Original Article

Clinical and videourodynamic study characteristics in female primary bladder neck obstruction and outcomes of bladder neck resection: A tertiary care center experience in India

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Abstract

Introduction: Video urodynamic study (VUDS) with clinical correlation helps in diagnosing primary bladder neck obstruction (PBNO) in women. Bladder neck incision/bladder neck resection (BNR) though effective is not commonly practiced for the fear of complications and limited literature available.

Methods: The records of ten women diagnosed with PBNO between 2017 and 2019 were reviewed and data pertaining to their clinical features, laboratory results, findings on abdominal ultrasonography, uroflowmetry, and VUDS was noted. Type of operative procedure performed and outcomes on follow-up were also assessed.

Results: Out of ten patients, two presented with lower urinary tract symptoms (LUTS), three with voiding LUTS and chronic retention and five had acute urinary retention. Mean serum creatinine was 3.4 mg/dl. In those able to void, mean maximum flow rate (Q max) was 7 ml/sec, and mean postvoid residual volume (PVR) was 360 ml. On VUDS, mean detrusor pressure at maximum flow (pdet@Qmax) was 54.2 cm of H20. Three patients opted conservative treatment and 7 had a successful surgical outcome with mean Q max of 26.2 ml/s (range: 13.9–41 ml/s), insignificant PVR and resolution of renal failure. Patients with pdet@Qmax <20 cm H_2O ($n = 3$, mean 18.3 cm H_2O) did equally well as compared to those with pdet@Qmax >20 cm H_2O ($n = 4$, mean 93 cm H_2O). None of the patients developed any complications on follow-up.

Conclusions: Clinical assessment supported with VUDS correlation holds a key in identifying patients with PBNO. BNR is a safe and effective treatment of PBNO in women who fail or are not candidates for conservative treatment.

Keywords: Bladder neck resection, female bladder outlet obstruction, primary bladder neck obstruction, urodynamic studies

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INTRODUCTION

Bladder outlet obstruction (BOO) in women is defined as a persistent, low Qmax of <12 ml/s in repeated noninvasive uroflow studies, combined with high pdet@Qmax >20 cm H_2O during detrusor pressure-uroflow studies.[1] Causes of

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BOO in women include urethral stricture, meatal stenosis, Fowler's syndrome, detrusor external sphincter dyssynergia, dysfunctional voiding (DV), and primary bladder neck obstruction (PBNO). It is essential to differentiate these conditions as the management differs. PBNO in women is often under diagnosed due to varied clinical presentations of BOO and its inadequate correlation with video urodynamic study (VUDS). Clinical and videourodynamic correlation is invaluable in diagnosing and differentiating PBNO from other causes of BOO in women. Medical treatment with alpha blockers is widely followed for PBNO in women but has poor outcomes. Surgical management in the form of bladder neck incision/resection (BNI/BNR), though described, is not very commonly practiced for the fear of complications and limited literature is available on the outcomes of such procedures. Various techniques of BNI have been described in literature. However, there is no clear understanding regarding the extent and depth of incision. An inadequate or over enthusiastic treatment can result in unsuccessful outcome and dreaded complications. In this study, we describe our surgical technique of BNR and tried to ascertain the factors aiding in diagnosing such a problem. Furthermore, we have tried to study the efficacy of BNI/BNR in effectively treating female PBNO along with factors predicting outcomes without complications.

