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Original Research / Özgün Araştırma

Determining the learning curve for robot-assisted radical perineal prostatectomy in surgeons familiar with robotic retropubic prostatectomy

Robotik retropubik prostatektomiye aşina cerrahlar için robot yardımlı perineal prostatektomi için öğrenme eğrisi

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Özet

Amaç: Robot yardımlı transperitoneal radikal prostatektomi ameliyatını rutin olarak gerçekleştiren cerrahlar için Robot yardımlı laparoskopik perineal prostatektomi (Robotik RPP) ameliyatının öğrenme eğrisinin belirlenmesi

Gereç ve Yöntemler: Tek cerrah tarafından gerçekleştirilen ilk 120 Robotik RPP vakasının perioperatif verileri değerlendirildi. Operasyon zamanı, tahmini kan kaybı, postoperatif yatış süresi, komplikasyonlar ve pozitif cerrahi sınır olmak üzere perioperatif tüm veriler derlendi. Olgular operasyon zamanlarına göre dört gruba ayrıldılar; 1–30. olgular (Grup 1), 31–60.olgular (Grup 2), 61–90.olgular (Grup 3) and 91-120. olgular (Grup 4).

Bulgular: Hastaların yaş ortalaması 61.4 (46-73) yıl ve PSA seviyeleri 8.4 (2-32) idi. Ortalama operasyon süresi 143.2 dakika iken cerrahi süresi progresif olarak zamanla azalmıştır. (Grup 1'den grup 4'e ; P<001). Ortalama konsol zaman 90.6 dakika iken grup 3 ve 4 arasında anlamlı bir fark bulunmuştur. (p=0.047). Ortalama hastane yatış süresi 1.6 gün iken 60.vakadan sonra anlamlı bir şekilde azalmaya başlamıştır. Katater çıkarılma zamanı Grup 4 için anlamlı bir şekilde daha kısa idi (P1vs4=0.012). Gruplar arasında patolojik evre, pozitif cerrahi sınır ve komplikasyonlar açısından anlamlı bir fark yoktu.

Sonuç: Bu çalışma ile deneyimli robotik cerrahlar için Robotik RPP ameliyatında yeterliliğinin 90 vakadan sağlanabileceğini sonucuna varılmıştır.

Anahtar Kelimeler: prostatektomi, robot yardımlı, perineal, öğrenme eğrisi, prostat kanseri

Abstract

Objective: To investigate the learning curve for robot assisted laparoscopic radical perineal prostatectomy (robotic RPP) for surgeons who already perform transperitoneal robot assisted laparoscopic radical prostatectomy.

Material and Methods: A total of initial 120 robotic RPP cases were analyzed for perioperative data from single surgeon performing to determine the learning curve. Perioperative all data are collected including operation time, estimated blood loss, postoperative length of stay, complications and positive surgical margin results. The consecutive patients were classified into four groups: cases 1–30 (Group 1), cases 31–60 (Group 2), cases 61–90 (Group 3) and cases 91-120 (Group 4).

Results: Median age of 61.4 (46-73) years and PSA level was 8.4 (2-32). Mean operative time was 143.2 minutes, and the length of surgery progressively decreased over time (from group 1 to group 4; P<001). Mean console time was 90.6 minutes and significant differences was found group 3 vs. 4 (p=0.047). The mean length of stay was 1.6 days, and significantly decrease after 60 cases over time (P<0.001). Mean removal of the urethral catheter significantly earlier in group 4 (P1vs4=0.012). There was no statistically significant difference between the groups with respect to pathologic tumor Gleason score, positive surgical margine of the specimen and complications.

Conclusions: This study suggests that surgical qualification for robotic RPP can be obtained at least after 90 cases for an experienced robotic surgeon.

Keywords: prostatectomy, robot-assisted, perineal, learning curve, prostate cancer

The study was approved by Memorial Bahçelievler Hospital Ethical Committee, (Decision No: 2022-63, Date: 2022/07/27).
All research was performed in accordance with relevant guidelines/regulations, and informed consent was obtained from all participants.

