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<td><strong>Author(s)</strong></td>
<td>Yip, SKH; Yee, CH; Ng, CF; Lam, NY; Ho, KL; Ma, WK; Li, CM; Hou, SM; Tam, PC; Yiu, MK; Fan, CW</td>
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Robot-Assisted Radical Prostatectomy in Hong Kong: 
A Review of 235 Cases

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Abstract

Objectives: To report the outcome of all robot-assisted laparoscopic radical prostatectomy (RALP) in the public health care system in Hong Kong.

Patients and Methods: All patients who underwent RALP in the public health care system with at least 1 year of follow-up were evaluated. Data analysis included age, body mass index, preoperative prostate-specific antigen (PSA) level, D’Amico risk category, operative details, pathologic stage, follow-up continence, potency, and biochemical recurrence.

Results: Between 2005 and 2009, 235 patients underwent RALP, with a mean age of 66.4 ± 5.9 years and a mean preoperative PSA level of 11.0 ± 10.5 ng/mL. Complications were 16 (7%) in total. There were 176 (74.9%) patients with pT2 disease and 55 (23.4%) patients with pT3 disease. The overall rate of positive surgical margins (PSM) was 20.7%. At postoperative 12 months, 72.5% of the patients were pad free. For those 83 preoperative potent patients having nerve-sparing surgery, the overall trifecta rate at 12 months was 37.3%. Multivariate analysis identified that pathologic T staging was significantly associated with PSM, with an odds ratio (OR) of 7.884 (95% confidence interval [CI]: 3.576–17.379; \( P < 0.001 \)) for the pT3 group compared with the pT2 group. When comparing D’Amico medium- and high-risk categories with low-risk categories, they were found to be significantly associated with biochemical failure (medium- compared with low-risk: OR = 3.536, 95% CI: 1.253–10.173, \( P = 0.016 \); high- compared with low-risk: OR = 10.214, 95% CI: 2.958–35.274, \( P < 0.001 \)).

Conclusions: Our data demonstrate the feasibility, safety, and efficacy of RALP in low-to-intermediate volume centers. Our early oncologic outcomes were significantly correlated with pathologic stage and D’Amico risk stratification.

Introduction

Prostate cancer is the second most common cancer in the world, with a world age-standardized rate of 28 per 100,000.1 While the Western nations have a higher incidence of prostate cancer, it is increasing rapidly in Asian countries because of a more westernized lifestyle.2 In Hong Kong, prostate cancer is currently the third most common cancer in men and ranks fifth in cancer mortality.3

For localized prostate cancer, radical prostatectomy (RP) remains the standard for long-term cure.4 In an effort to reduce morbidity of open RP, Schuessler and associates5 first described a minimally invasive surgical approach to treat patients with prostate cancer with laparoscopic RP in 1997. The subsequent introduction of the da Vinci® Surgical System (Intuitive Surgical, Sunnyvale, CA) paved the breakthrough in minimally invasive prostatectomy. With the promise of improved ergonomics and a shortened learning curve that accompany the da Vinci Surgical System, robot-assisted laparoscopic radical prostatectomy (RALP) is rapidly gaining acceptance in the urologic community.6

RALP is blossoming in Asia as well as in the West. Since the implementation of robotics in the Asian region, a dramatic increase in the number of RALP has been seen.7 This "halo effect," as referred to by Sung and colleagues,8 contributes to the evolution of robotic surgical techniques into maturity in the region. Hong Kong had its first robotic system installed in 20059 and is among the first few cities in Asia that acquired such technology. While most of the RALP in the West are performed in the context of a private insurance scheme, the

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Patients and Methods

There are a total of five da Vinci Surgical Systems for clinical use in Hong Kong. Four of them are being used in the public sector in four different hospitals. They were introduced between 2005 and 2009. We evaluated all patients who underwent RALP in the public health care system with at least 1 year of follow-up.

