Original Article

Early Experience with Robot-assisted Laparoscopic Radical Prostatectomy

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INTRODUCTION: We assessed the feasibility of a robot-assisted laparoscopic radical prostatectomy (rLRP) programme through a review of our early experience.
PATIENTS AND METHODS: Seventeen patients underwent rLRP between 1 February 2003 and 31 December 2003 at Singapore General Hospital. All patients had histologically confirmed adenocarcinoma on prostate biopsy and a negative bone scan. The Da Vinci robot was employed. The Montsouris technique was used for our first eight patients, and the Vattikuti Institute Prostatectomy technique was used for all subsequent patients. We studied perioperative parameters and early surgical outcome prospectively.
RESULTS: The mean age at diagnosis was 63.9 ± 5.6 years. The median Gleason sum was 6 (range, 5–9), and mean pretreatment prostate-specific antigen level was 10.5 ± 5.4 ng/mL. The mean set-up time was 34 ± 18 minutes, and mean dissection time was 247 ± 43 minutes. Perioperative blood loss averaged 494 ± 330 mL, and three patients required blood transfusion. Normal diet was resumed after 1.7 ± 0.6 days. The mean duration of bladder catheterization was 9.8 ± 6.1 days, and mean hospital stay was 2.7 ± 1.3 days. There was no perioperative mortality or major complications, and no conversion to open radical prostatectomy. From Case 9 onwards, there was significant reduction in operating time (284 vs 215 minutes), blood loss (650 vs 400 mL) and hospital stay (3.8 vs 1.8 days).
CONCLUSIONS: rLRP is feasible in a practice with a low volume of radical prostatectomies. Significant improvement in perioperative parameters occurs after the first eight cases. This technique confers the benefits of enhanced precision and dexterity for complex laparoscopic work in the pelvic cavity. [*Asian J Surg* 2004;27(4): 321–5]

Introduction

The evolution of laparoscopic radical prostatectomy (LRP) took a long time. It was first reported in the mid-90s when initial attempts were met with tremendous technical difficulty and unduly long operating times.[1] It was not until 1999 that Guillonneau and Vallancien made LRP technically feasible and safe.[2] Even then, reports of long operating times and steep learning curves hindered its widespread application. Robot-assisted surgery, first conceived in a military setting, was then applied to laparoscopic surgery. It was first used in cardiothoracic surgery and later in urology. The technology brings with it the advantages of laparoscopic surgery with additional degrees of freedom and wrist-like fine control at the instrument tip, permitting careful dissection and meticulous suturing in a confined space such as the thorax or pelvis. The additional visual magnification and intuitive hand controls help the laparoscopically-naïve surgeon to reduce the learning curve substantially.

In recent years, robot-assisted LRP (rLRP) has emerged as a feasible treatment option in selected high-volume centres for patients with organ-confined prostate cancer. We assessed the

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feasibility of a rLRP programme at our centre, where prostate cancer is less common and the urologists have moderate experience with open radical prostatectomy and modest experience in laparoscopic surgery, through a review of our early experience.

Patients and methods

A team of four surgeons underwent intensive training, including overseas attachment, dry laboratory training and animal laboratory training, before operating on live patients. Seventeen patients underwent rLRP between 1 February 2003 and 31 December 2003 at the Department of Urology, Singapore General Hospital. All patients had prior histologically confirmed adenocarcinoma of the prostate and a negative bone scan. Informed consent for rLRP was obtained from all patients. Preoperative assessment included the International Prostate Symptoms Score, International Index of Erectile Function and a global continence questionnaire in all patients, administered by a uro-oncology nurse clinician. Comorbid status was assessed using the Charlson Comorbidity Index.[3,4] Demographic and pathological profile, perioperative statistics and outcome following surgery were charted prospectively.

Inclusion and exclusion criteria

Patients were included if they had primary untreated organ-confined prostate cancer, a prostate-specific antigen (PSA) level of less than 50 ng/mL, a negative bone scan, no upper tract obstruction, and the general condition and mental fitness to undergo radical prostatectomy and follow-up for at least 5 years. Patients were excluded if they had extra-prostatic disease or had previously received radiotherapy. Previous neoadjuvant hormonal therapy was not an exclusion criterion.

