Surgical modifications in bladder neck reconstruction and vesicourethral anastomosis during radical retropubic prostatectomy to reduce bladder neck contractures

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Purpose: *We describe surgical modifications in radical retropubic prostatectomy (RRP) which have significantly reduced the incidence of bladder neck contractures (BNC).*
Materials and methods: Between March 1994-July 2005, 977 men underwent a RRP by a single surgeon. Group I comprised 548 patients operated upon July 1994-December 1999, without the modifications described below. Group II comprised 429 men operated upon January 2000-December 2004, with the following surgical modifications: 1) reconstruction of the bladder neck (BN) to a diameter of 28 French; 2) placement of the posterior (6 o'clock) vesicourethral suture on mild traction before placing this suture into the bladder, allowing inspection and, if necessary, replacement of any of the previously placed sutures; 3) bladder displacement when tying the vesicourethral sutures which allows the sutures to be tied under direct vision and prevents incorporation of extraneous tissue. Data were retrospectively analyzed.
Results: *Demographic data were comparable between groups. In group I, 31/548 (5.7%) developed a BNC compared to 1/429 (0.2%) in Group II, $p < 0.001$. Urinary continence (no pads/maximum of one light pad for security in 24 hours) at 12 months in the 32 patients who developed a BNC was worse when compared to patients who did not develop a BNC (58% versus 80%, $p = 0.003$). After excluding the patients who developed a BNC, continence rates were comparable between both groups. The positive margin rate at the BN was not adversely affected by these modifications.*
Conclusions: *Simple, easily applied modifications to the management of the BN and vesicourethral anastomosis can substantially reduce the incidence of BNC.*

Key Words: prostatectomy, bladder neck obstruction, prostatic neoplasm

Introduction

The management of the bladder neck (BN) and the subsequent vesicourethral anastomosis (VUA) are important in reducing the incidence of bladder neck contractures (BNC) and positive surgical margins. Additionally, the development of a BNC significantly worsens postoperative continence and usually necessitates secondary procedures.[1] Some urologists prefer to preserve the BN[2,3] while others perform a wide excision and subsequent reconstruction.[4] BN preservation may increase the risk of positive surgical margins at the BN, especially in men with high volume disease.[5]

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BNC occur in 5%-32% of men following RRP.[6-8] Although the etiology of BNC is poorly understood, several etiologic factors have been proposed. These include excessive narrowing of the reconstructed BN, ischemia of the BN and/or membranous urethra (e.g. secondary to TURP), and, most importantly, failure to achieve mucosal apposition and a watertight anastomosis between the BN and membranous urethra.[7-9]

We describe simple and easily applied modifications in the surgical management of the BN and subsequent VUA that have greatly reduced the incidence of BNC.

Materials and methods

A retrospective analysis was performed on 977 consecutive men, who underwent RRP for clinically localized adenocarcinoma of the prostate (stage T1c-T2b) between March 1994 and July 2005. All cases were performed by a single surgeon (C.B.B.), using the surgical technique described by Walsh et al[10] with previously described modifications to decrease positive surgical margins.[11,12] The senior surgeon had performed over 1000 RRPs as a staff surgeon at another institution prior to the collection of the current data. As such, issues of the RRP learning curve would not likely influence the results. Group I consisted of 548 men who underwent RRP between March 1994 and December 1999. Group II included 429 men who underwent RRP with surgical modifications in the management of the BN and subsequent VUA. Demographic data and postoperative outcomes were compared between groups I and II. Postoperative data were obtained by chart review and patient completed questionnaires obtained and analyzed by a third party. The mean follow up for patients in groups I and II were 95.4 months and 26.7 months, respectively. Urinary continence was defined as wearing no pads or, at most, one light pad for security in 24 hours.

The study was performed with the approval of our Institutional Review Board and informed consent was obtained from all patients. Data were analyzed using a File Maker Pro 6.0 database. Groups I and II were compared using the Student's t-test, the Fisher exact test, and the Chi square test. Double-sided p-values less than 0.05 were considered statistically significant.

Surgical modifications

Reconstruction of the BN to a diameter of 28 French (F)

The BN is not preserved but widely excised, as originally described by Walsh, leaving a 3 mm-5 mm cuff of bladder tissue with the prostate. After reconstruction of the BN in a tennis racquet fashion over a 28 F catheter/sound, using a running 3-0 Vicryl suture along the 12 o'clock aspect of the bladder neck, followed by eversion of the bladder mucosa using interrupted 4-0 Vicryl, the BN is narrowed to a diameter of 28 F rather than 20 F as performed previously.

