Oncological and functional outcomes of 722 robot-assisted radical prostatectomy (RARP) cases: The largest Canadian 5-year experience

Côme Tholomier;[*] Marc Bienz;[*] Pierre-Alain Hueber, MD, PhD;[*] Quoc Dien Trinh, MD, FRCSC;[*] Assaad El Hakim, MD, FRCSC;[†] Naif Alhathal, MD;[†] Thierry Lebeau, MD;[†] Serge Benayoun, MD;[†] Roger Valdivieso, MD;[*] Dan Liberman, MD;[*] Fred Saad, MD, FRCSC;[*] Jean-Baptiste Lattouf, MD, FRCSC;[*] Hugues Widmer, MD;[*] Louis Begin, MD;[§] Mathieu Latour, MD;[¥] Kevin C. Zorn, MD, FRCSC[*]*

[*]Section of Urology, Department of Surgery, Centre Hospitalier de l'Université de Montréal, Montréal, QC; [†]Division of Robotic Urology, Department of Surgery, Hopital du Sacre Coeur de Montreal, Montreal, QC; [§]Department of Pathology, Centre Hospitalier de l'Universite de Montreal, Montreal, QC

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Abstract

Introduction: While RARP (robotic-assisted radical prostatectomy) has become the predominant surgical approach to treat localized prostate cancer, there is little Canadian data on its oncological and functional outcomes. We describe the largest RARP experience in Canada.

Methods: Data from 722 patients who underwent RARP performed by 7 surgeons (AEH performed 288, TH 69, JBL 23, SB 17, HW 15, QT 7, and KCZ 303 patients) were collected prospectively from October 2006 to December 2013. Preoperative characteristics, as well as postoperative surgical and pathological outcomes, were collected. Functional and oncological outcomes were also assessed up to 72 months postoperative.

Results: The median follow-up (Q1-Q3) was 18 months (9-36). The D'Amico risk stratification distribution was 31% low, 58% intermediate and 11% high-risk. The median operative time was 178 minutes (142-205), blood loss was 200 mL (150-300) and the postoperative hospital stay was 1 day (1-23). The transfusion rate was only 1.0%. There were 0.7% major (Clavien III-IV) and 10.1% minor (Clavien I-II) postoperative complications, with no mortality. Pathologically, 445 men (70%) were stage pT2, of which 81 (18%) had a positive surgical margin (PSM). In addition, 189 patients (30%) were stage pT3 and 87 (46%) with PSM. Urinary continence (0-pads/day) returned at 3, 6, and 12 months for 68%, 80%, and 90% of patients, respectively. Overall, the potency rates (successful penetration) for all men at 6, 12, and 24 months were 37%, 52%, and 59%, respectively. Biochemical recurrence was observed in 28 patients (4.9%), and 14 patients (2.4%) were referred for early salvage radiotherapy. In total, 49 patients (8.4%) underwent radiotherapy and/or hormonal therapy.

Conclusions: This study shows similar results compared to other high-volume RARP programs. Being the largest RARP experience in Canada, we report that RARP is safe with acceptable oncologic outcomes in a Canadian setting.

Introduction

Prostate cancer is the most frequently diagnosed cancer in Canadian men, with an incidence of 104 cases/100 000 per year, and with an estimated 23 600 newly cases diagnosed in 2013.[1] In the United States, robotic-assisted radical prostatectomy (RARP) has gained increasing importance in the surgical management of prostate cancer since its first implementation in 2001.[2] In 2009, 61% of these procedures were robotically assisted and in 2013, 69% to 85% of prostatectomies were performed robotically, and a minority by radical retropubic prostatectomy (RRP), perineal prostatectomy (PR) or laparoscopic radical prostatectomy (LRP).[3] In Canada, however, the shift in prostatectomy practice and the growing interest for RARP is more recent, with only 20 active daVinci systems in 2013.

Robotic surgery provides certain inherent advantages, including high definition 3-D vision, magnification, tremor filtration, movement scaling, and wristed instrumentation with 6-degrees of freedom.[4] These features refine the surgeon's dexterity, especially when working in a narrow space like the male pelvis during radical prostatectomy, all with the benefits of pneumoperitoneum to reduce blood loss.

Urinary incontinence and erectile dysfunction are the most common and bothersome side effects following prostatectomy.[5] Recent meta-analyses have shown superior functional outcomes associated with RARP, in addition to the advantages associated with minimally invasive surgery; there are also equivalent oncological outcomes when comparing RARP to open or laparoscopic prostatectomy.[6,7] Unfortunately, very few Canadian centres have reported functionnal and/or oncological outcomes of RARP since most radical prostatectomies were performed with the traditional open technique.[8] The only published Canadian RARP series are by Pautler and colleagues[9] from Western

University in London, Ontario (n = 305) and Al-Hathal and colleagues[10] from our group (n = 250). The purpose of this study is to expand the Canadian robotic prostatectomy literature by reporting an even larger, multi-surgeon experience of RARP with a complete account of functional and oncological outcomes, along with peri- and postoperative complications.

