Urinary continence outcomes of four years of follow-up and predictors of early and late urinary incontinence in patients undergoing robot-assisted radical prostatectomy

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Abstract

Background Although the wide application of robot-assisted radical prostatectomy (RARP) in recent years, studies about long urinary continence were few. In this study, we aimed to examine the outcomes of continence rates (CRs) and determine the predictive factors of early and late urinary incontinence (UI) in patients with prostate cancer (PCa) undergoing RARP.Methods This retrospective study included 650 patients treated with RARP who completed perioperative data and at least one year of follow-up from January 2009 to November 2017. We analyzed the preoperative, intraoperative, and postoperative parameters of the patients. Continence was defined as no pad use. CRs from one to 48 months postoperatively were examined. Logistic regression analysis was performed to evaluate the associations between the risk factors and UI in the early and late stages.Results CRs of the patients at one, three, six, 12, 24, 36, and 48 months postoperatively were 40.62%, 60.92%, 71.38%, 78.77%, 79.96%, 79.51%, and 76.50%, respectively. There were no significant differences in CR from 12 to 48 months postoperatively (P =0.766). Logistic regression analysis proved that pelvic lymph node dissection (PLND) was a significant predictor of UI at one month, while age was an independent predictor of UI at six and 12 months, respectively. Other variables were not statistically significant predictors.Conclusions Our results demonstrated that CR gradually improved with time within one year and stabilized one year after the surgery. PLND and age were significant determinants of continence in the early and late stages, respectively. These parameters could be used for preoperatively identifying patients at high risk for UI and counselling about postoperative expectations for urinary continence.

Background

Despite advances in surgical technique and methodology, postprostatectomy urinary incontinence (UI) remains a significant adverse event that leads to decreased quality of life [1,2]. It has been suggested that a number of factors are involved in recovery of urinary continence after radical prostatectomy (RP) [3,4]. Many patients have learned about this disease from the media. Hence, it is necessary to predict recovery of urinary continence early to minimize patients' concerns and embarrassment [5].

Along with technical progress, robot-assisted radical prostatectomy (RARP) is increasingly used worldwide. It is reported that about 85% of RPs were performed using the robotic platform in 2009 [6]. However, even with the assistance of robotic systems, UI places physical and psychosocial burdens on patients because the procedure can induce different degrees of damage to the bladder and urethra [7,8].

It has been reported that UI improves little in the 12 months after surgery [9]. Hence, many previous reports mainly addressed continence rates (CRs) and potential predictors within one year post RARP. However, continence may continue to develop two years postsurgery [10]. Few data are available at longer follow-up with UI after 24 to 48 months. In addition, although a series of studies reported outcomes one year after surgery, most of them included a relatively small number of patients (usually fewer than 200). In addition, the follow-up period was discontinuous or incomplete. For example, Yanagiuchi and co-workers examined and identified outcomes one and three months post RARP, while

Olgin and Haga analyzed and evaluated outcomes three and 12 months after surgery [11-13]. In addition, Honda and colleagues reported continuous outcomes from one to six months postoperatively [14].

To the best of our knowledge, continuous follow-up data from one to 48 months on CRs and predictive factors for UI after RARP with a higher number of patients have not been collected. Therefore, in this retrospective study, we examined the outcomes of CRs one, three, six, 12, 24, 36, and 48 months after surgery and determined the predictive factors of UI in the early and late stages.

Methods

Patients diagnosed with clinically localized prostate cancer who received treatment from September 2009 to November 2017 at our institution were retrospectively studied. Only patients who completed the outpatient visits or telephone interviews for at least one year were enrolled. We excluded patients with incomplete data and those unavailable for follow-up of continence. Patients who received preoperative transurethral resection; enuclation of the prostate; radioactive seed implantation; orchidectomy; bladder neck, urethral, or pelvic surgery and who underwent retropubic radical prostatectomy (RRP) or laparoscopic radical prostatectomy (LRP) were also excluded. In total, 650 eligible patients were left for the analysis.

Clinical data on demographic characteristics and surgery-related variables were retrieved from the patient medical records. Together with follow-up records, they were retrospectively collected in a computerized database. The tested factors were age at operation, body mass index (BMI), serum prostate-specific antigen (PSA) level, biopsy-determined Gleason score, clinical stage, surgical time, pelvic lymph node dissection (PLND) during surgery, and duration of indwelling catheter after surgery. UI was defined as any leakage of urine after the surgery, according to International Continence Society (ICS) guidelines [15].