METHODS

We identified 10 patients diagnosed with PBNO over the last 2 years in the department of Urology at our tertiary care center from November 2017 to October 2019. Their records were reviewed and data pertaining to their clinical features, laboratory results, findings on abdominal ultrasonography (USG), uroflowmetry and findings on VUDS were noted. Medical and surgical treatments were reviewed. In addition, type of operative procedure performed and outcomes on follow-up were recorded. Women who presented with voiding symptoms along with a maximum flow rate (Qmax) <15 ml/s on uroflowmetry and International Prostate Symptom Score (IPSS) >8 were considered to have the possibility of BOO. Anatomical obstruction such as urethral stricture or meatal stenosis was ruled out by performing urethro-cystoscopy initially with a semirigid ureteroscope (7.5 fr) to characterize urethral mucosal abnormality along with any obvious obliteration and further, with a 17F cystoscope sheath to assess rigidity and distensibility of the urethra. Patients were then subjected to VUDS to ascertain bladder compliance, detrusor pressure at maximum flow (pdet@Qmax), Qmax, bladder contractility index, sphincter activity on electromyogram (EMG) and bladder neck opening on fluoroscopy. PBNO was diagnosed based on the following findings on VUDS– Qmax of <15 ml/s with a sustained detrusor contraction of any magnitude and inadequate bladder neck opening on fluoroscopy. Patients with poor flow with abdominal straining were assessed for underactive bladder. EMG and video characteristics on Urodynamic studies (UDS) were used to distinguish DV from PBNO. Findings of increased sphincter activity on EMG during voiding with interrupted flow along with a spinning top deformity of urethra on fluoroscopy were suggestive of DV. Investigations such as serum creatinine and ultrasound of the abdomen (USG) to assess upper tract changes, urinary bladder and Post void residual volume (PVR) were performed to assess the severity of obstruction. Once diagnosis of PBNO was established, all patients without complications were offered conservative management with alpha blocker and when needed, clean intermittent self-catheterization (CIC). Patients with renal failure and back pressure changes were catheterized to drain the bladder and were monitored for normalization of renal function and resolution of hydroureteronephrosis (HUN). VUDS was performed in these patients once this was achieved. This subset of patients and the ones who did not improve with medical management at 3 months were offered surgical treatment in the form of BNI at 5 and 7'o clock position from bladder neck to mid urethra and patients whose symptoms persisted were offered BNR. Initially, two patients who opted for surgical management were subjected to BNI at 5 and 7 o'clock positions. However, in view of poor or no response, they were subjected to BNR and the response was immediate and subsequently, all the other patients who opted or required surgery underwent BNR straight away.

Technique of bladder neck resection

Our technique of BNR begins with an incision over bladder neck at 5 and 7 o'clock positions using Collin's knife from bladder neck to proximal one thirds of urethra till circular muscle fibers are seen. This is followed by resection of tissue between these incisions the extent to which subsequent resection follows circumferentially. Meanwhile, depth assessment of resection is done regularly by per vaginal palpation to look for the thickness of interposing tissue so as to avoid vaginal injury. Subsequently, circumferential resection is performed for the same extent and depth preserving tissue at 12 o'clock position using a bipolar resectoscope to prevent future bladder neck contracture [Figure 1]. Postprocedure, a 14Fr Foley catheter is placed for 2 days before a voiding trial is given. These women were followed at 3, 6, and 12 months after surgery with IPPS symptom score, uroflowmetry, and PVR estimation. Increase in IPPS symptom score and maximum flow rate (Qmax) <15 ml/s or PVR more than 100 ml

were considered as failure of treatment. Furthermore, the assessment for any urinary leakage on history and examination was performed to rule out any stress urinary incontinence (SUI).

RESULTS

Out of 10 patients, two presented with voiding lower urinary tract symptoms (LUTS) only, three had voiding LUTS with chronic retention and five presented with refractory urinary retention. Five patients had evidence of back pressure changes with deranged renal parameters and HUN on USG. Mean serum creatinine was 3.4 mg/dl (standard deviation [SD] ±4.13) (range: 0.8–11.41 mg/dl) at the time of presentation and mean IPSS was 18 [Table 1]. On VUDS, Mean Qmax was 7 ml/s (SD ± 3.08), mean pdet@Qmax was 54.2 cm of H2O (SD ± 45.19) and mean PVR was 360 ml (SD ± 129). VUDS showed closed or poor funneling of bladder neck during voiding phase [Table 2].

Seven patients underwent surgical intervention (BNI/BNR) while the remaining three opted for medical management for the fear of complications. Initial two patients who underwent BNI subsequently underwent BNR because of no clinical improvement. Hence, all the other patients were directly subjected to BNR. Postoperatively, all patients who presented with retention had successful voiding trial with mean Qmax was 26.2 ml/s (SD ± 8.26) (range: 13.9–41 ml/s) and mean IPSS of 7 [Table 3]. PVR was insignificant and there was resolution in HUN and renal failure postoperatively in all patients. Patients with pdet@Qmax <20 cm H_2O (n = 3, mean 18.3 cm H_2O) did equally well as compared to those with pdet@Qmax >20 cm H_2O (n = 4, mean 93 cm H_2O) [Figure 2]. None of the patients (even with higher pdet@Qmax) developed incontinence, bladder neck contracture or urethrovaginal fistula on follow-up. Patient demographics, pre- and post-treatment-parameters of all 10 patients are summarized in Table 4.

