The Role of Anterior Bladder Flap Neourethra (ABFN) in Early Urinary Continence after Laparoscopic Radical Prostatectomy The Anterior Bladder Flap Neourethra (ABFN) in RP

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Abstract

Purpose

To evaluate the impact of anterior bladder flap neourethra (ABFN) technique on early urinary continence after laparoscopic radical prostatectomy(RP).

Materials and Methods

Forty patients who underwent laparoscopic RP January 2019 to January 2021 were prospectively randomized into two groups: the ABFN group (n = 20) and the control group (n = 20). We compared continence rates and ICIQ-SF at 1d, 30 d, 90 d and 180 d after catheter removal. In addition, the urethral pressure of two groups, the length and thickness of neourethra in the ABFN group were measured at one week after catheter removal.

Results

The ABFN group had marked improvement incontinence rates at 1d, 30d and 90d after catheter removal vs the control group, while had the nearly same continence rate at 180 d. ICIQ-SF scores of the ABFN group were lower than the control group. Maximal urethral pressure (MUP), functional urethral length (FUL) and functional urethral area (UFA) for the ABFN group has significantly improvement than the control group. MRI showed that the neourethral length of the ABFN group was 13.7–16.2 mm, the thickness was 3.6–5.2 mm.

Conclusions

The ABFN technique markedly improved the early continence rate after laparoscopic RP.

Background

Early incontinence rates are as high as 26–93% in the first Mon and 19–85% in the third Mon after the standard radical prostatectomy (RP), dramatically impacting the patient's quality of life^{1–4}. Multiple surgical techniques aimed to improve post-RP early continence rate, for instance, methods with preservation of membranous urethra^{5,6}, bladder neck⁷, Retzius space⁸, puboprostatic ligaments⁹, endopelvic fascia¹⁰, apical complex and lateral prostatic fascia¹¹, and also techniques with the reconstruction of posterior reconstruction of rhabdomyosphincter¹², periurethral suspension stitch¹³, anterior reconstruction¹⁴, anterior suspension and posterior reconstruction², total anatomical reconstruction¹⁵. Although many patients had benefited from the above techniques, the effect is still uncertain and unreproducible¹⁶. For example, continence rates one month after RP with posterior

reconstruction technique were 8.2%-82.6%¹⁶⁻¹⁹. In addition, some methods had a risk of positive surgical margin (PSM)^{20,21}.

This study presented an improved surgical technique, anterior bladder flap neourethra (ABFN), to form a functional neourethra to achieve high continence rates in the early post-RP period.

Materials And Methods

Study Population and Design

We prospectively analyzed 40 patients (average age 73.1 ±3.2 years) with localized prostate cancer from January 2019 to January 2021 and randomly divided them into two groups. Twenty patients in the control group underwent standard laparoscopic RP, and the other 20 patients underwent laparoscopic RP with ABFN. Age, BMI, PSA, prostate volume, IPSS score, biopsy Gleason score, clinical T stage, risk assessment CAPRA score, previous benign prostatic hyperplasia (BPH) surgery and neoadjuvant hormone therapy were recorded and compared (Table 1). Lung CT, abdominal ultrasound, pelvic MRI, and bone scan were conducted in all patients to exclude tumour metastasis. All patients were informed of the detailed surgical plan and possible risks before surgery and signed the informed consent. All methods were carried out in accordance with relevant guidelines and regulations. This study protocol was approved by the Research Ethics Committee of Jiangsu Taizhou People's Hospital.

Surgical Technique

All operations were performed by a team in transperitoneal access with five trocars distributed as a fan.

The control group: After standard laparoscopic prostatectomy, bladder outlet and urethra were directly anastomosed. The wide bladder outlet was narrowed by suturing the posterior wall longitudinally before anastomose.

The ABFN group: After standard laparoscopic prostatectomy, the bladder outlet was trimmed into a wide circle (Fig. 1A). An area approximately 15 mm wide was selected from the anterior bladder neck between 5 and 7 o'clock. A longitudinal incision of about 15 mm was made vertically on both sides to form a lingual bladder flap (Fig. 1B). The bladder outlet was closed using 3-0 barbed sutures in a continuous longitudinal pattern from 12 o'clock to the base of the lingual bladder flap (Fig. 1C). Longitudinal sutures were applied to both margins of the bladder flap, and a tubular neourethra was formed approximately 15 mm in length (Fig. 1C). The suture was inserted at a distance of 3 mm from the incision margin and was discharged from the mucosal edge of the bladder so that the mucosa and muscle layer of the bladder were tightly aligned. Neourethra was then anastomosed to the distal urethra (Fig. 1D). The detailed surgical method can refer to the supplementary video.