Methods

Between October 2006 and October 2013, 722 RARP were performed by 7 surgeons, in 2 teaching hospitals of the University of Montreal (KCZ performed 303, AEH 288, TH 69, JBL 23, SB 17, HW 15, and QT 7), each with a minimum experience of 200 cases during their specific robotic-fellowship training. Preoperative and perioperative data, as well as surgical outcomes and pathological parameters, were collected. Follow-up prostate-specific antigen (PSA), erectile dysfunction and continence were also encompassed in a comprehensive database. Follow-up was conducted by the same surgeon at 1, 3, 6, 9, 12 months, and then at regular intervals up to 6 years. Data were prospectively collected for all parameters and analyzed retrospectively. Patients were not pre-selected; any patient who was a surgical candidate was offered RARP and only the patients who underwent the whole procedure were included in the study. No men had previous pelvic radiation or neo-adjuvant therapy. We include herein updated data on 250 patients previously published by our group,[10] with 14 months of additional follow-up.

Surgical technique

We have previously reported on our RARP surgical technique.[11-13] Urethral catheter was routinely removed on postoperative day 4 (KCZ) or 7 (AE, SB, TL) without cystogram.

Data collection

After institutional-review board approval, patient demographic and baseline parameters were collected, including PSA, Gleason score, clinical stage, International Prostate Symptoms Score (IPSS) and Sexual Health Inventory for Men (SHIM). Detailed intraoperative data and postoperative complications (<30 days) were recorded on a standardized data collection sheet. Postoperatively, PSA values, IPSS, SHIM and Erection Hardness Score (EHS) scores were collected at each visit. EHS scores are defined as follows: 1 if the penis is larger but not hard; 2 if the penis is hard but not hard enough for penetration; 3 if the penis is hard enough for penetration but not completely hard; and 4 if the penis is completely hard and fully rigid.[14,15]

Continence was assessed by a modified question added to IPSS score "How many pads per 24 hours on average did you use in the past month for urinary incontinence: 0, 1 security liner, 1 pad, 2 pads, 3 pads, 4 or more pads?" We used a strict definition of 0 pads as the definition of continence for analysis.

Patients who had a preoperative SHIM score of 12 to 25 were included in the potency analysis. Potency was defined as the ability to penetrate, with a SHIM score of 17 or more (with at least a score of 3 on question number 2) and/or an EHS ≥3 with or without phosphodiesterase type 5 inhibitors (PDE5-I).[14] Furthermore, patients who underwent inter-fascial bilateral nerve preservation at RARP were also looked at separately.

Positive surgical margin (PSM) was defined as the presence of cancer at the inked margin. All specimens were reviewed by 1 of the 3 dedicated academic uro-pathologists.

Biochemical recurrence (BCR) was defined as a rising PSA >0.20 ng/mL in patients who had an undetectable PSA (<0.10 ng/mL) at the first visit.

Statistical analysis

For each variable, a Shapiro-Wilk's test ($p > 0.05$) and a visual inspection of their histograms, normal Q-Q plots and box plots were used to evaluate their distribution. The IBM SPSS Statistics package (IBM Corporation, version 21, Armonk, NY) was used for analysis. Data were summarized using descriptive statistics. The median followed by the first and third quartiles (Q1-Q3) was used as a measure of central tendency, unless specified otherwise.

Results

Median patient age was 61 (56-65), median body mass index was 27.0 kg/m^2 (25.1-29.6), and the median follow-up was 18 months (9-36). The PSA at the time of diagnosis was 5.5 ng/ml (4.3-7.5) and the transrectal ultrasound (TRUS) prostate volume was 36 mL (28-46). The preoperative Gleason sum ≥7 accounted for 65.4% of our cohort and clinical stage T2 to T3 for 29.6% (Table 1). Of these, 22 had missing values for clinical stage, 10 for Gleason score and many were lost follow-up. The D'Amico risk stratification distribution was 31.0%, 58.2% and 10.8% for low-, mid- and high-risk groups, respectively.

The median operative time was 178 minutes (142-205) with no open or laparoscopic intervention. Estimated blood loss was 200 mL (150-300) and only 5 patients (0.7%) required blood transfusion in the perioperative period. The median catheterization time was 7 days (4-7). The median hospital stay was 1 day (1-23) and 86% of patients were discharged on postoperative day 1. In total, 400 patients (63.0%) had bilateral nerve-sparing surgery, 114 (18.0%) had unilateral nerve sparing and 86 (13.5%) had partial nerve sparing. Only 35 patients (5.5%) had bilateral wide excision of neurovascular bundle and thus non-nerve spar-

