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Original Research Article.

Voiding Patterns In Pitcher Pot Ileal Neobladder

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ABSTRACT

Objectives: A good long term functional outcome of any orthotopic bladder substitution will ultimately decide its utility. Therefore, we analyzed exclusively voiding patterns in patients with Pitcher Pot Ileal Neobladder.

Materials and Methods: Fifty male patients treated for invasive urothelial cancer by open radical cystectomy followed by creation of Pitcher Pot Ileal Neobladder, were included in the study. Day and nighttime continence status, voiding frequency and pad usage was evaluated using a detailed patient questionnaire. Ultrasonography and uroflowrate were performed in all patients and cystometrography was done in 17 patients.

Results: Out of all 90% of the patients had desire to void and 70% voided with good stream. One year after surgery, continence was reported as good or satisfactory in 96% and 88% patients during the day and night respectively which is maintained over time. No patients required intermittent clean self-catheterization to empty the neobladder. The maximum capacity of the reservoir increased with postoperative follow-up, with a corresponding fall in average vesical pressure. Average volume of the reservoir was 276 cc at the end of 1 year and 290cc at end of 2 years. A mean maximum uroflow rate was 17 cc/sec and 18cc/sec at 1 and 2 years of follow-up respectively. The average residual urine at 1 and 2 years was 27cc and 15 cc respectively. Three patients required revision of ureteroileal anastomoses. Three patients had urethrovesical anastomotic stricture which was cystoscopically dilated and 5 patients had prolapsed neobladder mucosa obstructing the bladder outlet which was resected transurethrally. Overall, 96% of our patients were satisfied with the procedure.

Conclusions: Pitcher Pot Ileal Neobladder provides excellent intermediate and long term functional results as an orthotopic ileal neobladder reservoir.

Keywords: Voiding Patterns, Pitcher Pot Ileal Neobladder, Urothelial Cancer.

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INTRODUCTION

Since the early 1900's, surgeons have investigated how best to replace the original bladder removed for either benign or malignant disease. Ureterosigmoidostomy was the diversion of choice until the 1950's[1]. An ileal conduit urinary diversion was developed during the 1940's and is still one of the most used techniques[1]. With the continent forms of urinary diversion becoming more realistic since the 1980's, the popularity of incontinent urinary conduits started waning[1]. Continent urinary diversion requires the creation of a reservoir, ureteric implantation and establishment of a continence mechanism in the efferent segment. Presently, the orthotropic bladder substitute has evolved into the most ideal form of available urinary diversion, which resembles the original bladder in both location and function[1].

The quality of life after cystectomy has improved as lower urinary tract options have evolved into an orthotopic form of diversion; allowing most patients to store urine and void per urethra, without the need of a stoma, an ostomy appliance, or the need for catheterization[2]. Critical to the success of any continent urinary diversion is the construction of a reservoir that can accommodate a large volume of urine under low pressure, without the reflux or absorption of urinary constituents. The constantly improving survival of patients undergoing radical cystectomy raises the issue of long term functional voiding outcomes of those with an orthotopic bladder substitute[3]. We report the functional and physiological outcomes of Pitcher Pot Ileal Neobladder (Figure 1).

MATERIALS AND METHODS

Inclusion Criteria

Approximately 250 male patients underwent open radical cystectomy between February 2005 and May 2015 at Rajiv

Gandhi Cancer Institute, for invasive urothelial cancer and creation of a Pitcher Pot Ileal Neobladder. Out of these 50 randomly selected patients who had maintained at least 2 years of regular followup, were considered for this study and clinical records were evaluated. All patients had transitional cell carcinoma and tumor stage ranged from T1 grade3 to T2-4 and NO -1 MO. Contraindications to orthotopic diversion were tumor involving the urethra, serum creatinine greater than 2mg/dl and significant co-morbid health problems or advanced pathological findings at surgery.

