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ORIGINAL ARTICLE

Functional and perioperative outcomes in elderly men after robotic-assisted radical prostatectomy for prostate cancer

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Abstract

Purpose We aimed to compare postoperative functional outcomes following robotic-assisted radical prostatectomy (RARP) in elderly men with localized prostate cancer.

Methods A retrospective review of a prospectively maintained database of men who underwent RARP between January 2007 and November 2018 was performed. Patients over 65 years of age were selected ($N=302$) and then stratified by age group: 66–69 years old ($N=214$) and ≥ 70 years old ($N=88$). Full continence was defined as strict 0-pad per day usage. Preoperative potency included those with a Sexual Health Inventory for Men score ≥ 17. Preoperative and postoperative functional outcomes were assessed. Kaplan–Meier analysis was used to estimate time to recovery of continence in both groups.

Results Both groups had comparable preoperative parameters. Continence rates at 1, 3, 6, 9, 12, 18 and 24 months in the 66–69-year-old group were 6%, 34%, 61%, 70%, 74%, 80% and 87%, respectively. Comparatively in the ≥ 70-year-old group, continence rates were significantly lower at all time points (3%, 22%, 50%, 56%, 66%, 69% and 75%, respectively). Men in the 66–69-year-old group were significantly more likely to be continent after RARP when compared to patients 70 years of age and above [(Hazards ratio (HR) 0.73; 95%confidence interval 0.54–0.97, ($p=0.035$)].

Conclusion Our results suggest that RARP is feasible in elderly patients. Nevertheless, elderly patients in the ≥ 70-year-old group had significantly inferior postoperative continence rates compared to patients aged 66–69 years. Such information is valuable when counselling men during preoperative RARP planning to ensure that they have realistic postoperative expectations.

Keywords Prostate cancer · Robotic-assisted radical prostatectomy · Outcomes · Continence · Potency

Introduction

Prostate cancer (PCa) is the most prevalent cancer in Canadian men [1]. It is predominantly a disease of the elderly with 64% of new cases diagnosed in men aged ≥ 65 years and 23% in men aged ≥ 75 years [2].

Over the last two decades, robotic-assisted radical prostatectomy (RARP) has gained importance in the surgical management of prostate cancer worldwide. This minimally invasive procedure harbors several advantages for patients such as reduced blood loss, postoperative pain, hospital stay, and recovery time. Additionally, studies have demonstrated favorable oncological outcomes, feasibility and safety of RARP in elderly men [2, 3]. However, urinary incontinence and erectile dysfunction are of concern, especially in old patients, due to considerable impact on health-related quality of life [4, 5].

Few studies have reported functional and perioperative outcomes of RARP among Canadian elderly men with PCa in the contemporary era [6]. In this study, we aimed to compare postoperative functional outcomes in Canadian elderly patients with PCa who underwent robotic-assisted radical prostatectomy between 2007 and 2018.

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Material and methods

Patient selection

Between January 2007 and November 2018, 1654 patients underwent RARP for prostate cancer at the University of Montreal Hospital Centre and the Sacred Heart of Montreal Hospital. After institutional-review board approval was obtained, a retrospective review of data was performed. Inclusion criteria consisted of elderly patients defined by participant 66 years old and above with available functional outcomes data at baseline and up to 2 years of follow-up post-RARP. Three hundred and two patients met the selection criteria. Considering that the average life expectancy of Canadians men continues to rise and has reached 79.9 years for men by 2017, and that most guidelines for PCa recommend curative treatment for patients with a life expectancy of more than 10 years. These patients were further divided into 2 groups. The first group included patients in the 66–69-year age range (Group 1) and the second group included patients aged ≥ 70 years (Group 2). Patient demographic and baseline parameters were collected prospectively, including body mass index (BMI), prostate specific antigen (PSA), Gleason score, clinical stage, number of pads used, International Prostate Symptoms Score (IPSS) and Sexual Health Inventory for Men (SHIM). We recorded patients' data at each follow-up visit (i.e., at 1, 3, 6, 9, 12, 18 and 24 months postoperatively).

Surgical technique

Our RARP surgical technique has been described in prior reports from our group [7–9].

Pathological analysis

All specimens were analyzed by our institution's uropathology service as described in previous reports [6]. Positive surgical margin (PSM) was defined as the presence of cancer at the inked margin.