Follow Up

Concerning early urinary continence, follow up was at 1d, 30 d, 90 d, 180 d after catheter removal in the outpatient department. Postoperative urinary control data were collected for all patients by January 2021. The patients were given the ICIQ-SF questionnaire. We defined Urinary continence as no pad or one safety pad. One week after catheter removal, we detected MUP, FUL and UFA of patients in the two groups, respectively. We performed an MRI examination to measure the distance, thickness and closure condition of the neourethra.

Statistical Analysis

Categorical variables were presented as percentages, while continuous variables were presented as mean and standard deviation or median and interquartile range. SPSS 25.0 software was used to perform independent samples χ^2 test, t -test, or Wilcoxon rank-sum test of the data. The difference was statistically significant when a p -value is <0.05 .

Results

Patient and Tumor Characteristics

There were no significant differences in age, BMI, PSA, prostate volume, IPSS score, biopsy Gleason score, clinical T stage, risk assessment CAPRA score, previous BPH surgery and neoadjuvant hormone therapy between the two groups, respectively (Table 1).

Perioperative and Pathological Outcomes

Operative times ($p=0.191$) and estimated blood loss ($p=0.964$) were similar in the control and ABFN groups. There were no anastomotic urine leakage and anastomotic stricture in the two groups. Pathological characteristics in terms of stage, Gleason score, PSM rates were similar between the two groups. PSM rates were 15.00% in both groups ($p=1.000$) (Table 2).

Continence Date

The ABFN group had marked improvement in continence rates at 1d, 30 d and 90 d after catheter removal vs the control group (100% vs 5%, 100% vs 10%, $p=0.001$ and 100% vs 60%, $p=0.006$), while had the nearly same continence rate at 180 d (100% vs 95%, $p=1.000$). The urinary continence rates of the ABFN group were 100% at different time spots (Table 3). Only two patients used a safety pad per day in 1-2 weeks after catheter removal. ICIQ-SF scores of the ABFN group were lower than the control group at 1d (20.00 vs 0.00 $p=0.001$), 30 d (15.50 vs 0.00 $p=0.001$), 90 d (8.00 vs 0.00 $p=0.001$) and 180 d (0.00 vs 0.00 $p=0.038$) after catheter removal respectively (Table 4).

Urethral Manometry Data

At one week after catheter removal, MUP, FUL and UFA of the control group vs the ABFN group were 45.18 ± 9.25 cmH₂O vs 61.56 ± 20.31 cmH₂O ($p=0.008$), 32.06 ± 5.06 mm vs 50.81 ± 5.48 mm ($p=0.001$)

and 301.00 ± 97.27 mm $\times$ cmH₂O vs 684.44 ± 202.73 mm $\times$ cmH₂O ($p=0.001$) respectively (Table 5). FUL in the ABFN group showed dual peak patterns, while the control group showed a single peak in urethral membrane pressure (Fig. 2A, 2B).

MRI of ABFN

The length and thickness of the neourethra were measured in the sagittal plane of the urethra MRI as 13.7-16.2 mm and 3.6-5.2 mm. The neourethra was narrow and long, with no urine filling (Fig. 3A, 3B), and the neourethral lumen in the cross-sectional plane was petal-shaped and tightly closed (Fig. 3C).

Other

One patient in the ABFN group had difficulty urinating one day after removing the urethral catheter, which was relieved one week after retaining the urethral catheter. One patient in the control group had difficulty urinating two weeks after removing the urethral catheter and failed to place catheter. Urethroscopy revealed vesicourethral anastomotic stricture, which was relieved by giving two weekly dilations. All other patients in both groups voided freely and had no residual urine.

Discussion

The mechanism of incontinence in the early post-RP period (within three months) is still unclear¹⁶. Still, many researchers have recognized the critical role of FUL in urinary continence¹⁶, and preserving bladder neck and apex urethra can maintain FUL and improve continence in the early post-RP period^{5,7,21}. However, the prostate protruded at the apex. The bladder neck often squeezes the urethra and bladder neck and resulted in the inability to preserve these tissues with sufficient thickness and length. Meanwhile, maintaining the apex urethra and bladder neck has a risk of PSM at both ends of the prostate^{20,21}.

More researchers also have recently recognized the function of FUL in RP is a significant cause of postoperative incontinence^{5,7,22}. From the aspect of urodynamics, higher intraurethral pressure than intravesical pressure is essential, and FUL is the determining factor for urinary continence. According to the laws of fluid dynamics, urethral resistance and FUL are directly proportional to each other. Therefore, when FUL becomes shorter, it will reduce the ability of the urethra in continence. In addition, the urethra is an elastic tubular tissue that closes under abdominal pressure. When FUL is significantly shortened, the abdominal pressure on the urethra decreases, which reduces the ability of the urethra in continence.