Fig 1:- Earthenware Pitcher Pot

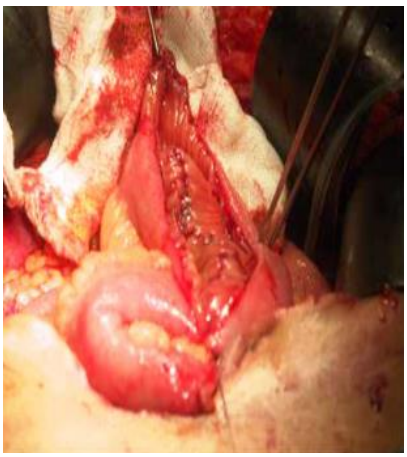

Fig 2: Detubularized bowel with dependent flap to form neourethra

Fig 3: Reconstruction in progress

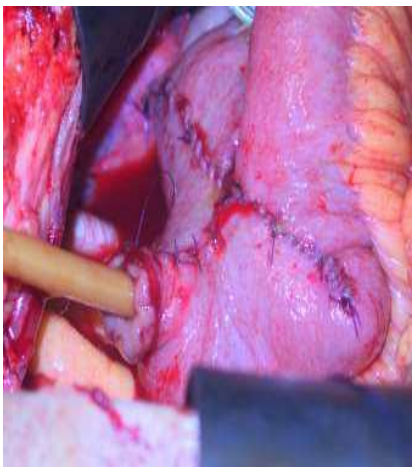

Fig 4: Neourethra Constructed

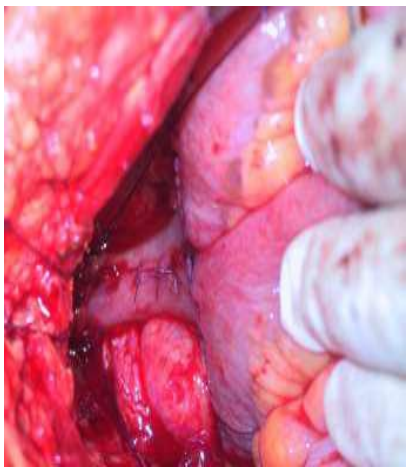

Fig 5: Pitchers Pot Ileal Neobladder

Fig 6: Cystogram of a Pitchers Pot Ileal Neobladder

Surgical Technique

Radical cystectomy was performed via transperitoneal approach in 9 patients until May 2006 and later the procedure was performed via minilap (incision size 10 cm) extraperitoneal retrograde approach in 41 patients.[4,5] Pelvic lymphadenectomy was performed in all patients. Nerve sparing technique was only attempted if it did not compromise radical tumor resection. The apex of the prostate was meticulously dissected to avoid damage to the sphincter complex.

To reconstruct the neobladder, initially the most dependent part of terminal ileum was marked by a marker suture at least 45-50 cm proximal to ileocaecal junction (ICJ) to preserve at least 25 cm of ileum at ICJ, which should be at least touching the upper border of symphysis pubis. Twenty cm of ileum distal and 35 cm of ileum proximal to marker suture were chosen to harvest the 55 cm segment of ileum. Distal 40 cm of segment was used to construct the neobladder and proximal 15 cm was used as afferent limb. Distal 40 cm of ileum was cut at the antimesenteric border for detubularisation. The incision turned towards the mesenteric border 2 cm on either side of the marker suture, thus creating a tongue-like flap at the marker suture (Figure 2).

