THE IMPACT OF RADICAL PROSTATECTOMY ON PATIENT WELL-BEING: A PROSPECTIVE URODYNAMIC STUDY FOCUSED ON DETRUSOR FUNCTION

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Prostate cancer is common in aged men and radical prostatectomy is established as a therapeutic measure. However, to date there is little information about its impact on voiding function. We conducted a prospective clinical study to elucidate the impact of radical prostatectomy on voiding function in 17 patients with prostate cancer, by urological evaluation including filling and voiding cystometry (pressure flow study). The patients who were estimated as having weak detrusor function including very weak detrusor function at 3 months postoperatively had significantly more frequent urinary incontinence compared with the others ($p<0.05$). Of 8 patients who showed urinary incontinence for more than 3 months, 7 (88%) patients developed weak detrusor function at 3 months after operation, but 4 of them were estimated as having normal detrusor function preoperatively. These patients revealed reduced maximum flow rate and significantly increased quality of life score compared with the other patients ($p<0.05$). An initially reduced bladder compliance disclosed a tendency to a rapid return to normal with time after surgery. Detrusor overactivity itself and neoadjuvant antiandrogen therapy were not related to prolonged postoperative urinary incontinence. The present study indicates that caution is required when administering medication that could potentially affect detrusor function, regardless of the type of preoperative detrusor function, in patients with persistent urinary incontinence or a reduced urinary stream. Particular emphasis is laid on the importance of urodynamic assessment of post-prostatectomy detrusor function and appropriate management modalities based on the results.

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Key words: Radical prostatectomy, Urinary incontinence, Detrusor weakness, Detrusor overactivity, Pressure flow study

INTRODUCTION

Prostate cancer is becoming more and more common in aged men. Even though radical prostatectomy is one of the essential treatment options, to date there are limited data available regarding the surgical impact on voiding function. Herein we report the results of urodynamic studies of urinary disturbance in 17 patients undergoing radical prostatectomy. Particular emphasis is laid on the importance of urodynamic assessment of post-operative detrusor function and appropriate management modalities based on the findings obtained.

PATIENTS AND METHODS

A total of nineteen patients from July 1999 to December 2000, were evaluated by urodynamics prior to radical prostatectomy at the Urology Department of Nara Medical University, excluding those complicated with any neurogenic deficit.

For objective assessment of voiding dysfunction, voiding cystometry (pressure flow study) was performed continuously in the standing position following water-filling cystometry with an infusion rate of 20 ml/min using normal saline at room temperature. A preoperative urodynamic study was performed prior to radical prostatectomy, but following neoadjuvant therapy in some cases. Postoperative urodynamic evaluation was scheduled at 1, 3 and 6 months after surgery. We used a 4 Fr intraurethral catheter (feeding tube) for monitoring intravesical pressure with a 3-channel subtracted Danteck 5000 urodynamic system. The Shäfer's nomogram was adapted to classify the evaluated detrusor function. In our series, all cases estimated as having very weak detrusor function were included in one group. At the same time, we used the AG number proposed by Abram and Griffith as an

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indicator of obstruction. Bladder compliance was determined by change in bladder volume divided by change of pressure before a voluntary or uninhibited detrusor contraction occurred. Detrusor overactivity (DO) was defined as an increase in detrusor pressure of 15 cm H_2O or greater, or documented instability during cystometry with or without urinary urgency. Aside from objective parameters concerning urinary disturbance, the international prostate symptom score (IPSS) and the quality of life (QOL) score were used for urinary symptom assessment of surgical outcome.

Whether clinically continent or not was defined from a hygienic aspect. That is, the patients who demanded one or more pads per day and those who were obliged to exchange their underwear due to frequent or occasional urinary incontinence were defined as incontinent. Those using no pads owing to complete control or loss of no more than a few drops of urine once or twice a month were considered as continent. Anastomotic stricture was also assessed endoscopically in patients complaining of dysuria or reduced urinary stream. Prior to urodynamic evaluation, administration of medications that could potentially affect detrusor function was discontinued for at least 7 days. Informed consent was obtained from all patients.

Differences in mean scores between two groups were tested for statistical significance with a Student's paired or unpaired t test. A probability of $p<0.05$ was considered to be statistically significant. When appropriate, all continuous variables are given as mean values±standard deviation of the mean.

