

Therapeutic Efficacy and Predictive Factors for Treatment Outcomes of Transurethral Incision of the Bladder Neck in Women with Voiding Dysfunction Due to an Underactive Bladder

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Abstract

Introduction:

Transurethral incision of the bladder neck (TUI-BN) can effectively improve voiding efficiency in women with bladder neck obstruction. However, its role in women with low detrusor contractility remains unclear. This study retrospectively evaluated the clinical efficacy of TUI-BN and identified predictive factors for treatment failure in women with detrusor underactivity (DU).

Methods

Women with videourodynamic study (VUDS)-proven bladder neck dysfunction (BND), DU, detrusor acontractility (DA), and neurogenic lower urinary tract dysfunction (NLUTD) who underwent TUI-BN were retrospectively analyzed. Treatment outcomes were graded according to the ability to void spontaneously and postvoid residual (PVR) volume. Successful treatment was defined as spontaneous voiding with a PVR of < 33% of bladder capacity. Treatment outcomes were assessed and compared among the different subgroups.

Results

A total of 212 women were analyzed, including 76 with DU, 75 with DA, and 61 with NLUTD. Among the three subgroups, patients with DA had the highest success rate (84.4%), followed by those with DU (76.5%), whereas those with NLUTD had the lowest success rate (67.3%) ($p = 0.006$). Logistic regression analysis of clinical and VUDS parameters showed that a large PVR, NLUTD, and chronic medical disease were predictive of treatment failure after TUI-BN. Patients with successful outcomes had significantly increased maximum flow rate, voiding efficiency, and bladder contractility index and significantly decreased PVR and bladder outlet obstruction index after TUI-BN.

Conclusion

TUI-BN is an effective surgical procedure for improving voiding efficiency in women with VUDS-proven BND and low detrusor contractility. A high PVR, had central nervous system-associated NLUTD, and chronic medical diseases may predict less favorable treatment outcomes.

Introduction

Voiding dysfunction in women may result from detrusor acontractility (DA), detrusor underactivity (DU), or bladder outlet obstruction (BOO) [1, 2]. The treatment of female DA or DU remains challenging because no medications have been shown to reliably restore detrusor contractility. Current treatment aims to reduce bladder outlet resistance, improve bladder emptying, decrease postvoid residual (PVR), and enhance quality of life [3].

Conservative treatment typically involves alpha-blockers and cholinergic agents to facilitate bladder emptying through increased abdominal pressure [4]. However, these approaches are effective in only a small proportion of women with DU, and their success rate is particularly low in women with impaired bladder sensation, particularly those with DU and absent bladder fullness sensation [5]. Clean intermittent catheterization (CIC) is recommended by most guidelines to periodically evacuate PVR and prevent urinary tract infections and deterioration of upper urinary tract function [3, 6].

Transurethral incision of the bladder neck (TUI-BN) has been reported to facilitate spontaneous voiding in women with voiding dysfunction due to DU for more than a decade [7]. By making two incisions at the bladder neck, TUI-BN reduces urethral resistance, allowing women to resume spontaneous voiding through abdominal straining or regain effective self-voiding by improving detrusor contractility after the procedure [7]. Treatment success has been shown to be durable, even in patients with DA and large PVR volumes [8, 9]. However, TUI-BN is not widely used for female voiding dysfunction caused by DU or DA because most urologists are concerned about the potential development of stress urinary incontinence after the procedure. In practice, however, the incidence of stress urinary incontinence may be lower than anticipated.

This study retrospectively analyzed our previous large cohort of women who underwent TUI-BN for voiding dysfunction caused by DA, DU, or DU associated with neurogenic lower urinary tract dysfunction (NLUTD) secondary to central nervous system (CNS) diseases. We evaluated the clinical efficacy and adverse events of TUI-BN and investigated predictive factors for treatment failure.

Methods

Women with voiding dysfunction underwent videourodynamic study (VUDS) to investigate the underlying pathophysiology. Patients with DA, DU, or NLUTD-related DU, as documented in the medical records, who also had a tight bladder neck during the voiding phase were initially treated with an alpha-blocker (silodosin 8 mg once daily) for at least 3 months and regular clean intermittent catheterization (CIC). TUI-BN was recommended when a large PVR volume persisted despite conservative treatment to facilitate spontaneous voiding.

TUI-BN was performed under light intravenous general anesthesia. Two incisions were made at the 5- and 7-o'clock positions of the bladder neck and extended proximally and distally to completely disrupt the bladder neck smooth muscle to the level of the serosa plane [8] (Fig. 1). After TUI-BN, a transurethral Foley catheter was indwelled for 2 days. Patients were instructed to void per urethram, after which PVR was measured. CIC was discontinued when PVR decreased to < 33% [9]. Otherwise, CIC was continued until PVR decreased to < 33%. Alpha-blocker therapy was continued until patients could void with a voiding efficiency (VE) of > 90% of bladder capacity.