The medial borders of incision were closed in longitudinal fashion with 3-0 polydioxanone suture (PDS) in continuous fashion and 4-0 interrupted PDS to form the posterior wall of Neobladder.The tongue-like flap at the apex of U-shaped ileum was closed in a tube-like fashion (Figure 3) with 4-0 PDS sutures resulting in lumen sufficient to accommodate a 24 Fr Foley catheter (Figure 4). Thus about 3 cm of tube was formed resulting in a neourethra that was to be used for anastomosis. With a 3-0 PDS suture proximal most ends of the posterior longitudinal suture line were brought down to the distal end of anterior suture line, thus folding the bladder in Heineke Mikulicz fashion and giving it a spherical shape with a tube (neourethra). After transposition of the left ureter to the right side, the ureters were spatulated and anastomosed by running PDS 4-0 sutures using the Nesbit's technique in an end to side fashion to proximal non-detubularized segment of ileum. Ureters were stented with 6 Fr feeding tube and are negotiated across ureteroileal anastomosis and brought out of the bladder through non-detubularized afferent limb towards the mesenteric side. The anterior wall was closed transversely with continuous 3-0 PD sutures. Finally, the

neourethra was anastomosed to the membranous urethra with interrupted/continuous 2-0 monocryl sutures, on Uroneedle over a three-way 24 Fr Foley catheter (Figure 5). The ureteric splints were brought out of the anterior abdominal wall on the right side and a urostomy bag was applied over it for urine collection. A suprapubic catheter (SPC) was also inserted. This neobladder, on filling, resembled like an inverted 'Pitcher Pot', a traditional clay pot for storing drinking water in summer in the Indian subcontinent (Figure 1).

The pelvis was drained with a 24 Fr tube drain. Catheter was fixed to the glans. Ureteric splints were removed on 10th post-operative day, SPC on the 11th day and catheter on 12th day depending on patient's recovery. All patients were taught perineal exercises and timed voiding after catheter removal. As the reservoir capacity increased gradually, patients were advised to hold urine for 3-4 hours and to use alarm clock at night. All patients were started on oral sodium bicarbonate supplementation.

Table 1: Definitions of Continence

DEFINITIONS	CONTINENCE LEVEL	SATISFACTION LEVEL
DAYTIME		
Completely dry without need for protection completely dry, protection for safety	Continent	Good
No More than 1 pad a night, damp once or twice a week No More than 1 pad a day, damp	Socially Continent	Satisfactory
More than 1 pad a day, wet or soaked	Incontinent	Unsatisfactory
NIGHTIME		
Completely dry without need for protection completely dry, protection for safety	Continent	Good
No More than 1 pad a night, damp once or twice a week No More than 1 pad a day, damp	Socially Continent	Satisfactory
More than 1 pad a day, wet or soaked	Incontinent	Unsatisfactory

Table 2: Proforma

S.NO.				
	Desire to void	Yes	No	-
1	**Voiding pattern**	Spontaneous	Assisted Valsalva Postural	-
2	**Force of Micturition**	Poor	Straining	Good
3	**Urinary continence**	Yes	No	-
4	**If Incontinent, when**	Always	Diurnal	Nocturnal
5	**Pad /diapers If used how often**	Occasional	Frequent	Always
6	**Pad /diapers If used How many**	1	2-5	>5
7	**Soakage of pads**	Damp	Soaked	-
8	**Need for ICSC**	Yes	No	
9	**ICSC if yes, how often**	Occasional (not more than twice /week)	Frequent(at least once a day)	Always
10	**Overall Level of Satisfaction**	Not Satisfied	Not fully Satisfied	Completely satisfied

Post-Surgey Follow-Up

All patients were evaluated at 3 months interval after surgery for the first 2 years, then 6 monthly thereafter. At each visit, they were assessed by a detailed history and clinical examination. After detailed history taking, patients were interviewed by a urologist other than the surgeon who performed the procedure. Micturition and continence was assessed in a standardized manner using a detailed questionnaire asking questions about micturition like desire to void or mode of voiding and questions about continence like diurnal or nocturnal continence, use of pads, number of pads used or need of intermittent clean self-catheterization (ICSC) and whether pads were dry, damp or soaked. Effort was made to ascetain overall degree of satisfaction of the patients. (See appendix).