All surgeons who were involved in the series were proficient in laparoscopic surgery, and some had previous robotic experience in other localities. The majority of cases were performed using the six-port technique. All adopted the transperitoneal approach. The general criteria for considering a nerve-sparing procedure were potent patients in the low to moderate D’Amico risk category. The final decision also involved patient preference and the intraoperative condition. Most of the nerve-sparing procedures were performed with the interfascial technique. A few cases were performed intrafascially. The vesicourethral anastomosis was created using continuous running suture as originally described by van Velthoven and coworkers.

Data collection included age, body mass index (BMI), preoperative prostate-specific antigen (PSA) level, D’Amico risk category, operative details, postoperative course, pathologic stage, follow-up continence, potency, and biochemical recurrence. Follow-up protocols across the four centers were similar. Clinical outcome of patients at postoperative 3, 6, and 12 months were reviewed. Continence status was classified into four groups: (1) Pad free, (2) use of one pad for security or occasional stress incontinence, (3) two to three pads per day, and (4) four or more pads per day. Potency was defined as the ability to achieve and maintain satisfactory erections firm enough for sexual intercourse for more than 50% of times, with or without the use of oral phosphodiesterase type 5 inhibitors. Biochemical recurrence was defined as two consecutive values of PSA >0.2 ng/mL.

Descriptive statistics were used to characterize the clinical characteristics of the study cohort. Univariate and multivariate logistic regression analyses were performed to identify clinical covariates that were significantly associated with surgical margin status, erectile function status, continence status, and biochemical recurrence. Odds ratios (ORs) and their associated 95% confidence interval (CI) were estimated. P values < 0.05 were considered statistically significant. SPSS software package version 17 (SPSS Inc, Chicago, IL) was used for all calculations.

Results

Between November 2005 and December 2009, 235 consecutive patients underwent RALP in the public sector in Hong Kong. Patient characteristics are outlined in Table 1. Median follow-up time was 20 months. The majority of the cohort belonged to the D’Amico low-risk category (65%). About half of the patients were potent preoperatively.

Table 1 summarizes the perioperative parameters. Among the 235 cases, 64 cases underwent pelvic lymphadenectomy. Mean operative time was 362±124 mins. Mean estimated blood loss was 626±657 mL. Four patients needed open conversion in our series; two of the procedures were converted for hemostasis purposes, and the other two because of the dense adhesion encountered during dissection. Mean hospital stay and mean catheter time were 7±4 days and 13±6 days, respectively.

Complications were 16 (7%) in total and comprised 6 anastomotic leakages (2.6%), 3 deep vein thrombosis (DVT) (1.3%), 3 wound infection (1.3%), 1 rectal perforation (0.4%), 1 urethral stricture (0.4%), 1 lymphocele (0.4%), and 1 pulmonary embolism (0.4%). The patient with pulmonary embolism was about to be discharged when a sudden postoperative event developed on postoperative day 9 and he succumbed.

Histopathologic analysis of the RALP specimen found a mean prostate weight of 49.4±20.8 g (Table 2). There were 176 (74.9%) patients with pT2 disease while 55 (23.4%) patients had pT3 disease. The overall rate of positive surgical margin (PSM) was 20.7%. In the subcategorical analysis review, pT2 patients and pT3 patients had a PSM rate of 12% and 41%, respectively. At postoperative 12 months, 72.5% of the patients were pad-free (Table 3). For those 83 preoperative
potent patients who underwent nerve-sparing surgery (including unilateral nerve-sparing RALP), 31 (37.3%) patients remained potent at postoperative 12 months (Table 4). In the cohort of these 83 patients, the overall trifecta rate (pad free, potent, no biochemical recurrence) at 12 months was 37.3%.

Among the 235 cases, 29 (12.3%) patients were given adjuvant therapies. These adjuvant therapies included radiotherapy (n=18), antiandrogen (n=1), surgical (n=4), and medical castration (n=6).

While no correlation was found between nerve sparing and PSM, multivariate analysis with logistic regression identified that pathologic T staging was significantly associated with PSM, with an OR of 7.884 (95% CI: 3.576–17.379; P < 0.001) for pT3 group compared with the pT2 group (Table 5). There was a negative correlation between prostate specimen weight and PSM, with an OR of 0.972 (95% CI: 0.950–0.994; P = 0.013).

