ORIGINAL ARTICLE

Short-term outcome of patients with robot-assisted versus open radical prostatectomy: for localised carcinoma of prostate

KL Lo 羅家麟
CF Ng 吳志輝
Cleo NY Lam 林雅儀
Simon SM Hou 侯仕明
KF To 杜家輝
Sidney KH Yip 葉錦洪

Objective To compare the short-term outcome of patients undergoing robot-assisted versus open radical prostatectomy.

Design Retrospective analysis of prospectively collected data.

Setting A university teaching hospital in Hong Kong.

Patients Twenty consecutive cases having robot-assisted radical prostatectomy were compared with the last 20 cases of open radical prostatectomy (prior to November 2005 when the robotic system was introduced).

Main outcome measures Perioperative functional evaluation (with special emphasis on continence) and oncological evaluation (included margin studies and prostate-specific antigen levels).

Results Regarding baseline clinical characteristics of the patients, there was no statistically significant difference between the robotic and open radical prostatectomy groups. For perioperative outcome, in the robotic group the blood transfusion rate was significantly lower (5 vs 65%), hospital stay was shorter (8 vs 17 days), and the catheter time was shorter (12 vs 18 days). For early oncological outcome, there was no statistically significant difference in the margin positive rate and early prostate-specific antigen results. Regarding continence (use of 0-1 pads/day), it was achieved by 95% in the robotic group with a mean follow-up of 6 months compared to 85% in the open group with a mean follow-up of 42 months.

Conclusions Robot-assisted radical prostatectomy offered the benefits of a minimally invasive operation with less blood loss, shorter catheter time and hospital stay, and earlier continence. It has therefore become the preferred surgical option in our institution.

Introduction

In the early 1990s, Schuessler et al[1] performed the first successful laparoscopic radical prostatectomy. Due to the long operating time, steep learning curve, and failure to demonstrate major advantages over open surgery, initially the procedure did not gain widespread acceptance. Laparoscopic radical prostatectomy was popularised in late 1990s by a French group, who demonstrated its technical feasibility as well as the advantage of reduced blood loss.[2] Nevertheless, the laparoscopic approach remains technically demanding and practised in a limited number of centres.

After introduction of the robotic system however, the minimally invasive surgical approach has gained popularity. Thus, since 2001 when the procedure was first reported,[3] the number of robotic radical prostatectomy operations being performed has increased dramatically in many countries. Up to 2008, more than 1000 robotic systems have been installed worldwide.[4] Early reports demonstrated short-term advantages over open radical prostatectomy with respect to blood loss, transfusion rates, and convalescence, especially in high-volume centres.[5,6] Moreover, the reduced extent of urinary incontinence and erectile dysfunction results are also encouraging,[7] while long-term data on oncologic cure rates are gradually becoming available.[7,8]

In Hong Kong, the first robotic system was installed in the Prince of Wales Hospital, The Chinese University of Hong Kong in November 2005. The system was utilised by surgical disciplines including urology, paediatric surgery, gynaecology, and others.[9] Herein,

Key words
Prostate-specific antigen; Prostatectomy; Prostatic neoplasms; Robotics; Treatment outcome

Hong Kong Med J 2010;16:31-5

Prince of Wales Hospital, The Chinese University of Hong Kong, Shatin, Hong Kong:
Division of Urology, Department of Surgery
KL Lo, MB, ChB, MRCS (Edin)
CF Ng, FRCS (Edin), FHKAM (Surgery)
CNY Lam, BSc
SSM Hou, FRCS (Edin), FHKAM (Surgery)
SKH Yip, FRCS (Edin), FHKAM (Surgery)
Department of Anatomical and Cellular Pathology
KF To, MB, ChB, FRCPA