Table 1. Demographic and preoperative characteristics

Variable	Group (median)	Q1-Q3	Range
Age (years)	61	56-65	40-76
BMI	27.0	25.1-29.6	17.4-50.5
Preoperative PSA (ng/mL)	5.5	4.3-7.5	0.5-68.0
TRUS prostate volume (mL)	36	28-46	12-149
IPSS	6	3-11	0-35
SHIM	21	16-24	0-25
Biopsy Gleason score	**Frequency (n=712)**	**Rate**	
6	246	34.6%	
7	411	57.7%	
8	43	6.0%	
9	12	1.7%	
Clinical TNM stage	**Frequency (n=700)**	**Rate**	
T1a/1b	3	0.4%	
T1c	490	70.0%	
T2a	186	26.6%	
T2b	17	2.4%	
T3	4	0.6%	

BMI: body mass index; PSA: prostate-specific antigen; TRUS: transrectal ultrasound; IPSS: International Prostate Symptoms Score; SHIM: Sexual Health Inventory for Men.

ing surgery (Table 2). Indications for unilateral and bilateral nerve sparing, and wide excision were previously described by Zorn and colleagues.[16]

There were a total of 7 (0.9%) major (Clavien-III and IV) postoperative (<30 days) complications.[14] All 7 patients had a fully functional recovery. There was no perioperative mortality (Table 3).

The median specimen weight was 46 g (38-57). On final pathology, 25.9% were non-organ confined (≥pT3). The pathological Gleason sum 7 or more accounted for 82.7%, including 10.0% Gleason 8-10. The overall PSM rate was 26.3%. PSM was 18.3% in pT2 and 46.0% in pT3 disease (Table 4).

The rate of urinary continence recovery (0-pads) was 41.7% at 1 month, 68.4% at 3 months, 79.9% at 6 months, 90.4% at 12 months and 91.4% at 24 months (Table 5).

A potency analysis was conducted for all patients with the following preoperative SHIM scores (12-16, 17-21 and 22-25). The potency rates for each score category were (successful penetration with or without medication) 11.1%, 17.7% and 28.3%, respectively at 1 month; 26.2%, 31.4% and 50.0%, respectively at 6 months; 43.3%, 48.5% and 66.9%, respectively at 12 months; and 40.0%, 53.3% and 76.6%, respectively at 24 months (Table 6).

We also considered only the patients who underwent bilateral nerve sparing surgery (SHIM score of 12-16, 17-21, and 22-25). Their potency rates were 20.0%, 18.5% and 37.0%, respectively at 1 month; 33.3%, 35.1% and 50.0%, respectively at 6 months; 62.5%, 58.8% and 72.4%, respectively at 12 months; 55.6%, 60.0% and 84.4%, respectively at 24 months (Table 7).

Table 2. Intraoperative and immediate postoperative parameters

Variable	Group (median)	Q1-Q3
"Robot time" ± SD (minutes)	178	142-205
"Docking time" ± SD (minutes)	14	11-16
"Skin to skin" ± SD (minutes) "Robot time" + "Docking time"	192	153-221
Open or lap conversion	0	
Estimated blood loss ± SD (cc)	200	150-300
Transfusion rate, n (%)	5/722 (0.7%)	
Catheterization time (days)	7	4-7
Hospitalization (days)	1	1-1
Nerve preservation	Frequency (n=635)	Rate
Bilateral NSS	400	63.0%
Unilateral NSS	114	18.0%
Partial NSS	86	13.5%
Non-NSS	35	5.5%

SD: standard deviation; NSS: nerve-sparing surgery.

There were 36 (6.3%) patients with a PSA that did not reach undetectable levels at first visit (PSA <0.1 ng/mL); 11 (1.9%) of them had a PSA higher than 1.0 ng/mL. Of the remaining patients, 28 (4.9%) had biochemical recurrence

Table 3. Intra- and postoperative complications (<30 days)

Clavien classification[14]	n (%)	
		Intraoperative complications
IIIb	13 (1.8)	Bladder/Urethral tear (6), Epigastric vessels injury (3), Rectal injury (2), Small bowel injury (1), Incisional hernia (1)
		Postoperative complications
I	44 (6.1)	Hematoma (9), Pain (6), Bleeding (5), Hematuria (4), Constipation (4), Urine retention (4), Acute renal failure (3), VUA leak (3), Wound dehiscence (2), Urinoma (1), Urinary leak (1), Raynaud's phenomenon (1), Uretric oedema (1)
II	29 (4.0)	Wounds infection (10), Transfusion (5), Ileus (5), Urinary tract infection (3), Trocar infection (1), Epididymo-orchitis (1), Fever treated with IV antibiotics (1), Clot retention requiring irrigation (1), Hematuria requiring irrigation (1), Arrhythmia (1)
IIIb	1 (0.1)	Incisional hernia (1)
IVa	6 (0.8)	Pulmonary embolism (2), Evisceration (2), Myocardial infarction (2)
V	0 (0)	Death (0)

Table 4. Postoperative oncologic outcomes: Pathological characteristics

Variable	Groups (median)	Q1-Q3
Prostate weight (g)	46	38-57
Pathology Gleason score	**Frequency (n=640)**	**Rate**
6	111	17.3%
7	465	72.7%
8	40	6.3%
9	22	3.4%
10	2	0.3%
Pathological staging	**Frequency (n=635)**	**Rate**
pT2a	114	18.0%
pT2b	331	52.1%
pT3a	157	24.7%
pT3b	32	5.0%
pT4	1	0.2%
Positive surgical margin	168/638	26.3%
pT2	81/442	18.3%
pT2a	18/111	16.2%
pT2b	63/331	19.0%
pT3	87/189	46.0%
pT3a	66/157	42.0%
pT3b	21/3	65.6%