The use of the Da Vinci robot (Intuitive Surgical Inc, Sunnyvale, CA, USA) for rLRP was approved by the hospital's ethics committee. Informed consent was obtained with full explanation of the novel technology and potential risks and benefits; patients who did not agree to rLRP could opt for open radical prostatectomy.

Operative technique

All patients underwent bowel preparation using polyethylene glycol 1 day prior to surgery. Preoperative chest physiotherapy, prophylactic broad-spectrum intravenous antibiotics on induction and prophylaxis for deep vein thrombosis were routine practice.

We used the Montsouris[5] technique for our first eight patients and the Vattikuti Institute Prostatectomy (VIP)[6] technique for all subsequent patients. The difference in the two techniques centres on the sequence of dissection. The anterior approach of the VIP technique closely mimics the sequence of open radical prostatectomy and improves visualization of the anatomical landmarks. The Montsouris approach starts with posterior dissection of the seminal vesicles, which are difficult to visualize at this stage. The VIP technique allows easy access to the seminal vesicles after transection of the bladder neck and posterior dissection of the prostate along Denonvilliers' fascia.

Pathological assessment

All prostatectomy specimens were assessed by a central pathologist. Staging used the 1997 American Joint Committee on Cancer TNM staging system[7] and histological grading used the Gleason grading system.[8]

Analysis

Length of hospital stay and survival were measured from the date of surgery. Operative mortality, defined as postoperative death within 30 days of the operation, was recorded. The time to return to normal diet, length of stay and time to catheter removal were documented. The results were analysed using SPSS version 10 (SPSS Inc, Chicago, IL, USA). A p value of less than 0.05 indicated statistical significance.

Results

Over the study period, 27 consecutive patients underwent radical prostatectomy for prostate cancer. We successfully performed rLRP in 17 patients and open radical retropubic prostatectomy in 10 patients. Only the rLRP cases are assessed in this review.

Patient characteristics

The mean age at diagnosis was 63.9 ± 5.6 years (median, 63 years; range, 53–74 years). Most patients were Chinese (88%). The median Gleason sum was 6 (range, 5–9), and mean pretreatment PSA was 10.5 ± 5.4 ng/mL (median, 8.4 ng/mL; range, 5.5–27.0 ng/mL). The predominant Gleason pattern on transrectal ultrasound guided prostate biopsy was 3+3 (53%) followed by 3+4 (24%).

Perioperative results

The mean set-up time was 34 ± 18 minutes (median, 25 minutes; range, 15–60 minutes), and the mean dissection time was 247 ± 43 minutes (median, 240 minutes; range, 170–330 minutes). Perioperative blood loss averaged 494 ± 330 mL (median, 500 mL; range, 100–1,200 mL), and three patients required blood transfusion. Our patients resumed a normal diet after a mean of 1.7 ± 0.6 days (range, 1–3 days). The mean duration of bladder catheterization was 9.8 ± 6.1 days (median, 7 days; range, 5–28 days), and mean hospital stay was 2.7 ± 1.3 days (median, 3 days; range, 1–5 days).

Technical progression (with change to VIP technique)

The first eight patients had a mean set-up time of 47 minutes and dissection time of 284 minutes, while the subsequent nine patients had a mean set-up time of 23 minutes and dissection time of 215 minutes (Figure). The intraoperative estimated blood loss decreased from a median of 650 mL to 400 mL after the first eight cases. The length of stay after surgery was reduced from a mean of 3.8 days to 1.8 days after the first eight cases.

Complications

There was no perioperative mortality and no conversion to open radical prostatectomy. There were no major complications in our series. One patient had pulmonary atelectasis that resolved on the third postoperative day after chest physiotherapy. Three patients had moderate urinary incontinence at 3 months and required the use of 1–2 pads per day. Only one patient had resumed normal sexual activity at 3 months' follow-up.

