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Initial study of learning curves in robot-assisted radical prostatectomy

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Abstract:

The application of robot-assisted laparoscopic techniques is new and generates numerous benefits for patients. Here, we summarise the experience of our first series through 52 cases of prostate cancer treated by robot-assisted radical prostatectomy (RARP) in the Department of Urology of Binh Dan Hospital, from December 2016 to September 2017, to study the learning curves of this procedure. In this clinical comparative study, 52 patients diagnosed with prostate cancer (clinical stage T1 to T3) received RARP with and without nerve sparing as well as standard pelvic lymphadenectomy. Patients were divided into 4 groups according to their surgeon (surgeons A, B, C, and D, with 22, 12, 10, and 8 patients, respectively) for comparison. Research variables were cancer stage, pre- and postoperative prostate-specific antigen (PSA) serum levels, Gleason scores, lymph node metastasis, estimated blood loss, surgery time, urinary incontinence, hospital stay, and complications. Mean age, PSA, and stage of cancer were statistically similar (p>0.3). Operative times were 194.55, 269.17, 236.00, and 306.88 min, respectively (p<0.01). Mean estimated blood losses were 363.64, 404.17, 322.22, and 253.75 ml, and were significantly different (p<0.01). Nine patients required blood transfusion. The lengths of hospital stay were 5.73, 12.92, 5.10, and 6.13 days, and were not similar among groups (p<0.05); however, drainage times and complication rates between groups (p<0.01) were statistically significant. The optimal learning curve for operative times was achieved after 20 cases. Our initial RARP results were relatively strong, suggesting that surgery could be safely performed with acceptable complications.

Keywords: **learning curve, prostate cancer, radical prostatectomy, robot-assisted surgery.**

Classification number: **3.2**

Introduction

Radical prostatectomy is considered the gold standard in treating locally advanced prostate cancer. Currently, 3 main methods of surgery exist: open, classic endoscopic, and robot-assisted surgery. The application of robot-assisted surgery is a new step that engenders numerous benefits to patients. We studied the learning curves (LCs) of robot-assisted surgery through 52 cases of radical prostatectomy performed in the Department of Urology, Binh Dan Hospital, from December 2016 to September 2017.

Materials and methods

This longitudinal study focused on 52 patients with prostate cancer (clinical stage T1 to T3) who underwent robot-assisted radical prostatectomy (RARP) with and without preservation of neurovascular bundle, as well as standard pelvic lymphadenectomy. The study variables were cancer stage, pre- and postoperative prostate-specific antigen (PSA) levels, Gleason scores, lymph node metastasis, estimated blood loss during surgery, operative time, and postoperative urinary incontinence. We examined the improvement of these variables over an 11-month period, comparing the differences between the 4 console surgeons: surgeon A (22 patients), surgeon B (12 patients), surgeon C (10 patients), and surgeon D (8 patients).

Results

Age

Table 1. Age.

Age	All (*)	A	B	C	D
Min	49	55	49	52	62
Max	80	80	79	77	80
Mean	66.27	66.59	64.17	64.40	70.88
SD	8.96	8.12	8.58	7.06	5.82

All (*): means all patients.

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No differences in age exists between All and groups A, B, and C. However, group D was older ($p<0.05$; Table 1).

Preoperative PSA

Table 2. Preoperative PSA (ng/ml).

PSA	All	A	B	C	D
Min	4.5	7	18	9	5
Max	100	100	100	100	50
Mean	41.51	43.38	41.00	55.11	22.06
SD	28.81	35.51	24.77	38.07	13.53

Furthermore, no differences existed in PSA levels between All and groups A and B. Group C had higher levels and group D had lower levels ($p<0.01$; Table 2).

Gleason scores and tumour stages

Table 3. Gleason scores.

Gleason	All	A	B	C	D
≥ 3+4	24	11	5	5	3
4+3	8	3	2	2	1
≥ 4+4	20	8	5	3	4
Stage					
1	8%	5.3%	9.1%	11.1%	14.3%
2	42%	50%	22.7%	38.9%	57.1%
3	50%	44.7%	68.2%	50%	28.6%

No differences existed in Gleason scores between the groups (Table 3).

Operative time (minutes)

Table 4. Operative time (OT).

OT	All	A	B	C	D
Min	105	120	105	150	225
Max	480	270	480	315	420
Mean	237.02	194.55	269.17	236.00	306.88
SD	69.14	46.72	109.15	60.91	56.06

The mean operative time was equal between All and groups B and C ($p>0.05$), whereas it was shorter in group A and longer in group D ($p<0.05$; Table 4).

Estimated blood loss (ml)

Table 5. Estimated blood loss (EBL).