Placement of the posterior urethral suture on gentle traction

Six anastomotic sutures are placed into the membranous urethra, with placement of the posterior (six o'clock) suture first. The posterior urethral (6 o'clock) suture incorporates the striated urethral sphincter as well as the mucosa of the membranous urethra. After placing this suture, it is placed on gentle traction by securing the suture to the abdominal wall with a clamp, Figure 1. This improves exposure of the membranous urethral stump, permitting the surgeon to place the remaining sutures. It also allows to carefully inspect, and, if necessary, to replace the vesicourethral sutures, thus ensuring that all six sutures have incorporated urethral mucosa. This maneuver is easily performed, facilitates accurate placement/replacement of all six sutures, and serves the same purpose as external perineal compression to expose the membranous urethra, which we have found more difficult and less satisfactory. After accurate placement of all six sutures, they are placed into their corresponding positions in the BN.

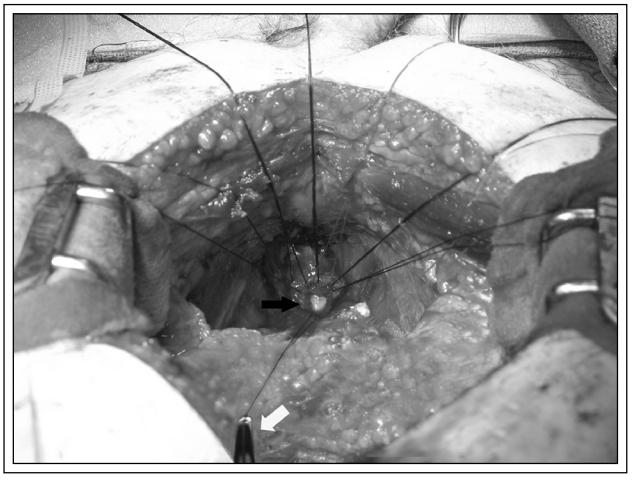

Figure 1. The black arrow shows the urethral stump with the vesicourethral sutures in place. The white arrow shows the 6 o'clock suture on mild cephalad traction with the aid of a hemostat.

Displacement of the bladder when tying the vesicourethral sutures

After placing the six VUA sutures into the bladder, a 20 F catheter is inserted into the bladder, and the bladder is brought down to the urethra manually. Prior to tying the vesicourethral sutures, the anastomosis should be palpated to ensure that the bladder and membranous urethra are well-approximated. As the six VUA sutures are tied, the bladder is gently displaced with a ring forceps, which allows the sutures to be tied under direct vision and avoids incorporation of extraneous tissue into the anastomosis.

Results

Preoperative demographic data are shown in Table 1. There were no significant differences in mean age, BMI, prostate specific antigen (PSA) levels, previous transurethral resection of the prostate, and Gleason grade between groups I and II. There was however a greater number of patients with cT2b disease in group 1 compared to group 2 (21.8% versus 8.2%, $p < 0.001$). Other post-operative factors, such as pathological stage, mean estimated blood loss (EBL), pathological stage and post-operative urinary leakage, defined as prolonged drain output with elevated fluid creatinine levels, were comparable between the groups.

Symptomatic BNC developed in 31/548 (5.7%) of group I and 1/429 (0.2%) of men in group II ($p < 0.0001$). Twenty-eight of the 31 men (90.3%) in group I who developed a BNC were managed successfully with a single direct vision internal urethrotomy (DVIU). Three patients required an additional DVIU to resolve the BNC. The single patient that developed a BNC in group II was treated with a single DVIU. This patient was incontinent at his 12-month follow up visit. Patients who developed a BNC had a significantly lower continence rate at 12 months compared to the patients who did not develop this complication (58% versus 77.7%, $p = 0.01$). In addition, continence rates at 12 months between group I and group II after excluding the 32 patients who developed a BNC from were comparable (76.4% and 79.3%, for groups I and II, respectively, $p = 0.28$). As expected, the positive margin rate at the BN was not adversely affected by these modifications. (Seven patients (1.2%) in group I and two patients (0.4%) in group II, $p = 0.15$).

