

ACHIEVING ONCOLOGIC COMPETENCY WITH ROBOTIC ASSISTED LAPAROSCOPIC RADICAL PROSTATECTOMY: CAN A COMMUNITY UROLOGIST WITHOUT LAPAROSCOPIC OR ONCOLOGIC FELLOWSHIP TRAINING ACHIEVE OPTIMAL RESULTS?"

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ABSTRACT

PURPOSE: We examined the oncologic learning curve of a single community urologist without specific oncologic or laparoscopic fellowship training during the initiation of a robot assisted prostatectomy (RAP) program.

MATERIALS AND METHODS: The records of patients undergoing RAP during the first 4 years of a single surgeon's experience were examined for positive surgical margins (PSM). A univariate analysis was performed in an attempt to identify predictors of the creation of a PSM, and logistic regression was performed to assess the correlation between a PSM with surgeon experience.

RESULTS: A total of 469 patients underwent RAP during the study period. The overall, pT2 and pT3 PSM rates were 23.9%, 20.5%, and 39.5%, respectively. Preoperative PSA, pathologic stage and year of surgery were associated with the occurrence of a PSM. Pathologic stage correlated to the risk of PSM in pT2 specimens for the first time during the 4th year, after 290 patients had been treated. The pT2 PSM rate before and after case 290 was 24% and 10%, respectively ($p < 0.001$). Surgeon experience failed to demonstrate a statistically significant correlation with the occurrence of a PSM on logistic regression (ROC 0.530, 95% confidence intervals 0.469, 0.592), but the probability of a PSM decreased with time despite a negative stage migration.

CONCLUSIONS: The probability of creating a PSM following RAP decreased with experience for a surgeon without fellowship training or prior extensive experience. Oncologic competence was achieved after 290 cases had been performed, representing a significantly longer learning curve than previously reported.

INTRODUCTION

Robotically assisted prostatectomy (RAP) has become the most common approach to radical prostatectomy in the United States. Approximately 65% of U.S. prostatectomies in 2007 were performed with robotic assistance.¹ Many believe robotic assistance reduces the procedural learning curve associated with pure laparoscopic prostatectomy.² This belief built tremendous popularity before oncologic efficacy could be proven over the gold

standard, open retropubic radical prostatectomy (RRP).

The earliest RAP series reported alarmingly high rates of positive surgical margins (PSM) compared to historical RRP series, leading to warranted criticism of the new technology.²⁻⁴ Since then, the oncologic efficacy of RAP rivals the RRP once the surgeon has overcome the technical learning curve.^{3,5,6} A recent multi-institutional analysis examining several surgeons concluded that the oncologic learning curve associated with the RAP is 100-200 cases.⁷ However, these investigators referenced surgeons who trained in advanced laparoscopy or robotic surgery prior to the initiation of their individual RAP programs, which may have artificially underestimated the oncologic learning curve of RAP.⁷ The effect of this underestimation might lead to worse oncologic outcomes if new surgeons assume they will follow the same curve.

In this analysis, we examine the oncologic learning curve of a single community urologist without specific oncologic or laparoscopic fellowship training during the initiation of a RAP program.

MATERIALS AND METHODS

The George Washington University Hospital Institutional Review Board approved this study design and retrospective analysis from our prospectively maintained RAP electronic database. We examined the records of all men who underwent RAP at our institution by a single surgeon (JDE) between February 2, 2004 (inception date of our RAP program) and December 31, 2007.

RAP technique

Our RAP technique initially followed that described by Menon et al, including the “veil of Aphrodite”, or intrafascial, neurovascular bundle (NVB) dissection.^{8,9} One year after the inception of the RAP program we moved the incision in the lateral prostatic fascia more posteriolaterally, to approximately 5 and 7 o’clock, and attempted to purposely perform an interfascial NVB dissection, leaving fibers of the lateral prostatic fascia on the prostate.⁹ We avoid sharp dissection of the NVBs, utilizing a blunt technique using the Maryland dissector or hook electrode. If there is any evidence of desmoplastic reaction preventing blunt incision of the lateral fascia or easy release of the NVB, we convert to a sharp dissection later in the surgery after releasing the rectum and exposing the posterior prostate. Generally, the NVBs and much of the rectum are dissected from a lateral vantage point rather than a posterior approach. At the same time, we adopted the apical dissection technique described by Ahlering et al, performing a more complete apical dissection prior to ligating the dorsal venous complex.⁵

A PSM was defined as cancerous glands present at the inked margin. Glands did not need to be transected to be

considered positive. Pathologic staging was performed using the AJCC 2002 TNM guidelines.

