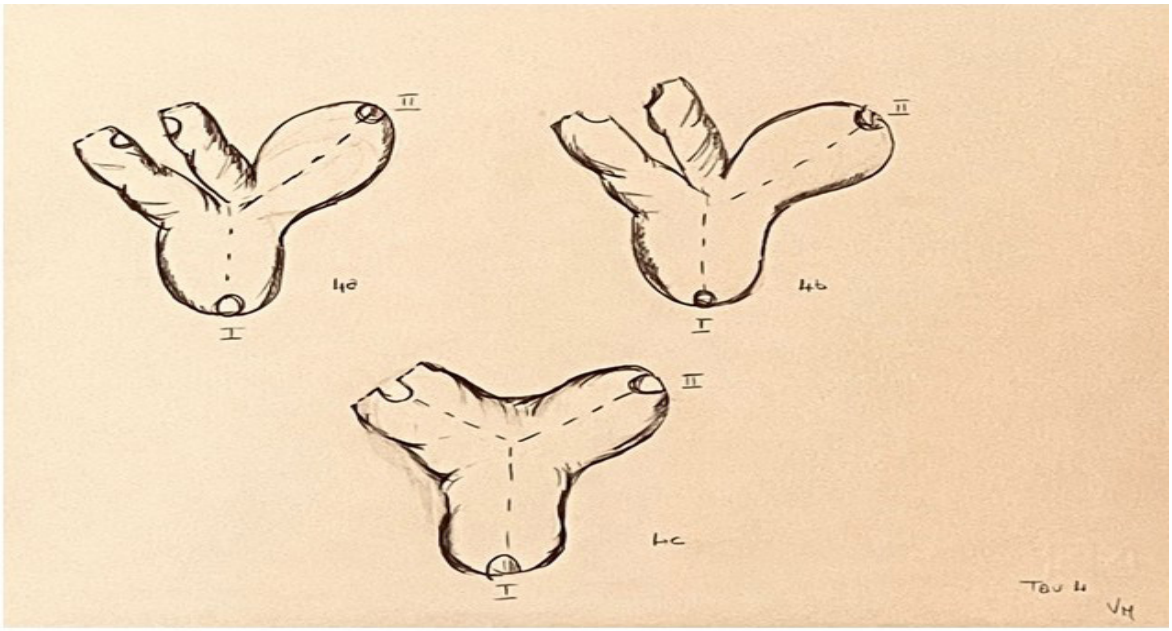

Figure 4. A 60-mm stapler is introduced through the first incision to make the caudal horn **(4a)**, followed by a second 60-mm stapler through the second incision for the left horn **(4b)**. After removal of the central part of the metal suture exceeding the intestinal resection, the afferent and efferent stumps are sutured together with a 60-mm mechanical stapler forming the right lateral horn **(4c).**

tion, since the spherical configuration is the ideal form for maintaining a good storage volume. However, it should also be emphasized that our neobladder is packaged with 36 cm of ileum, one of the shortest lengths used among the neobladder packaging techniques, but obtaining an excellent final volume, which is between 250 and 290 cc. This can only be an advantage for the patient's future well-being[12,25]. However, we believe there is a need for more comprehensive and robust data on larger series and longer follow-up.

CONCLUSIONS

The new Vesuvian Orthotopical Neobladder technique is a good alternative to traditional orthotopic bladder procedures and offers the advantage of speeding up the procedure, using a shorter bowel length and obtaining a good storage capacity. The ten surgical steps can be considered as a good starting point for additional surgical technique upgrades. More robust data, concerning number of procedures and length of follow-up, are required.