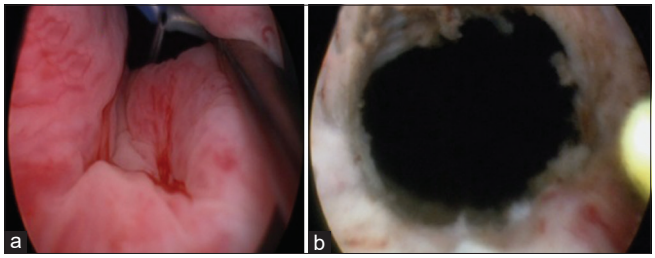

Figure 1: (a) Preoperative picture of bladder neck in case of female primary bladder neck obstruction; (b) Postbladder neck resection

DISCUSSION

The true incidence of PBNO in women is limited as most of the epidemiologic studies looking at the data on PBNO in women do so in a subset of women presenting with symptoms of (BOO) and not the general population. It is estimated that 4.6% to 16% of women presenting with obstructive voiding have PBNO.[2-4] Crux of female BOO is diagnosis of the cause of obstruction because the management is governed by the type, i.e., anatomical (meatal stenosis, urethral stricture) or functional (PBNO, DV, Fowler's syndrome). While UDS, in general, aids in depicting the effect of chronic obstruction on bladder contractility, VUDS helps in differentiating PBNO from DV based on EMG characteristics. Chassagne *et al.*, in 1983, studied 35 women with BOO based on history, radiographic, endoscopic, and urodynamic findings and

Table 1: Preoperative clinical, radiological and biochemical parameters of the 10 patients

Variable	Value
Mean age (range)	40 years (28-60)
Number of patients with voiding LUTS	2
Number of patients with voiding LUTS with chronic retention	3
Number of patients with acute urinary retention	5
Number of patients with HUN on USG	5
Mean serum creatinine	3.4 mg/dl (SD±4.13) (range: 0.8-11.41 mg/dl)
Mean IPSS	18 (range: 14-34)

LUTS: Lower urinary tract symptoms, HUN: Hydroureteronephrosis, USG: Ultrasonogram, IPSS: International prostate symptom score, SD: Standard deviation

Table 2: Preoperative video urodynamic characteristics of the 10 patients

Variable	Value
Mean pdet@qmax	54.2 cm of H_2O (SD±45.19) (range: 18-165 cm of H_2O)
Mean Qmax	7 ml/s (SD±3.08) (range: 3-11 ml/s)
Number of patients with closed bladder neck on VUD image	8
Number of patients with poor funneling on VUD image	2
Mean PVR	360 ml (SD±129) (range: 200-600 ml)

pdet@qmax: Detrusor pressure at maximum flow, SD: Standard deviation, Qmax: Maximum flow rate, VUDS: Video urodynamic study, PVR: Post void residual volume

concluded that the strict diagnosis of obstruction on the basis of UDS cut off values is not possible but a cut off value for Qmax of 15 ml/s or less and a PdetQmax of 20 cm H_2O or more in conjunction with a high clinical suspicion of obstruction provides reasonable predictive values.[5] We diagnosed PBNO on the basis of VUDS characteristics of high-pressure, low-flow voiding with radiographic evidence of obstruction at the bladder neck with relaxation of the striated sphincter and no evidence of distal obstruction and hypocontractile bladder. This is in accordance with the description of PBNO by Victor Nitti who defined PBNO as a condition in which the bladder neck fails to open adequately during voiding, resulting in obstruction of urinary flow in the absence of another anatomic obstruction.[6]