(PSA >0.2 ng/mL) at median follow-up of 18 months (range: 9-24) and required either radiotherapy alone or in combination with androgen deprivation therapy (ADT). In addition, there were 14 cases (2.4%) that were electively referred for early salvage radiotherapy for rising PSA that did not reach 0.2 ng/mL. Three patients (0.5%) with undetectable PSA levels at first visit (PSA <0.1 ng/mL) received radiotherapy treatment within 6 months postoperatively. In total, 49 patients (8.4%) were treated with radiotherapy or/and ADT. We stratified these findings using the D'Amico Risk classification (Table 8). The D'Amico risk distribution of all patients was 31.0% low, 58% intermediate and 11% high risk.

Discussion

We report the largest RARP experience in Canada, with a complete account of perioperative, functional and oncological outcomes. The results are analyzed in comparison with the data of other Canadian and international institutions (Table 9).

Table 5. Return of urinary continence (0-pads or 1-security liner) after RARP

Follow-up (months)	0-pad/day n (%)	0 to 1-security pad/day n (%)
1	235/564=41.7%	317/564=56.2%
3	288/421=68.4%	333/421=79.1%
6	315/394=79.9%	353/394=89.6%
9	290/334=86.8%	306/334=91.6%
12	284/314=90.4%	293/314=93.3%
18	229/247=92.7%	233/247=94.3%
24	169/185=91.4%	173/185=93.5%
30	126/135=93.3%	130/135=96.3%
36	99/108=91.7%	102/108=94.4%
48	69/72=95.8%	69/72=95.8%
60	20/22=90.9%	20/22=90.9%

RARP: robot-assisted radical prostatectomy.

In Canada, the daVinci robot was only adopted in 2004. In the context of the Canadian social healthcare system, all the systems were acquired through the aide of private donor foundations with no support from the provincial or federal governments. Thus, both the relatively recent adoption and limited availability associated with Canadian healthcare budgetary constraints underlie the paucity of the national RARP data in the current medical literature.

Urinary incontinence can be the most bothersome side effect following prostatectomy and may be an important source of anxiety for patients early on in the postoperative period.[5,17] A strict definition (0-pads) was used to report the rate of urinary continence. The early continence rate at 3 months was 68.4% and improved to 90.4% at 1 year. Pautler and colleagues reported 70% no-pad use at 1 year.[9] The University of Alberta group reported continence rates post-RRP of 57% at 3 months, and 85% at 12 months (definition of incontinence, >8 g of urine loss on pad test per day).[18] In another prospective study from the same group, a cohort of 239 patients was studied (172 RRP and 67 LRP). According

Table 6. Return of erectile function/successful penetration (≥Grade 3 erection scale) after RARP for all patients

Time (months)	Preoperative SHIM 12-16	Preoperative SHIM 17-21	Preoperative SHIM >21	All patients
1	6/54=11.1%	20/113=17.7%	63/223=28.3%	95/488=19.5%
3	9/44=20.5%	21/87=24.1%	82/178=46.1%	121/385=31.4%
6	11/42=26.2%	27/86=31.4%	87/174=50.0%	139/374=37.2%
9	10/34=29.4%	23/74=31.1%	91/151=60.3%	139/316=44.0%
12	13/30=43.3%	33/68=48.5%	91/136=66.9%	153/292=52.4%
18	12/24=50.0%	27/55=49.1%	80/104=76.9%	136/228=59.6%
24	6/15=40.0%	24/45=53.3%	59/77=76.6%	101/170=59.4%
30	4/10=40.0%	17/31=54.8%	40/50=80.0%	74/121=61.2%

RARP: robot-assisted radical prostatectomy; SHIM: Sexual Health Inventory for Men.

Table 7. Return of erectile function/successful penetration (≥Grade 3 erection scale) after RARP for patients who underwent bilateral nerve sparing surgery

Time (months)	Preoperative SHIM 12-16	Preoperative SHIM 17-21	Preoperative SHIM >21	All patients
1	5/25=20.0%	15/81=18.5%	57/154=37.0%	83/305=27.2%
3	6/18=33.3%	15/55=27.3%	75/122=61.5%	103/229=45.0%
6	8/24=33.3%	20/57=35.1%	63/126=50.0%	114/242=47.1%
9	8/18=44.4%	19/48=39.6%	76/111=68.5%	112/206=54.4%
12	10/16=62.5%	30/51=58.8%	76/105=72.4%	126/203=62.1%
18	8/14=57.1%	25/39=64.1%	71/86=82.6%	115/164=70.1%
24	5/9=55.6%	21/35=60.0%	54/64=84.4%	90/128=70.3%
30	2/5=40.0%	16/25=64.0%	39/45=86.7%	67/94=71.3%