EBL	All	A	B	C	D
Min	80	100	100	100	80
Max	1400	1000	1400	800	700
Mean	345.77	363.64	404.17	322.22	253.75
SD	205.45	209.96	272.01	223.76	201.35

Drainage time (days)

Table 6. Drainage time.

Drainage time	All	A	B	C	D
Min	1	1	3	1	3
Max	35	8	35	11	7
Mean	5.67	4.45	9.83	3.70	5.25
SD	4.05	2.15	9.42	2.87	1.49

Drainage time was different between groups ($p<0.05$; Table 6).

Postoperative hospital stay (days)

Table 7. Hospital stay and complication rate.

Postoperative hospital stay	All	A	B	C	D
Min	2	2	4	3	5
Max	38	11	38	11	7
Mean	7.33	5.73	12.92	5.10	6.13
SD	4.33	2.45	9.70	2.56	0.99
Complications	13/52	4/22	6/12	2/10	1/8

Drainage time differed between groups ($p<0.05$); however, it exhibited a close relationship with hospitalised time and complication rate in each group ($p<0.01$; Table 7).

LCs

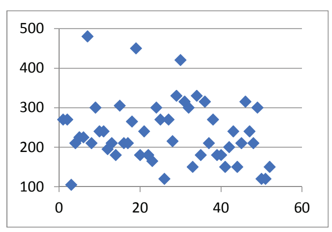

Chart 1. LC in time for All.

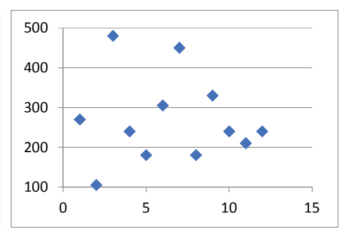

Chart 2. LC in time for group B.

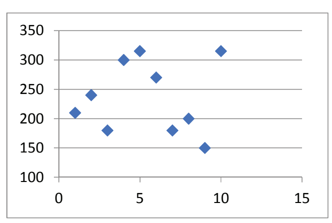

Chart 3. LC in time for group C.

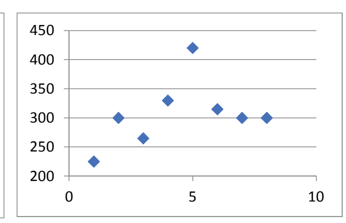

Chart 4. LC in time for group D.

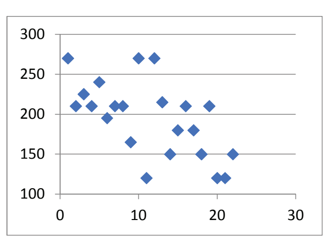

Chart 5. LC in time for group A.

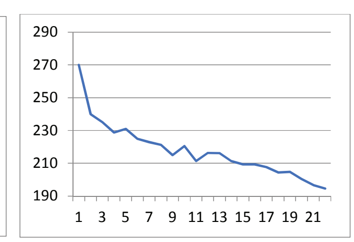

Chart 6. Group A: cumulative mean.

The LCs of All and group A were linear, whereas those of groups B, C, and D were nonlinear because of an insufficient number of cases. In conclusion, approximately 20 cases are required to achieve optimum efficiency in terms of LCs (Charts 1-6).

Postoperative recovery

Early complications in postoperative recovery included:

- Nine cases of abdominal fluid collection, in which 2 cases had to be redrained.

- Two cases of urethral catheters slipping, which necessitated reinsertion.

- One case of subcutaneous emphysema.

- One case of acute myocardial infarction.

- One case of intestinal occlusion, which necessitated emergency reoperation.

In addition, 16 out of the 52 patients suffered urinary incontinence from 3 weeks to 2 months postoperatively. PSA levelswere measured every 3 months after surgery. In 49 cases, they dropped to a nadir of 0.01-0.4 ng/ml. In 3 cases of stage 3 prostate cancer, we performed salvage prostatectomy and PSA did not reach ideal levels (4.7, 11.3, and 14.7 ng/ml). Thus, we had to send these patients to the oncology department to begin androgen blockade therapy.

Discussion

The prostate gland is an organ of the genitourinary system; it is small and deep in the pelvis of men. As previously mentioned, radical prostatectomy is still considered the gold standard in treating local and locally advanced prostate cancer. It is used for prostate cancer in otherwise healthy patients and with a life expectancy over 10 years. Furthermore, it is the most common urology surgery at present [1, 2].

Open radical prostatectomy for cancer has been performed at Binh Dan hospital for a long time, although the number is not high. Since 2000, as endoscopic surgery has developed worldwide, laparoscopic surgery has developed quite strongly in our Urology Department. At the end of 2004, we began employing laparoscopic surgery for prostatectomy. During the period of 2004-2006, we performed laparoscopic radical prostatectomy for 23 cases of prostate cancer. Since then, we have performed over 200 cases using this type of surgery and have published numerous papers both nationally and internationally regarding surgical and stitching techniques, patients' quality of life, and the value of the predictors of surgery [3-7].