D’Amico risk stratification had an implication on biochemical recurrence and surgical margin status. When comparing medium- and high-risk categories with low-risk categories, they were found to be significantly associated with biochemical failure (medium- compared with low-risk: OR = 3.536, 95% CI: 1.253–10.173, P = 0.016; high- compared with low-risk: OR = 10.214, 95% CI: 2.958–35.274, P < 0.001).

**Discussion**

Since the first robot-assisted laparoscopic radical prostatectomy performed by Binder and Kramer in 2000, RALP has become a popular approach for the management of prostate cancer in many regions. While the da Vinci robotic system offers several advantages for surgeons, including 10x magnification with three-dimensional stereoscopic optics and end-of-wrist instrument with 7 degrees of freedom in range of motion, its expensive implementation cost has been a concern to many centers. Contrary to other regions, the four robotic surgery systems in the public sector in Hong Kong were donated initially as charity and run subsequently by receiving support from the public health care system. Robotic surgery in Hong Kong thus carries a low price tag for patients, although not necessarily for the whole health care system.

Oncologic outcome would definitely be one of the main interests during the evaluation of any cancer surgery. The parameters for such assessment include overall survival, disease-specific survival, and biochemical recurrence-free survival, which is commonly defined as a PSA level <0.2 ng/mL. Not all of these parameters are applicable, however, in the comparison between an RALP series and an open RP series at this junction, where the latter had 15-year outcome data available. Biochemical recurrence and surgical margin status are thus often used as surrogates for cancer control when evaluating oncologic efficacy.

The largest series of RALP to date was reported by Badani and colleagues from the Henry Ford Center in Detroit. It involved 2766 patients with a follow-up of up to 5 years. In their series, they reported a PSA recurrence of 7.27%. Among pT2 and pT3 patients, the rates of PSM were 13% and 35%, respectively. Patel and associates evaluated a single-surgeon experience of 1500 consecutive RALP, and reported a PSM rate of 4% for pT2 and 34% for pT3.

Our series had a PSM rate of 12% for pT2 and 41% for pT3, and an overall PSM rate of 20.7%. These figures fell within the range of previous reports in the literature, which showed a mean overall PSM rate of 15.2% (range of means 9.3%–33%), a mean PSM rate for pT2 of 9.6% (range of means 2.5%–18%), and a mean PSM rate for pT3 of 37.1% (range of means 20.9%–53.8%).

A higher T stage of the tumor has been implicated to have a higher risk for PSM in the open RP series. There were very few reports in the literature on this subject for RALP, however. Weizer and coworkers reviewed a cohort of 633 patients, consisting of both open prostatectomy and RALP. It showed that patients with a lower pathologic stage (pT2) had a lower risk of PSM compared with patients with pT3 or more disease. In a study by Ham and associates, the authors noted that there was a significant difference in PSM rate between clinically localized and locally advanced prostate cancer (48% vs 59% respectively, P < 0.001). Our finding of pathologic T stage being significantly associated with PSM rate in RALP would complement the

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**Table 2. Oncologic Outcome**