RARP: robot-assisted radical prostatectomy; SHIM: Sexual Health Inventory for Men.

to the 24-hour pad testing, 13% of RRP patients and 17% of LRP patients remained incontinent at 1 year.[19] Even with a stricter definition of continence, the results reported here compare favourably, but are equivalent when compared to the results of a recent meta-analysis on urinary incontinence after RARP from high volume centres worldwide. In this comparison, the weighted mean rate of urinary continence at 12 months was 84% (69-96) using the no-pad definition.[6]

In the era of PSA screening, younger patients with good functional status are being diagnosed with prostate cancer.[20] Therefore, all efforts are made to preserve and maximize quality of life in the postoperative period. In the current cohort, 63.0% of patients had bilateral, 18.0% unilateral and 13.5% partial nerve-sparing surgery. The potency rates were 37.2% at 6 months, 52.4% at 12 months, and 59.4% at 24 months. Coelho and colleagues performed a meta-analysis on potency after RARP from pooled literature of centres of excellence.[21] The weighted mean potency rates were 61.1%, 71.2% and 94% at 6, 12 and >18 months, respectively. It is worth noting that more than 75% of these patients were previously potent men (considered as SHIM ≥21). Although a higher rate of phosphodiesterase inhibitor prescription may have played a role, the main likely factors explaining this difference in potency rate may be related to patient selection, comorbidities, use and motivation of penile rehabilitation, and technical aspects of the nerve-sparing technique (interfascial vs. extrafascial plane, traction injury during dissection and thermal vs. athermal clip use during vascular pedicle control).[16,22,23]

Table 8. Follow-up PSA analysis stratified by D'Amico Risk (low, medium and high)

D'Amico Risk	Low	Medium	High
Radiotherapy treatment/ADT (n=49)	3	34	12
Rate	6.1%	69.4%	24.5%
Mean postoperative time when therapy started (months)	44	16	11
BCR (n=28)	1	21	6
Rate	3.6%	75.0%	21.4%
Mean postoperative time when BCR diagnosed (months)	3	21	23
Early salvage radiotherapy (n=14)	3	7	4
Rate	21.4%	50.0%	28.6%
Mean postoperative time when therapy started (months)	44	19	8
PSA >0.1 at first visit (n=36)	5	20	11
Rate	13.9%	55.6%	30.5%

ADT: androgen deprivation therapy; PSA: prostate-specific antigen; BCR: biochemical recurrence.

In this study, a total of 80 postoperative complications were noted including, 1.0% major and 10.1% minor according to Clavien classification. This is comparable to Pautler and colleagues' study. They recorded 70 complications in 350 RARP cases, 7.5% major and 15.4% minor; overall, 5.2% of their cases required further intervention.[9] The mean hospital stay of 1.3 days reported in our study matched large RARP series in the United States, but is lower compared to other Canadian series of LRP (3.4 days)[24] and RARP (3 days).[9] Badani and colleagues analyzed 2766 RARP procedures at a single institution. They reported an overall complication rate of 12.2%, of which 0.6% were major and 11.7% minor according to Clavien classification.[25]

With regards to surgical pathology outcomes, the overall PSM rate was 26.3%, subdivided into 18.3% for pT2 and 46.0% for pT3 disease. This is consistent with other Canadian reports, such as Fradet and colleagues from Quebec City. They reported an overall PSM rate of 34.5% in 1712 RRP, with 38.1% for pT2 and 52.7% for pT3 disease.[26] Similarly, Corcoran and colleagues reported a 24.4% PSM rate, with 16.5% for pT2 and 46% for pT3, in 1514 patients who underwent RRP from a combined series of the University of British Columbia and the University of Melbourne.[27] In our series, the overall PSM rate was affected in part due to a higher rate of PSM observed during the initial experience and associated with the surgeon-learning curve. Furthermore, the more aggressive nerve-sparing approach adopted by some surgeons to maximize potency and continence may have also contributed to the PSM.

In contrast, Pautler and colleagues reported an overall PSM rate of 16.1% in their cohort of low- to intermediate-

Table 9. Functional and oncological outcomes in contemporary series of open, laparoscopic and RARP

Series	Technique	n	Mean follow-up (months)	Overall PSM rate (pT2 PSM, pT3 PSM) (%)	Intercourse at 1 year (%)	Pad-free at 1 year (%)	BCR at 1 year (%)
Rabbani et al.[31]	Open	225	12	NA	42	NA	NA
Schover et al.[32]	Open	240	52	NA	NA	NA	NA
Guillonneau et al.[33]	Laparoscopic	550	36	16.7 (11.9, 36.7)	66	82	14
Hoznek et al.[34]	Laparoscopic	134	12	25 (16.8, 48.8)	5.6	86	11
Rassweiler et al.[35]	Laparoscopic	438	12	22 (7.0, 35.4)	NA	90	13.2
Stolzenburg et al.[36]	Laparoscopic	70	12	21 (6.1, 35.1)	33 (6 months)	90 (6 months)	NA
Hara et al.[37]	Laparoscopic/open	52	6	NA	NA	NA	NA
Ahlering et al.[38]	RARP	60	9	17 (4.5, 50)	33 (9 months)	76 (3 months)	NA
Patel et al.[39]	RARP	200	9.7	10.5 (5.7, 28.5/20)	NA	98	5
Bentas et al.[40]	RARP	40	15	30 (8.0, 67)	22	84 (15 months)	NA
Menon et al.[41]	RARP	200	7.9	6 (3)	68	90	4
Tewari et al.[42]	RARP	530	12	9	78	98	4
Kaul et al.[43]	RARP	154	12	6.4 (4.6)	96	97	0
Present study	RARP	722	18	26.3 (18.3, 46.0)	52.4	90.4	2.1