Tumour pathology

Pathological assessment showed that 53% (*n* = 9) had organ-confined disease (pT2b-c), while 47% (*n* = 8) had extra-prostatic extension (pT3a-b). The median Gleason sum was 7 (range, 6–8). The most common pathological Gleason pattern was 3+4 (47%), followed by 3+3 (41%). Margins were positive in 10 patients (59%), most often in the posterolateral and apical aspects.

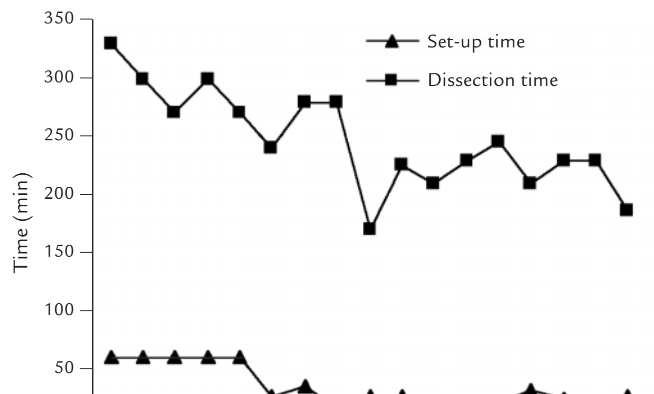

Figure. Operating time for robot-assisted laparoscopic radical prostatectomy (*n* = 17).

Follow-up

The median follow-up was 3.0 ± 2.7 months (range, 1–9 months), and all patients had a postoperative PSA of less than 0.1 ng/mL at 3 months.

Discussion

To our knowledge, we are the first centre in Asia to use the Da Vinci robot routinely for urology. We have a predominantly Chinese population of 4 million with a relatively low age-standardized incidence rate of prostate cancer (13.0 per 100,000/year[9]) compared to American and European centres. The team of four surgeons has moderate experience in open prostatectomy and modest experience in laparoscopy. Structured training helped to prepare our team for the transition from open surgery to robot-assisted laparoscopy. The laparoscopic skills needed for prostatectomy were obtained via overseas attachments, and the robot-handling skills were gradually acquired from robot surgery symposiums, site visits and laboratory training. Most significantly, we found that expert advice was critical in the introduction of the programme (Cases 1 to 3) and in the transition from the Montsouris to the VIP technique (Cases 9 and 10).

Our initial results demonstrated a clear trend in reduction of intraoperative estimated blood loss, lower transfusion rate, reduced length of stay and reduced pain score relative to open retropubic radical prostatectomy (Table). Comparatively, our concurrent open radical retropubic prostatectomy series showed a shorter mean operation time, but this was offset by a higher median blood loss and transfusion rate. The time to return to normal diet and catheter removal were similar but the mean length of stay was longer in the open prostatectomy group.

Our perioperative statistics improved significantly after the first eight cases. The set-up time, operating time, blood loss and hospital stay were all reduced significantly. This coincides with our switch of technique, but we believe that both the accumulation of experience and the choice of technique have significant bearings. It is noteworthy that the VIP technique was developed after hundreds of cases, and that

Table. Comparison of perioperative parameters between open prostatectomy and robot-assisted laparoscopic radical prostatectomy (rLRP) in an Asian population

	rLRP	Open prostatectomy	*p*
Number of patients	17	9	
Mean age (yr)	63.9 ± 5.6	63.0 ± 4.1	NS
Mean pretreatment PSA (ng/mL)	10.5 ± 5.4	9.9 ± 4.0	NS
Median Gleason sum (range)	6 (5–9)	6 (5–7)	NS
Mean operating time (min)	247 ± 43	168 ± 79	NS
Mean estimated blood loss (mL)	494 ± 330	939 ± 583	NS
Transfusion rate	18% (3/17)	67% (6/9)	0.044
1^{st} post-op day mean pain score	2.2 ± 0.6	2.9 ± 1.1	0.045
Mean time to return to normal diet (d)	1.7 ± 0.6	1.6 ± 0.7	NS
Mean length of stay (d)	2.7 ± 1.3	3.7 ± 1.8	NS
Mean time to catheter removal (d)	9.8 ± 6.1	7.8 ± 1.2	NS