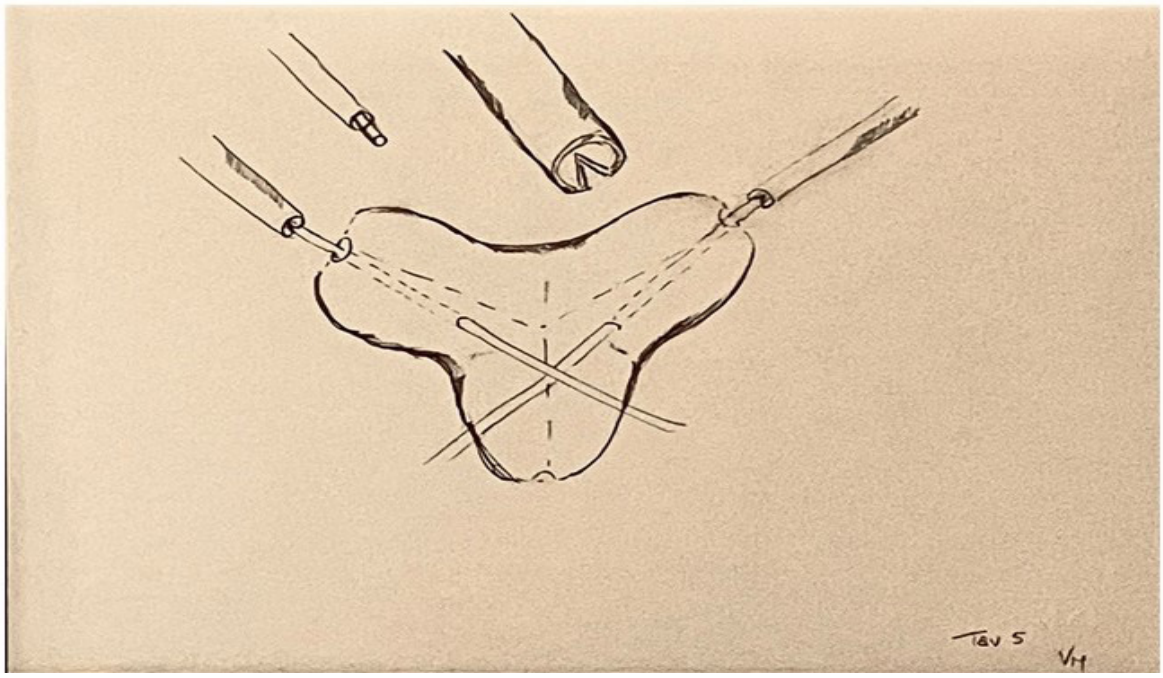

Figure 5. The ureters are cannulated with 8fr ureteral catheters. The ureters are placed homolaterally to the horns and the uretero-neovesical anastomosis is performed in detached 3-0 monofilament stitches with anti-reflux technique **(6a, 6b)**. Then ureteral catheters were passed contralaterally through the anterior wall of the neobladder. The anastomosis with the urethra is packaged with five detached 2-0 monofilament stitches at the apex of the caudal horn, site of the incision used for the stapler using 22 ch neobladder catheter with 15cc in the balloon **(6c)**.