RESULTS

Of the 19 patients who were evaluated preoperatively 2 patients were excluded from the study because they did not come to our hospital for the postoperative periodical follow-up after discharge. Data on the remaining 17 were available from postoperative analysis. Sixteen patients underwent retropubic radical prostatectomy and only one underwent laparoscopic radical prostatectomy (Montsouris technique). Patient characteristics are shown in Table 1.

Urinary continence was achieved in 9 (53%), 12 (71%) and 13 (76%) patients at 3, 6 and 12 months after operation, respectively. Persistent urinary incontinence was seen in 4 patients at the average follow-up period of 24 months. The incidence for more than 6 months did not correlate with the age, initial PSA level, preoperative prostate volume, the clinical stage or histological grade of the tumor. There was also no link with antiandrogen therapy (Fisher's exact probability test).

DO was seen in a total of 3 patients (18%) preoperatively, in 2 (29%) of the 7 undertaking neoadjuvant maximum androgen blockade therapy combined with goserelin acetate and bicalutamide, and in one (10%) of the 10 without neoadjuvant therapy. The incidence of DO was not related to preceding antiandrogen therapy. None of them exhibited prolonged urinary incontinence postoperatively. In addition, there were two patients who newly showed DO postoperatively who lacked the condition preoperatively. One case, who developed severely decreased bladder compliance (5 ml/cmH_2O) 6 months postoperatively, still remained urge incontinent after 24 months.

Table 1. Preoperative patients characteristics and the results of urodynamic evaluation

Mean age (range); yrs	69.4 (62–76)
Clinical stage	
T1c	6
T2	6
T3	5
No. of pts. with neoadjuvant therapy	8
Mean PSA level (range)	30.0 (6.6–248.5)
No. of pts. with less than 10 ng/ml	6
No. of pts. with 10 ng/ml or more	11
Mean prostate vol. (range)	21 (10–36)
Type of detrusor function	
Strong	3
Normal	8
Weak*	6
Mean IPSS (range)	10.8 (0–28)
Mean QOL score (range)	3.3 (0– 6)
Mean functional bladder vol. (range)	252 (58–504)
Mean postvoid residual vol. (range)	20 (0–103)
Mean % postvoid residual vol. (range)	9.4 (0–43)

* Here weak detrusor implies either weak or very weak detrusor function on nomogram

Bladder compliance decreased significantly at 1 month after surgery. However, as a whole it recovered with time early in the postoperative period (Table 2.). Pdet·Qmax ($p<0.05$), opening pressure ($p<0.05$) and rate of the postvoid residual urine volume ($p<0.05$) were also only decreased significantly at 1 month postoperatively, then returning to the preoperative level. Voided volume and peak flow rate showed no statistically significant change. Anastomotic stricture was evident in 2 patients 3 months postoperativery and the AG numbers at that time were 41 and 40, respectively. One case was treated by transurethral incision and the other was relieved by urethral bougie alone.

One month after radical prostatectomy 10 (77%) of the 13 patients who were evaluated for detrusor function showed weak detrusor function and half of them revealed strong or normal detrusor function preoperatively. After 3 months urinary incontinence was observed in only 1 (14%) of the 7 patients estimated as having strong or normal detrusor and in

Table 2. Postoperative urodynamic parameters compared with preoperative evaluation of men underwent radical prostatectomy