TABLE 1. **Baseline patient demographics of patients undergoing RRP**

	Group I	**Group II**	**P value**
No. patients	548	429	-
Mean age (years)	59.3 (41-77)	58.7 (41-67)	0.71
Mean BMI (kg/m^2)	26.6 (22-41)	27.1 (19.1-46.4)	0.49
Mean preop PSA(ng/ml)	7.42 (0.5-37.5)	6.38 (0.5-14.8)	0.22
Previous TURP (%)	15 (2.7)	12 (2.8)	0.95
Clinical stage (%)			
T1c	339 (61.8)	309 (72)	< 0.001
T2a	90 (16.4)	85 (19.8)	
T2b	119 (21.8)	35 (8.2)	
Pre-operative Gleason score			
5-6	429 (78.3)	319 (74.3)	0.28
7	99 (18.1)	95 (22.1)	
8-9	20 (3.6)		15 (3.6)
Mean EBL (ml)	1230 (300-5500)	1213 (350-5000)	0.57
Pathologic stage (%)			
pT2a	142 (26)	120 (28)	0.45
pT2b	281 (51)	223 (52)	
pT3a	108 (20)	69 (16)	
pT3b	17 (3)	17 (4)	
Post-operative urinary leakage (%)	8 (1.5)	5 (1.2)	0.69

TURP-transurethral resection of the prostate; EBL-estimated blood loss

Discussion

Urinary incontinence following RRP results primarily from damage to the membranous urethra and striated urethral sphincter. Other factors that may contribute to postoperative incontinence include advanced age, increased body mass, excessive intraoperative bleeding, prolonged urinary leakage, and development of a BNC.[7-9]

There remains a lack of consensus regarding the optimal management of the BN.[13,14] Some investigators have reported that BN preservation leads to improved overall and more rapid return of continence,[2,3,14] while others have concluded that BN preservation does not improve continence.[14,15] Licht et al reported that, while bladder neck preservation per se did not improve urinary continence, it did reduce the incidence of BNC, and that patients who developed a BNC had a greater risk of subsequent urinary incontinence.[13] Recently, several authors have reported that intussusception of the reconstructed BN facilitates recovery of urinary control.[15,16]

Cancer control must also be considered when evaluating whether to preserve or excise the BN. Although some authors have reported that the BN is an infrequent site of positive surgical margins, Aydin et al recently reported that 23% of patients had a positive surgical margin at the BN. They concluded that patients who had a single positive margin at the BN were at significantly greater risk for cancer recurrence and that the BN margin status was an independent risk factor for biochemical progression.[17] Poulos et al recently reported similar findings and concluded that bladder neck invasion is an independent predictor of PSA recurrence.[18] We have found that, with wide excision of the BN, positive surgical margins at this site are rare. Indeed, in our series, only 9/977 (0.9%) of patients had a positive surgical margin at the BN; however, in eight of these patients the BN was the only positive surgical margin.

In summary, we would agree with other investigators who have concluded that there are no convincing data that the BN contributes significantly to urinary continence following RRP,[15] and that preservation of the BN may risk cancer control. Therefore, we prefer to excise and subsequently reconstruct the BN, and the modifications described in this manuscript have virtually eliminated postoperative BNC.

Previously, it was recommended that the BN be narrowed to a diameter of 18 F-20 F.[19] Indeed, this was our previous technique, but we now believe, as do others, that excess narrowing of the reconstructed BN may contribute to ischemia and increase the risk of a subsequent BNC. We have observed that the final diameter of the reconstructed BN is, for the most part, dependent on the size of the catheter that is left indwelling, and that a BN reconstructed to a diameter of 28 French will heal around the 20 F catheter that we leave indwelling for 10 days postoperatively.

Besides ischemia of the BN, one of the major causes of a BNC is failure to obtain mucosal apposition and a watertight anastomosis between the BN and urethra. Placing the posterior (6 o'clock) vesicourethral anastomotic suture on gentle traction draws the membranous urethra into the pelvis and facilitates accurate placement/replacement of all six anastomotic sutures. Placing the posterior suture on traction to draw the membranous urethra into view thus more easily and effectively accomplishes the same goal as perineal compression without having to position patients in lithotomy position. Similarly, gentle displacement of the bladder with a forceps when tying the anastomotic sutures allows the sutures to be tied under direct vision and avoids incorporation of extraneous tissue into the anastomosis, thus insuring mucosal apposition and watertight closure.

To address the weaknesses of our study, this is a retrospective data analysis in which selection bias may be a problem. Furthermore, patient medical co-morbidities were not analyzed with regards to BNC rates and continence recovery.

Conclusions

The development of a BNC impacts negatively on recovery of urinary continence following RRP. Simple, easily applied modifications in the reconstruction of the BN and subsequent vesicourethral anastomosis have significantly reduced the incidence of BNC. □

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