INTRODUCTION

Prostate cancer (PCa) is reported to be the second common cancer among men (1) with organ-confined disease rates up to 90% through the last decade. The surgical options vary and develop as with the developments in technology along with the popularity robot-assisted approaches gained. Radical perineal prostatectomy (RPP) is the main technique for removal of prostate as defined by Hugh Hampton Young in 1905 (2). Radical retropubic prostatectomy (RRP) technique is respectively described by Walsch and those 2 techniques reveal the same anatomic relationship, success rate in cancer control besides preserving the parasympathetic and sympathetic nerves that control penile erection and ejaculation (3). RRP is accepted as the preferred approach for radical prostatectomy (RP) for years. Minimal invasive surgery for prostate cancer has developed with the advent of robotic platforms at the beginning of new millennium (4,5). Overall learning curve for robotic-assisted laparoscopic surgery was recorded comparable until >150 cases (6).

Although RPP had advantages as decrease in morbidity, in hospital costs, in hospitalization duration with shorter operation time, it has lost its popularity with the developments of robotic platforms (7). However RPP became preferred technique again during the last two decades due to increased interest in nerve sparing techniques and facility of performing lymphadenectomy (8). In light of those developments Laydner et al., as the first researchers who describing the robotic RPP technique in a cadaveric model, published their clinical experience in 2016 (9,10).

In the present study, we aim to examine the learning curve of a high volume robotic surgeon with no previous experience at robotic RPP at a single center.

MATERIAL AND METHODS

This study is approved by Local Ethical Committee of Bakirkoy Sadi Konuk Training and Research Hospital, and written informed consent is obtained from all patients. Retrospective data of 120 patients operated by single surgeon (VT), between November 2016 and February 2020 included in the study. Experienced surgeon has robotic experience over 1500 cases and more than 20 cases of RPP under supervision of highly experienced surgeon who defined the first technique of robot-assisted RPP. The patients are divided into 4 groups, as patients 1 to 30 included in Group 1; patients between 31-60 in Group 2; patients between 61 and 90 in Group 3 and patients between 91 and 120 are included in Group 4. Patients' age, body mass index (BMI), American Society of Anesthesiologists anesthetic/surgical risks class (ASA), prostate-specific antigen (PSA) levels, PSA density, biopsy percentage, Gleason score, and the clinical stage of the patients are recorded. Patients treated for prostate cancer, neoadjuvant or adjuvant hormonal therapy were nor included in the study.

The preoperative and postoperative PSA levels and Gleason scores, hospitalization duration, skin to skin operative time, estimated blood loss, complications, the status of surgical margin, and the presence of capsular penetration are accepted as primary outcome variables.

Statistical Analysis

Categorical data were presented as numbers and percentages. Data for continuous variables are presented as mean and standard deviation. The Shapiro-Wilk test was used to determine whether the distributions of continuous variables were normal. Mean differences between more than two related groups of normally distributed data were compared with ANOVA, while the Kruskal-Wallis Test was used to compare non-normally distributed data. The frequencies of categorical variables were compared using Fisher›s exact test. Statistical significance was considered when p value was<0.05. In normally distributed data, Bonferroni correction was used in pairwise comparison of more than two groups with statistically significant differences. In non-normally distributed data, Tamhane's correction was used in pairwise comparison of more than two groups with statistically significant differences. Statistical analysis was performed using Statistical Package of Social Sciences version 21 (IBM SPSS Statistics; IBM Corp.,

Armonk, NY).

RESULTS

The median age of the patients was 61.4 (46-73) years, the median prostate size was 50.2 ml (15-100), the median preoperative PSA was 8.4 (2-32) and the median preoperative Gleason score was 6 (6-8). Table 1 lists the baseline demographic characteristics and surgical data.

The mean operative time was 143.2 minutes (between 110 and 255 minutes), and the surgery time observed to be decreased from group 1 to group 4 (P<001). Mean console time was 90.6 minutes (range, 55-155 minutes), progressively decreased and significant differences was found group 3 vs. 4 (p=0.047). The mean hospitalization duration was 1.6 days (range, 1-4 days). The length of hospitalization time is found to be significantly decreased after 60 cases (P<0.001). Mean removal of the urethral catheter was 7.2 days (range, 6-25 days) and significantly earlier in group 4 (Group 1 vs Group 4=0.012). The difference in the results of the pathological tumor Gleason score and positivity of the surgical margin were not statistically significant between the groups. Pelvic lymph node dissection was performed in 12 patients since they are accepted as having high risk of node involvement according to Partin nomogram. A mean of 14.6 ± 1.7 lymph nodes were resected and 4 patients are found to have lymph node metastasis.