Continence was strictly defined as good if the patient was completely dry without need for protection, satisfactory if no more than 1 pad was required during the day or night and unsatisfactory if the patient used more than 1 pad during the day or night (see appendix). Renal function tests, serum electrolytes, chest X-ray and ultrasonography (USG) was done to asses for metabolic complications, any metastases, status of upper tracts, capacity of pouch and postvoid residual urine (PVRU), if any. Computed Tomography (CT) of the abdomen was done annually. Uroflowrate was done on every visit which revealed the voiding volume, voiding pattern, maximum and average flow rate. Cystometrography (CMG) was done after at least one year of follow up in 17 patients to evaluate the capacity of the neobladder,

compliance, filling pressures and voiding pressures. Any patient who complained of voiding difficulty and had significant PVRU was subjected to cystoscopic evaluation to assess for any mechanical obstruction which was corrected. All the data for this study was collected both prospectively and retrospectively from the patient data base.

Table 2: Level of continence achieved postoperatively

DAY TIME	At 1 year	At 2 years
Completely dry, no protection	37	41
Completely dry, protection for safety	6	5
No more than 1 pad/day ,damp	5	2
More than 1 pad /day, wet	2	2
NIGHT TIME	**At 1 year**	**At 2 year**
Completely dry, no protection	16	15
Completely dry, protection for safety	3	5
No more than 1 pad/Night	15	13
Occasional leak, no pad	10	12
More than 1 pad !Night, wet	6	5

RESULTS

Patient Follow Up

The age of these patients ranged from 41 years to 72 years, the average age being 57.6 years. The follow up of these patients ranged from 2 years to 6 years, the average being 40 months. Evacuation of the neobladder was prompted by sensation in 90% (45 out of 50) of patients and by schedule in 10% of the patients.70% of the patients had spontaneous voiding by relaxation of the urethral sphincter mechanism and the rest voided with Valsalva or change of posture. None of the patients required ICSC for emptying the neobladder. 70% of the patients had good stream while voiding, 26% voided with straining and 4% had poor stream.

Urinary Continence

Urinary incontinence is a universal phenomenon with almost all neobladders, especially in the early post-operative period: Its severity was evaluated by the frequency and the number of pads or any other protective device used by the patient to keep him from wetting. Three months after surgery, 40% of patients were completely dry and 60% of patients had nocturnal incontinence. At one year after surgery, during the day time 43 patients were completely dry without need of protection and 5 patients used occasional pads and only 2 patients had to use more than 1 pad regularly. During the night time, 29 patients didn't require any protection, 15 patients required occasional protection, and 6 patients used pads regularly. Continence was reported as good or satisfactory in 96% and 88% during the day and night respectively. At 2 years of the follow up, continence was reported as good or satisfactory in 96% and 90% during the day and night respectively.

Functional Reservoir Capacity and Frequency

Average day time frequency was 3 hours. Out of all patients 35 patients got up at night to void with an average of 2 times, whereas 15 patients didn't get up to void. On USG, at 1 year average volume of the reconstructed bladder was 276 cc (110-717 cc) with a mean residual urine of 27 cc (0-185 cc). At the end of 2 years, average volume of the reservoir was 290 cc (97-544 cc) with mean residual urine of 15 cc (0 -150 cc).

Urodynamics

After 1 year of the post-treatment follow-up, maximum uroflow rate ranged from 6 to 36 cc/sec with a mean of 17 cc/sec and the average flow ranged from 4 to 13 cc/sec with a mean of 7cc/sec. At 2 years, maximum flow ranged from 7 to 43 cc/sec with a mean of 18cc/sec, and the average flow ranged from 3 to 15 cc/sec with a mean of 10 cc/sec. On CMG, the maximum capacity of the urobladder was found to be more in cases where the postoperative period was longer. Correspondingly, there was proportional fall in average vesical pressure as the bladder capacity increased. Eight patients had maximum bladder capacity of more than 500cc and 9 patients had capacity between 250-500cc. Average vesical pressure at micturition was 67 cm of water for neobladders with less than 500 cc capacity and 35 cm of water with neobladders capacity more than 500 cc. No uninhibited contractions were seen and compliance was good in all cases.