ABFN forms a neourethra with specific length and thickness, which theoretically can increase FUL and improve urinary continence in the early postoperative period. However, ABFN conducted by Steiner in 1993 with a continence rate of only 55% in the third-month post-RP has no significant advantage over other current techniques²³. Steiner found by cystography that the funnel-shaped bladder neck was filled with contrast medium in the early postoperative period. According to the laws of fluid dynamics, urethral resistance is inversely proportional to the urethral diameter. Therefore, we believe that Steiner cut the

bladder outlet at 10 and 2 o'clock. As a result, the anterior bladder flap was too broad, resulting in a neourethra with an apparent funnel shape, which could not form a well-closed functional urethra. Unfortunately, since Steiner did not perform a functional analysis, such as urethral manometry, it was not possible to understand the functional status of the neourethra. In addition, since the surgery approach has been proved to be one of the factors affecting urinary continence²⁴, the open surgery performed by Steiner may be one of the possible reasons for the low urinary continence rate.

Based on Steiner's work, we made a vertical incision in the anterior bladder wall at 5 and 7 o'clock of the bladder outlet and took a bladder flap about 15 mm wide and 15 mm long for curling and suturing to form a narrow, tubular neourethra. MRI showed narrow and long neourethras with sufficient thickness and good static closure shape. The functional urodynamic test revealed that the pressure of the neourethra formed the first peak of the pressure curve (Fig. 2B). The increased MUP and FUL significantly improved UFA in the ABFN group. As a result of the fact that ABFN had reconstructed FUL in morphology and function, all of the patients in the ABFN group achieved immediate urinary continence from the catheter removal.

ABFN does not require preservation of the structures and tissues surrounding the urethra and prostate, nor does it require deliberate protection of bladder neck or maximal urethra length. Thus, it avoids the PSM risk and the difficulty of the above preservation techniques and can be applied in all organ-confined prostate cancer cases. Furthermore, because the operation of the ABFN technique is simple and the diameter and length of the ABFN are relatively constant, ABFN does not increase the operation time and blood loss, which can be completed by any doctor who masters the standard laparoscopic technique. In addition, since ABFN is made of the bladder wall, its blood supply is abundant, and its edges heal well, avoiding neourethral luminal strictures and urinary fistulas.

Despite the prospective randomized study design, the limitations of this study included the small sample size, the lack of comparisons with other techniques, and the single-center setting.

Conclusions

In summary, ABFN showed a significantly better early continence rate than standard RP, an effective, safe and reproducible technique to improve the early continence rate. More definitive results would require further clinical studies with large numbers of cases.

Declarations

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Data availability: Not applicable.

Author's contributions:

All authors whose names appear on the submission have contributed sufficiently to the scientific work and therefore share collective responsibility and accountability for the results. Jiangping Wang: Project development, data collection, data analysis, manuscript writing/editing. Zhibin Xu: Data collection, data analysis, manuscript writing. Maomao Guo: Data collection, data analysis, manuscript writing. Hao Bian: Data collection, manuscript writing. Zhenchi Li: Data collection, data analysis. Chen Wang: Data collection, data analysis. Zengxu Hong: Data collection, data analysis.