Statistics

A two-tailed Pearson chi-square test was used for comparing categorical variables in univariate and multivariate analyses. Logistic regression was used to assess correlation of PSM with surgeon experience (defined as number of overall cases performed). All calculations were performed using SPSS software (SPSS Inc, Chicago, IL). Statistical significance was declared for p-values less than 0.05.

RESULTS

A total of 469 patients underwent RAP during the study period. The cohort demographics are listed in Table 1. Five patients were removed from analysis for lack of preoperative PSA and risk group stratification. The overall, pT2 and pT3 PSM rates were 23.9%, 20.5%, and 39.5%, respectively. The univariate analysis of risk factors for the creation of a PSM in this cohort is listed in Table 2. Preoperative PSA, risk group stratification, year of surgery and pathologic stage all correlated with PSM in a statistically significant manner. Pathologic stage correlated to the risk of PSM in pT2 specimens for the first time during the 4th year after 290 patients had been treated (Table 3). The pT2 PSM rate before and after case 290 was 24% and 10%, respectively ($p < 0.001$).

Logistic regression analysis of surgeon experience and PSM rate over time failed to demonstrate a statistically significant correlation (ROC area 0.530, 95% confidence intervals 0.469, 0.592). The probability of a PSM decreased over time (Figure 1), despite no statistically significant change in preoperative PSA or biopsy Gleason score. The proportion of pT3 patients steadily increased during the study period (Table 3).

PSM was strongly associated with BCR during the initiation of this RAP program ($p = 0.001$). This data will be reported separately. After an average of 30 months of follow-up, the overall freedom from BCR was 72%, 78% if the surgical margin was negative and 57% for PSM patients ($p < 0.001$).

DISCUSSION

The oncologic efficacy of any extirpative procedure is based on several factors, but biologic aggressiveness of the tumor, surgeon experience, and surgical volume are unequivocally the most important variables.¹⁰⁻¹² Tumor stage is a validated and significant predictor of biologic aggressiveness for prostate cancer.¹⁰ It follows that a properly performed prostatectomy should result in complete resection of organ confined disease (pT2), with

negative surgical margins. Extracapsular disease (pT3) should represent the primary risk factor for a PSM if a NVB dissection is performed. Because tumor stage is not always easily predicted preoperatively, we believe that the quality of a prostatectomy is most closely related to the PSM rate in pT2 disease, and that this rate is a reasonable surrogate measure of oncologic competency along with BCR.

Accurate representation of the RAP oncologic learning curve has been difficult to accurately describe. Ahlering et al reported a pT2 PSM rate of 16.7% after approximately 140 procedures during the initiation of a RAP program.⁴ Herrell and Smith suggested competence with RAP after approximately 150 procedures, which was based on surgeon comfort with the technology. In a large, multi-institutional review examining several surgeons, Lavery et al reported that the RAP learning curve was between 100-200 cases.⁷ A common fault made by all of these excellent studies is that the surgeons described underwent fellowship training in oncology or laparoscopy, or had extensive surgical experience prior to initiating their respective RAP programs. This fact likely underestimates the true oncologic learning curve associated with RAP given that the vast majority of urologists performing RAP at this time have neither fellowship training nor the experience of a master surgeon.