Upper Tracts

After 1 year of follow up, serum creatinine ranged from 0.8 to 2.0 mg/dl with a mean of 1.2mg/dl. Pre-operatively, there was dilatation in 6 renal units. After surgery, 2 out of these 6 showed improvement. At 1 year of follow up dilatation was seen in 7 renal units 6 mild and 1 moderate (4 were previously existing and 3 had new development) At 2 years of follow up, serum creatinine ranged from 0.9 to 1.8 mg/dl, with a mean of 1.15 mg/dl. On USG, mild hydronephrosis was noted in 7 renal units and moderate hydronephrosis in 3 renal units. Three patients required revision of ureteroileal anastomosis for deteriorating function of the renal unit at 1 year, 2.5 years and 3 years post-surgery respectively.

Outflow Obstruction

Eight out of 50 (16%) patients had to undergo cystoscopic evaluation due to poor flow and significant residual urine. Three patients had anastomotic stricture and were cystoscopically dilated and 5 patients had prolapsed neobladder mucosa obstructing the bladder outlet which was resected trausurethrally. All showed significant improvement in flow and PVRU after the procedure.

Overall level of satisfaction with the procedure was

absolutely the personal assessment of the patient himself as regards to the quality of life after surgery. Forty eight of 50 the patients (96%) were satisfied with the procedure, whereas 2 of 50 patients (4%) were not satisfied due to incontinence.

DISCUSSION

The optimal goals of the treatment of any invasive bladder cancer should be long term survival, prevention of local recurrence or distant metastases, and an excellent quality of life[1,2]. Initially ureterosigmoidostomy and later ileal conduits became the mainstay of urinary diversion.[1] Nowadays orthotopic neobladder substitution is considered the gold standard.[1]

Currently, proponents to continent diversion estimate that 80% of men and greater than 65% of women with invasive bladder cancer are candidates for orthotopic continent urinary diversion[3,6]. When measuring quality of life in patients with orthotopic bladder substitution functional voiding is an important factor. Day and nighttime urinary incontinence, urethral or anastomotic strictures as well as failure to empty the bladder substitute requiring intermittent or permanent catheterization may distract substantially from any perceived quality of life advantages of orthotopic bladder reconstruction[7]. The clinical and functional success of any bladder replacement procedure is intrinsically associated with reservoir geometry[8]. Voiding pressures and voiding dysfunction depend on the type, length and configuration of bowel segment harvested along with the choice of surgical technique and the age of the patient. Along with this, what also matters is the tension on the urethrovesical anastomosis. Studer bladder substitution gives the advantage of satisfactory continence rate, absence of urinary leakage, and freedom from ICSC, preservation of renal function and avoidance of fluid and electrolyte imbalances[7]. It has been described by many authors that they had difficulty in bringing down the reservoir to the membranous urethra which was also encountered by us initially (short ileal mesentery being the commonest reason).[4,7,9,10] We understand that any tension in joining the neobladder with urethra will lead to leakage of urine causing fibrosis on healing. It can lead to obstruction at anastomosis and urinary retention and thus requiring ICSC. To circumvent this problem, we modified the Studer ileal neobladder to form a neourethral tube from the most dependent part of the reservoir and this provides an additional 2-3 cm of length that ensures a tension free anastomosis[5].

We evaluated the voiding pattern, continence and the urodynamics of Pitcher Pot Ileal Neobladder and our results confirmed that this modification stood the test of time and gave excellent functional outcomes. Long term outcome of voiding function in several studies showed that 50 - 97% of the patients with ileal neobladder and 40-100% of patients with sigmoid neobladder were capable of spontaneous voiding[11,12]. Many of these studies have considered Valsalva maneuver to micturate as spontaneous voiding. In our study 70% of our patients micturated spontaneously and further 30% required assistance mainly in the form of Valsalva. 90% of our patients developed the sensation to the extent of having the desire to void. Importantly, none of our patients was on ICSC.