RARP: robot-assisted radical prostatectomy; PSM: positive surgical margin; BCR: biochemical; *Table was reproduced and modified with courtesy Kaul et al.[43]

risk RARP, with 10.2% for pT2 and 32% for pT3.[9] In Ontario, the median province-wide PSM rate for pT2 disease was 33% among 43 hospitals, with RRP volumes ranging from 12 to 625, with no differences between community and teaching hospitals.[28] A group from the University of Toronto reported an overall 20.8% PSM in 1268 men who underwent RRP from 1992 to 2008.[29]

It is important to note that this present experience has met the goals established by the Cancer Care Ontario guidelines on radical prostatectomy, namely PSM rate of <25% for pT2 disease, a mortality rate of <1%, rectal injury rate of <1% and blood transfusion rates of <10%.[30]

This work has several limitations besides bias associated with a single-institution study. The fact that this is a single-institution experience and that the postoperative data were obtained by the use of charts could have underestimated the complications rate, mainly for minor ones (such as hematoma, hematuria or even urinary tract infections); patients could have gone to another hospital or clinic for treatment. However, most patients had access through email to their surgeon and most often communicated any adverse event for medical charting and data collection, thus favouring relatively reliable results.

Conclusion

Our results compare favourably with other global high-volume RARP centres of excellence, despite initial difficulties and the fact that we operated mostly on intermediate- to high-risk patients. To date, this represents the largest Canadian experience published, which confirms that RARP is feasible and provides favourable oncological outcomes with the benefits of reduced morbidity in the Canadian medical system.

Competing interests: Mr. Tholomier, Mr. Bienz, Dr. Hueber, Dr. El Hakim. Dr. Alhathal, Dr. Lebeau, Dr. Benayoun, Dr. Valdivieso, Dr. Liberman, Dr. Widmer, Dr. Bégin and Dr. Latour all declare no competing financial or personal interests. Dr. Saad and Dr. Lattouf are Advisory Board members for Amgen, Astellas, Janssen, Abbott, Sanofi and Bayer. They have also received research grants and honoraria from Amgen, Astellas, Janssen, Abbott, Sanofi and Bayer. They have also participated in clinical trials in the past 2 years for Amgen, Astellas, Janssen, Sanofi and Bayer. Dr. Zorn is an advisor, speaker, and proctor for Greenlight laser surgery from AMS. Dr. Trinh received honorarium from Intuitive Surgical in the past.

This paper has been peer-reviewed.

References

1. Canadian Cancer Society's Advisory Committee on Cancer Statistics. Canadian Cancer Statistics 2013. Toronto, ON: Canadian Cancer Society; 2013.
2. Abbou CC, Hoznek A, Salomon L. et al. Laparoscopic radical prostatectomy with a remote controlled robot. *J Urol* 2001;165(6 Pt 1):1964-6.
3. Trinh QD, Sammon J, Sun M, et al. Perioperative outcomes of robot-assisted radical prostatectomy compared with open radical prostatectomy: Results from the nationwide inpatient sample. *Eur Urol* 2012;61:679-85. http://dx.doi.org/10.1016/j.eururo.2011.12.027
4. Berryhill Jr R., Jhaveri J, Yadav R, et al. Robotic prostatectomy: A review of outcomes compared with laparoscopic and open approaches. *Urology* 2008;72:15-23. http://dx.doi.org/10.1016/j.urology.2007.12.038
5. Miller DC, Sanda MG, Dunn RL, et al. Long-term outcomes among localized prostate cancer survivors: Health-related quality-of-life changes after radical prostatectomy, external radiation, and brachytherapy. *J Clin Oncol* 2005;23:2772-80. http://dx.doi.org/10.1200/JCO.2005.07.116
6. Ficarra V, Novara G, Rosen RC, et al. Systematic review and meta-analysis of studies reporting urinary continence recovery after robot-assisted radical prostatectomy. *Eur Urol* 2012;62:405-17. http://dx.doi.org/10.1016/j.eururo.2012.05.045