VUDS was routinely performed at baseline to assess detrusor contractility and bladder outlet function. The following urodynamic parameters were recorded: first sensation of filling (FSF), fullness sensation (FS), urge sensation (US), bladder compliance, intravesical pressure (Pves), detrusor pressure (Pdet),

maximum flow rate (Qmax), voided volume (Vol), PVR, cystometric bladder capacity (CBC), and VE. The bladder outlet obstruction index (BOOI, $P_{det} - 2 \times Q_{max}$) and bladder contractility index (BCI, $P_{det} + 5 \times Q_{max}$) were also calculated.

Patients were classified as having BND with DU (BND + DU) when VUDS demonstrated a tight bladder neck with a low P_{det} ($< 25 \text{ cmH}_2\text{O}$), BND with DA (BND + DA) when no detrusor contractions were elicited, and BND with NLUTD (BND+NLUTD) when a tight bladder neck and low detrusor contractility were associated with CNS disease.

TUI-BN was performed only in women with a tight bladder neck on voiding cystourethrography during detrusor contraction, a P_{det} of $< 25 \text{ cmH}_2\text{O}$ and a low Qmax of $< 10 \text{ mL/s}$, with either a PVR of $> 50\%$ of bladder capacity or reliance on abdominal straining to void (Fig. 2). Women with high voiding pressure and a narrow bladder neck during voiding were considered to have bladder neck obstruction. TUI-BN was also performed in these patients to restore efficient voiding; however, they were excluded from the present study because their detrusor contractility was adequate.

Patients were regularly followed at the outpatient clinic after TUI-BN to assess voiding function and PVR volume. VUDS was repeated 3 months after the initial TUI-BN in patients who continued to experience voiding difficulty and had a large PVR. Repeat TUI-BN was performed if the bladder neck remained tight during voiding. Urethral sphincter injection of 100 U of botulinum toxin A was performed when the bladder neck was open but a narrow urethral sphincter was identified during voiding in VUDS [10].

Treatment outcomes were graded on a 5-point scale. Grade 0 (no improvement) indicated no improvement or worsening of VE. Grade 1 (mild improvement) indicated that the patient required abdominal straining to assist voiding and had a PVR of $> 33\%$ of bladder capacity. Grade 2 (moderate improvement) indicated that the patient required abdominal straining to assist voiding and had a PVR of $< 33\%$. Grade 3 (marked improvement) indicated that the patient could void with or without abdominal straining and had a PVR of $10\% - 33\%$. Grade 4 (excellent improvement) indicated that the patient could void with or without abdominal straining and had a PVR of $< 10\%$. Patients with grade 2, 3, or 4 outcomes were considered to have achieved treatment success.

Patients who continued to experience difficulty voiding at least 3 months after the initial TUI-BN and desired more efficient voiding underwent an additional procedure. The final treatment outcome was assessed at the last follow-up visit. Adverse events, including micturition pain, hematuria, urinary incontinence, urinary tract infection, and vesicovaginal fistula, were also recorded.

The study was approved by the hospital's Research Ethics Committee (IRB: 115-015-B; dated January 25, 2026). The requirement for informed consent was waived because of the retrospective nature of the study. Continuous variables are presented as means $\pm$ standard deviations, and categorical variables are presented as counts and percentages. Differences in clinical characteristics among subgroups and changes after TUI-BN were analyzed using one-way analysis of variance. Logistic regression analysis was performed to identify predictive factors of treatment failure. A p -value < 0.05 was considered

statistically significant. All statistical analyses were performed using Statistical Package for the Social Sciences, version 20.0 (IBM Corp., Armonk, NY, USA).

Results

A total of 212 women who underwent TUI-BN were retrospectively analyzed for treatment outcomes, adverse events, and predictive factors for treatment failure. Based on baseline VUDS findings, 76 patients were classified as BND + DU, 75 as BND + DA, and 61 as BND+NLUTD. Patients with BND+NLUTD were significantly older than those with BND + DU or BND + DA ($p = 0.032$). Medical comorbidities and surgical histories were retrieved from the medical records. Table 1 summarizes the distribution of these conditions among the three TUI-BN subgroups. Medical comorbidities among patients with DU included diabetes mellitus, coronary artery disease, chronic kidney disease, and chronic obstructive pulmonary disease. Patients with DA had a history of radical hysterectomy or peripheral neuropathy (PN), whereas those with NLUTD had cerebrovascular disease, Parkinson’s disease (PD), dementia, and intracranial lesions. A total of 26 women had previously undergone enterocystoplasty (AE) for contracted bladders.