We have shown that such a surgeon can achieve oncologic competency with RAP after 290 cases, when the pathologic stage (i.e. tumor biology) first predicted the risk of a PSM. The probability of creating a PSM for the entire cohort decreased from 27% to 21%, which is a reflection of the dramatic decrease in the PSM rate in pT2 disease (24% in years 1-3 vs. 10% in year 4). Importantly, the overall probability of a PSM improved despite a steady increase in the number of high-risk patients each year, from 4.8% in the first year to 33% in the fourth year (Table 3), and no change in patient's preoperative PSA or risk group stratification over the study period. Not unexpectedly, our data supports a significantly longer learning curve than previously reported. We believe these results make a strong argument for robotic fellowship training prior to starting a RAP program. In the absence of fellowship training, a surgeon at the beginning of the RAP learning curve should carefully select patients, have a low threshold to convert to RRP, more aggressively resect the NVB in moderate and high risk patients, or obtain expert assistance in an effort to minimize the risk of a PSM.

The main weakness of our study is the absence of a detectable correlation between the incidence of PSM and surgeon experience on logistic regression. We believe this analysis failed to achieve statistical significance because the small cohort size, however, additional cofounders could exist that we did not identify in our analysis. The imperfections of margin status following prostatectomy as a surrogate of oncologic efficacy are well documented, particularly when the PSM is apical. However, the preponderance of evidence suggests that a PSM is associated with BCR and worse oncologic outcome.^{13,14} In our cohort, with only 30 months of follow-

up, a PSM strongly predicted BCR ($p < 0.001$), validating PSM as a prognostic measure in this cohort. This finding may prove margin status is a more sensitive prognostic factor at the beginning of a surgeon's experience with RAP than for a surgeon who has overcome the learning curve, which we will report on in the near future.

CONCLUSIONS

We confirmed that the probability of creating a PSM decreases with surgeon experience for a single surgeon without fellowship training in oncology or laparoscopy/robotics. The risk of creating a PSM became dependent on tumor biology after 290 cases, which represents a longer learning curve than previously reported. It is possible that this difference is explained by surgeon experience and/or training prior to initiating a RAP program. In the absence of fellowship training, surgeons at the beginning of their RAP learning curve should attempt to minimize the incidence of a PSM by carefully selecting patients, performing aggressive NVB dissections in high-risk patients, converting to an open procedure if that increases the confidence of the surgeon, or obtaining expert assistance.

Table 1. Cohort characteristics.

Table 2. Univariate analysis of clinical risk factors for a PSM tested within this cohort.

Table 3. Risk of a PSM for pathologic T2 and T3 disease during the study period.

Figure 1. Predicted probability of a PSM with increasing surgeon experience for a) the cohort overall, b) pathologic T2 disease, c) pathologic T3 disease.

Table 1. Clinical characteristics of the cohort.

	n	%
Total patients	469	
Age (mean)	60	
PSA (mean)	6.47	
Clinical Stage		
T1c	379	80.8%
T2	90	19.2%
Biopsy Gleason Score		
5-6	304	64.8%
3+4	80	17.1%
4+3	41	8.7%
8-10	44	9.4%
Risk Group		
Low	272	58.6%
Moderate	142	30.6%
High	50	10.8%
Year of surgery		
2004	42	9%
2005	97	20.7%
2006	151	32.2%
2007	179	38.2%

Table 2. Univariate analysis of potential risk factors for the creation of a PSM.

	NSM	PSM	p Value
Age			
≤50	25	8	
50-54	59	18	
55-59	77	33	
60-64	113	31	
≥65	82	22	0.535
DRE			
Normal	289	90	
Abnormal	68	22	0.889
PSA			
<10	319	84	
≥10	35	29	<0.001
Biopsy Gleason Score			
5-6	239	65	
3+4	59	21	
4+3	28	13	
8-10	31	13	0.327
Risk Stratification Group			
Low	222	50	
Intermediate	100	42	
High	32	18	0.004
Year of Surgery			
2004	26	16	
2005	77	20	
2006	109	42	
2007	145	34	0.031
Pathologic Stage			
pT2a	49	9	
pT2b	3	1	
pT2c	241	64	

pT3a	40	30	
pT3b	18	8	0.001

Table 3. Risk of PSM for pT2 and pT3 by year of surgery.