Statistical analysis

SPSS version 19.0 (SPSS, Inc., Chicago, IL, USA) was used for statistical analysis. Results are reported as mean ±standard deviation or percentage. The chi-square test was used to compare CRs at 12, 24, 36, and 48 months. The independent sample t-test or chi-square test was used to compare the risk factors for UI after RARP. Univariate and multivariate logistic regression analysis were done to identify factors related to UI at one, three, six, and 12 months. $P<0.05$ was considered significant.

Results

CRs at one, three, six, 12, 24, 36, and 48 months postsurgery were 40.62%, 60.92%, 71.38%, 78.77%, 79.96%, 79.51%, and 76.50%, respectively. They gradually improved with time within one year (Table 1). No significant difference in continence outcomes were observed during the four-year follow-up ($P=0.766$) (Table 2).

We compared the demographic data and baseline clinical characteristics of the two groups (continence and incontinence group) at one and 12 months. One-month follow-up data are presented in supplemental Table 1. The incontinence group had more intraoperative PLND than the continence group ($P<0.05$). No significant variables were observed at three-month follow-up (supplemental Table 2). Data from the six- and 12-month follow-ups are presented in supplemental Tables 3 and 4. UI at six and 12 months after RARP was associated with age at surgery ($P<0.05$).

All variables significant on bivariate analysis were entered into the logistic regression analysis. Univariate and multivariate associations between UI and risk factors are shown in Tables 3, 4, 5, and 6. In univariate logistic analysis, PLND was associated with incontinence one month postsurgery ($P=0.009$). In multivariate logistic analysis, PLND was a significant independent predictive factor of early urinary continence at one month (OR 1.638, 95% CI 1.163-2.306, $P=0.005$) (Table 3). No significant predictors of early urinary continence were seen at three months (Table 4).

Univariate logistic analysis showed that age was associated with incontinence at six months (OR 1.028, 95% CI 1.005-1.052, $P=0.019$) and 12 months (OR 1.034, 95% CI 1.007-1.061, $P=0.012$) (Tables 5 and 6). In multivariate logistic analysis, age was a significant independent predictive factor of late urinary continence at six months (OR 1.027, 95% CI 1.003-1.052, $P=0.025$) and 12 months (OR 1.031, 95% CI 1.004-1.059, $P=0.024$) (Tables 5 and 6). Other variables were not statistically significant predictors.

Discussion

RARP quickly became the most widespread surgical procedure for prostate cancer in recent years [16]. Despite technical and methodological improvements in RP, UI does occur and negatively affects quality of life [17]. Assessment of risk factors associated with UI has been tried in many studies [7,14,18,19]. This is important for patients and surgeons [18]. Early expectation of a good outcome would help reduce patient anxiety, while early estimation of postoperative outcomes could help surgeons identify patients who are at high risk of UI and counsel them on postoperative expectations for urinary continence.

It has been reported that UI is stable 12 months postsurgery [2]. Hence, many previous reports mainly address CRs within one year post RARP. Few data are available at more than 24 months follow-up for UI. In our study, CRs one, two, three, and four years after surgery were 78.77%, 79.96%, 79.51%, and 76.50%, respectively (Table 2). No significant differences in continence outcomes were observed during the four-year follow-up. Our results certified that one year after RARP was the stable continence period [20]. Few studies have evaluated CR rates after 12 months. Shao and assists reported that CR at 24 months after RARP were 89.4%, while Xylinas and co-workers reported a 24-month urinary continence rate of 88% using the no-pad definition [7,21]. Murphy and colleagues reported a 36-month urinary continence rate of 94.7% using the no-pad or safety pad definition [22]. Our CR 48 months after RARP was 76.50%, which we believe is the longest follow-up on the topic to date.

While many studies have evaluated predictors of urinary continence within one year after surgery, these studies either included a relatively small number of patients or had discontinuous follow-up. To our

knowledge, this is the first study to evaluate predictors of continence one to 12 months after RARP in a relatively large sample.

In our cohort, CRs one, three, six, and 12 months after RARP were 40.62%, 60.92%, 71.38%, and 78.77%, respectively (Table 1). CR gradually improves at these times. Our results are in agreement with the recent study by Honda and assists which found that CRs at one, three, and six months were 40.7%, 63.0%, and 73.1%, respectively [14]. The definition of postoperative urinary continence varied among several studies. There is no consensus on UI after RP so far [23]. We chose the ICS definition of incontinence, which seems to be the strictest. It has been reported that continence rate one year after RARP is 69% to 97% [1,24]. Our overall continence rate at 12 months was 78.77%, based on defining continence as no pad use. Although it is not excellent, it is within the average range.