Despite the excellent functional results of orthotopic urinary diversion after radical cystectomy, nocturnal incontinence is a significant problem in 20-40% of patients[7,13]. This wide range of difference may be attributed to the adoption of different definitions. Light[14] suggested five possible causes of nocturnal incontinence including loss of vesicospinal external sphincter reflexes, osmotic pseudodiuresis, denervation of sphincter mechanism, decreased muscle tone of the pelvic floor and/or elevated pouch pressure. Steven et al[5] studied urinary continence by patients' interview, the need to use protective devices and provocative testing on 166 patients who underwent radical cystectomy and ileal Kock Neobladder. Daytime continence was reported as 97% and 100% at 1 and 5 years respectively, 75% of patients reported nighttime continence at 1 year and 94% at 5 years. Hautmann et a1[8] in their study of 363 patients reported good or satisfactory continence during the day in 95.9% of patients and during the night in 95% of patients respectively. They showed that ultimate level of daytime and nighttime continence was achieved by 5 years postoperatively. Studer et al used stricter definition of continence as complete dryness or loss of no more than a few drops of urine once or twice a month[7]. In Studer's early report [16] continence rate by day and night was 66% and 50% respectively, and they stated that continence improved with time, which they attributed to the increase in pouch capacity.

In a later report,[17-19] they found a daytime continence in 92% after 1 year and nighttime continence rate of 80% after 2 years. The daytime continence rate was 94% and 91% after 5 and 10 years while the nighttime continence rate was 72% and 60% respectively. Abol-Enein and Ghoneim[20] in their experience with 450 patients of orthotropic ileal neobladder with serous lined extramural tunnel reported that during the day 93.3% patients were completely continent. Eighty percent of patients were dry at night without medication. Overall 77% of patients were continent during the day with a frequency of 3 to 5 times and dry at night with a frequency of 0 to 2.

In our study, at 3 months after surgery 60% patients had nocturnal incontinence and 13% had daytime incontinence, 40% patients were completely dry. Good or satisfactory continence during the day and night was achieved in 96% and 88% of patients at 1 year and 96% and 90% of patients at 2 years follow up respectively. At all time points nighttime incontinence rates were considerable higher than daytime rates. The functional capacity of reservoir made of 40 cm ileum increases within weeks or months in most patients from 150 to 450 cc as seen in different series[17,21]. Abd Alla et al[21] reported a functional capacity 6 to 12 months post-operatively from 215 cc to 635 cc with median reservoir capacity of 447 cc. Studer et al[17] reported an average functional reservoir capacity of 473 cc after 12 months as assessed by frequency /volume charts. In the series by Hautmann et al[8], average volume of the reconstructed bladder was 433 cc with residual urine of 28 cc. Urodynamic analysis of a subgroup of patients revealed maximum bladder capacity of 768 cc with an absolute intravesical pressure of 12 cm of water at half capacity and 30 cm at capacity. Micturition pressure of 71 cm of water was achieved by abdominal straining with average residual urine of 18 cc. In our series, average volume of the reservoir on USG was 276 cc with mean residual urine of 27cc at 1 year of follow-up and 290 cc and 15cc at 2 year of follow up respectively. The mean maximum flow rate and average flow rate was 17cc/sec and 7cc/sec at 1 year and 18cc/sec and 10cc/sec at 2 years of follow up respectively. Urodynamic assessment was not done in all cases. Average vesical pressure at micturition was 67 cm water in reservoirs with less than 500 cc capacity and 35cm water in reservoirs with more than 500ml capacity. Compliance was good and no uninhibited contractions were encountered.