Table 1
Demographic characteristics of patients with different TUI-BN subgroups

Patient number	BND + DU	BND + DA	BND+NLUTD	P value
	78	75	61	
Age	65.5 ± 15.1	66.3 ± 15.4	71.8 ± 13.4	0.032
CVA, Dementia, PD, ICL	0	0	46(75.4%)	0.000
Radical hysterectomy	21(27.6%)	41(54.7%)	19(31.1%)	0.001
Peripheral neuropathy	7(9.2%)	11(14.7%)	7(11.5%)	0.580
Chronic medical diseases	50(65.8%)	47(62.7%)	42(68.9%)	0.751
Previous bladder AE	11(14.5%)	14(18.7%)	1(1.6%)	0.000
Psychogenic, idiopathic	32(42.1%)	16(21.3%)	2(4.0%)	0.000
BND: bladder neck dysfunction, DU: detrusor underactivity, DA: detrusor acontractile, NLUTD: neurogenic lower urinary tract dysfunction, CVA: cerebrovascular accident, PD: Parkinson’s disease, ICL: intracranial lesions, AE: augmentation enterocystoplasty				

Table 2
Treatment outcomes of TUI-BN in patients with different TUI-BN subgroups

CVA, Dementia, PD, ICL	Total	GRA ≥ 2	GRA < 2	P value
	46	29 (63.0%)	17 (37.0%)	0.012
Radical hysterectomy	81	69 (85.2%)	12 (24.5%)	0.024
Peripheral neuropathy	25	17 (68.0%)	8 (32.0%)	0.262
Chronic medical diseases	139	99 (71.2%)	40 (28.8%)	0.007
Previous bladder AE	26	19 (73.1%)	7 (14.3%)	0.623
Psychogenic, idiopathic	50	39 (78.0%)	11 (22.4%)	0.831
GRA: global response assessment, CVA: cerebrovascular accident, PD: Parkinson's disease, ICL: intracranial lesions, AE: augmentation enterocystoplasty				

The rate of previous radical hysterectomy was significantly higher in the BND + DA group (41/75, 54.7%) than in the BND + DU (21/76, 27.6%) and BND+NLUTD (19/61, 23.5%) groups ($p = 0.001$). cerebrovascular disease, PD, and dementia accounted for 75.4% (46/61) of patients with BND+NLUTD. The prevalence of PN was similar among the three subgroups ($p = 0.580$). Psychogenic or idiopathic voiding dysfunction was significantly more common in the BND + DU group (32/76, 42.1%) than in the BND + DA (16/75, 21.3%) and BND+NLUTD (2/61, 4.0%) groups ($p = 0.000$). Previous AE was significantly more common in the BND + DA (14/75, 18.7%) and BND + DU (11/76, 14.5%) groups than in the NLUTD group (1/61, 1.6%) ($p = 0.000$). The prevalence of medical comorbidities was similar among the three groups ($p = 0.751$).

Among the three BND subgroups, patients with BND + DA had the highest success rate ($n = 63$, 84.0%), followed by those with BND + DU ($n = 59$, 77.6%) and BND+NLUTD ($n = 41$, 67.2%) (**$p = 0.068$**). The treatment success rate was significantly higher among patients with a history of radical hysterectomy (69/81, 85.2%) than those without a history of radical hysterectomy (94/131, 57.7%) ($p = 0.024$). Patients with BND+NLUTD had a lower success rate (29/46, 63.0%) than those without NLUTD (134/166, 82.2%) ($p = 0.012$). Patients with medical comorbidities also had a significantly lower success rate (99/139, 71.2%) than those without comorbidities (64/73, 87.7%) ($p = 0.007$).

Univariate analysis identified PVR ($p = 0.002$), previous radical hysterectomy ($p = 0.026$), NLUTD ($p = 0.013$), and chronic medical comorbidities ($p = 0.009$) are predictive factors for treatment failure. Multivariate analysis showed that PVR ($p = 0.004$), NLUTD ($p = 0.029$), and chronic medical comorbidities ($p = 0.027$) were independent predictors of treatment failure after TUI-BN (Table 3).

Table 3

Logistic regression of videourodynamic parameters to predict treatment failure after TUI-BN in female bladder neck dysfunction.