Functional outcomes

Functional outcomes were evaluated at baseline (preoperatively) and at 1, 3, 6, 12, 18 and 24 months. Lower urinary tract symptoms were evaluated using the self-administered IPSS questionnaire during clinic visits. Full continence was defined as zero pad usage per day or the use of a security pad for heavy physical activity. Potency was evaluated using the SHIM questionnaire to divide patients into standard categories of erectile function. (SHIM 1–7: Severe erectile dysfunction (ED); 8–11: Moderate ED; 12–16: Mild-moderate ED; 17–21: Mild ED; 22–25: No ED). The use of oral type phosphodiesterase-5 (PDE-5) inhibitors was also noted. In this study, patients with a SHIM score of ≥ 17 (with or without PDE5i) were considered potent. In our descriptive analysis of potency outcomes, patients with a preoperative SHIM score of less than 17 and those men who did not have any nerve sparing prostatectomy were excluded from analysis.

Statistical analysis

Descriptive statistics were used to summarize our study population's baseline characteristics. Continuous variables were reported as median followed by the range as a measure of central tendency. All categorical variables were reported as proportions. Means of continuous variables were compared using independent sample t-test, while categorical variables were analyzed using the Chi-square test. Kaplan–Meier analysis was performed to compare the time to recovery of continence and its distribution among elderly age groups using the log-rank test. Subset analysis of two age groups was performed to compare clinical and pathological data, perioperative outcomes as well as functional outcomes. A p value < 0.05 was considered statistically significant in all two-tailed tests. All statistical analyses were performed using the IBM SPSS Statistics package (IBM Corporation, version 21, Armonk, NY).

Results

After patients' exclusion, a total of 302 consecutive men undergoing RARP for PCa were divided into two age groups, 66–69 years old (Group 1; $n = 214$) and ≥ 70 years old (Group 2; $n = 88$). Overall, the mean age was 68.4 years (range 66–75). At the time of analysis, no included patients were lost to follow-up. Complete follow-up data were available up to 2 years post-RARP or to the date of last visit. The cohort's follow-up-visit completeness rates at 9, 12, 18, and 24 months post-RARP were 100%, 93.4%, 91.8% and 80.5%, respectively.

Characteristics of elderly patients undergoing RARP

Clinical and pathological data stratified by age are summarized in Table 1. Both group's baseline characteristics were comparable.

Continence outcomes

All patients were continent prior to surgery. In the 66–69 years old group, pad-free continence rates at 1, 3, 6, 9,

Table 1 Baseline characteristics of 302 men undergoing robotic-assisted radical prostatectomy for prostate cancer stratified by age

Variable	66–69 years old ($n=214$)	≥ 70 years old ($n=88$)	p value
Age, years, median (range)	67 (66–69)	71 (70–75)	
BMI, kg/m^2, median (range)	26.6 (15.7–41.1)	26.1 (16.9–43.3)	0.53
BMI groups % (n)			
< 30	82.7 (177)	81.8 (72)	0.85
≥ 30	17.3 (37)	18.2 (16)	
Preoperative PSA level, ng/dL, median (range)	6.2 (0.3–19.5)	7.1 (1.1–28)	0.06
TRUS prostate size, gm, median (range)	41 (13–170)	42 (16–149)	0.65
Pathology (specimen) prostate size, gm, median (range)	52 (17–164)	56.5 (29–145)	0.15
Operative time, minutes, median (range)	176 (90–300)	173 (104–310)	0.57
Estimated blood loss, ml^3, median (range)	200 (50–800)	210 (50–900)	0.22
Postoperative hospital stays, days, median (range)	1 (1–7)	1 (1–5)	0.87
D'Amico risk group, % (n)			
Low	16.4 (35)	10.2 (9)	0.38
Intermediate	65.4 (140)	71.6 (63)	
High	18.2 (39)	18.2 (16)	
Biopsy Gleason score, % (n)			
6	19.6 (42)	12.5 (11)	0.24
7	64 (137)	75.0 (66)	
≥ 8	16.4 (35)	12.5 (11)	
Pathology (specimen) Gleason score, % (n)			
6	8.9 (19)	10.2 (9)	0.48
7	73.4 (157)	75.0 (66)	
≥ 8	17.7 (38)	14.8 (13)	
Clinical stage, % (n)			
≤ T1c	71.9 (154)	68.2 (60)	0.20
T2a	20.6 (44)	19.3 (17)	
T2b	3.7 (8)	10.2 (9)	
T2c	1.9 (4)	2.3 (2)	
T3	1.9 (4)	0	
Pathologic stage, % (n)			
T2a	3.3 (7)	2.3 (2)	0.29
T2b	4.7 (10)	4.5 (4)	
T2c	57 (122)	48.9 (43)	
T3a	26.2 (56)	38.6 (34)	
T3b	8.9 (19)	5.7 (5)	
Preoperative IPSS, median (range)	7 (0–35)	8 (0–35)	0.65
Preoperative IPSS groups % (n)			
0–7	51.9 (111)	47.7 (42)	0.13
8–19	37.9 (81)	38.6 (34)	
20–35	10.2 (22)	13.6 (12)	
Preoperative potency, % (n)			
Potent (SHIM ≥ 17)	52.8 (113)	40.9 (36)	0.31
Impotent (SHIM < 17)	47.2 (101)	59.1 (52)	
Nerve sparing, % (n)			
Bilateral	35.5 (76)	37.5 (33)	0.66
Unilateral	49.5 (106)	44.3 (39)	
None	15 (32)	18.2 (16)	
Positive margins, % (n)			
Negative	80.4 (172)	75.0 (66)	0.30
Positive	19.6 (42)	25.0 (22)	