<table>
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<tr>
<th>Parameter</th>
<th>Value</th>
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<tr>
<td>Mean prostate specimen weight, g±SD</td>
<td>49.4±20.8</td>
</tr>
<tr>
<td>Pathological T stage (n)</td>
<td></td>
</tr>
<tr>
<td>T2 (n)</td>
<td>176 (74.9%)</td>
</tr>
<tr>
<td>T3 (n)</td>
<td>55 (23.4%)</td>
</tr>
<tr>
<td>T4 (n)</td>
<td>4 (1.7%)</td>
</tr>
<tr>
<td>Prostate specimen Gleason score</td>
<td></td>
</tr>
<tr>
<td>6 (n)</td>
<td>144 (61.3%)</td>
</tr>
<tr>
<td>7 (n)</td>
<td>63 (26.8%)</td>
</tr>
<tr>
<td>8 (n)</td>
<td>15 (6.4%)</td>
</tr>
<tr>
<td>9 (n)</td>
<td>6 (2.6%)</td>
</tr>
<tr>
<td>Positive surgical margin (n)</td>
<td></td>
</tr>
<tr>
<td>T2 (n)</td>
<td>47 (20.7%)</td>
</tr>
<tr>
<td>T3 (n)</td>
<td>21</td>
</tr>
<tr>
<td>T4 (n)</td>
<td>26</td>
</tr>
<tr>
<td>Overall biochemical recurrence (n)</td>
<td>22 (9.4%)</td>
</tr>
<tr>
<td>D’Amico low risk (n)</td>
<td>7</td>
</tr>
<tr>
<td>D’Amico medium risk (n)</td>
<td>9</td>
</tr>
<tr>
<td>D’Amico high risk (n)</td>
<td>6</td>
</tr>
<tr>
<td>Mean biochemical recurrence time, months±SD</td>
<td>18±11</td>
</tr>
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SD = standard deviation.

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**Table 3. Continence Outcome**

<table>
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<tr>
<th>Parameter</th>
<th>3 mos</th>
<th>6 mos</th>
<th>12 mos</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pad-free (n)</td>
<td>98 (42.4%)</td>
<td>138 (60.8%)</td>
<td>166 (72.5%)</td>
</tr>
<tr>
<td>Occasional incontinence (n)</td>
<td>60 (26.0%)</td>
<td>35 (15.4%)</td>
<td>22 (9.6%)</td>
</tr>
<tr>
<td>2–3 pads per day (n)</td>
<td>43 (18.6%)</td>
<td>35 (15.4%)</td>
<td>24 (10.5%)</td>
</tr>
<tr>
<td>4 or more pads per day (n)</td>
<td>30 (13.0%)</td>
<td>19 (8.4%)</td>
<td>17 (7.4%)</td>
</tr>
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**Table 4. Erectile Function Outcome of Preoperative Potent Patients**

<table>
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<th>Parameter</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Preoperative potent patients undergoing nerve-sparing RALP (n)</td>
<td>83</td>
</tr>
<tr>
<td>Postoperative 1-year potent patients (n)</td>
<td>31 (37.3%)</td>
</tr>
<tr>
<td>Number of patients on PDE5 inhibitor (n)</td>
<td>45 (54.2%)</td>
</tr>
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RALP = robot-assisted laparoscopic prostatectomy; PDE5 = phosphodiesterase type.
current reports in the literature. Furthermore, we demonstrated that D’Amico risk stratification was associated with biochemical failure in our cohort. The low-risk group was significantly better than those of medium- and high-risk groups. While this supports the D’Amico risk stratification as an effective predictor of early outcomes after RALP, our study is among the first few to evaluate the significance of risk stratification on early outcomes in a robotic cohort.

Besides complete removal of the cancer, recovery of potency and urinary continence are the other two long-term goals of RP. Potency is not easy to evaluate because there is significant variation in the literature as to the definition of potency after RP. A systemic review reported that at 12-month follow-up, potency rates ranged from 20% to 97%. Our series reported a 12-month potency rate of 37.3%. While a lack of universal potency definition may render it difficult to compare our data with other cohorts, a few factors may account for our relatively low potency rate. Mulhall and colleagues demonstrated that postoperative early penile rehabilitation significantly increased the likeliness of achieving functional erections. The investigation by Rogers and coworkers found that younger men had earlier return of sexual function and higher overall potency rates at 1 year after RALP. In our locality, an early penile rehabilitation program is not yet available. Furthermore, data from the multi-institutional study do not support the administration of prophylactic heparin to all patients undergoing RP, in view of its minimal benefit with an increased complication rate. Based on current evidence, such judicious use of heparin is being adopted by the authors of this article.