According to Clavien-Dindo classification overall grade 2 and 3 complications rate was 14% (11.7%), and no significant decrease in the complication rate is observed as the surgeon's experience increased (Groups 1, 2, 3, and 4; 16.7%, 6.7%, 16.7%, and 6.7%, respectively; P=0.450) No grade 4 and 5 complications were seen. In 4 patients wound infection and wound dehiscence were detected and repaired primarily. In 3 patients postoperative fever which responded to antipyretics is detected. In 4 patients urinary leakage occurred which is treated with prolonged urethral catheterization. Three patients are diagnosed to have

Table 1. Demographic data and clinical parameters

Number of patients	120
Age (year)	
Mean ± SD	61.4 ± 6.7
Median (range)	62 (46-73)
BMI	
Mean ± SD	28.0 ± 2.2
Median (range)	28 (23-35)
PV (ml)	
Mean ± SD	50.2 ± 17.4
Median (range)	48 (15-100)
PSA(ng/dl)	
Mean ± SD	8.4 ± 5.6
Median (range)	7 (2-32)
Gleason skor	
Mean ± SD	6.2 ± 0.4
Median (range)	6 (6-8)
MpMRI PIRADS, n(%)	
PIRADS 1	10 (8.3)
PIRADS 2	31 (25.8)
PIRADS 3	23 (19.2)
PIRADS 4	54 (45.0)
PIRADS 5	2 (1.7)

Clinical stage, n(%)	
T1c	12 (10.0)
T2a	12 (10.0)
T2b	31 (25.8)
T2c	65 (54.1)
ASA score, n(%)	
ASA 1	5 (4.2)
ASA 2	96 (80.0)
ASA 3	19 (15.8)
Operation time (min)	
Mean ± SD	143.2 ± 17.8
Median (range)	140 (110-255)
Console time (min)	
Mean ± SD	90.6 ± 14.0
Median (range)	90 (55-155)
Blood loss (ml)	
Mean ± SD	67.1 ± 13.6
Median (range)	65 (45-120)
LOS (day)	
Mean ± SD	1.58 ± 0.69
Median (range)	1 (1-4)
Removal of catheter time (day)	
Mean ± SD	7.2 ± 2.3
Median (range)	7 (6-25)
Return to job time (day)	
Mean ± SD	10.5 ± 2.8
Median (range)	10 (7-30)

***SD:** standart deviation; **BMI:** body massindex; **PV:** prostate volume; **LOS:** lenght of stay*

Table 2. Comparison of patients' characteristics according to time

Variables	**1st 30**	**2nd 30**	**3rd 30**	**4th 30**	**P value**
Number of patients	30	30	30	30	
Mean age ± SD, year	61.5 ± 7.0	60.4 ± 7.8	61.8 ± 6.5	62.2 ± 5.5	0.752*
Age (year) Mean ± SD	61.5 ± 7.0	60.4 ± 7.8	61.8 ± 6.5	62.2 ± 5.5	0.752*
Mean BMI ± SD	28.3 ± 2.0	27.3 ± 2.4	27.8 ± 2.3	28.7 ± 2.2	0.102*
Mean PV ± SD (ml)	42.3 ± 14.0	58.6 ± 21.0	49.1 ± 17.4	50.8 ± 12.8	0.015¥ 1 vs 2 0.006
Mean PSA(ng/dl)	6.3 ± 2.4	9.1 ± 6.4	10.8 ± 8.1	7.6 ± 2.2	0.045¥ 1 vs 3 0.035
Mean GS score ± SD	6.4 ± 0.5	6.2 ± 0.4	6.2 ± 0.4	6.3 ± 0.4	0.353¥