BMI Body-mass index, *PSA* Prostate-specific antigen, *TRUS* Trans-rectal ultrasound, *IPSS* International Prostate Symptoms Score, *SHIM* Sexual Health Inventory for Men

12, 18, and 24 months after RARP were 6%, 34%, 61%, 70%, 74%, 80% and 87%, respectively. Moreover, in the ≥ 70-year-old group, postoperative pad-free continence rates were 3%, 22%, 50%, 56%, 66%, 69% and 75%, respectively.

Incidence plot estimates (Fig. 1) demonstrated significantly superior continence outcomes in the group of patients aged 66–69 years (p-log-rank = 0.02). On multivariate analyses (Table 2), younger patients are 27% more likely to fully return to continence per unit time following RARP compared to older patients [hazard ratio 0.73; 95% confidence interval (0.54–0.97); $p = 0.035$]. Furthermore, age was the only statistically significant risk factor for postoperative incontinence.

In addition to lower continence rates seen in older individuals, the average pad usage in older patients who did not reach pad-free status after surgery is significantly higher except at 9 months when compared to younger patients who did not achieve pad-free status following RARP (Fig. 2).

Potency outcomes

There were 54 patients in the 66–69-year-old group who were potent preoperatively (SHIM ≥ 17) and who received unilateral nerve sparing. Eight (14.8%) patients were potent postoperatively. In the ≥ 70-year-old group, there were 23 patients who were potent preoperatively (SHIM ≥ 17) and who received unilateral nerve sparing. Four (12.1%) patients were potent postoperatively (Table 3). There were 77 patients in the 66–69-year-old group who were potent preoperatively (SHIM ≥ 17) and who received bilateral nerve sparing. Twelve (15.6%) patients were potent postoperatively. In the ≥ 70-year-old group, there were 22 patients who were potent preoperatively (SHIM ≥ 17) and who received bilateral nerve sparing. Six (27.2%) patients were potent postoperatively (Table 4).

Discussion

There is reluctance to subject elderly patients to a definitive surgical treatment because of overall lower life expectancy and poorer postoperative functional results. Age has clearly been demonstrated to be an independent predictive factor for incontinence after radical retropubic prostatectomy [10] and RARP [11]. With an ever increasing trend in estimated life expectancy for males (79.8 years in Canada in 2018) [12], a more significant proportion of elderly patients are diagnosed with clinically significant prostate cancer who may have > 10 years life expectancy. Using chronological age alone as the most important factor for selecting surgical candidates for RARP means denying older prostate cancer patients from receiving potentially curative surgical treatment.

Albertsen et al. in their landmark Scandinavian watchful waiting study, showed that while patients above 70 years of age have a minimal risk of PCa related deaths, 40% of those

