The impact of surgeon volume on perioperative outcomes and cost for patients receiving robotic partial nephrectomy

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Introduction

- Little is known about the impact of surgeon volume on the success of robot assisted Partial Nephrectomy.
- We reviewed the literature using pubmed database and found two major studies from the united states almost identical to our topic. Thirty five more articles similar were also found but were excluded because of small volume studies within these articles.

The impact of surgeon volume on perioperative outcomes and cost for patients receiving Robotic Partial Nephrectomy

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Introduction

- Nephron-sparing surgery has rapidly become the preferred treatment modality for small renal tumors
- Nonetheless, RAPN remains a technically challenging operation with substantial risk.
- Recently, large population-based studies have suggested that morbidity, in-hospital complication rates and oncological outcomes of RAPN are similar or superior to laparoscopic and open Partial Nephrectomy.
- Significant debate remains on the impact of RAPN adoption by inexperienced surgeons. Thus, the authors sought to compare perioperative complications and hospital cost between surgeons with very low, low, intermediate, high and very high RPN volumes.

Patients and Methods

- Premier hospital database was used from January 2003 through December 2015.
- Final cohort of 39,773 patients who underwent RAPN were included in the study.
- Patient characteristics included age, sex, race, insurance status and Charlson comorbidity index. Hospital characteristics included teaching status, hospital size, location.
- The annual surgeon volume was analyzed as a categorical variable by dividing surgeons into approximately equal quintiles based on annual volume for each year by surgeon:(1)very low volume,(2) low volume,(3)intermediate volume,(4)high volume,(5)very high volume. In accordance, these quintiles were defined as very low≤2 cases/year; low, 3 to 4 cases/year;intermediate,5 to 7 cases/year; high, 8 to 13 cases/year; and very high≥14 cases/year.
- Chi-square test for categorical variables was used.
- Multivariate logistic regression was utilized to determine factors prediciting complications when RAPN was performed.

Results

TABLE 1. BASELINE CHARACTERISTICS OF ROBOTIC PARTIAL NEPHRECTOMIES BY SURGEON VOLUME

		Surgeon volume					
	Total	*Very low*	*Low*	*Intermediate*	*High*	*Very high*	P
No. of points	39,773	10,611	7162	7199	6875	7926	
Age, *N* (%)							0.535
<55	12,653 (31.8)	3332 (31.4)	2361 (33.0)	2289 (31.8)	2234 (32.5)	2438 (30.8)	
55 to 64	12,195 (30.7)	3454 (32.6)	2216 (30.9)	2054 (28.5)	2067 (30.0)	2403 (30.3)	
65 to 74	10,573 (26.6)	2790 (26.3)	1908 (26.6)	1970 (27.4)	1785 (26.0)	2119 (26.7)	
>74	4353 (10.9)	1035 (9.7)	677 (9.5)	885 (12.3)	789 (11.5)	966 (12.2)	
Sex							0.449
Male	22,256 (56.0)	5989 (56.4)	3819 (53.3)	4098 (56.9)	3806 (55.4)	4545 (57.3)	
Female	17,517 (44.0)	4623 (43.6)	3343 (46.7)	3101 (43.1)	3069 (44.6)	3381 (42.7)	
Race, *N* (%)							0.149
White	29,860 (75.1)	7616 (71.8)	5369 (75.0)	5395 (74.9)	5138 (74.7)	6342 (80.0)	
Black	3798 (9.5)	943 (8.9)	708 (9.9)	648 (9.0)	710 (10.3)	789 (10.0)	
Others	6116 (15.4)	2053 (19.3)	1085 (15.1)	1157 (16.1)	1027 (15.0)	795 (10.0)	
Charlson comorbidity index, *N* (%)							0.421
0	22,729 (57.1)	6067 (57.2)	4258 (59.5)	4171 (57.9)	3965 (57.7)	4267 (53.8)	
1	9945 (25.0)	2593 (24.4)	1770 (24.7)	1739 (24.2)	1738 (25.3)	2105 (26.6)	
≥2	7100 (17.9)	1951 (18.4)	1134 (15.8)	1289 (17.9)	1172 (17.0)	1554 (19.6)	
Insurance status, *N* (%)							0.144
Medicare	15,481 (38.9)	3934 (37.1)	2623 (36.6)	2931 (40.7)	2614 (38.0)	3379 (42.6)	
Medicaid	2182 (5.5)	555 (5.2)	480 (6.7)	320 (4.4)	416 (6.1)	412 (5.2)	
Private	20,040 (50.4)	5490 (51.7)	3791 (52.9)	3590 (49.9)	3440 (50.0)	3728 (47.0)	
Others	2072 (5.2)	633 (6.0)	268 (3.8)	358 (5.0)	405 (5.9)	408 (5.2)	
Hospital type, *N* (%)							0.015
Nonteaching	23,824 (59.9)	7528 (70.9)	4783 (66.8)	4161 (57.8)	4122 (60.0)	3230 (40.8)	
Teaching	15,949 (40.1)	3083 (29.1)	2379 (33.2)	3038 (42.2)	2753 (40.0)	4.696 (59.2)	
Hospital bed size, *N* (%)							0.052
<300	9711 (24.4)	3012 (28.4)	1555 (21.7)	1406 (19.5)	2188 (31.8)	1550 (19.6)	
300 to 500	14,670 (36.9)	4744 (44.7)	3204 (44.7)	2865 (39.8)	1786 (26.0)	2071 (26.1)	
>500	15,392 (38.7)	2855 (26.9)	2403 (33.6)	2928 (40.7)	2901 (42.2)	4305 (54.3)	
Hospital location, *N* (%)							0.235
Rural	787 (2.0)	149 (1.4)	171 (2.4)	113 (1.6)	297 (4.3)	56 (0.7)	
Urban	38,987 (98.0)	10,462 (98.6)	6991 (97.6)	7086 (98.4)	6578 (95.7)	7870 (99.3)	