	No. of patients	NSM	PSM	p Value
2004				
pT2	40 (95%)	25	15	
pT3	2 (4.8%)	1	1	1.000
2005				
pT2	84 (86%)	69	15	
pT3	13 (14%)	8	5	0.134
2006				
pT2	129 (85%)	97	32	
pT3	22 (15%)	12	10	0.069
2007				
pT2	120 (67%)	108	12	
pT3	59 (33%)	37	22	<0.001

REFERENCES

1. Information from customer relations, Intuitive Surgical, Inc. Sunnyvale, California.
2. Ahlering TA, Skarecky D, Lee D, Clayman RV: Successful transfer of open surgical skills to a laparoscopic environment using a robotic interface: initial experience with laparoscopic radical prostatectomy. *J Urol* 2003; **170**: 1738.
3. Atug F, Castle EP, Srivastav SK, Bugess SV, Thomas R, Davis R: Positive surgical margins in robotic-assisted radical prostatectomy: Impact of learning curve on oncologic outcomes. *Eur Urol* 2007; **49**: 866.
4. Weizer AZ, Ye Z, Hollingsworth JM, Dunn RL, Shah RB, Wolf JS, et al: Adoption of new technology and healthcare quality: surgical margins after robotic prostatectomy. *Urol* 2007; **70**: 96.
5. Ahlering TE, Eichel L, Edwards RA, Lee DI, Skarecky DW: Robotic Radical Prostatectomy: A technique to reduce pT2 positive margins. *Urol* 2004; **70**: 1224.
6. Smith JA Jr., Chan RC, Chang SS, Herrell SD, Clark PE, Baumgartner R, et al: A comparison of the incidence and location of positive surgical margins in robotic assisted laparoscopic radical prostatectomy and open radical retropubic prostatectomy. *J Urol* 2007; **178**: 2385..
7. Lavery HJ, Ahlering T, Tewari A, Smith JA, Shalhav A, Albala D, et al: The advanced learning curve in robotic-assisted laparoscopic radical prostatectomy: a multi-institutional survey. *Urology* 2007; **70** (Supp 3A, Podium session abstract POD-01.05): 2.
8. Savera AT, Kaul S, Bandani K, Stark AT, Shah NL, Menon M: Robotic radical prostatectomy with the “Veil of Aphrodite” technique: histologic evidence of enhanced nerve sparing. *Eur Urol* 2006; **49**: 1065.
9. Myers RP, Villers A: Anatomic considerations in radical prostatectomy. In Kirby RS, Partin AW, Feneley M, Kellogg Parsons JK (Eds): *Prostate Cancer; principles and practice*. Abingdon, Taylor and Francis, 2006, pp 701-713.
10. Prostate Cancer, In AJCC (American Joint Committee on Cancer) *Cancer Staging Manual*, 6th ed. Greene, FL, Page, DL, Fleming, ID, Fritz A, Balch CM, Haller DG, et al (Eds). Springer-Verlag, New York, 2002: pp 309-316.
11. Vickers AJ, Bianco FJ, Serio AM, Eastham JA, Schrag D, Klein EA, et al: The surgical learning curve for prostatectomy for prostate cancer. *J Natl Cancer Inst* 2007; **99**: 1171.
12. Chun FK, Briganti A, Antebi E, Graefen M, Currilin E, Steuber Y, et al: Surgical volume is related to the rate of positive surgical margins at radical prostatectomy in European patients. *BJU Int* 2006; **98**, 1204.

13. Swindle P, Eastham JA, Ohori M, Kattan MW, Wheeler T, Maru N, et al: Do margins matter? The prognostic significance of positive surgical margins in radical prostatectomy specimens. *J Urol* 2005; **174**: 903.
14. Karakiewicz PI, Eastham JA, Graefen M, Cagiannos I, Stricker PD, Klein E, et al: Prognostic impact of positive surgical margins in surgically treated prostate cancer: multi-institutional assessment of 5831 patients. *Urol* 2005; **66**: 1245.