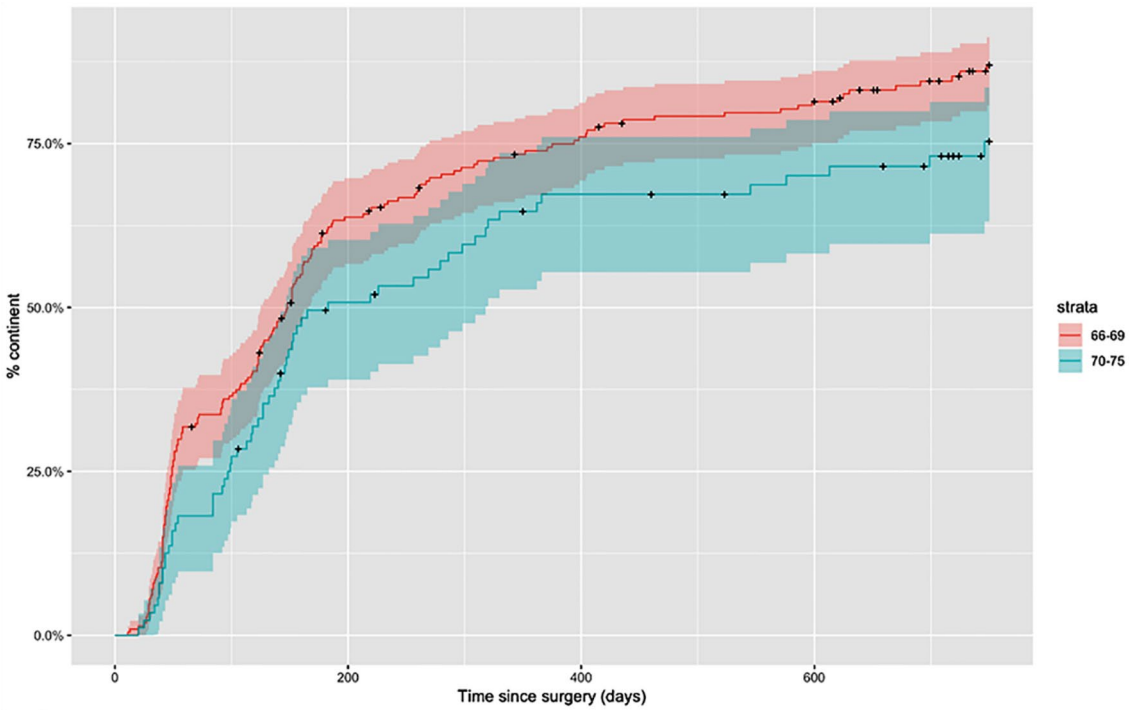
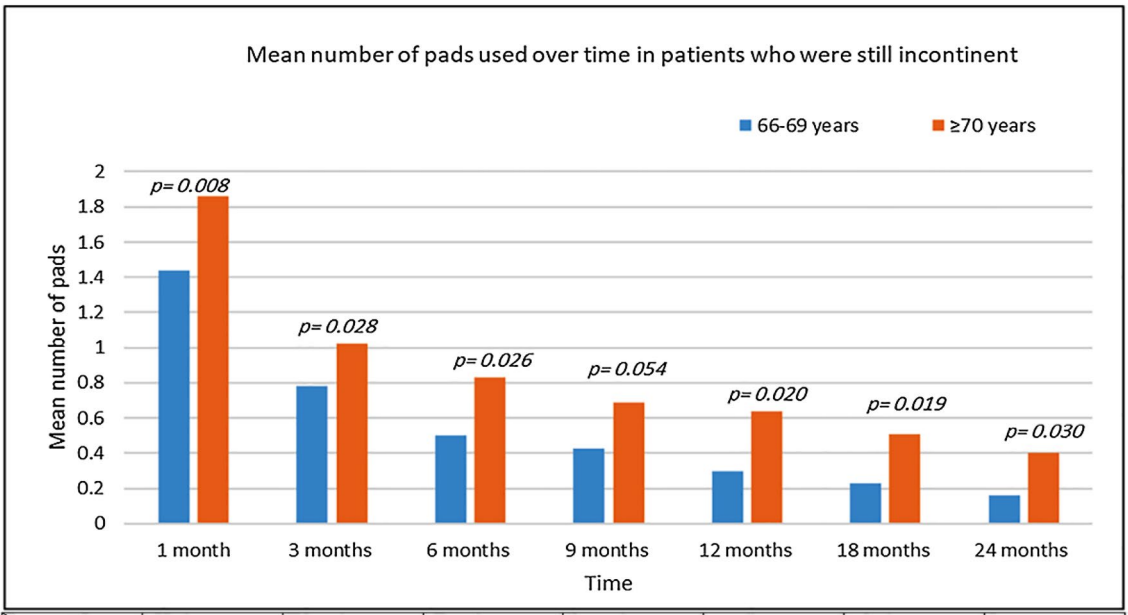


Fig. 1 Incidence plot of time to recovery of continence, comparing ages 66–69 to ≥ 70 years old