results

- Median age of all patients was 61 years.No significant differences in patient characteristics among surgeon volume quintiles.
- Surgeons with higher annual RAPN volume were more likely to practice in teaching hospitals.
- Very high volume surgeons had lower complication rates compared with very low volume surgeons (23.3% vs 29%).
- Surgeons with very high volume and high volume had lower major complication rates of 2.3% and 2.4% respectively,compared with 3.9% for very low volume surgeon.
- ORT and prolonged hospital time were also significantly shorter for patients treated by very high volume surgeons.
- Surgeons performing more than 13 RAPNs/year had 42% fewer odds of having a major complication, 56% fewer odds of having a prolonged length of hospital stay and risk-adjusted mean 90-day hospital costs were also lower for patients treated by the very high volume surgeons.

TABLE 2. ADJUSTED OUTCOMES OF PATIENTS UNDERGOING ROBOTIC PARTIAL NEPHRECTOMY BY SURGEON VOLUME

	Surgeon volume				
	Very low	*Low*	*Intermediate*	*High*	*Very high*
Any complications (%, 95% CI)	29.0 (25.2, 32.9)	25.3 (21.4, 29.2)	24.4 (20.7, 28.1)	22.9 (18.5, 27.3)	23.3 (19.8, 26.8)[a]
Major complications (%, 95% CI)	3.9 (3.0, 4.8)	4.4 (3.1, 5.6)	2.8 (1.7, 3.9)	2.4 (1.5, 3.3)[a]	2.3 (1.5, 3.1)[a]
Operating room time (minutes, mean, 95% CI)	316 (277, 355)	272 (244, 300)[b]	264 (240, 289)[a]	255 (227, 282)[b]	248 (227, 282)[b]
Blood transfusion (%, 95% CI)	15.5 (11.5, 19.4)	18.3 (10.5, 26.2)	14.8 (7.2, 22.4)	17.5 (8.5, 26.5)	19.2 (1.9, 36.4)
Prolonged length of stay (%, 95% CI)	33.9 (29.2, 38.6)	30.8 (25.3, 36.3)	25.9 (20.9, 30.9)[b]	21.2 (16.6, 25.9)[c]	19.2 (15.2, 23.3)[c]

Adjusted for age, gender, race, Charlson comorbidity index, insurance status, teaching status, number of beds, hospital location, hospital volume, and hospital clustering.

Statistically significant compared with the reference group (very low-volume surgeon) with [a]*p*-value <0.05; [b]*p*-value <0.01; [c]*p*-value <0.001.

CI = confidence interval.