GS at biopsy, n(%)					
6 7 8-10	19 (63.3) 10 (33.3) 1 (3.3)	24 (80.0) 6 (20.0) 0 (0.0)	24 (80.0) 6 (20.0) 0 (0.0)	21 (70.0) 9 (30.0) 0 (0.0)	0.487&
Mean MpMRI score± SD	3.06 ± 1.08	2.96 ± 1.06	3.16 ± 1.05	3.03 ± 1.06	0.908*
MpMRI Score, n(%)					
PIRADS 1 PIRADS 2 PIRADS 3 PIRADS 4 PIRADS 5	3 (10.0) 6 (20.0) 8 (26.7) 12 (40.0) 1 (3.3)	3 (10.0) 8 (26.7) 6 (20.0) 13 (43.3) 0 (0.0)	2 (6.7) 7 (23.3) 6 (20.0) 14 (46.7) 1 (3.3)	2 (6.7) 10 (33.3) 3 (10.0) 15 (50.0) 0 (0.0)	0.925&
Clinical stage, n(%)					
T1c T2a T2b T2c	3 (10.0) 5 (16.7) 7 (23.3) 15 (50.0)	3 (10.0) 6 (20.0) 5 (16.7) 16 (53.3)	2 (6.7) 0 (0.0) 13 (43.3) 15 (50.0)	4 (13.3) 1 (3.3) 6 (20.0) 19 (63.3)	0.091&
ASA score, n(%)					
Asa 1 Asa 2 Asa 3	0 (0.0) 26 (86.7) 4 (13.3)	0 (0.0) 21 (84.0) 4 (16.0)	2 (6.7) 20 (66.7) 8 (26.7)	3 (10.0) 25 (83.3) 2 (6.7)	0.133&
Mean OT ± SD (min)	157.0 ± 28.6	140.0 ± 7.3	140.5 ± 5.9	135.6 ± 10.8	<0.001¥ 1 vs 2 0.021 1 vs 3 0.025 1 vs 4 0.003
Mean CT ± SD (min)	96.8 ± 23.2	90.5 ± 6.4	90.8 ± 4.7	84.5 ± 11.4	0.041¥ 3 vs 4 0.047
Mean BL ± SD (ml)	68.1 ± 13.4	70.5 ± 15.7	67.6 ± 12.9	62.3 ± 11.1	0.121*
Mean LOS ± SD (day)	2.0 ± 0.7	1.6 ± 0.7	1.4 ± 0.5	1.2 ± 0.4	<0.001* 1 vs 3 0.001 1 vs 4<0.001
Removal of UC ± SD (day)	8.2 ± 2.8	7.2 ± 3.4	7.1 ± 0.9	6.3 ± 0.6	0.021* 1 vs 4 0.012
Return to job time ± SD (day)	11.3 ± 3.7	10.6 ± 3.8	10.3 ± 1.0	10.0 ± 1.2	0.179¥
SM, n(%) Negative Positive	 27 (90.0) 3(10.0)	 29 (96.7) 1 (3.3)	 27 (90.0) 3 (10.0)	 26 (86.7) 4 (13.3)	 0.685&
Comlication, n(%)					
Positive Negative	5 (16.7) 25 (83.3)	2 (6.7) 28 (93.2)	5 (16.7) 25 (83.3)	2 (6.7) 28 (93.3)	0.450&
Mean RP specimen GS score ± SD	6.5 ± 0.7	6.2 ± 0.4	6.7 ± 0.5	6.5 ± 0.5	0.121*
GS at RP, n(%)					
6 7 8-10	16 (53.3) 12 (40.0) 2 (6.7)	19 (63.3) 11 (36.7) 0 (0.0)	9 (30.0) 20 (66.7) 1 (3.3)	14 (46.7) 15 (50.0) 1 (3.3)	0.110&

***SD,** standart deviation; **BMI,** body massindex; **PV,** Prostate volume; **GS,** Gleason score; **OT,** Operation time; **CT,** Console time; **BL,** Blood loss; **LOS,** Lenght of stay; **UC,** Urethral Catheter; **SM,** Surgical margine; **RP,** Radical prostatectomy*
** One way ANOVA; **¥** Kruskal Wallis test; **&** Fisher's Exact Test*

transient neurological deficit in the lower extremity due to exaggerated lithotomy position which improved by time (Table 2).

DISCUSSION

In 1905, although it was first described technique in the surgical treatment of PCa, RPP, which was not performed commonly for a century, resurgenced again in the early 2000s. Having less blood loss, lower pain after the operation, shorter hospitalization time and more rapid recovery were the main advantages of the RPP when compared to RRP (11). The others are having shorter learning curve (11) and the less surgical complexity in patients who experienced prostate or bladder surgery (12). RPP provides relatively convenient anatomical approach to the prostate with a small incision. However, in RPP, the surgeon may have ergonomic issues during operation due to the superior position of the prostate as per surgeon, and those challenges may have inhibited its utilization. The application of the robotic system to RP, utilized to reduce the above mentioned difficulties in conventional RPP (13). Robotic surgery is actually a validated treatment option for localized prostate cancer. Lower blood loss, lower blood transfusion need and early continence were reported to be the main advantages of robotic surgery. Improved cosmetic appearance and shorter recovery time also served to higher patient acceptance of robotic procedures.