References

1. Ficarra, V. *et al.* Systematic review and meta-analysis of studies reporting urinary continence recovery after robot-assisted radical prostatectomy. *Eur Urol*, **62**, 405–417 (2012).
2. Hurtes, X. *et al.* Anterior suspension combined with posterior reconstruction during robot-assisted laparoscopic prostatectomy improves early return of urinary continence: a prospective randomized multicentre trial. *BJU Int*, **110**, 875–883 (2012).
3. Menon, M., Muhletaler, F., Campos, M. & Peabody, J. O. Assessment of early continence after reconstruction of the periprostatic tissues in patients undergoing computer assisted (robotic) prostatectomy: results of a 2 group parallel randomized controlled trial. *J Urol*, **180**, 1018–1023 (2008).
4. Sutherland, D. E. *et al.* Posterior rhabdosphincter reconstruction during robotic assisted radical prostatectomy: results from a phase II randomized clinical trial. *J Urol*, **185**, 1262–1267 (2011).
5. Hamada, A., Razdan, S., Etafy, M. H., Fagin, R. & Razdan, S. Early return of continence in patients undergoing robot-assisted laparoscopic prostatectomy using modified maximal urethral length preservation technique. *J Endourol*, **28**, 930–938 (2014).
6. Choi, S. Y. *et al.* Does intraoperative frozen section really predict significant positive surgical margins after robot-assisted laparoscopic prostatectomy? A retrospective study. *Asian J Androl*, **23**, 74–79 (2021).
7. Nyarangi-Dix, J. N., Radtke, J. P., Hadaschik, B., Pahernik, S. & Hohenfellner, M. Impact of complete bladder neck preservation on urinary continence, quality of life and surgical margins after radical prostatectomy: a randomized, controlled, single blind trial. *J Urol*, **189**, 891–898 (2013).
8. Umari, P. *et al.* Retzius-Sparing versus Standard Robot-Assisted Radical Prostatectomy: A Comparative Prospective Study of Nearly 500 Patients. *J Urol*, **205**, 780–790 (2021).
9. Assem, A., Abou Youssif, T., Hamdy, S. M., Beltagy, A. M. & Gozen, A. S. Role of sparing of puboprostatic ligaments on continence recovery after radical prostatectomy: a randomized controlled trial. *Scand J Urol*, **55**, 22–26 (2021).
10. Siltari., A., Riikonen., J. & Murtola., T. J. Preservation of Endopelvic Fascia: Effects on Postoperative Incontinence and Sexual Function - A Randomized Clinical Trial. *J Sex Med*, **18**, 327–338 (2021).

11. Covas Moschovas, M. *et al.* Modified Apical Dissection and Lateral Prostatic Fascia Preservation Improves Early Postoperative Functional Recovery in Robotic-assisted Laparoscopic Radical Prostatectomy: Results from a Propensity Score-matched Analysis. *Eur Urol*, **78**, 875–884 (2020).
12. Jeong, C. W. *et al.* Effects of new 1-step posterior reconstruction method on recovery of continence after robot-assisted laparoscopic prostatectomy: results of a prospective, single-blind, parallel group, randomized, controlled trial. *J Urol*, **193**, 935–942 (2015).
13. Patel, V. R., Coelho, R. F., Palmer, K. J. & Rocco, B. Periurethral suspension stitch during robot-assisted laparoscopic radical prostatectomy: description of the technique and continence outcomes. *Eur Urol*, **56**, 472–478 (2009).
14. Han, K. S. & Kim, C. S. Effect of Pubovesical Complex Reconstruction During Robot-Assisted Laparoscopic Prostatectomy on the Recovery of Urinary Continence. *J Laparoendosc Adv Surg Tech A*, **25**, 814–820 (2015).
15. Porpiglia, F. *et al.* Total Anatomical Reconstruction During Robot-assisted Radical Prostatectomy: Implications on Early Recovery of Urinary Continence. *Eur Urol*, **69**, 485–495 (2016).
16. Vis, A. N. *et al.* Posterior, Anterior, and Periurethral Surgical Reconstruction of Urinary Continence Mechanisms in Robot-assisted Radical Prostatectomy: A Description and Video Compilation of Commonly Performed Surgical Techniques. *Eur Urol*, **76**, 814–822 (2019).
17. Salazar, A. *et al.* Early continence after radical prostatectomy: A systematic review. *Actas Urol Esp (Engl Ed)*, **43**, 526–535 (2019).
18. Beattie, K. *et al.* A novel method of bladder neck imbrication to improve early urinary continence following robotic-assisted radical prostatectomy. *J Robot Surg*, **7**, 193–199 (2013).
19. Wagner, J. R. & Editorial comment. Long-term functional urinary out outcomes comparing single-vs double layer urethrovesical anastomosis: two year follow-up of a two-group parallel randomized controlled trial. *Urology* **76**, 1107; author reply 1107–1108(2010).
20. Bellangino, M. *et al.* Systematic Review of Studies Reporting Positive Surgical Margins After Bladder Neck Sparing Radical Prostatectomy. *Curr Urol Rep*, **18**, 99 (2017).
21. Heo, J. E., Lee, J. S., Goh, H. J., Jang, W. S. & Choi, Y. D. Urethral realignment with maximal urethral length and bladder neck preservation in robot-assisted radical prostatectomy: Urinary continence recovery. *PLoS One*, **15**, e0227744 (2020).
22. Schlomm, T. *et al.* Full functional-length urethral sphincter preservation during radical prostatectomy. *Eur Urol*, **60**, 320–329 (2011).
23. Steiner, M. S. *et al.* Tubularized neourethra following radical retropubic prostatectomy. *J Urol*, **150**, 407–410 (1993).
24. Park, B. *et al.* Comparison of oncological and functional outcomes of pure versus robotic-assisted laparoscopic radical prostatectomy performed by a single surgeon. *Scand J Urol*, **47**, 10–18 (2013).