Discussion

- Large sample size accessible through the Premier Database allow for an unbiased and generalizable impact analysis of surgeon experience on perioperative outcomes and financial cost.
- In this study surgeons with a very high annual RAPN volume have significantly decreased odds of any and major surgical complication.
- No association between surgeon volume and rates of blood transfusion were found.
- Greater surgeon volume is correlated with shorter ORTs, shorter hospital stays.
- Significant debate remains on the severity of the learning curve period and its consequentiality on patient care. Mottrie and colleagues evaluated warm ischemia time, console time, blood loss and overall complications of a single experienced surgeon performing his first 62 RAPNs. The authors concluded that the learning curve for RAPN was about 30 cases to achieve optimal warm ischemic time<30 min. and console time<100 min.
- There is sufficient evidence that increased experience through repetition continues to improve outcomes.
- The intention of the current study is not to comment on the validity of RAPN use compared with other surgical approaches, but rather to provide greater clarity on important considerations surrounding the adoption of robot technology for PNs.

The Impact of Hospital Volume on Postoperative Complications Following Robot-Assisted Partial Nephrectomy

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Introduction

- With the present study the authors sought to evaluate the relationship between hospital volume and postoperative complications following RAPN using the Nationwide Inpatient Sample(NIS).
- Adoption of robotic assistance for PN and other urologic procedures has been exponential in the past decade in both academic and community institutions without significant oversight of operative competence.
- Given the fact that previous studies have demonstrated an inverse relationship between hospital volume and postoperative complications following nephrectomy the authors sought to evaluate if this relationship existed for RAPN.

Materials and Methods

- The Nationwide Inpatient Sample**(NIS**) is a nationally representative database that provides data on 20% of in-patient hospitalizations at nonfederal hospitals each year in the United States.
- In a retrospective cohort analysis using the 2009 to 2011 NIS data, authors identified all patients undergoing RAPN.
- The primary outcomes of interest were in-hospital complications and length of stay(LOS).Complications included urinary, vascular, cardiac, respiratory, neurologic, and digestive system complications along with seroma, hematoma, hypotension, pain, venous thromboembolism, and pneumothorax.
- As a separate outcome, blood transfusion at any point during hospital stay was identified.
- Hospital volume status was determined on an annual basis because the hospitals reporting to NIS vary by year.
- Tertile breakdowns for **low** (2009:4-13; 2010:4-14; 2011: 5-13), **medium** (2009: 14-34; 2010: 14-38; 2011: 14-40), and **high** (2009: ≥35; 2010: ≥39; 2011: ≥41) varied between the years.
- Descriptive analysis comparing across low-, medium-, and high-volume RAPN hospitals was performed using chi-squared test for categorical variables.
- A subanalysis was performed after separating out the highest 10% RAPN hospitals to determine whether patient outcomes were different at these hospitals compared with the low (≤ 33 percentile), medium(34-66 percentile), and high(67-89 prcentile).

Results

- 323 individual hospitals were identified as having performed at least one RAPN during the study period.
- 112 hopsitals were considered low volume, 112 medium volume, and 99 high volume.
- A total of 17,583 patients underwent RAPN;964 at low-volume hospitals, 2975 at medium-volume hospitals and 13,645 at high-volume hospitals.There were no demographic or comorbidity differences between patients in each of the three hospital volume categories.High-volume hospitals were more commonly teaching hospitals and located in urban settings.

TABLE 1. CHARACTERISTICS OF PATIENTS UNDERGOING ROBOT-ASSISTED PARTIAL NEPHRECTOMY AT LOW-, MEDIUM-, AND HIGH-VOLUME INSTITUTIONS

	Low volume	*Medium volume*	*High volume*	p-*Value*
Total number of unique hospitals	112	112	99	—
Number of cases	964	2975	13645	—
Gender (female)	441 (46)	1214 (41)	5679 (42)	0.524
Age, mean (SD)	56.0 (13)	58.4 (14)	58.0 (13)	0.066
Race[a]				
White	674 (80)	2128 (81)	8766 (77)	0.187
Black	72 (9)	198 (8)	982 (9)	
Hispanic	92 (11)	188 (7)	723 (6)	
Other	NR	121 (5)	969 (8)	
Hospital region				
Northeast	207 (22)	432 (15)	2385 (17)	0.791
Midwest	244 (25)	827 (28)	4543 (33)	
South	304 (32)	1137 (38)	4003 (29)	
West	208 (22)	580 (19)	2712 (20)	
Teaching hospital	484 (52)	1629 (55)	10524 (78)	0.004
Urban hospital	877 (94)	2853 (96)	13477 (99)	0.004
Primary payer				
Medicare	286 (30)	1077 (36)	4431 (32)	0.297
Medicaid	80 (8)	126 (4)	704 (5)	
Private insurance	534 (55)	1644 (55)	7924 (58)	
Other	64 (7)	128 (4)	585 (4)	
Charlson comorbidity index				
1 or more (compared to 0)	125 (13)	498 (17)	2231 (16)	0.465
Kidney cancer	634 (66)	2086 (70)	8422 (62)	0.048

[a]Race unknown for 16% total.