The Robotic prostatectomy technique has also developed rapidly with different approaches where robotic RPP is a more recent developed technique. After Kaouk et al., first described the robotic RPP technique in a cadaveric model, they reported their first clinical experience and concluded that combining robotic technology with RPP, eliminated narrow and deep operative field observed in open RPP and provided a magnified 3D view of the periprostatic tissues (10). Tugcu et al. reported early results of 95 patients who underwent robotic RPP. Median operation duration was 140 min, the console time was 90 min and the mean blood loss was 67.4 ml. Positive surgical margins were detected in 8.4% of the patients. Immediate continence rate was 41% , in the first month it was 78%, in the third month it was 87% and at the first year 91%. Complication rate was 11.6% and they reported no grade 4 and 5 complication. The authors concluded that robotic RPP is an effective surgical technique which can be utilized in the treatment of localized prostate cancer regardless of prostate size, and it can be applied in patients with a history of abdominal surgery, where pelvic lymph node dissection may be performed through the same incision (14).

The learning curve is a one of the prominent problem in surgery, where the surgical procedure is often more difficult and slow to perform, associated with a higher risk of complications and low performance due to the inexperience of the surgeon. If a basic assessment is made, the learning curve is mainly a theoretical concept, because this is a subject of research rarely present in residency programs and urologic literature. A minimum of 60 surgery cases are required to attain proficiency (15). With improvement in the techniques performed, structured training programs are developed to provide safe and effective training of surgeons with no previous experience of open or laparoscopic surgery (16) On the other hand, surgeons with robotic experience will also have a short learning curve, because they already have a certain competence and proficiency of the instruments. For this reason, the learning curve of robotic surgery is generally shorter than that of laparoscopic surgery. Patel et al., reported that after 20-25 cases, the surgeon could perform the surgery on his own. In this study, the robotic surgery team consisted of a trained laparoscopic surgeon and an experienced open surgery surgeon (17). Kouok et al., published their initial data of the robot assisted laparoscopic radical perineal prostatectomy using new robotic single port platform by Da Vinci System. They reported that the new system had encouraging results (18). In our series, an experienced surgeon in robotic surgery, performed all the operations. The articles In the surgical literature about learning curve, report that the most typical approach to exhibit the relationship between the experience and the outcome is to categorize, such as dividing 100 or 120 cases into three to four equal groups respectively and then draw conclusions by making comparison between groups (19). Similarly, in our study, we divided 120 patients into 4 equal and

consecutive groups and compared them with each other. Surgical time was shortened in each group, but console time was significantly less only in the 4th (in patients between 90 and 120) group compared to the 3rd group. While the duration of hospitalization was significantly less after the 60th patient, the duration of catheter removal was significantly earlier after the 90th patient. There was no statistically significant difference between the groups in terms of surgical margin positivity and complications. With these results, we can conclude that surgical parameters in robotic RPP improved after the 90th case. This duration seems longer when compared to other robotic prostatectomy methods. A multi-centric study (LAPPRO trial) with inclusion of total 2672 clinical localized PCa patients treated with RARP, reported outcomes regarding incontinence and erectile function, claims that incontinence was stable all through the learning period, and erectile function preserved in 38% in the first 74 cases while the percentage increased to 53% after 300 cases (20). It would not be wrong to think that this situation is due to the narrowness of the working area and encountering more difficulties than the standard procedure. However, the fact that surgical margins and complications are not different between all groups; one may conclude that experienced surgeons can be adapted to this difficult surgical procedure in a short time. The main limitations of our study are the lack of urinary incontinence and erectile function data.

CONCLUSION

In conclusion this study demonstrates that surgeons with significant experience in robotic surgery are able to provide successful surgical outcomes in short time comparable to standard methods in robotic RPP.

Conflict of Interest

The author declare to have no conflicts of interest.

Financial Disclosure

The author declared that this study has received no financial support.

Informed Consent

Informed consent was obtained from all individual participants included in the study.

Ethical Approval

The study was approved by Memorial Bahçelievler Hospital Ethical Committee (Decision No: 2022-63, Date:2022/07/27) and written informed consent was received from all participants. The study protocol conformed to the ethical guidelines of the Helsinki Declaration.

Author Contributions

Conception and design; Çömez Yİ, Balcı M, Tuğcu V, Data acquisition; Çömez Yİ, Sökmen D, Şeker KG, Tuğcu V, Data analysis and interpretation; Çömez Yİ, Balcı M, Drafting the manuscript; Çömez Yİ, Balcı M, Tuğcu V, Critical revision of the manuscript for scientific and factual content; Çömez Yİ, Tuğcu V, Statistical analysis; Balcı M, Supervision; Çömez Yİ, Sökmen D, Şeker KG, Tuğcu V.

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