Variable at baseline	Univariable		Multivariable	
	Odds ratio (95% CI)	p -value	Odds ratio (95% CI)	p -value
Age (years)	1.009 (0.987–1.031)	0.444	-	-
FSF (ml)	1.001 (0.998–1.004)	0.618	-	-
FS (ml)	1.000 (0.998–1.003)	0.859	-	-
US (ml)	1.001 (0.998–1.003)	0.554	-	-
Compliance	0.999 (0.995–1.003)	0.675	-	-
Pves (cmH ₂ O)	1.002 (0.994–1.010)	0.680	-	-
Pdet (cmH ₂ O)	1.006 (0.980–1.033)	0.642	-	-
Qmax (ml/s)	0.965 (0.898–1.037)	0.335	-	-
PVR (ml)	1.003 (1.001–1.004)	0.002*	1.003 (1.001–1.004)	0.004*
VUDS findings				
BND + DU	Ref.	0.073	-	-
BND + DA	0.661 (0.291–1.501)			
BND+NLUTD	1.693 (0.792–3.618)			
Radical hysterectomy	0.442 (0.215–0.909)	0.026*	0.486 (0.228–1.038)	0.062
Peripheral neuropathy	1.676 (0.675–4.159)	0.266	-	-
FSF: first sensation of filling, FS: full sensation, US: urge sensation, Pves: intravesical pressure, Pdet: detrusor pressure, Qmax: maximum flow rate, PVR: post-void residual, VUDS: videourodynamic study, BND: bladder neck dysfunction, DU: detrusor underactivity, DA: detrusor acontractile, NLUTD: neurogenic lower urinary tract dysfunction, CNS: central nervous system, AE: augmentation enterocystoplasty				

Variable at baseline	Univariable		Multivariable	
	Odds ratio (95% CI)	<i>p</i> -value	Odds ratio (95% CI)	<i>p</i> -value
CNS_NLUTD	2.455 (1.204–5.004)	0.013*	2.347 (1.092–5.048)	0.029*
Idiopathic/psychogenic	0.920 (0.430–1.971)	0.831	-	-
Bladder AE	1.263 (0.497–3.209)	0.623	-	-
Chronic medical diseases	2.873 (1.306–6.321)	0.009*	2.517 (1.113–5.693)	0.027*
FSF: first sensation of filling, FS: full sensation, US: urge sensation, Pves: intravesical pressure, Pdet: detrusor pressure, Qmax: maximum flow rate, PVR: post-void residual, VUDS: videourodynamic study, BND: bladder neck dysfunction, DU: detrusor underactivity, DA: detrusor acontractile, NLUTD: neurogenic lower urinary tract dysfunction, CNS: central nervous system, AE: augmentation enterocystoplasty				

Baseline and posttreatment urodynamic parameters are presented in Table 4. All three subgroups showed significant improvements in Qmax, VE, and BCI after TUI-BN. CBC, PVR, and BOOI also decreased significantly after treatment. However, Pdet significantly increased only in patients with BND + DA, from 0 to 5.2 ± 12.8 cmH₂O.

Table 4

Urodynamic parameters at baseline and after treatment, as well as changes in parameters among patient groups with underactive bladder

Urodynamic parameters		BND + DU (n = 76)	BND + DA (n = 75)	BND+NLUTD (n = 61)	p-value
FSF (ml)	Baseline	180.5 ± 95.1	192.9 ± 98.0	172.0 ± 104.2	0.262
	Follow up	152.7 ± 83.6	178.0 ± 72.8	184.0 ± 99.5	
	Δ change	-27.8 ± 111.3	-14.9 ± 104.4	12.0 ± 97.3	
FS (ml)	Baseline	268.6 ± 109.6	310.1 ± 122.0	270.5 ± 146.5	0.590
	Follow up	252.1 ± 115.6	293.3 ± 105.1	282.9 ± 129.5	
	Δ change	-16.6 ± 133.5	-16.8 ± 127.2	12.4 ± 150.4	
US (ml)	Baseline	307.7 ± 112.9	368.3 ± 126.7	305.4 ± 156.0	0.298
	Follow up	300.2 ± 127.2	327.7 ± 113.6	315.7 ± 137.8	
	Δ change	-7.6 ± 139.0	-40.6 ± 132.7	10.2 ± 161.1	
Compliance	Baseline	55.6 ± 47.2	81.5 ± 84.9	65.5 ± 100.3	0.110
	Follow up	70.5 ± 70.2	67.5 ± 75.4	97.2 ± 118.8	
	Δ change	14.9 ± 85.6	-14.1 ± 93.2	31.7 ± 108.0	
Pves (cmH2O)	Baseline	36.7 ± 21.4	78.2 ± 43.0	48.9 ± 50.3	0.033*
	Follow up	49.8 ± 28.3	68.5 ± 34.3	45.0 ± 39.8	
	Δ change	13.1 ± 29.0*	-9.7 ± 45.3	-3.9 ± 55.0	
Pdet (cmH2O)	Baseline	12.7 ± 7.4	0.0 ± 0.0	13.5 ± 14.3	0.252
	Follow up	14.0 ± 19.2	4.9 ± 12.8	11.6 ± 14.3	
	Δ change	1.3 ± 20.6	4.9 ± 12.8*	-2.0 ± 18.1	
Qmax (ml/s)	Baseline	4.6 ± 5.3	2.2 ± 3.3	4.0 ± 6.1	0.293
	Follow up	10.4 ± 8.4	10.3 ± 8.2	10.0 ± 11.5	
	Δ change	5.7 ± 8.6*	8.1 ± 8.6*	6.0 ± 10.6*	