NR = not reportable due to the limited incidence of other race; however, the number was used in calculation of the Pearson's chi-squared; SD = standard deviation.

TABLE 2. POSTOPERATIVE CHARACTERISTICS OF CASES AT LOW-, MEDIUM-, AND HIGH-VOLUME INSTITUTIONS

	Low volume	*Medium volume*	*High volume*	*p-Value*
Perioperative transfusion	87 (9)	233 (8)	676 (5)	0.015
Any complication	146 (15)	364 (12)	1371 (10)	0.071
Length of hospitalization, median (IQR)	3 (2–4)	3 (2–4)	3 (2–3)	0.002
Hospital cost, median (IQR)	$14,287 (10,880–18,505)	$14,410 (10,651–20,260)	$13,956 (10,539–18,442)	0.090

IQR = interquartile range.

Results

- 11% of patients(n=1881) developed an in-hospital complication.
- The incidence of complications was higher among patients operated upon at low-volume (15%) and medium-volume (12%) hospitals compared with high-volume (10%) hospitals.
- Blood transfusion occurred less commonly at high-volume institutions.
- Median LOS was 3 days for patients at low-, medium-, and high-volume hospitals.
- High-volume hospitals were at a 42% decreased odds of developing a postoperative complication compared with low-volume hospitals.
- Median hospital costs for patients with a complication were significantly higher than for patients without complications regardless of hospital volume.
- On subanalysis, there were 32 hospitals considered highest volume(top 10%).47% of patients undergoing RAPN were operated upon at the highest volume hospitals
- The incidence of blood transfusion at high-volume and highest volume hospitals was comparable(5.2% vs 4.8%).
- 15% of patients at low-volume, 12% at medium-volume, 11% at high volume and 9% at the highest volume centers developed a postoperative complication.

Discussion

- Understanding the role of hospital volume on RAPN outcomes is important in light of the significant increase in PN over the past decade.
- The authors hypothesized that hospital volume of RAPN would play a significant role in developing postoperative complications due to the complexity of PN.
- Nearly half of RAPNs in the United States are performed at the top 10% of hospitals by volume and being a high-volume RAPN hospital is independently associated with decreased risk of postoperative complications.
- Repeatedly, studies have found that hospitals that are high volume in specific procedures have incremental , but significant, decreases in the incidence of postoperative complications and reduced hospitalization time.
- While hospital volume has been advocated as a potential quality indicator, its utility and potential shortcomings have been debated.One potential shortcoming is that recent graduates will likely have lower case volumes than well-established urologists,which could unintentionally create a bias against these new practitioners.
- Studies examining both hospital and surgeon volume have found that each is associated with reduced complications. This is reflective of the critical complementary roles that both surgeon and ancillary staff play in the care of surgical patients. If the ancillary staff is unable to provide necessary, specialized postoperative care, then complications will occur more commonly.

Our own experience in RAPN

- We present our series of 450 patients who underwent RAPN from 2011 through 2017.
- These patients were divided in 3 groups according to chronological order
- (2011-2013:150, 2013-2015:150, 2015-2017:150)
- There was no statistically significant difference in comorbidities among those patients .
- We observed that there was no statistically significant difference between the groups as far as postoperative complications are concerned.4-5% of patients required transfusion due to blood loss .1% of patients required angioembolism.
- All patients underwent creatinine clearance before and three months after the surgery.Results showed almost identical figures of creatinine clearance.This did not come as a surprise,since numerous studies have shown the benefit of PN in correlation with mid- and long-term renal function.
- Mean warm ischemia time was 14 min., and mean LOS was 2-3 days.

General Conclusions

- Surgeons with a very high annual volume tend to have lower odds of reporting major surgical complications, have shorter ORTs, and fewer prolonged hospital stays.
- Learning curve period and subsequently the increase of annual number of RAPN for the new practicioner is crucial in order to achieve low percentage of postoperative complications .
- The majority of robot-assisted partial nephrectomies occur in high volume hospitals,which are independetly associated with decreased postoperative complications and lower incidence of blood transfusion.

Thank you for your patience!!!