Variable Group	Pre-Op (n=17)	1 Month (n=13, I: 11, C; 2)	3 Months (n=12, I: 6, C; 6)	6 Months (n=12, I: 4, C; 8)
Mean compliance (ml/H_2O)	37.3±28.1	16.1±12.7*	32.8±21.6	40.4±31.5
I		16.1±13.3*	35.1±22.5	26.0±14.6
C		16.1±12.6	30.5±22.5	47.6±36.0
Mean max flow rate (ml/s)	11.8± 3.5	11.3± 4.7	9.6± 3.9	13.6± 7.0
I		11.4± 5.1	9.2± 3.0	13.3± 8.9
C		10.5± 1.4	10.1± 4.9	13.8± 6.6
Mean voided volume (ml)	252±140	248± 85	274±106	302±135
I		244± 85	292±111	306±132
C		270±115	257±108	301±146
Mean % postvoid residual (%)	9.4±14.8	1.0± 2.5*	3.6± 8.9	4.0± 8.4
I		1.1± 2.7	7.0±12.0	1.8± 3.5
C		0.5± 0.7	0.2± 0.4	6.3± 9.9
Mean Pdet·Qmax (ml/H_2O)	49.1±28.5	30.8±15.0*	38.0±17.8	44.4±30.1
I		30.5±16.4	29.0±16.8	29.0±16.2
C		32.5± 0.7	47.0±14.9	52.1±33.3
Mean AG number	22.9±34.3	5.0±20.7	18.8±22.8	15.6±35.2
I		3.8±22.4	10.7±22.1	2.5±32.6
C		11.5± 3.5	26.9±22.5	24.6±34.3
Mean opening pressure (ml/H_2O)	56.4±27.0	32.7±15.2*	44.8±21.3	40.6±25.0
I		32.7±16.6	49.5±20.6	35.0±13.9
C		32.5± 5.0	40.0±22.8	43.4±29.6*
Mean IPSS	10.8±8.3	13.3±10.4*	9.5± 9.5	6.1± 6.4
I		14.5±10.1	11.0±11.8	7.8± 8.9
C		4.0± 1.4	8.9± 9.4	5.4± 5.9
Mean QOL score	3.3± 1.9	4.3± 1.5*	2.9± 2.1	1.8± 1.3*
I		4.5± 1.3	4.2± 1.7	2.3± 1.5
C		2.5± 0.7	1.7± 1.6	1.5± 1.3

Asterisks indicates $p<0.05$ when compared to the preoperative value. I, incontinence group; C, continence group.

7 (70%) of the 10 patients estimated as having weak detrusor function including very weak function. The latter patients had significantly more frequent urinary incontinence compared with the others ($p<0.05$; Fisher's exact probability test), that is, of the 8 patients who showed urinary incontinence for more than 3 months, seven patients (88%) revealed weak detrusor function, but 4 of them were estimated as having normal detrusor function preoperatively (Fig. 1). These incontinent patients with weak detrusor function demonstrated a worse maximum flow rate (8.7 ml/s) than the other patients (14.6 ml/s), although no statistical significance was observed ($p=0.067$) (voided volume also demonstrated no significant difference). In addition, these patients also had significantly higher QOL scores as compared with the others at 3 months post operatively ($p<0.05$).

Pre-op detrusor function	Post-op detrusor function		
	Strong	Normal	Weak
Strong	○*	○*	○
Normal		○○○●*	●●●●*
Weak		○*	○○●●●

Fig. 1 Results of estimation for detrusor function and continent or not at 3 months after surgery (partly substituted by evaluation of detrusor function at 6 months after surgery: *). ○: continent patient, ●: incontinent patient. A bar (−) indicates a case with prolonged urinary incontinence more than 24 months postoperatively.

IPSS and QOL scores revealed significant deterioration only for 1 month in the postoperative period ($p<0.05$) and both scores decreased with time as a whole. However, the group complicated with urinary incontinence for more than 3 months postoperatively had significantly increased QOL scores compared with the non-complication group ($p<0.05$). This was also the case for individuals with weak detrusor function at 3 months postoperatively as compared with their counterparts showing a normal or strong detrusor function ($p<0.005$).

DISCUSSION

The reported rates for urinary incontinence after radical prostatectomy have shown a wide variation, partly because of the lack of unified postoperative

continence assessment. In general, the incidence of post-prostatectomy urinary incontinence tends to improve with passage of time, recently reported continence rates ranging from 70 to 90% or more after 1 year or more[1-3]. The results in the present study are thus in line with previous reports. A variety of factors have been implicated in the etiology of involvement of urinary incontinence following radical prostatectomy. Previous urodynamic studies suggested that the most common cause may be sphincteric insufficiency due to direct myogenic and/or denervation injury in most cases[3-7]. Aside from this, the absence of urethral post void milking may be an additional predictive factor[8].

Prospective studies have shown a high prevalence of decreased bladder compliance after radical prostatectomy. Chao et al.[4] reported that this finding may be temporary and reduced bladder compliance may be infrequent in patients with persistent post-prostatectomy urinary incontinence. Our study also revealed an initial significant decrease in postoperative bladder compliance and a rapid return to normal, with no definite evidence as to the etiology of persistent urinary incontinence.