However, this technique has increasingly had disadvantages exposed, such as a narrow surgical field, difficult operation, and long LC. When robotic surgery was born, these drawbacks were minimised, and both patients and urologists have increasingly advocated this type of surgery when the patient's choice of treatment is surgery rather than radiotherapy [8, 9].

The concept of LCs is a crucial topic in surgery and one of the less mentioned aspects. Abboudi, et al. [10] presented a noteworthy article that evaluated the concept of LCs in urological procedures. Specifically, the authors undertook a unified approach to systematically evaluate materials focusing on the LC of some urological procedures, including primarily radical prostatectomy and partial segmental kidney surgery.

Most studies have focused on prostatectomy but have poorly documented their methodological quality, including a series of surgeries that primarily limited the number of surgeons and selection of heterogeneous results to study the LC, focusing on short-term results [11-13].

By contrast, the literature on open surgery or open prostatectomy is of higher quality, including many large studies and the application of sophisticated statistical methods; however, robotic surgery is still preferable. With these limitations, we concluded that the duration of the LC for the operative time of robotic surgery is between 50 and 200 cases and the benefit of surgical margin is between 50 and 600 cases. Moreover, urine and erectile control were reported in 200 cases [10]. Thompson, et al. [14] evaluated the LC of an open surgeon with experience of more than 3,000 prostatectomy cases before beginning robot-assisted surgery. The study demonstrated that the effect of the robot overtook open surgery after 100 cases of sexual function scores and marginal rates of pT2 cancer, whereas approximately 150 cases was necessary to achieve urinary function. In addition, the efficiency of the robot continued to improve, with scores of sexual function increasing after 600-700 cases and urine continence increasing after 700-800 cases. Similarly, the negative margin was stable after 400-500 cases in pT2 and 200-300 in pT3-4. However, no evidence exists that further improvements can be achieved.

Davis, et al. studied the LCs of more than 71,000 prostatectomy cases in 300 hospitals in the United States, and between laparoscopic and open radical prostatectomy revealed a longer operative time (4.4 vs. 3.3 hours), shorter hospital stay (2.2 vs. 3.2 days), and fewer complications (10.4% vs. 15.8%) for laparoscopic prostatectomy [15].

Other studies have shown improvements in the LCs of robotic surgeons when robotic surgery is part of formal residency/fellowships [16], graduate training [17], and/or regular surgical simulator practice [18]. A study of numerous surgeons who performed open prostatectomy and robots demonstrated that robotic surgery has fewer complications, shorter hospital stays, and reduced blood transfusion rates [19]. Moreover, the LC is enhanced in robotic arms, which have been shown to be superior in terms of team work as opposed to the surgeon's time undergoing surgery.

Good, et al. [20] studied match cases, comparing 531 open and 550 laparoscopic prostatectomies to investigate the LCs on blood loss, surgery time, and rate of complications (Clavien-Dindo grade III). The LC for the overall margin free rate was longer for the pT2 group than for the laparoscopy group but was shorter for urinary control. For apex margins, the long LC for the laparoscopy group and lower rates for the robot-assisted group ($p \leq 0.001$). They concluded that both methods have a long LC; however, we found significant benefits in lower margin rates and early improvements in urinary control over laparoscopy, particularly in the prostate apex.

In our series, it is too early to draw conclusions about our LC because of the experience of the console surgeons of only 8-22 cases. However, it can clearly be seen that the mean operative time decreased when the surgeon had more cases and was clearly identified in 20 cases (group A; Charts 5-6). Furthermore, we observed that the surgeon with the longest duration of surgery had the least blood loss (group D, 307 minutes and 237 ml; Table 4-5). One factor to consider was the correlation between the longest hospital stay and the highest incidence of complications (group B, 12.9 days, complication 6/12; Table 7). One of this study's weaknesses is that it did not investigate the margins of surgical specimens.

Conclusions

Although the number of patients was low and the follow-up time was short, our initial results for RARP suggest that this type of surgery can be performed safely with acceptable complications. The optimal LC for operative time was achieved after 20 cases.

The authors declare that there is no conflict of interest regarding the publication of this article.

REFERENCES

[1] V.L. Chuyen, D.Q. Oanh, T.N.K. Linh (2010), "Mass screening of prostate cancer in Vietnam: status and our opinion", *Urologic Oncology*, **10(6)**, pp.673-676.

[2] H.T. Dong, V.L. Chuyen (2014), "Epidemiology and prevention of prostate cancer in Vietnam", *Asian Pac. J. Cancer Prev.*, **15(22)**, pp.9747-9751.