7. Rocco B, Matei DV, Melegari S, et al. Robotic vs open prostatectomy in a laparoscopically naive centre: A matched-pair analysis. *BJU Int* 2009;104:991-5. http://dx.doi.org/10.1111/j.1464-410X.2009.08532.x
8. Grover SA, Coupal L, Zowall H, et al. The economic burden of prostate cancer in Canada: Forecasts from the Montreal Prostate Cancer Model. *CMAJ* 2000;162:987-92.
9. Fuller A, Pautler SE. Complications following robot-assisted radical prostatectomy in a prospective Canadian cohort of 305 consecutive cases. *Can Urol Assoc J* 2013;7:116-21. http://dx.doi.org/10.5489/cuaj.11116. Epub 2012 March 2.
10. Al-Hathal N, El-Hakim A. Perioperative, oncological and functional outcomes of the first robotic prostatectomy program in Quebec: Single fellowship-trained surgeon's experience of 250 cases. *Can Urol Assoc J* 2013;7:326-32. http://dx.doi.org/10.5489/cuaj.319
11. Zorn KC, Widmer H, Lattouf JB, et al. Novel method of knotless vesicourethral anastomosis during robot-assisted radical prostatectomy: Feasibility study and early outcomes in 30 patients using the interlocked barbed unidirectional V-LOC180 suture. *Can Urol Assoc J* 2011;5:188-94. http://dx.doi.org/10.5489/cuaj.10194
12. Valdivieso RF, Hueber PA, Zorn KC, et al. Robot assisted radical prostatectomy: How I do it. Part II: Surgical technique. *Can J Urol* 2013;20:7073-8.
13. Valdivieso, R.F., P.A. Hueber, and K.C. Zorn, Robot assisted radical prostatectomy: how I do it. Part I: Patient preparation and positioning. *Can J Urol* 2013;20:6957-61.
14. El-Hakim A, Leung RA, Richstone L, et al. Athermal robotic technique of prostatectomy in patients with large prostate glands (>75 g): Technique and initial results. *BJU Int* 2006;98:47-9. http://dx.doi.org/10.1111/j.1464-410X.2006.06252.x
15. Cappelleri JC, Bushmakin AG, Symonds T, et al. Scoring correspondence in outcomes related to erectile dysfunction treatment on a 4-point scale (SCORE-4). *J Sex Med* 2009;6:809-19. http://dx.doi.org/10.1111/j.1743-6109.2008.01155.x
16. Zorn KC, Gofrit ON, Steinberg GP, et al. Planned nerve preservation to reduce positive surgical margins during robot-assisted laparoscopic radical prostatectomy. *J Endourol* 2008;22:1303-9. http://dx.doi.org/10.1089/end.2008.0009
17. Penson DF, McLerran D, Feng Z, et al. 5-year urinary and sexual outcomes after radical prostatectomy: results from the prostate cancer outcomes study. *J Urol* 2005;173:1701-5. http://dx.doi.org/10.1097/01.ju.0000154637.38262.3a
18. Moore KN, Truong V, Estey E, et al. Urinary incontinence after radical prostatectomy: Can men at risk be identified preoperatively? *J Wound Ostomy Continence Nurs* 2007;34:270-9; quiz 280-1. http://dx.doi.org/10.1097/01.WON.0000270821.91694.56
19. Jacobsen NE, Moore KN, Estey E, et al. Open versus laparoscopic radical prostatectomy: A prospective comparison of postoperative urinary incontinence rates. *J Urol* 2007;177:615-9. http://dx.doi.org/10.1016/j.juro.2006.09.022
20. Pelzer AE, Tewari A, Bektic J, et al. Detection rates and biologic significance of prostate cancer with PSA less than 4.0 ng/mL: Observation and clinical implications from Tyrol screening project. *Urology* 2005;66:1029-33. http://dx.doi.org/10.1016/j.urology.2005.05.025
21. Coelho RF, Chauhan S, Palmer KJ, et al. Robotic-assisted radical prostatectomy: A review of current outcomes. *BJU Int* 2009;104:1428-35. http://dx.doi.org/10.1111/j.1464-410X.2009.08895.x
22. Shikanov S, Woo J, Al-Ahmadie H, et al. Extrafascial versus interfascial nerve-sparing technique for robotic-assisted laparoscopic prostatectomy: Comparison of functional outcomes and positive surgical margins characteristics. *Urology* 2009;74:611-6. http://dx.doi.org/10.1016/j.urology.2009.01.092
23. Karakiewicz PI, Tanguay S, Kattan MW, et al. Erectile and urinary dysfunction after radical prostatectomy for prostate cancer in Quebec: A population-based study of 2415 men. *Eur Urol* 2004;46:188-94. http://dx.doi.org/10.1016/j.eururo.2004.04.020
24. Al-Shaiji TF, Kanaroglou N, Thoma A, et al. A cost-analysis comparison of laparoscopic radical prostatectomy versus open radical prostatectomy: The McMaster Institute of Urology experience. *Can Urol Assoc J* 2010;4:237-41. http://dx.doi.org/10.5489/cuaj.09166