Correspondence to: Dr SKH Yip
Email: sidneyyip@surgery.cuhk.edu.hk

機械人輔助式與開放式根治性前列腺切除術對於治療局限性前列腺癌的短期結果之比較

目的 比較機械人輔助式與開放式兩種根治性前列腺切除術的短期治療結果。

設計 回顧分析以往收集的前瞻性資料。

安排 香港一所大學教學醫院。

患者 把20例機械人輔助式根治性前列腺切除術與2005年之前的20例開放式根治性前列腺切除術作比較。

主要結果測量 探討兩種技術的術中功能方面（集中於尿失禁）及腫瘤方面（包括切緣及前列腺特異抗原水平）。

結果 兩組患者之間的基線臨床特徵沒有顯著分別。術中結果顯示，機械人輔助式組的輸血機率明顯較低（5%比65%）、住院期較短（8天比17天）、置尿管時間較短（12天比18天）。腫瘤方面，兩組之間的切緣陽性率及早期前列腺特異抗原水平並沒有顯著分別。尿失禁方面，機械人輔助式組在6個月的隨訪期內有95%患者達至每天使用0至1包失禁用墊，而開放式組在42個月的隨訪期內只有85%患者達至此目標。

結論 機械人輔助式根治性前列腺切除術帶給病人微創術的好處，即輸血量少，以及置尿管時間、住院期和失禁期較短。正因如此，我們醫院把這技術視作根治性前列腺切除術的首選。

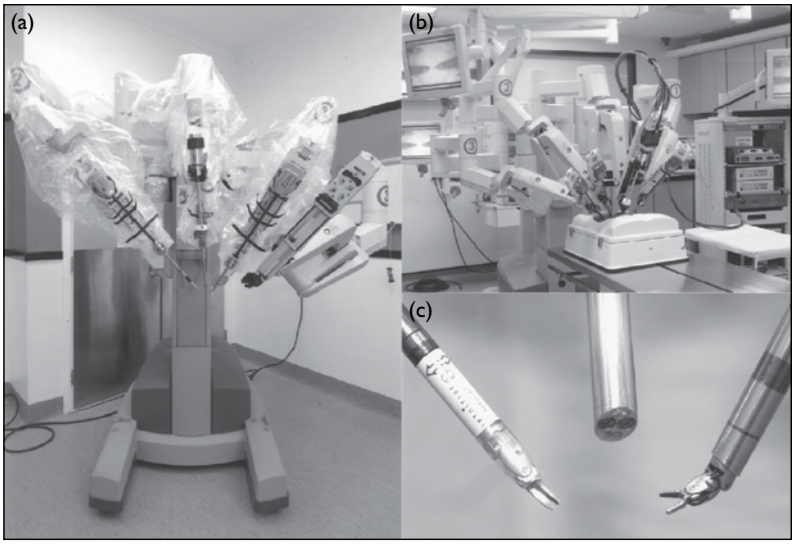

FIG 1. (a) Assembly of a typical 4-arm system, the last instrument arm is not draped and does not carry an instrument in this picture; (b) the layout in a simulated operating environment; and (c) the key components including a dual lens endoscope, for acquisition of a 3-dimensional image and the 'endowrist' instruments

we report the early experience of robot-assisted laparoscopic radical prostatectomy, compared to conventional open surgery.

Methods

Our robotic surgery programme first started in late 2005 (da Vinci standard 3-arm system). Since then, robotic prostatectomy was routinely offered for suitable candidates. The system was upgraded to a 4-arm da Vinci S-HD in 2008 (high-density). Records of 20 consecutive patients having such robotic surgery from 2008 were retrieved for comparison with historical controls consisting of the last 20 open cases operated on before November 2005 (when the first robotic system was installed). The latter were chosen to minimise 'selection bias' as open radical prostatectomy was the only surgical option at that time. The authors considered that for the period between 2006 and 2007, there were too few open cases to make a fair comparison. The clinical characteristics, perioperative results, and early oncological outcomes were compared. The results were analysed by *t* tests, a P value of less than 0.05 being regarded as statistically significant. While data from the open group were retrospective, all robotic group data were collected prospectively; incontinence status, in particular, was evaluated by an independent party.

Operative technique

The da Vinci S-HD system consists of an endowrist with 7 degrees of movement, and a dual-channel telescope with a 3-dimensional up to 10 times magnified view (Fig 1). It also offers the advantage of tremor filtration for the 'console' surgeon (Fig 2). For robotic radical prostatectomy, the 6-port transperitoneal VIP technique was used.[5] The vesico-urethral anastomosis after prostatectomy was performed using the 3 'o' monocryl continuous suture technique that resembles the VIP technique. The typical theatre set-up is shown in Figure 3. For open radical prostatectomy, the extraperitoneal retropubic approach was used. All prostatectomy specimen reporting was supervised by two designated pathologists.