FSF: first sensation of filling, FS: full sensation, US: urge sensation, Pves: intravesical pressure, Pdet: detrusor pressure, Qmax: maximum flow rate, PVR: post-void residual, CBC: cystometric bladder capacity, VE: voiding efficiency, BOOI: bladder outlet obstruction index, BCI: bladder contractility index

Urodynamic parameters		BND + DU (n = 76)	BND + DA (n = 75)	BND+NLUTD (n = 61)	p-value
PVR (ml)	Baseline	296.1 ± 161.0	408.3 ± 189.3	344.3 ± 237.2	0.001*
	Follow up	135.7 ± 159.1	121.7 ± 157.1	192.9 ± 219.6	
	Δ change	-160.4 ± 188.5*	-286.7 ± 227.3*	-151.4 ± 261.3*	
CBC (ml)	Baseline	389.1 ± 144.2	460.3 ± 185.9	438.4 ± 221.2	0.077
	Follow up	313.8 ± 154.4	306.2 ± 180.7	363.2 ± 192.7	
	Δ change	-75.3 ± 190.0*	-154.1 ± 216.3*	-75.2 ± 269.5	
VE	Baseline	0.28 ± 0.30	0.13 ± 0.23	0.17 ± 0.24	0.009*
	Follow up	0.61 ± 0.34	0.65 ± 0.32	0.52 ± 0.40	
	Δ change	0.34 ± 0.37*	0.52 ± 0.35*	0.35 ± 0.39*	
BOOI	Baseline	3.9 ± 12.1	-4.0 ± 6.1	6.6 ± 17.8	0.492
	Follow up	-1.7 ± 20.7	-14.8 ± 20.3	-1.6 ± 21.7	
	Δ change	-5.6 ± 20.2	-10.8 ± 20.3*	-8.2 ± 21.6*	
BCI	Baseline	34.6 ± 29.6	10.0 ± 15.2	30.9 ± 34.4	0.003*
	Follow up	53.1 ± 40.1	54.6 ± 36.4	44.5 ± 49.6	
	Δ change	18.5 ± 43.4*	44.6 ± 36.7*	13.5 ± 48.4	
FSF: first sensation of filling, FS: full sensation, US: urge sensation, Pves: intravesical pressure, Pdet: detrusor pressure, Qmax: maximum flow rate, PVR: post-void residual, CBC: cystometric bladder capacity, VE: voiding efficiency, BOOI: bladder outlet obstruction index, BCI: bladder contractility index					

Thirty-three patients had an elevated Pdet after TUI-BN, including 5 (6.2%) with BND + DU, 21 (27.3%) with BND + DA, and 7 (12.7%) with BND+NLUTD. Patients with BND + DA showed a significant increase in Pdet after TUI-BN, whereas no significant change was observed in the other two subgroups. Among patients with an increased Pdet after TUI-BN, dysfunctional voiding with high Pdet developed in 5 patients (Fig. 2).

Table 5 presents the urodynamic parameters at baseline and after TUI-BN, as well as changes in these parameters according to treatment outcome. Patients with successful treatment outcomes had significantly increased Qmax, VE, and BCI and significantly decreased PVR and BOOI after TUI-BN. Interestingly, CBC decreased in both the successful and unsuccessful treatment groups. All subgroups

showed improvements in Qmax, CBC, PVR, VE, BOOI, and BCI after TUI-BN. Patients with a GRA < 2 also showed improvements in Qmax, PVR, and VE, although the degree of improvement was smaller.

Adverse events, including stress urinary incontinence (SUI), urgency urinary incontinence (UUI), vesicovaginal fistula, persistent dysuria, and urinary retention, are summarized in Table 6. Overall, 97 (46%) patients experienced difficult urination, 26 (12.2%) developed SUI, 19 (8.9%) developed UUI, 22 (10.3%) had persistent urinary retention, and 4 (1.9%) developed a vesicovaginal fistula during TUI-BN. The vesicovaginal fistulas were primarily repaired immediately after TUI-BN. Except for urinary retention, which required continued CIC, SUI and UUI were generally mild and were appropriately managed with medications. The rates of SUI (26/212, 12.3%), UUI (19/212, 9.0%), and urinary retention (22/212, 10.4%) were similar among the three groups. However, dysuria was significantly less common in patients with BND+NLUTD (18/61, 29.5%) than in those with BND + DU (40/76, 52.6%) or BND + DA (39/75, 50.0%) ($p = 0.010$).

Table 6
Adverse events associated with TUI-BN in patients with different subgroups.