PSA = prostate-specific antigen; post-op = postoperative.

institute has the most extensive robotic prostatectomy experience to date.[10] Every single step and manoeuvre had been thoroughly thought through and the technique appeared entirely reproducible. However, successful implementation of the robotic programme requires a dedicated team that can rotate between the console and assist the operating surgeon. This helps to combat fatigue in a single surgeon from a prolonged procedure in the initial stages. In addition, the team system allows less experienced urologists to be co-opted into the programme more effortlessly by a gradual increase in the complexity of assistant tasks. The junior assistant will stay on the patient's left with a single 5 mm assistant port to facilitate retraction, while the senior assistant will be positioned on the patient's right with a 5 mm port and a 10/12 mm port to facilitate suction and dissection.

The main drawback of the robot-assisted approach is a longer set-up and dissection time when compared to the standard open technique, and a lack of tactile feedback for the surgeon on the console. We addressed these problems by developing several counter strategies. During the preparatory phase when the patient is about to be put under general anaesthesia, a team of nurses will start to drape the robotic arms and calibrate the laparoscopic camera lenses concurrently. Once the patient is anaesthetized, the surgical team immediately inserts the ports and docks the robot to the ports. This reduced the set-up time from 60 minutes in our first few cases to about 15–20 minutes in our subsequent cases.

The longer dissection time may be the result of several factors, including difficulty in demarcating the anatomical landmarks from a lack of tactile feedback, bleeding in a confined space obscuring the operating field, and prolonged urethrovesical anastomosis time. The urethra, bladder neck, apex of the prostate and seminal vesicles are easily felt in the open technique. The lack of tactile feedback in the robotic approach, however, makes dissection of these structures more challenging. Nonetheless, experienced assistants can retract, apply suction and display these non-bony landmarks using laparoscopic instruments and improve visualization significantly. Teamwork is, therefore, paramount to the success of the technique, and a structured sequence of dissection prepares the assistants to guide the console surgeon more effectively. In our experience, the trainee robotic surgeon should start by assisting on the left side of the patient and move to the right side of the patient when more experienced, as the right-side assistant controls the suction device and guides the dissection. Laparoscopic haemostasis must be meticulous as the surgery is highly dependent on good visualization of the operating field. We used six interrupted sutures for urethrovesical anastomosis in the first few cases, but found that continuous suture anastomosis using 3-0 polyglactin decreased the anastomosis time tremendously without compromising the quality of the anastomosis.

There was minimal attempt at nerve sparing in most patients in this initial series as more than half the patients were not sexually active prior to prostatectomy. In addition, bleeding in some of the cases made visualization of the neurovascular bundles difficult and necessitated the use of monopolar coagulation diathermy for haemostasis. We now use bipolar forceps and scissors for dissection around the neurovascular bundle and tease off the nerves laterally.

Our study is limited by the small sample size and short follow-up, but other centres with higher case volumes have shown similar progressive improvement after the first 12 cases.[11] Long-term functional and oncological outcome will require further follow-up and assessment. Furthermore, we did not include a cost-benefit study between this technique and conventional open radical prostatectomy. Our patients do not pay additional charges for robot-assisted surgery as it is funded under a research programme.

Currently, we offer robot-assisted surgery as the preferred surgical option (over open surgery) to our patients with clinically localized prostate cancer. Our findings have demonstrated that the robotic interface can bring down the learning curve tremendously to make it feasible even in a lower-volume setting.

Conclusions

Robot-assisted LRP is feasible in a practice with a low volume of radical prostatectomies. Significant improvement in perioperative parameters occurs after the first eight cases. This technique confers the benefits of enhanced precision and dexterity for complex laparoscopic work in a confined pelvic cavity.

Acknowledgements

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