Morgia *et al.* prescribed alpha blockers and CIC for cases with PVR more than 100 ml and showed that 56% patients of functional BOO improved with this management.[7] Contrary to this, Fu and Xu noted that medical management with adrenergic blockers failed in 40 patients of PBNO and hence subjected them to BNI using potassium titanyl phosphate (KTP) laser successfully.[8] Furthermore, Shen *et al.* enrolled 59 patients of female PBNO in their study for controlled transurethral resection and incision of the bladder neck after they failed medical management with alpha blockers for a period of 3 months.[9] In our study too, seven out of 10 patients (70%) underwent surgery because of failure of conservative strategy. Medical management may not be an effective option in the context of female PBNO because the smooth muscles of female bladder neck and urethra are usually poorer in alpha receptors than the males and hence a pronounced effect of alpha blockers in relieving the functional obstruction in women cannot be achieved.[10] Moreover, in our series, three patients did not undergo surgical intervention primarily for the fear of complications.

Table 3: Postoperative characteristics of seven patients who underwent surgery

Variable	Value
Number of patients who underwent surgery	7
Mean Qmax	26.2 ml/s (SD±8.26) (range: 13.9-41 ml/s)
Mean serum creatinine	0.9mg/dl (SD±0.29) (range: 0.43-1.5mg/dl)
Mean PVR	30 ml (range: 0-50ml)
Mean IPSS	7 (range: 2-10)

Qmax: Maximum flow rate, SD: Standard deviation, PVR: Post void residual urine, IPSS: International prostate symptom score

The most commonly described surgical procedure in the context of female BOO is BNI. However, there is no standardized technique of BNI in the literature and different authors have described it differently. Delaere *et al.*, in 1983, attempted BNI in female BOO of various etiologies with incision at 12 o'clock position and concluded that this is a moderately successful procedure with 18% requiring repeat incisions.[11] Similarly, Peng and Kuo reported success of BNI with incisions at 5 and 7 o'clock positions in 10 out of 11 (91%) of his study subjects of female BOO.[12] Jin *et al.* described their technique of BNI in female PBNO where incisions were made at the 3-, 6-,

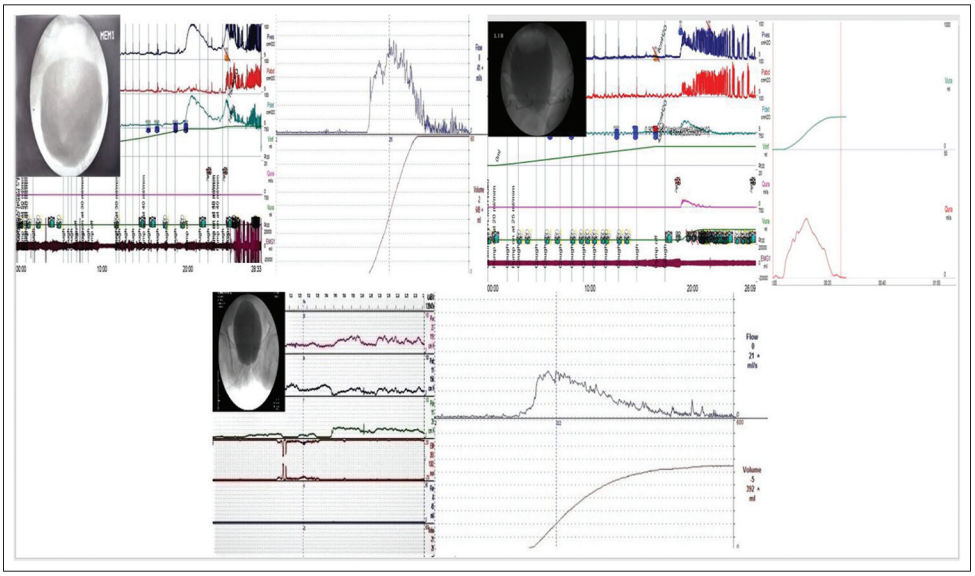

Figure 2: Video urodynamic study (videourodynamic study) along with postoperative uroflowmetry after bladder neck/resection; (a) Video urodynamic study showing closed bladder neck during voiding with very high pdet@Qmax (97 cm H_2O) and postoperative Qmax of 41 ml/s; (b) Video urodynamic study showing poor funneling of bladder neck during voiding with high pdet@Qmax (40 cm H_2O) and postoperative uroflowmetry with Qmax of 25 ml/s. (c) Video urodynamic study showing closed bladder neck during voiding, low pdet@Qmax (18 cm H_2O) and postoperative Qmax of 21 ml/s