Patient number	N=	BND + DU	BND + DA	CNS_NLUTD	P value
		76	75	61	
Dysuria	97	40 (52.6%)	39 (52.0%)	18 (29.5%)	0.010
Stress urinary incontinence	26	8 (10.5%)	10 (13.3%)	8 (13.1%)	0.846
Urgency urinary incontinence	19	4 (5.3%)	7 (9.3%)	8 (13.1%)	0.276
Persistent urine retention	22	3 (3.9%)	9 (12.0%)	10 (16.4%)	0.051
Vesicovaginal fistula	4	1 (1.3%)	2 (2.7%)	1 (1.6%)	0.994

Discussion

The results of this study demonstrated that TUI-BN is an efficient surgical treatment for improving voiding efficiency in women with voiding dysfunction and VUDS-proven BND. Overall, 163 (76.9%) women achieved a successful treatment outcome after TUI-BN. Among the BND subgroups, patients with BND + DA (84.4%) or BND + DU (77.6%) had higher success rates than those with BND+NLUTD (67.2%).

BND is a urodynamic diagnosis characterized by failure of the bladder neck to open during voiding on VUDS [11]. Bladder neck opening may occur through active relaxation during normal reflex voiding, passive relaxation in response to increased abdominal and intravesical pressure, or persistent incompetence during both the storage and voiding phases [11]. Patients with a tight bladder neck during voiding may have intact detrusor contractility with bladder neck discoordination, DU with inadequate bladder neck opening, a DA without bladder neck opening, or failure of bladder neck relaxation caused by

inhibitory activity of the pelvic floor muscles and urethral sphincter in patients with psychogenic inhibition or other idiopathic conditions [11, 12]. All of these lower urinary tract dysfunctions can result in female voiding dysfunction with a nonopening bladder neck.

Women with intact detrusor contractility and BND typically have a high Pdet, low Qmax, and low VE because of BOO [13]. TUI-BN is a standard procedure for reducing bladder neck obstruction and restoring normal voiding [14]. However, not all patients with BND + DU, BND + DA, or BND+NLUTD achieve successful outcomes after TUI-BN [15]. Furthermore, because there is no clear anatomical landmark distinguishing the bladder neck from the external urethral sphincter in women, urologists are often concerned about adverse events, particularly SUI, UUI, or persistent urinary retention. Consequently, TUI-BN is not routinely recommended in clinical guidelines for female voiding dysfunction in the absence of VUDS-proven significant BOO [3]. Our results demonstrated that TUI-BN can safely and effectively restore spontaneous voiding without catheterization, with acceptable and manageable adverse events.

TUI-BN itself is technically straightforward. However, accurate diagnosis of BND in women with voiding dysfunction requires VUDS to demonstrate a nonfunneling bladder neck during the voiding phase, either during detrusor contraction or abdominal straining [15]. Without VUDS evidence of BND, TUI-BN is unlikely to be effective if the bladder neck is not functionally obstructed during voiding. Once adequate bladder neck opening is achieved, bladder outlet resistance decreases, allowing patients with DU or DA to generate sufficient abdominal pressure to achieve higher Qmax and VE and lower PVR after TUI-BN [7–9]. However, in patients who cannot perceive bladder fullness or generate adequate abdominal pressure for voiding, improvement in VE may be limited because the increase in intravesical pressure is insufficient. Therefore, bladder fullness sensation and the ability to generate abdominal pressure during baseline urodynamic testing should be carefully assessed when selecting candidates for TUI-BN [16]. In the present study, patients with BND+NLUTD had lower Pves than those in the other two subgroups, whereas Pves was highest in patients with BND + DA. These findings further suggest that a higher baseline Pves may predict a better treatment response to TUI-BN in patients with DU or DA.

DU may result from detrusor muscle dysfunction, chronic bladder ischemia, or systemic diseases that cause mitochondrial dysfunction [2]. Previous biomarker studies have demonstrated elevated urinary levels of inflammatory proteins and oxidative stress biomarkers in patients with DU [17–19]. DU may also result from inhibitory effects of an incompletely relaxed urethral sphincter or sympathetic hyperactivity [20]. After TUI-BN, interruption of the sympathetic reflex arc may reduce this inhibitory effect on the detrusor nucleus. An increase in Pdet after TUI-BN was observed in a subset of patients with DU or DA, further supporting a potential role of autonomic dysfunction in voiding dysfunction associated with DU and DA [7].

Most patients with DA in this study had peripheral neuropathy associated with previous spine surgery or radical hysterectomy and pelvic plexus injury. Although these patients had diminished bladder sensation, they were younger and generated greater abdominal pressure than patients in the BND + DU and BND+NLUTD subgroups. After TUI-BN, reduced bladder neck resistance allowed these patients to void

using lower abdominal pressure through a widely opened bladder neck. The high success rate among patients with BND + DA suggests that TUI-BN may be a reasonable treatment option for women with DU associated with peripheral neuropathy.