To identify predictive factors for UI, we defined early continence as return of urinary continence within three months after surgery, just as Lavigueur-Blouin and Hatiboglu described [25,26]. Because UI tends to be stable 12 months after surgery, late continence was regarded as return of urinary continence three months after surgery [2].

In general, PLND was selectively performed for sampling purposes in intermediate- and high-risk patients [27]. However, some surgeons perform routine lymphadenectomy in our center. One month after surgery, PLND in the continence group occurred in 121 patients (45.83%), while it occurred in 217 patients in the incontinence group (56.22%) ($P<0.05$). Three, six, and 12 months after surgery, there were no significant differences in both groups. Logistic analysis showed that PLND was a significant independent predictive factor of early urinary continence at one month. Men who had more PLND during surgery had a higher risk of UI. More lymphadenectomy may give rise to more transient damage to nerve vessel bundles (NVBs), which affects the recovery of urinary continence. However, with the recovery of body function, this impact is gradually diminishing.

Multiple studies have demonstrated that age is an independent risk factor for return of continence one to 12 months after RARP. Lavigueur-Blouin and co-workers evaluated early continence after RARP [25]. In their group, 44% of patients were pad-free one month after RARP. Advanced age was an independent predictor at one month. Kim and colleagues have demonstrated that younger men are most likely to have an earlier return of continence three months after RARP [28]. Greco and assists performed a study that compared continence outcomes in RARP in older men with those of younger men [29]. They showed that CRs at one, three, and 12 months were comparable in two groups, but the older group had significantly lower continence rate at six months. Their results partly agree with those of our study. Shikanov and co-workers demonstrated that age was one predictor of continence return 12 months after RARP, which is partially in accordance with our results [30]. Our results show that age is a significant determinant of continence six and 12 months after surgery (defined as late stages). Men of advanced age had a higher risk of UI. Kumar explained that age may affect functional outcomes in several ways: (1) aged men may have chronic diseases with associated poor urinary function; (2) older men have poor endothelial

dysfunction, which affects the vascular supply of the NVBs; and (3) it is difficult to perform pelvic floor exercises (PLE) due to an age-related decrease in skeletal muscle and neuronal plasticity mass [17].

Limitations

Our results must be considered in light of some limitations. First, this is a retrospective study from a single institution, and surgeries were not performed by a single surgeon. Second, we did not analyze all variables due to undocumented surgical steps of the procedure, variations in surgical experience, and differences in pathological reports. Third, although we used the strict definition of continence, the continence conditions were reported by the patients rather than by using a quality questionnaire. In addition, missing data were unavoidable because many patients were lost to follow-up. Although our study has the aforementioned limitations, it clearly had a large sample size, and the survey of postoperative UI was time-continuous.

Conclusions

Our study has shown that CR gradually improves with time within one year after surgery and stabilizes one year later. PLND and age were significant determinants of continence in the early and late stages, respectively. These parameters could be used to preoperatively identify patients at high risk for UI and counsel them on postoperative expectations for urinary continence.

Abbreviations

BMI: Body mass index; CRs: Continence rates; ICS: International Continence Society; LRP: Laparoscopic radical prostatectomy; NVBs: Nerve vessel bundles; RARP: Robot-assisted radical prostatectomy; RRP: Retropubic radical prostatectomy; PSA: Prostate-specific antigen; PLND: Pelvic lymph node dissection; PLE: Pelvic floor exercises; RP: Radical prostatectomy; UI: Urinary incontinence

Declarations

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Not applicable.

Authors’ contributions

XL: Protocol/project development, Data Collection, Data management, Statistical analysis, Manuscript writing HZ: Data Collection, Data analysis ZJ: Data Collection, Data analysis YW: Data Collection, Data analysis YS: Data Collection, Data analysis LL: Critical revision of the manuscript, Manuscript editing XZ: Critical revision of the manuscript, Manuscript editing. All authors read and approved the final version of the manuscript.

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Availability of data and materials

All the data supporting our findings is contained in the manuscript. The datasets used and/or analysed in the current study is available from the corresponding author on reasonable request.

Ethics approval and consent to participate

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study. This study was approved by the Chinese PLA General Hospital Local Ethics Committee.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interest.