Table 4: Patient demographics, pre- and post-operative parameters

Parameters	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5	Patient 6	Patient 7	Patient 8	Patient 9	Patient 10	Mean with SD/median with range
Age (years)	36	40	33	36	28	29	60	54	45	40	40 (28-60)
Presentation	Voiding LUTS with chronic retention	Voiding LUTS with incomplete emptying	Acute urinary retention	Acute urinary retention	Acute urinary retention	Acute urinary retention	Voiding LUTS with incomplete emptying	Voiding LUTS with chronic retention	Voiding LUTS with chronic retention	Acute urinary retention	
IPSS score	16	14	19	16	34	15	14	16	18	18	18 (14-34)
Initial serum creatinine (mg/dl)	11.41	1.0	2.0	11.0	1.6	2.0	1.0	0.8	1.4	1.8	3.4 (SD±4.13) (range: 0.8-11.41)
HUN on USG (+/−)	+	−	+	+	+	−	−	−	+	−	
Q max at presentation (ml/s)	6	9	-	-	-	-	6	11	3	-	7 (SD±3.08) (range: 3-11)
Voided volume	130	110	20	10	-	-	200	120	130	-	102 (SD±66) (range: 10-220)
PVR	600	250	260	450	-	-	200	360	400	-	360 (SD±129) (range: 200-600)
pdet@Qmax (cmH_2O)	165	48	18	47	97	19	43	47	18	40	54.2 (SD±45.2) (range: 18-165)
Qmax (VUDS) (ml/s)	5	6	Couldn't void	3	Couldn't void	4	6	9	5	5	5.3 (SD±1.7)
Bladder neck status on flouroscopy	Closed bladder neck	Closed bladder neck	Closed bladder neck	Poor funneling of bladder neck	Closed bladder neck	Closed bladder neck	Closed bladder neck	Closed bladder neck	Closed bladder neck	Poor funneling of bladder neck	
Treatment (medical/surgical)	Surgical	Medical	Surgical	Surgical	Surgical	Surgical	Medical	Medical	Surgical	Surgical	
Posttreatment IPSS	6	12	8	8	9	8	14	16	8	2	9.1 (SD±4.0) (range: 2-16)
Posttreatment Qmax (ml/s)	40	12	21	22	41	20	10	12	13.9	25	21.9 (SD± 10.9) (range: 10-41)
Posttreatment PVR	40	200	30	15	0	25	150	220	50	50	78 (SD±80.5) (range: 0-220)
Posttreatment serum creatinine	1.5	1.0	0.8	0.43	0.9	1.1	1.0	0.8	1.0	0.6	0.9 (SD±0.29) (range: 0.43-1.5)

LUTS: Lower urinary tract symptoms, HUN: Hydroureteronephrosis, USG: Ultrasonogram, IPSS: International prostate symptom score, SD: standard deviation, pdet@Qmax: Detrusor pressure at maximum flow, SD: Standard deviation, Qmax: Maximum flow rate, PVR: Post void residual volume

9-, and 12- o'clock position with an adult resectoscope extending from just inside the bladder neck through the proximal one-third of the urethra. Their depths of incisions were different at different positions. At the 3- and 9- o'clock positions, the incisions were made deep enough until the fat could be visualized through the distracted capsular fibers. At the 6- and 12-o'clock positions, the incisions were just deep enough until the bladder neck cuff disappeared with smooth access from the proximal urethra to the bladder.[13]

Markić *et al.* came up with encouraging results where 42 female patients of PBNO underwent BNI. Their description of BNI was from ureteric orifices to striated sphincter at the junction of proximal and mid thirds of urethra across the bladder neck. They described two important caveats in achieving good outcome with minimal complications after BNI. The first one is identification of a striated sphincter because damaging this structure can lead to urinary incontinence. Hence, using repeated movements of the urethrocystoscope from the bladder neck in the urethra, one can reveal a striated sphincter as a relatively narrow urethral segment and to prevent injury, the maximal length of the incision should be the proximal third of the urethra. The second critical point is the incision depth where the cutting device movement must be gentle to avoid a deep incision.[14] While all the aforementioned studies used Collin's knife in a bipolar resectoscope for BNI, Fu and Xu described the same procedure using KTP laser in 40 patients of PBNO and concluded that KTP laser for BNI is very effective in the treatment of female voiding dysfunction due to PBNO.[8]