Time / Group	1 month *p= 0.008*	3 months *p= 0.028*	6 months *p= 0.026*	9 months *p= 0.054*	12 months *p= 0.020*	18 months *p= 0.019*	24 months *p= 0.030*
66-69 years, mean number of pads (SD):	1.44 (1.68)	0.78 (1.35)	0.50 (0.98)	0.43 (0.87)	0.30 (0.72)	0.23 (0.55)	0.16 (0.42)
≥ 70 years, mean number of pads (SD):	1.86 (1.64)	1.02 (1.21)	0.83 (1.19)	0.69 (1.11)	0.64 (1.02)	0.51 (0.98)	0.40 (0.84)

Fig. 2 Degree of leaking in patients who are still incontinent over time, mean number of pads used (SD)

Table 2 Cox proportional-hazards time to continence recovery analysis

Variable	Hazard ratio (95% confidence intervals)	*p* value
Age (≥ 70 vs. 65–69)	0.73 (0.54–0.97)	0.035
BMI (≥ 30 vs. < 30)	0.84 (0.58–1.22)	0.37
SHIM score (continuous)	1.19 (0.92–1.55)	0.17
IPSS		
0–7: (reference)	–	–
8–19:	0.75 (0.57–1.00)	0.054
20–35	0.69 (0.45–1.07)	0.10
Nerve sparing:		
None: (reference)	–	-
Unilateral	1.02 (0.70–1.49)	0.90
Bilateral	1.12 (0.76–1.64)	0.55
Intra-operative prostate size (continuous)	0.99 (0.90–1.00)	0.26

with biopsy gleason scores of 7 and 60% of patients with Gleason 8–10 ultimately died from PCa with conservative management alone [13]. Therefore, the authors advocated for curative treatment in healthy patients with a life expectancy of at least 10 years [13]. Another report showed that radical prostatectomy resulted in significantly improved life expectancy and quality-adjusted life years when performed in elderly men with few comorbidities [14]. Therefore, in the presence of aggressive disease in patients with few comorbidities and a life expectancy exceeding 10 years, a definitive surgical option is justifiable.

In our current study, 87% of men aged 66–69 regained complete control of continence at 24 months in comparison to patients above 70 years of age who achieved continence rates of 75%. Increasing age is associated in declines in strength and function of skeletal muscle [15]. Furthermore, in vitro studies have shown that there is an age-related decline in neuronal excitability and plasticity. It follows that aging humans are at a disadvantage when re-adapting and re-acquiring pelvic floor control following surgery [16]. A previous study by Zorn et al. evaluated the postoperative return of urinary and sexual function in men undergoing robotic-assisted radical prostatectomy [6]. Patients ≤ 60 years of age achieved better continence rates at 3 months compared to patients > 60 years of age (67% vs. 41%, respectively). Nevertheless, the authors found that at 12 months postoperatively, men of all age groups seem to have similar continence rates. In other words, older age only delayed return to subjective continence. Similar findings were reported by Greco et al. who found no difference in continence rates

Table 3 SHIM in patients with unilateral nerve-sparing

66–69-years-old with UNILATERAL nerve-sparing						
		SHIM category postoperative, *n* (%)				
		0–10	11–16	17–21	22–25	not available
SHIM category preoperative, *n*						
17–21	32	23 (71.9)	5 (15.6)	1 (3.1)	0 (0.0)	1 (3.1)
22–25	22	15 (68.1)	2 (9.1)	5 (22.7)	2 (6.2)	0 (0.0)
≥ 70 years old with UNILATERAL nerve-sparing						
		SHIM category postoperative, n (%)				
		0–10	11–16	17–21	22–25	not available
SHIM category preoperative, *n*						
17–21	12	10 (83.3)	0 (0.0)	2 (16.7)	0 (0.0)	0 (0.0)
22–25	11	8 (72.7)	0 (0.0)	2 (18.1)	0 (0.0)	1 (9.1)

Table 4 SHIM in patients with bilateral nerve sparing

66–69-years-old with BILATERAL nerve-sparing						
		SHIM category postoperative, *n* (%)				
		0–10	11–16	17–21	22–25	not available
SHIM category preoperative, *n*						
17–21	44	33 (75.0)	5 (11.4)	3 (6.8)	0 (0.0)	1 (2.3)
22–25	33	23 (69.7)	2 (6.1)	7 (21.2)	2 (4.5)	1 (3.0)
≥ 70-years-old with BILATERAL nerve-sparing						
		SHIM category postoperative, *n* (%)				
		0–10	11–16	17–21	22–25	not available
SHIM category preoperative, n						
17–21	12	7 (58.3)	2 (16.7)	1 (8.3)	0 (0.0)	2 (16.7)
22–25	10	4 (40.0)	0 (0.0)	4 (40.0)	1 (10.0)	1 (10.0)