One of the key factors in construction of any neobladder is preservation of renal function. Good long term results have been

reported for the isoperistaltic long afferent segment known as the Studer limb, where direct end-to-side ureteroileal anastomoses was performed.[17,18] Mild pelvicaliectatic dilatation on the follow-up is not uncommon.[18] Studer et al[17] reported that 8 out of 176 renoureteral units developed dilatation and in 7 patients the preoperatively dilated renoureterel units became normal within 6 months, while in Benson et al [22] series only one patient out of 64 developed upper tract dilatation .In the ULm group[23], increase in dilatation was seen in 73 out of 393 renal units. Ureterointestinal stricture occurred in 2.7% of renal units undergoing the Studer neobladder[24], 9% undergoing the Hautmann neobladder[8], 6% with the modified chimmey procedure [9] and 3.8% undergoing serous-lined extramural ureteral reimplantation[20]. In the current series there was improvement in dilation in 2 renal units and dilatation occurred in 3 units at 1 year and 6 units at 2 year. Three patients required revision of ureteroileal anastomosis due to stricture for deteriorating function of the renal unit.

There is apprehension among some authors that interposition of any segment (like funnel or neourethra) between the reservoir and the urethra may lead to kinking and subsequent voiding dysfunction[7]. Studer et al[16,24] used a 5 cm tubular segment between the pouch and the membranous urethra in 4 patients. Two patients had intermittent pressure peaks in this segment resulting in incontinence, whereas the other 2 did well on follow-up. Abd Alla et al[21] also used a short tube of 2 cm length between the pouch and the urethra and did not find any pressure peaks. Smith et al[25] discussed neourethral modification in asssociation with Hautmann orthotopic bladder replacement with a chimney. In the median follow up 17 months, 12 of 17 of their patients were compeletly continent during day and night. There was a relatively higher incidence of requirement of ICSC (42%) due to chronic retention in their study. They postulated that it may be possible to reduce the retention rate by limiting the length of the neourethral tube to that which is just sufficient for tension free anastomosis. Hautmann et al[8] interposed a tubular segment between the reservoir and urethra when they were unable to bring the resevoir down to the membranous urethra. In both instances, patients required ICSC to evacuate the reservoir. Thus there are variable experiences with different types of segment interposition. However in our cases the neourethera is part of the same segment of intestine and has shown excellent outcome in this study. No patient required ICSC to evacuate the reservoir. We feel that this tube later on gets expanded and becomes part of neobladder.(Figure 6)

Ghoneim et al[20] reported outflow obstruction in 11 male patients due to urethral stricture in 4 and urethroileal stenosis in 7. The incidence of urethroileal stenosis was 7% in Hautmann series [8] and 10% in Rogers's series[26]. In our series, 3 patients (6%) had anastomotic stricture and were cystoscopically dilated. Studer et al[7] reported protrusion of mucosa of the intestinal bladder substitute into the anastomotic area causing voiding dysfunction in 4 pateints . In our series, 5 patients (10%) were evaluated for poor flow and significant PVRU by cystoscopy and were found to have prolopse of neobladder mucosa which was resected using a cutting loop resulting in significant reduction in PVRU and improvement in flow. So any patient with voiding dysfunction should be evaluated for any mechanical cause and corrected.

We agree with some authors that subjective grading of incontinence may not disclose completely the degree of abnormality[8]. Importantly, while urinary function is impaired following continent diversion, many patients do not appear to be significantly bothered, suggesting that adaptation to the functional impairment is also common[3,27]. In our experience also we found that patients were not much bothered with mild urinary leakage and 10 patients did not bother to wear any protection despite occasional leakage. Overall 96% of our patients were satisfied with the functional, physical and psychological aspects of the procedure and would have undergone the procedure again if given the choice.

CONCLUSION

We believe that the Pitcher Pot Ileal Neobladder, with the neo urethral modification is easy to construct and provides a tensionless urethroileal anastomosis, allowing orthotopic diversion in almost all patients undergoing radical cystectomy. Pitcher Pot Ileal Neobladder provides an excellent intermediate and long term functional results as an othotopic ileal neobladder reservoir.

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