Results

Regarding baseline clinical characteristics, there was no statistically significant difference between robotic and open surgery groups in terms of mean age (64 vs 66 years), mean serum prostate-specific antigen (PSA) level (14.2 vs 14.5 ng/mL), median Gleason sum and T-staging (Table 1).

For perioperative outcome, there was no conversion to open surgery and no perioperative mortality in the robotic group. One case of pelvic haematoma ensued in the robotic group, which was managed conservatively. There was no significant difference between robotic and open groups in terms of mean operating time (306 vs 289 minutes).

Moreover, in the robotic group the blood transfusion rate was significantly lower (5 vs 65%), the mean hospital stay was shorter (8 vs 17 days) as was the mean catheter time (12 vs 18 days). Prior to catheter removal, cystograms were performed to confirm absence of leakage in the robotic surgery group. Comparison of outcomes is shown in Table 2.

In the robotic group (with a mean follow-up period of 6 months), continence was 75% (defining continence as use of 0 pads/day) and 95% (use of 0 or 1 'security' pad/day). The same (0-1 pads/day) continence rate in the open group (with a mean follow-up of 42 months) was 85%.

The positive margin rates were similar in the robotic and open groups (20 vs 25%). There was no PSA recurrence in the robotic group (mean follow-up of 6 months), while in the open surgery group (mean follow-up of 42 months) it was 20% (Table 3).

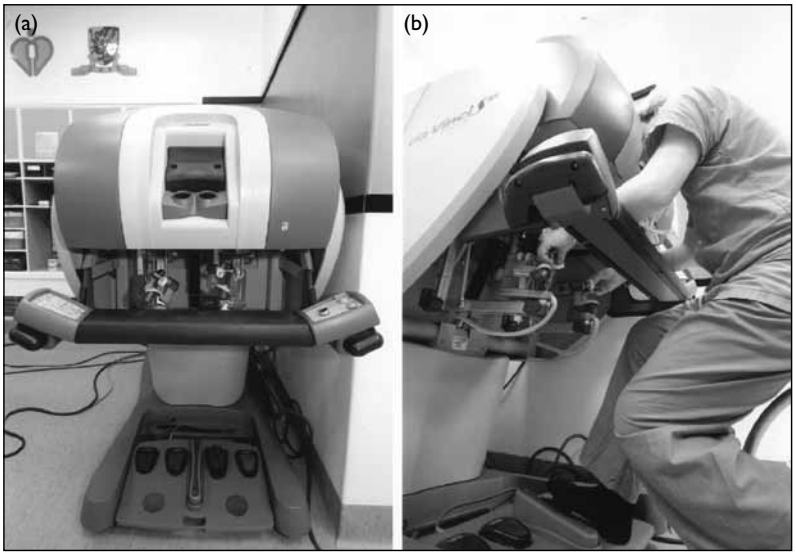

FIG 2. (a) The surgical console; and (b) the console surgeon viewing through the eye-pieces, simultaneously controlling instruments using the hands and a diathermy using the foot

FIG 3. The operating room layout for a typical case of robotic prostatectomy

Discussion

The robotic system has the advantages of a wide range (7 degrees) of movement, as well as 3-dimensional (dual-channel endoscopy) vision with a magnified view.[10] In addition, early experience adopting the technology to minimally access surgery has shown a very favourable learning curve, and in terms of reduced operating times, transfusion rates, and complication rates.[11,12] These advantages account for the worldwide trend to transit from open to robot-assisted prostatectomy. We have followed a similar path of development, though other local centres continue to embrace the laparoscopic approach as the minimally invasive modality.[13] Case loading and learning curves are important considerations, and we resolved that we can embrace and stay focused on one technology at any one time.

We have noted significantly reduced transfusion rates of around 0 to 7%, in line with worldwide reports.[5,6,12] The minimal blood loss, in connection with the minimal access for surgery, probably contributed to the reduced hospital stay. In addition, excellent functional outcomes including continence control and potency preservation have also been demonstrated worldwide.[14]

Nowadays, there is much emphasis on early functional outcomes, especially continence control with quality of life. Increasingly, we recognise that early and full control of urination is possible and expected from patients, many of whom had prostate carcinoma detected incidentally or had mild lower urinary tract symptoms only.[15] Reports from Menon's group suggest that median duration of incontinence was 4 weeks; only 0.8% of patients had total incontinence at 12 months. The intercourse rate was 93% in men with no preoperative erectile dysfunction.[7] We have not been able to ascertain this aspect of outcome in our patients, as the majority had erectile dysfunction to start with, or the extent of their tumour precluded nerve-sparing surgery. In patients with normal preoperative sexual function and clinically localised small volume disease, we nevertheless generally attempt selective nerve sparing.