at 12 months post-RARP between two groups of men with ages similar to subjects in our cohort [2]. In our series, younger and older patients experienced an improvement in continence rates over time, albeit at a slower pace for older individuals. However, continence rates did not equalize between the two groups at 24 months. We cannot attribute the discrepancy in findings between our study and the aforementioned studies to whether the individuals in our series had a higher baseline Eastern Cooperative Oncology Group (ECOG) score or to the fact that no longer-term follow-up was available. Nevertheless, despite differences between the 2 groups in our series, older men clearly achieved excellent overall continence rates. It is worth mentioning that contemporary studies evaluating functional outcome after RARP seem to show superior results compared to older studies. There are likely many reasons explain this, with improvement in surgical technique and experience of robotic surgeons likely the most important factors.

In addition to favorable functional outcomes, Kumar et al. reported very good intermediate-term oncological outcomes and low complication rates in patients above 70 years of age who underwent RARP [17]. In this large cohort study of 3241 patients, the authors carried out a propensity score matched evaluation of the aforementioned outcomes between 400 younger patients (< 70 years) and 400 older patients (≥ 70 years). Intraoperative and postoperative complication rates were similar in both groups. Furthermore, there was no significant difference in continence rates (91.3% at 34.1 months for younger patients compared to 87.3% at 37.2 months for older patients). Nevertheless, a greater proportion of younger patients regained potency in comparison to older patients (52.3% vs. 33.5%, $p < 0.001$). With regards to postoperative sexual function, our study had

small numbers of patients, and only a descriptive report was presented. It seems that both groups did not differ in potency outcomes, and that bilateral nerve sparing did not impact erectile function when compared to unilateral nerve sparing.

In contrast, previous studies showed reduced potency rates in older individuals. Labanaris et al. compared the postoperative and functional outcomes in 45 PCa patients aged ≥ 75 years to the overall cohort of 2000 patients [18]. There was a significantly lower rate of potency among elderly men compared to the overall cohort (39.6% vs. 66.2%, respectively). Of note, in their study, all patients who did not undergo a bilateral nerve-sparing surgery were excluded from sexual function analysis. Shikanov et al. also demonstrated that age had a significant influence on potency (OR: 0.92; $p < 0.0001$) with point estimates of 12-month postoperative potency after bilateral nerve sparing at age 65, 70 and 75 years being 0.66, 0.56 and 0.46, respectively [19].

Although our study failed to clearly show an association between age and potency after RARP, our data shows favorable continence in elderly patients undergoing RARP. Our study is also one of few studies that reported on functional outcomes following RARP in patients above 70 years of age. Nonetheless, there are a number of limitations that should be addressed. Older patients included in the study may have represented a highly selected, healthier-than-average, highly motivated cohort. Therefore, care should be taken not to generalize our findings to PCa patients at large based solely on chronological age. Another argument against generalization of these findings is that the surgeries were performed by high-volume surgeons. Furthermore, the operative techniques utilized (posterior reconstruction and full-length urethral sphincter preservation) likely also strongly influence postoperative urinary continence [20, 21].

Achieving full continence and return to baseline potency post-surgery (after surgery or postoperatively) is a gradual process, and continuous improvement in functional outcomes are known to occur for up to 2 years or more after radical prostatectomy. Therefore, another limitation is a lack of a longer follow-up that might have failed to capture further improvement in continence or sexual function. Furthermore, the lack of data on the use of PDE-5 inhibitors or intracavernous prostaglandin E1 post operatively, could have skewed the results.

Despite these limitations, our findings suggest that RARP for patients ≥ 70 years of age resulted in significantly lower pad-free incontinence (continence) rates compared to slightly younger individuals (66–69 years-old). Nevertheless, three quarters of patients above 70 years of age did achieve full continence 2 years postoperatively.

In conclusion, biological age ≥ 70 years alone should not be a contraindication to RARP. A careful health screening showing a life expectancy exceeding 10 years, in addition to good baseline functional outcome should prompt consideration of radical treatment in the older population. Elderly patients with a more aggressive, high-risk disease still benefit from surgical treatment. Nevertheless, these patients should be informed about inferior postoperative functional outcomes compared to younger individuals, and decision should be taken with the patient after weighing the risks and benefits of the procedure.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflicts of interest.

Ethical approval 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 For this type of study formal consent is not required (retrospective study).

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