25. Badani KK, Kaul S, Menon M. Evolution of robotic radical prostatectomy: Assessment after 2766 procedures. *Cancer* 2007;110:1951-8. http://dx.doi.org/10.1002/cncr.23027
26. Mauermann J, Fradet V, Lacombe L, et al. The impact of solitary and multiple positive surgical margins on hard clinical end points in 1712 adjuvant treatment-naive pT2-4 N0 radical prostatectomy patients. *Eur Urol* 2013;64:19-25. http://dx.doi.org/10.1016/j.eururo.2012.08.002
27. Corcoran NM, Hovens CM, Metcalfe C, et al. Positive surgical margins are a risk factor for significant biochemical recurrence only in intermediate-risk disease. *BJU Int* 2012;110:821-7. http://dx.doi.org/10.1111/j.1464-410X.2011.10868.x
28. Lawrentschuk N, Evans A, Srigley J, et al. Surgical margin status among men with organ-confined (pT2) prostate cancer: A population-based study. *Can Urol Assoc J* 2011;5:161-6. http://dx.doi.org/10.5489/cuaj.10085
29. Alkhateeb S, Alibhailow A, Fleshner N, et al. Impact of positive surgical margins after radical prostatectomy differs by disease risk group. *J Urol* 2010;183:145-50. http://dx.doi.org/10.1016/j.juro.2009.08.132
30. Chin JL, Srigley J, Mayhew LA, et al. Guideline for optimization of surgical and pathological quality performance for radical prostatectomy in prostate cancer management: Evidentiary base. *Can Urol Assoc J* 2010;4:13-25. http://dx.doi.org/10.5489/cuaj.08105
31. Rabbani F, Scardino P. Time course of recovery of potency after bilateral nerve sparing radical prostatectomy. J Urol 2004;171(Suppl):310.
32. Schover LR, Fouladi RT, Warneke CL, et al. Defining sexual outcomes after treatment for localized prostate carcinoma. *Cancer* 2002;95:1773-85. http://dx.doi.org/10.1002/cncr.10848
33. Guillonneau B, Cathelineau X, Doublet JD, et al. Laparoscopic radical prostatectomy: Assessment after 550 procedures. *Crit Rev Oncol Hematol* 2002;43:123-33. http://dx.doi.org/10.1016/S1040-8428(02)00024-0
34. Hoznek A, Salomon L, Olsson LE, et al. Laparoscopic radical prostatectomy. The Creteil experience. *Eur Urol* 2001;40:38-45. http://dx.doi.org/10.1159/000049747
35. Rassweiler J, Schulze M, Teber D, et al. Laparoscopic radical prostatectomy: Functional and oncological outcomes. *Curr Opin Urol* 2004;14:75-82. http://dx.doi.org/10.1097/00042307-200403000-00005
36. Stolzenburg JU, Do M, Rabenal R, et al. Endoscopic extraperitoneal radical prostatectomy: Initial experience after 70 procedures. *J Urol* 2003;169:2066-71. http://dx.doi.org/10.1097/01.ju.0000067220.84015.8e
37. Hara I, Kawabata G, Miyake H, et al. Comparison of quality of life following laparoscopic and open prostatectomy for prostate cancer. *J Urol* 2003;169:2045-8. http://dx.doi.org/10.1097/01.ju.0000063961.99940.6c
38. Ahlering TE, Woo D, Eichel L, et al. Robot-assisted versus open radical prostatectomy: a comparison of one surgeon's outcomes. *Urology* 2004;63:819-22. http://dx.doi.org/10.1016/j.urology.2004.01.038
39. Patel VR, Tully AS, Holmes R, et al. Robotic radical prostatectomy in the community setting–the learning curve and beyond: Initial 200 cases. *J Urol* 2005;174:269-72. http://dx.doi.org/10.1097/01.ju.0000162082.12962.40
40. Bentas W, Wolfram M, Jones J, et al. Robotic technology and the translation of open radical prostatectomy to laparoscopy: The early Frankfurt experience with robotic radical prostatectomy and one year follow-up. *Eur Urol* 2003;44:175-81.
41. Menon M, Tewari A, Baize B, et al. Prospective comparison of radical retropubic prostatectomy and robot-assisted anatomic prostatectomy: The Vattikuti Urology Institute experience. *Urology* 2002;60:864-8. http://dx.doi.org/10.1016/S0090-4295(02)01881-2
42. Tewari A, Kaul S, Menon M. Robotic radical prostatectomy: A minimally invasive therapy for prostate cancer. *Curr Urol Rep* 2005;6:45-8. http://dx.doi.org/10.1007/s11934-005-0066-6
43. Kaul S, Savera A, Badani K, et al. Functional outcomes and oncological efficacy of Vattikuti Institute prostatectomy with Veil of Aphrodite nerve-sparing: An analysis of 154 consecutive patients. *BJU Int* 2006;97:467-72. http://dx.doi.org/10.1111/j.1464-410X.2006.05990.x

Correspondence: Dr. Kevin Zorn, University of Montréal Hospital Centre, 235 Boul. Rene Levesque East, Suite 301, Montréal, QC H2X 1N8; zorn.chumurology@gmail.com