The concurrent assessment of cancer-free, continence, and potency was termed “trifecta,” after Salomon and coworkers first reported their functional and oncologic outcomes combined in their series of open, laparoscopic, and perineal prostatectomy. There were very scarce reports of trifecta outcome in RALP patients in the literature. Such an account was first made by Shikanov and associates, who reported a trifecta rate of 44% at 12 months after RALP. In our series, the trifecta rate is 37.3% at 12 months. As previously illustrated, study designs and criteria for continence and potency often lack consistency. This may prevent us from directly comparing our results with other larger series—for example, Patel and colleagues, who achieved a trifecta rate of 86% at 12 months. Furthermore, the larger RALP series in the literature were often the report of a few high-volume surgeons. While some suggested that the learning curve was adequately developed after 25 to 45 cases of RALP, there is evidence that the learning curve issue is much more complex, and individual surgeon results continue to improve up to 100 cases and beyond. Because only one center had performed more than 100 cases of RALP in our series, an accurate and comprehensive observation on the matter of learning curve in our series may be difficult.

When we reviewed the operative time, all except one center had a decrease in mean operative time when comparing the initial 50% of the cases with the later 50%. This may serve as an indicator of showing a gradual mastering of the technique on the way and may imply being able to overcome the learning curve when cases accumulate. Although the implementation of the da Vinci robotic system is gaining popularity rapidly, most urologists performed much fewer prostatectomies than those high-volume surgeons quoted in the literature. Thus, our account of RALP may be more applicable to most institutions, which belong to the category of low-to-moderate volume center.

While the cost of robotic surgery is one of the issues that concerns health institutes, surgeons, and patients, we have not explored this aspect in the current study. In terms of cost analysis, there are two aspects to be considered. On the one hand, the cost of robotic surgery is significantly higher than that of open or laparoscopic surgery. On the other hand, the cost of robotic surgery is significantly lower than that of open surgery. Therefore, the cost of robotic surgery is a complex issue that requires further exploration.
hand, there are the additional implementation cost, maintenance cost, consumables cost, and maybe a longer operative time in certain aspects. These factors have also been elaborated by Barbash and associates. On the other hand, the key attributes of robotic surgery are increased precision, miniaturization, articulation beyond normal manipulation, and three-dimensional magnification. These would contribute to a reduction in the length of hospital stay, postoperative complications, blood loss, and time off work. When these improvements are accounted for, there may be a considerable savings to hospitals and society as a whole, offsetting the additional cost. Because of the complexity of the model, this may be beyond the scope of the current study, and we would hope that a separate investigation could be carried out on the subject of RALP cost analysis.

There are certain limitations of the present study. First, being a retrospective study, it was difficult to have a standardized follow-up protocol and surgical technique. Different surgeons in the cohort performed RALP with slightly different modifications. Such heterogeneity in technique may cloud the picture. In addition, the assessment of potency and urinary continence was made by patient-surgeon interviews. This may not correlate with patient self-assessments of health-related quality of life. Furthermore, the mean follow-up was relatively short when compared with the open prostatectomy series. This may affect trifecta outcomes given that with time, the biochemical recurrence rate increases, while continence and potency may improve. As the robotic technique becomes more established, we hope that longer-term data would be available.

Conclusions

We report a 37.3% rate of trifecta at 12 months after RALP in 235 patients. Our early oncologic outcomes were significantly correlated with pathologic stage and D’Amico risk stratification and appear to be similar to those in larger RALP series. Our early oncologic outcomes were significantly correlated with pathologic stage and D’Amico risk stratification and appear to be similar to those in larger RALP series. Our data demonstrate the feasibility, safety, and efficacy of RALP in low-to-intermediate volume centers.

Disclosure Statement

No competing financial interests exist.

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3. Hong Kong Hospital Authority. Hong Kong Cancer Registry. hAccessed February 2011.


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Abbreviations Used
BMI = radical prostatectomy
CI = confidence interval
DVT = deep vein thrombosis
OR = odds ratio
PE = pulmonary embolism
PSA = prostate-specific antigen
PSM = positive surgical margins
RALP = robot-assisted laparoscopic radical prostatectomy
RP = radical prostatectomy