Many studies have revealed that DO is associated with irritable symptoms. However, the correlation of DO with urinary incontinence after radical prostatectomy may be disputable, despite reports referring to DO as a sole cause of incontinence[6,7,9]. We found no definitive relation with DO and postoperative urinary incontinence as a whole in the present study and of the two cases with newly detected DO postoperatively, only one case complicated with severe decreased bladder compliance showed prolonged urge urinary incontinence for more than 6 months. Therefore, we do not regard detrusor overactivity as a possible sole predictor contributing to urinary incontinence following radical prostatectomy.

In addition to survival rate, the surgical impacts on quality of life related to sexual dysfunction and urinary disturbance as well as incontinence are concerns for most patients[10,11]. These must be important factors with regard to choice of treatment and this aspect has recently been receiving increasing recognition in Japan[2,12]. However, to date there has been no detailed assessment of detrusor function in the convalescent period after surgery. Homma et al. found a forceless urinary stream to be the most significant determinant for overall urinary conditions in post-prostatectomy patients by a questionnaire survey[12]. This might result in part from a predisposition to weak detrusor function in the convalescent period.

There have been suggestions that preoperative variables can predict post-prostatectomy urinary incontinence, such as endocrine therapy, prostate specific antigen level and age at the time of surgery. However, contrary to the previous reports referring to antiandrogen therapy as a risk factor for prolonged urinary incontinence following radical prostatectomy[13,14], neoadjuvant antiandrogen therapy was not related to prolonged urinary incontinence in our series. Moreover, while it has been suggested that DO could partly be related to possible effects of testosterone on micturition reflex[15,16], there was no link between preoperative DO and antiandrogen therapy in our study.

The reason for our finding of postoperative predisposition of the bladder to weak detrusor function on nomograms in incontinent patients, some of whom had been normal preoperatively, remains unclear. One possible explanation is that excessive manipulation of membranous urethra or tight anastomosis may cause reduced spontaneous tubularization of the bladder neck at initiation of voiding due to decreased elasticity, and result in unsuccessful preservation or late recovery of continence mechanisms.

In conclusion, the present study indicates that a considerable number of patients with post-prostatectomy urinary incontinence persisting over 3 months appear to be predisposed to detrusor weakness. Therefore, caution is required when we administer medication that may potentially affect detrusor function. Although further study is required, the present data suggest that more precise evaluation of detrusor function is important for improving the quality of voiding following radical prostatectomy. Even if sphincteric insufficiency is a major cause of post-radical prostatectomy urinary incontinence, evaluation of detrusor function should be taken into account. We hope that our study will contribute to a closer follow-up of patients undergoing radical prostatectomy.

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和文抄録

根治的前立腺摘除術による排尿機能への影響：排尿筋機能に焦点をおいた前向きの尿流動態学的検討

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前立腺癌は高齢男性に多い疾患で，根治的前立腺摘除術がその根治療法として確立されている．しかし，これまで本手術による排尿機能への影響に関してはあまり報告は見られない．そこで，われわれは17名の前立腺癌患者の術後の排尿機能への影響につき蓄尿期ならびに排出期の膀胱内圧測定（pressure flow study）を含めた泌尿器科学的評価をとおして prospective に臨床的検討を行った．術後3カ月の時点で排尿筋機能が weak（very weak を含む）と判定された症例は，それ以外の症例と比較して有意に尿失禁の割合が高かった（$p<0.05$）．また，3カ月以上尿失禁が持続した8名のうち，7名（88%）は術後3カ月の時点で排尿筋機能は weak detrusor と診断された症例であった．それらのうち4名は術前評価では，排尿筋機能は normal detrusor と評価された症例であった．これらの症例では最大尿流量率が低下しており，また，他の症例群に比較して有意に QOL スコアの悪化を認めた（$p<0.05$）．術後，有意に低下した膀胱コンプライアンスは早期に経時的に回復傾向を示した．なお，排尿筋過活動やネオアジュバント抗アンドロゲン療法施行の有無は術後尿失禁の遷延との関連性は認められなかった．今回の検討から，遷延する尿失禁や尿勢低下を伴う患者において排尿筋機能に影響する薬物治療を行う際には，術前の排尿筋機能にかかわらず注意が必要であることを示している．術後 QOL を考慮するとき，排尿筋機能も含めた尿流動態評価に基づいた適切な排尿管理を行うことが重要であると考える．

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