Tables

Table 1 Patient and tumor characteristics

	Control (n=20)	ABFN (n=20)	<i>p</i> value
Age, yr	73.35±2.91	72.75±3.45	0.555
BMI, kg/m ²	23.93±2.55	24.71±2.56	0.343
PSA, ng/ml	17.45±6.26	16.80±5.40	0.352
Prostate volume, cm ³	56.65±12.01	54.50–48.25, 58.75	0.745
IPSS score	7.89±1.63	7.66±1.69	0.664
Biopsy Gleason score, n (%)			0.829
6	2 (10.00)	1 (5.00)	
7 (4+3)	12 (60.00)	12 (60.00)	
7 (3+4)	4 (20.00)	6 (30.00)	
8-10	2 (10.00)	1 (5.00)	
Clinical T stage, n (%)			1.000
T1	5 (25.00)	4 (20.00)	
T2	12 (60.00)	13 (65.00)	
T3	3 (15.00)	3 (15.00)	
Risk assessment CAPRA score, n (%)			0.780
Low	2 (10.00)	1 (5.00)	
Intermediate	13 (65.00)	15 (75.00)	
High	5 (25.00)	4 (20.00)	
Previous BPH surgery, n (%)	2 (10.00)	3 (15.00)	1.000
Neoadjuvant hormone therapy, n (%)	4 (20.00)	4 (20.00)	1.000

Table 2 Perioperative and pathological outcomes

	Controln=20	ABFNn=20	p value
Operative time, mins	157.25±38.73	173.30±37.44	0.191
Estimated blood loss, ml	252.75±125.61	251.00±121.25	0.964
Anastomotic urine leakage, n (%)	0 (0.00)	0 (0.00)	1.000
Anastomotic stricture, n (%)	0 (0.00)	0 (0.00)	1.000
Positive surgical margin, n (%)	3(15.00)	3(15.00)	1.000
Pathological stage, n (%):			0.744
T2	13(65.00)	12(60.00)	
T3	7(35.00)	8(40.00)	
Pathological Gleason score, n (%):			1.000
6	2(10.00)	1 (5.00)	
7 (4+3)	10(50.00)	11(55.00)	
7 (3+4)	5(25.00)	4(20.00)	
8-10	3(15.00)	4(20.00)	

Table 3 Continence date at in different time spots

Days after catheter removal	Postoperative continencen (%)		p value
	Controln=20	ABFNn=20	
1	15.00	20100.00	0.001
30	210.00	20100.00	0.001
90	1260.00	20100.00	0.006
180	1995.00	20100.00	1.000

Table 4 ICIQ-SF scores

Days after catheter removal	. ICIQ-SF score		p value
	Controln=20	ABFNn=20	
1	20.00(15.00,21.00)	0.00(0.00,0.00)	0.001
30	15.50(8.00,20.00)	0.00(0.00,0.00)	0.001
90	8.00(0.00,15.00)	0.00(0.00,0.00)	0.001
180	0.00(0.00,0.00)	0.00(0.00,0.00)	0.038

Table 5 Urethral manometry data

	Control n=20	ABFNn=20	p value
MUP, cmH ₂ O	45.18±9.25	61.56±20.31	0.008
FUL, mm	32.06±5.06	50.81±5.48	0.001
UFA, mm×cmH ₂ O	301.00±97.27	684.44±202.73	0.001

Figures

Figure 1. ABFN schematic diagram. (A) Morphology of bladder neck after prostatectomy. (B) Cutting the anterior bladder wall flap (blue) and turn it up in the direction of the green arrow. (C) Suturing bladder neck and forming ABFN (blue). (D) ABFN (blue) is pulled in the direction of the green arrow and anastomosed with the urethral end.

Figure 1

See image above for figure legend.

A

B

Figure 2. Postoperative urethral pressure curve. (A) In the control group, the urethral pressure curve showed a single peak of membranous urethra. (B) In the ABFN group, the pressure curve showed two peaks of new urethra and membranous urethra.

Figure 2

See image above for figure legend.

Figure 3. ABFN MRI image. (A) ABFN sagittal T1 image showed that the neourethra is narrow and long (yellow brackets). (B) ABFN frontal T2 image showed that the lumen of the neourethra the neourethra is narrow and long, with no urine filling in the lumen (yellow arrow). (C) ABFN frontal T2 image shows that the lumen of the neourethra is petal-shaped, closed tightly, and with no urine filling in the lumen (yellow arrow).

Figure 3

See image above for figure legend.

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