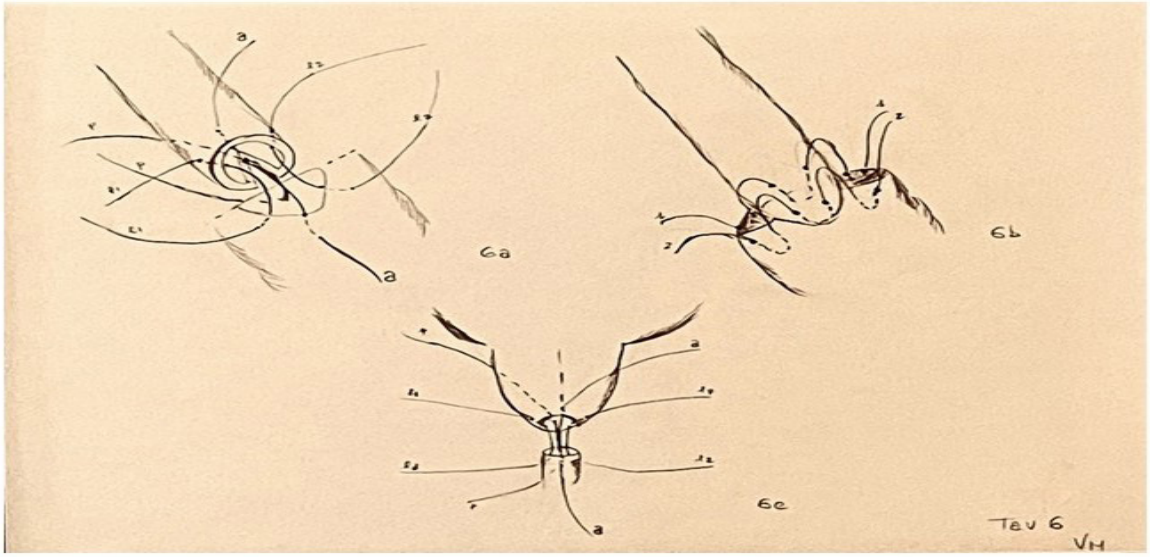

Figure 6. The ureters are cannulated with 8fr ureteral catheters. The ureters are placed homolaterally to the horns and the uretero-neovesical anastomosis is performed in detached 3-0 monofilament stitches with anti-reflux technique **(6a, 6b)**. Then ureteral catheters were passed contralaterally through the anterior wall of the neobladder. The anastomosis with the urethra is packaged with five detached 2-0 monofilament stitches at the apex of the caudal horn, site of the incision used for the stapler using 22 ch neobladder catheter with 15cc in the balloon **(6c)**.

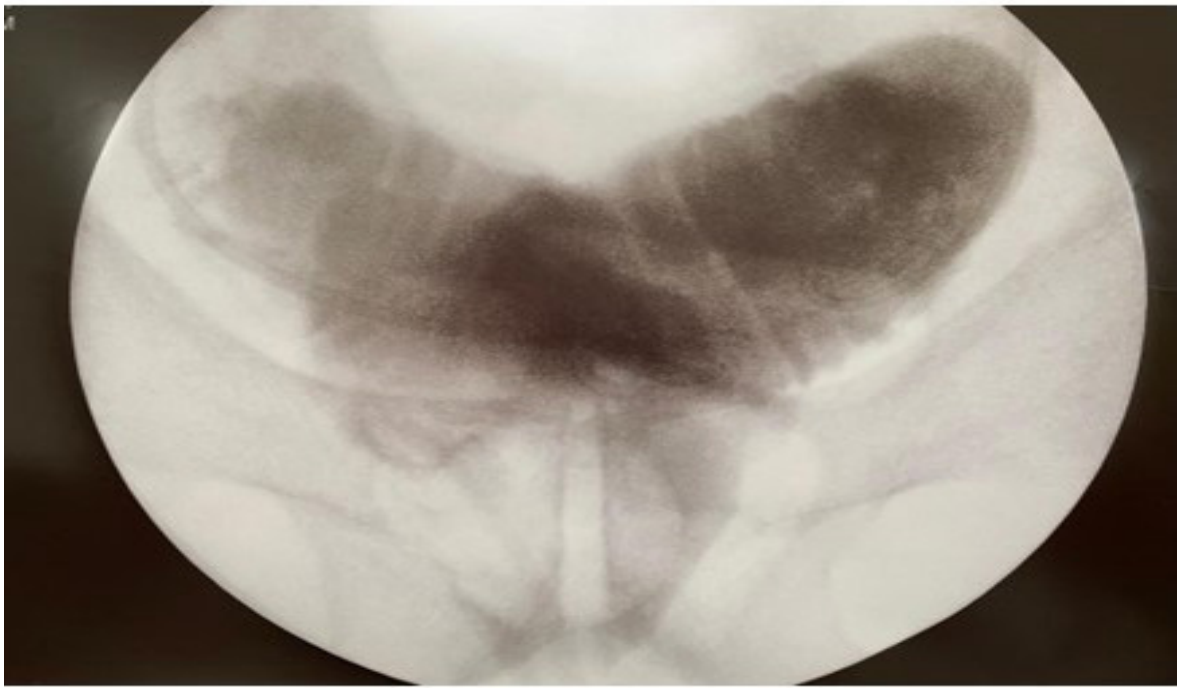

Figure 7. The cystometric image of the neobladder on day 15.

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