One of the earliest descriptions of BNR as a surgical technique in female PBNO was by Blaivas *et al.*, who in their study described BNR as a procedure where two incisions are given over bladder neck at 5 and 7 o'clock positions followed by resection of interposing tissue from bladder neck to the proximal third of urethra. Over a median follow-up period of 3 years, they reported that six patients out of seven considered themselves cured of LUTS and 1 was improved. In one patient, the obstruction site was not clear and one patient had mild stress incontinence under rare circumstances not severe enough to require protective pads.[15] Shen *et al.* described a novel procedure where a combination of both resection and incision was employed in their patients with intent to develop a method for controlled urethral-length resection and incision of the bladder neck for the treatment of female PBNO. Their technique consisted of resection of bladder neck between 5 and 7'o clock positions along with an incision at 12 o'clock position. They hypothesized that this procedure shortens the length of the urethra to 2.5 cm which both released the obstruction and maintained continence.[9]

In our study, BNI failed to achieve a satisfactory outcome in first two of our seven patients who underwent surgery. The reason for unsuccessful BNI could be the inability to adequately assess the length and depth of BNI for the fear of complications such as SUI, urethrovaginal fistula, and development of urethral stricture. Furthermore, Jin *et al.* compared bladder neck to a type of solid ring and described that it is difficult to break its stability by cutting only 1 or 2 adjacent points.[13] At the same time, we believe that a controlled circumferential resection of bladder neck not only creates a wide channel with reduced outlet resistance but also maintains adequate depth and length without endangering the surrounding structures. Hence, we eventually resorted to BNR in all the other five patients where bladder neck was circumferentially resected till proximal third of urethra while limiting the resection at 12 o'clock position to prevent future development of bladder neck contracture. However, BNR though with its initial success, might still be an excessive treatment and a longer follow-up is particularly needed to follow if some of these patients will develop bladder neck contracture due to circumferential resection. Thus, careful long-term data and further research need to be looked at for this particular point. We also tried to understand whether low detrusor pressure and not a hypocontractile bladder will benefit from such a procedure. Out of seven patients, three had pdet@Qmax <20 cm H20 (n = 3; mean 18.3 cm H_2O) and four had pdet@Qmax >20 cm H2O (n = 4; mean 93 cm H_2O). Both these patient groups had satisfactory subjective and objective outcomes and felt themselves significantly improved and possibly, cured. Sussman *et al.* retrospectively looked into patients with female PBNO and opined that VUDS predicted success after BNI independent of detrusor voiding pressures.[16]

An ideal resection or incision should relieve the obstruction without complications and without the need for adjuvant or repeat procedures. Although we have not encountered any complications in our experience over the follow-up of 6–12 months, two out of seven patients required reoperations in the form of BNR (who initially underwent BNI) within a month of first surgery due to nonimprovement. This is similar to the experience of Markić *et al.* who reported a reoperation in 7 out of 42 patients over 4 years after the first surgery. Although six patients improved after the second surgery, one patient could not get relief from reoperation in their study description.[14]

Although two of the 32 study subjects of female BOO developed SUI after BNI in a study reported by Delaere *et al.*,[11] we have not encountered any complications in our experience so far. Having said this, it is imperative to

counsel patients about the possibility of urethrovaginal fistula/SUI/bladder neck contracture following BNR. Moreover, our study has its own inherent limitations owing to small sample size and short period of follow-up and hence a study with significantly larger sample size and longer follow-up is required to validate our study findings so that the diagnosis and management of female PBNO can be standardized.

CONCLUSIONS

Clinical assessment with VUDS correlation is essential in diagnosing PBNO in women and BNR is an effective treatment in those who fail or are not candidates for conservative treatments. Complications are very low when it is performed adequately and despite low pdet@Qmax, BNR offers satisfactory results over long run.

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Conflicts of interest
There are no conflicts of interest.

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