Bladder sensation has been associated with treatment outcomes in patients with DU or DA. Previous studies have shown that patients with absent bladder sensation and no detrusor contractility have less favorable outcomes after medical or surgical treatment for DU or DA [16]. Effective use of abdominal pressure requires intact bladder fullness sensation so that patients can recognize the need to empty their bladder and initiate abdominal straining appropriately. In most cases, TUI-BN reduces bladder outlet resistance but does not restore detrusor contractility in patients with detrusor denervation or acontractility. Therefore, patients who cannot perceive bladder filling or fullness may be unable to achieve efficient micturition through abdominal straining alone.

Although TUI-BN has been shown to improve VE and decrease PVR, some patients may not achieve successful voiding after a single procedure. Patients with BND may also have a discoordinated urethral sphincter that continues to impair voiding after TUI-BN [21]. Furthermore, bladder neck contracture at the incision sites may develop over time in some patients. Additional procedures, such as urethral sphincter injection of botulinum toxin or repeat TUI-BN, may therefore be necessary to improve treatment outcomes [10]. Previous studies have shown that additional procedures can increase the overall success rate to 74.6% in women with BND + DU. During follow-up, adjunctive procedures, including urethral botulinum toxin injection, may therefore be considered in conjunction with TUI-BN to achieve a more favorable outcome.

Adverse events such as SUI and UUI can be bothersome after TUI-BN. Although the occurrence of SUI or UUI may reduce overall satisfaction with TUI-BN, most patients still value the ability to void spontaneously without a catheter or CIC. SUI can be treated with a suburethral sling, platelet-rich plasma injection, or Bulkamid injection. UUI can be managed with timed voiding, antimuscarinic medications, or detrusor injection of botulinum toxin.

This study has several limitations. First, its retrospective design introduces the potential for selection and information bias. Second, the study included patients with BND + DU, BND + DA, and BND+NLUTD, who represented a heterogeneous population with different underlying systemic diseases and bladder dysfunctions. Third, post-TUI-BN voiding status was assessed through chart review rather than direct patient interviews. We also did not use voiding diaries or validated questionnaires to quantify bothersome voiding symptoms after TUI-BN. Therefore, bias may have been present in the assessment of treatment outcomes, particularly because success was primarily graded according to VE. Nevertheless, we stratified patients with BND and low detrusor contractility into DU, DA, and NLUTD subgroups and evaluated their treatment outcomes separately. These findings provide a clinical reference for the use of this minimally invasive surgical procedure in women with voiding dysfunction.

Conclusion

TUI-BN is an effective surgical procedure for improving voiding efficiency in women with VUDS-proven BND + DU or BND + DA. Among the BND subgroups, patients with BND + DA or BND + DU had higher treatment success rates than those with BND+NLUTD. A high PVR, CNS-associated NLUTD, and chronic medical comorbidities may predict less favorable treatment outcomes.

Declarations

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Author contributions:

Data acquisition: Jia-Fong Jhang, Yuan-Hong Jiang, Wan-Ru Yu, Hann-Chorng Kuo; Manuscript writing: Yuan-Hong Jiang, Jia-Fong Jhang, Wan-Ru Yu, Hann-Chorng Kuo; Review: Hann-Chorng Kuo

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Table 5

Table 5 is available in the Supplementary Files section.

Figures

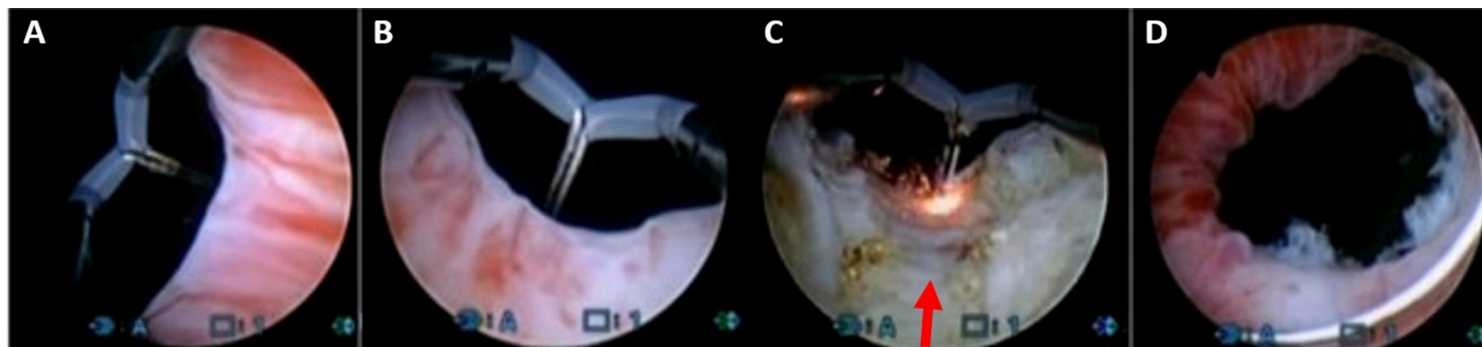


Figure 1

Transurethral incision of the bladder neck. (A) incision at the 5-o'clock position of the bladder neck. (B) Incision at the 5-o'clock position of the bladder neck. (C) The bladder neck incision is deepened to the serosa level (arrow) to ensure complete disruption of the smooth muscle. (D) The bladder neck is widely open after transurethral incision of bladder neck.