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Tables

Table 1 CRs at one, three, six and twelve months after RARP

	Continence	Incontinence	CR
One month (N = 650)	264	386	40.62%
Three months (N = 650)	396	254	60.92%
Six months (N = 650)	464	186	71.38%
Twelve months (N = 650)	512	138	78.77%

Table 2 CRs at 12, 24, 36 and 48 months after RARP

	Continence	Incontinence	CR
12 months (N = 650)	512	138	78.77%
24 months (N = 469)	375	94	79.96%
36 months (N = 327)	260	67	79.51%
48 months (N = 217)	166	51	76.50%

Table 3 Univariable and multivariable regression analysis for predictors of continence one month following RARP

	Univariable			Multivariable		
Predictors	OR	95% CI	P value	OR	95% CI	P value
Age	1.001	0.980-1.021	0.959	1.003	0.982-1.025	0.755
BMI	1.036	0.981-1.094	0.209	1.038	0.982-1.098	0.191
PSA	1.004	0.999-1.009	0.114	1.004	0.999-1.009	0.149
Gleason score	0.929	0.774-1.116	0.433	0.838	0.690-1.020	0.077
Clinical stage	1.060	0.899-1.250	0.487	1.016	0.856-1.024	0.860
Operation time	1.001	0.998-1.004	0.551	1.000	0.997-1.004	0.934
PLND	1.517	1.108-2.079	0.009	1.638	1.163-2.306	0.005
Duration of indwelling catheter	0.998	0.983-1.013	0.809	0.997	0.982-1.012	0.717

Table 4 Univariable and multivariable regression analysis for predictors of continence three months following RARP

	Univariable			Multivariable		
Predictors	OR	95% CI	P value	OR	95% CI	P value
Age	1.019	0.998-1.041	0.080	1.018	0.997-1.041	0.097
BMI	1.001	0.948-1.057	0.964	1.005	0.950-1.063	0.863
PSA	1.003	0.999-1.008	0.138	1.003	0.999-1.008	0.150
Gleason score	0.965	0.802-1.160	0.702	0.942	0.774-1.146	0.548
Clinical stage	1.077	0.913-1.270	0.379	1.061	0.896-1.258	0.491
Operation time	1.002	0.999-1.006	0.193	1.002	0.999-1.006	0.252
PLND	1.051	0.767-1.441	0.757	1.030	0.732-1.449	0.867
Duration of indwelling catheter	0.996	0.980-1.012	0.602	0.997	0.981-1.013	0.685

Table 5 Univariable and multivariable regression analysis for predictors of continence six months following RARP

	Univariable			Multivariable		
Predictors	OR	95% CI	P value	OR	95% CI	P value
Age	1.028	1.005-1.052	0.019	1.027	1.003-1.052	0.025
BMI	0.986	0.929-1.046	0.630	0.996	0.938-1.059	0.909
PSA	1.003	0.998-1.008	0.190	1.003	0.998-1.008	0.219
Gleason score	0.976	0.800-1.192	0.815	0.964	0.780-1.190	0.730
Clinical stage	0.973	0.814-1.164	0.767	0.962	0.800-1.157	0.682
Operation time	1.001	0.997-1.004	0.665	1.001	0.997-1.005	0.671
PLND	1.008	0.717-1.418	0.961	1.034	0.715-1.494	0.860
Duration of indwelling catheter	0.991	0.973-1.010	0.359	0.993	0.975-1.011	0.439

Table 6 Univariable and multivariable regression analysis for predictors of continence twelve months following RARP

	Univariable			Multivariable		
Predictors	OR	95% CI	P value	OR	95% CI	P value
Age	1.034	1.007-1.061	0.012	1.031	1.004-1.059	0.024
BMI	0.970	0.908-1.036	0.362	0.978	0.914-1.045	0.510
PSA	1.003	0.998-1.008	0.227	1.003	0.998-1.008	0.248
Gleason score	1.017	0.816-1.267	0.417	1.017	0.806-1.283	0.887
Clinical stage	1.470	0.818-1.214	0.970	0.979	0.799-1.201	0.842
Operation time	1.003	0.999-1.007	0.182	1.003	0.999-1.007	0.161
PLND	0.972	0.668-1.416	0.884	0.941	0.627-1.412	0.769
Duration of indwelling catheter	0.986	0.964-1.008	0.215	0.988	0.966-1.010	0.290

Supplementary Files

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

- Supplementaryfile.docx