[3] V.V. Ty, V.L. Chuyen (2006), "Radical prostatectomy for prostate cancer, Initial experiences at Binh Dan Hospital", *Medical Ho Chi Minh city*, **10(1)**, pp.136-144.

[4] V.L. Chuyen, V.T. Vu (2006), "Laparoscopic radical prostatectomy for prostate cancer, our experiences in first 23 cases at Binh Dan Hospital", *Medical Ho Chi Minh city*, **10(4)**, pp.173-182.

[5] V.L. Chuyen, N.T. De (2012a), "Retroperitoneoscopic radical prostatectomy: factors influencing surgical results", *Medical Ho Chi Minh city*, **16(3),** pp.88-92.

[6] V.L. Chuyen, N.T. De (2012b), "Endoscopic extraperitoneal radical prostatectomy: surgical complications", *Medical Ho Chi Minh city*, **16(3)**, pp.93-97.

[7] V.L. Chuyen (2013), "Survey the quality of life of the patients after having the endoscopic extraperitoneal radical prostatectomy", *Journal of Endoscopic Surgery*, **1**, pp.51-57.

[8] J.A.Jr Smith (2016), "Radical prostatectomy which patients benefit most from surgery?", *J. Urol.*, **176(2)**, p.437.

[9] V.R. Patel, A.S. Tully, R. Holmes, J. Lindsay (2005), "Robotic radical prostatectomy in the community setting the learning curve and beyond: initial 200 cases", *J. Urol.*, **174(1)**, p.26972.

[10] H. Abboudi, M.S. Khan, K.A. Guru, et al. (2014), "Learning curves for urological procedures: a systematic review", *BJU Int.*, **114**, pp.617-629.

[11] S.B. Farnham, T.M. Webster, S.D. Herrell, J.R.Jr Smith (2006), "Intraoperative blood loss and transfusion requirements for robotic assisted radical prostatectomy versus radical retropubic prostatectomy", *Urology*, **67(2)**, p.3603.

[12] M. Froehner, V. Novotny, R. Koch, S. Leike, L. Twelker, M.P. Wirth (2013), "Perioperative complications after radical prostatectomy: open versus robot assisted laparoscopic approach", *Urol. Int.*, **90**, p.3125.

[13] C.R. Ritch, C. You, A.T. May, S.D. Herrell, P.E. Clark, D.F. Penson, et al. (2014), "Biochemical recurrence free survival after robotic assisted laparoscopic vs open radical prostatectomy for intermediate and high-risk prostate cancer", *Urology*, **83(6)**, p.130915.

[14] J.E. Thompson, S. Egger, M. Böhm, et al. (2014), "Superior quality of life and improved surgical margins are achievable with robotic radical prostatectomy after a long learning curve: a prospective single-surgeon study of 1552 consecutive cases", *Eur. Urol.*, **65**, pp.521-531.

[15] J.W. Davis, U.S. Kreaden, J. Gabbert, R. Thomas (2014), "Learning curve assessment of robot-assisted radical prostatectomy

compared with open-surgery controls from the premier perspective database", *J. Endourol.*, **28(5)**, pp.560-566.

[16] G.B. Di Pierro, P. Baumeister, P. Stucki, et al. (2011), "A prospective trial comparing consecutive series of open retropubic and robot-assisted laparoscopic radical prostatectomy in a centre with limited caseload", *Eur. Urol.*, **59**, pp.1-6.

[17] T.J Leroy, D.D. Theil, D.A. Duchene, et al. (2010), "Safety and perioperative outcomes during learning curve of robot-assisted laparoscopic prostatectomy: A multi-institutional study of fellowship-trained robotic surgeons versus experienced open radical prostatectomy surgeons incorporating robot assisted laparoscopic prostatectomy", *J. Endourology*, **24**, pp.1665-1669.

[18] C.D. Lallas, J.W. Davis (2012), "Robotic surgery training with commercially available simulation systems in 2011: a current review and practice pattern survey from the society of urologic robotic surgeons", *J. Endourol.*, **26**, pp.283-293.

[19] F. Rozet, J. Jaffe, G. Braud, J. Harmon, X. Cathelineau, E. Barret, et al. (2007), " A direct comparison of robotic assisted versus pure laparoscopic radical prostatectomy: a single institution experience", *J. Urol*., **178(2)**, p.47882.

[20] D.W. Good, G.D. Stewart, A. Laird, J.U. Stolzenburg, D. Cahill, S.A. McNeill (2015), "A critical analysis of the learning curve and postlearning curve outcomes of two experience- and volume-matched surgeons for laparoscopic and robot-assisted radical prostatectomy", *J. Endourology*, **29(8)**, pp.939-947.