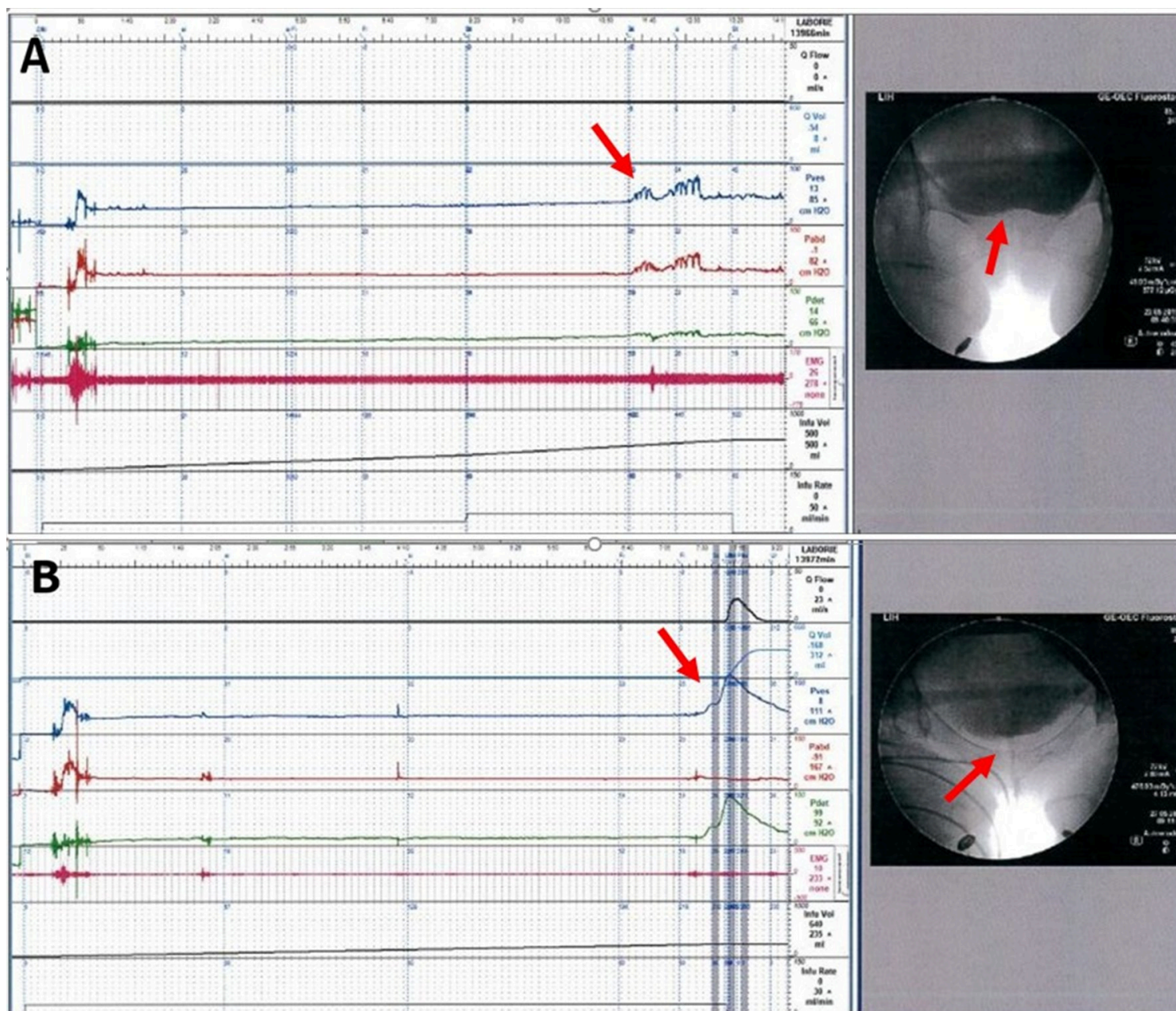


Figure 2

Changes in detrusor contractility after transurethral incision of the bladder neck (TUI-BN). (A) Baseline detrusor underactivity (arrow) with a tight bladder neck (arrow). (B) Detrusor overactivity and dysfunctional voiding with high detrusor pressure during voiding (arrow) after TUI-BN.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [Table5.docx](#)