Margin positivity is one of the key surgery factors that vary, depending on surgical experience, case volume, and technique. In non-randomised trials, the positive surgical margin rate was at least equivalent if not lower, after robotic than open radical prostatectomy.[16,17] While ours is a low-to-moderate volume centre, our margin positivity rate was in line with most major centres. This is a reflection of careful case selection and successful adoption of oncological principles in robotic surgery. There used to be some concern about the lack of long-term oncological data. However, according to mid-term cancer control results recently reported by Badani et al[8] in nearly 3000 patients, the 5-year biochemical-free survival was 84%, which was in line with most open surgery series.

We acknowledge that there are limits to the

TABLE 1. Baseline clinical characteristics

Characteristic*	Robotic group	Open group	P value
Mean (range) age (years)	64 (52-75)	66 (47-76)	0.31
Mean (SD) serum PSA level (ng/mL)	14.2 (11.8)	14.5 (14.3)	0.45
Median (range) Gleason sum	7 (6-9)	7 (6-10)	0.50
Median (range) T-staging	T2c (T1a-T3a)	T2c (T1c-T3b)	-

* SD denotes standard deviation, and PSA prostate-specific antigen

TABLE 2. Perioperative features/outcomes

Feature/outcome	Robotic group	Open group	P value
Mean (SD*) operating time (mins)	306 (85)	289 (64)	0.41
Blood transfusion rate	5%	65%	<0.001
Mean (SD) hospital stay (days)	8 (6)	17 (7)	<0.001
Mean (SD) catheter time (days)	12 (7)	18 (7)	0.004

* SD denotes standard deviation

TABLE 3. Oncological and functional outcomes

Outcome	Robotic group	Open group	P value
Positive margin rate	20%	25%	0.36
Continence rate (No. of pads/day)	75% (0); 95% (0-1)†	85%‡	-
PSA* recurrence rate	0%†	20%‡	-

* PSA denotes prostate-specific antigen
† Mean follow-up of 6 months
‡ Mean follow-up of 42 months

current study, especially because the open group consisted of historical controls in whom data were collected retrospectively, while robotic surgery data were maintained prospectively. The operating time for the open series was somewhat long, but may be an honest reflection of the difficulties in performing and learning open radical prostatectomy. On the other hand, the prior experience of the senior authors in laparoscopic surgery and robotic surgery (including working with an older version of da Vinci standard system) could well have contributed to the establishment of our current robotic programme. We are unable to comment on the utility of the da Vinci S system compared to the older version, as different staff were involved during different periods. Intrinsically, the newer system is more compact and may offer added advantages for Asian patients with smaller body builds. In that context, we cannot directly extrapolate that switching to a robot-based programme from an open surgery programme will always be smooth, though this is highly probable according to our own and other prior experience.[5,11,12]

Surgical practice in Hong Kong will undoubtedly change dramatically, as by now there are five robotic systems installed (in the public and private sectors). At the same time, the incidence of prostate cancer continues to increase.[18] The robotic systems entail substantial costs, which include an initial investment, as well as maintenance and consumables. The estimated cost of each machine is HK$18 million, the yearly maintenance expenditure is HK$1.2 million and consumables amount to HK$15 000 to 20 000 per case. If at least 75 cases in each centre were to be performed per year, average costs per case could be significantly reduced.[19] Our institute's statistics shows an annual utility rate that is in line with such a projection and is continuing to increase. While we believe that robotic systems will increasingly dominate this type of surgery, the cost issue may still be a constraint.

Conclusions

Compared to open radical prostatectomy, in our setting robotic radical prostatectomy has markedly improved perioperative outcomes, whilst early oncological outcomes are similar. In particular, robotic surgery entails less blood loss, shorter catheter times and hospital stays, all of which facilitate early mobilisation and reduce postoperative morbidity. With the increase in caseload and experience, we anticipate a further reduction in the average costs per patient and therefore improved cost-effectiveness of this procedure.

Acknowledgements

The first robotic machine was donated by the Hong Kong Jockey Club to the Minimally Invasive Surgery Skill Centre (MISSC) of the Chinese University of Hong Kong and was in use since 2005. The upgraded version (da Vinci S-HD) was donated to the Centre in 2008 by an anonymous donor. The original machine has since been used for surgical training of local and overseas surgeons in the MISSC.

References

1. Schuessler WW, Schulam PG, Clayman RV, Kavoussi LR. Laparoscopic radical prostatectomy: initial short-term experience. Urology 1997;50:854-7.
2. Guillonneau B, Cathelineau X, Barret E, Rozet F, Vallancien G. Laparoscopic radical prostatectomy: technical and early oncological assessment of 40 operations. Eur Urol 1999;36:14-20.
3. Binder J, Kramer W. Robotically-assisted laparoscopic radical prostatectomy BJU Int 2001;87:408-10.
4. Intuitive Surgical Company Backgrounder PN 871072 Rev. C 7/07. Intuitive Surgical, Inc website: http://www.intuitivesurgical.com/corporate/newsroom/mediakit/Intuitive_Surgical_Backgrounder.pdf. Accessed 8 Sep 2009.
5. Menon M, Tewari A; Vattikuti Institute Prostatectomy Team.

Robotic radical prostatectomy and the Vattikuti Urology Institute technique: an interim analysis of results and technical points. Urology 2003;61(4 Suppl 1):15S-20S.
6. Ahlering TE, Woo D, Eichel L, Lee DI, Edwards R, Skarecky DW. Robot-assisted versus open radical prostatectomy: a comparison of one surgeon's outcomes. Urology 2004;63:819-22.
7. Menon M, Shrivastava A, Kaul S, et al. Vattikuti Institute prostatectomy: contemporary technique and analysis of results. Eur Urol 2007;51:648-58.
8. Badani KK, Kaul S, Menon M. Evolution of robotic radical prostatectomy: assessment after 2766 procedures. Cancer 2007;110:1951-8.
9. Chan SY, Hou SM, Wong WS, Ng CF. Robotic urological surgery: prospects for Hong Kong. Surg Pract 2007;11:154-8.
10. Sim HG, Yip SK, Cheng CW. Equipment and technology in surgical robotics. World J Urol 2006;24:128-35.
11. Sim HG, Yip SK, Lau WK, Tan JK, Cheng CW. Early experience with robot-assisted laparoscopic radical prostatectomy. Asian J Surg 2004;27:321-5.
12. Sim HG, Yip SK, Lau WK, Tan YH, Wong MY, Cheng CW. Team-based approach reduces learning curve in robot-assisted laparoscopic radical prostatectomy. Int J Urol 2006;13:560-4.
13. Chan SW, Lam KM, Kwok SC, et al. Laparoscopic radical prostatectomy: single centre experience after 5 years. Hong Kong Med J 2008;14:192-7.
14. Menon M, Tewari A, Peabody JO, et al. Vattikuti Institute prostatectomy, a technique of robotic radical prostatectomy for management of localized carcinoma of the prostate: experience of over 1100 cases. Urol Clin North Am 2004;31:701-17.
15. Wang L, Chung SF, Yip SK, Lau WK, Cheng CW, Sim HG. The natural history of voiding function after robot-assisted laparoscopic radical prostatectomy. Urol Oncol 2009 April 10. Epub ahead of print.
16. Smith JA Jr, Chan RC, Chang SS, et al. A comparison of the incidence and location of positive surgical margins in robotic assisted laparoscopic radical prostatectomy and open retropubic radical prostatectomy. J Urol 2007;178:2385-90.
17. White MA, De Haan AP, Stephens DD, Maatman TK, Maatman TJ. Comparative analysis of surgical margins between radical retropubic prostatectomy and RALP: are patients sacrificed during initiation of robotics program? Urology 2009;73:567-71.
18. Hong Kong Cancer Registry. Hong Kong: Hong Kong Hospital Authority website: http://www3.ha.org.hk/cancereg/e_canstat2006.pdf. Accessed 8 Sep 2009.
19. Menon M, Shrivastava A, Tewari A. Laparoscopic radical prostatectomy: conventional and robotic. Urology 2005;66(5 Suppl):101S-104S.