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Effect of the Need for Pre-operative Dialysis on Peri-operative Outcomes on Patients Undergoing Laparoscopic Nephrectomy: An Analysis of the NSQIP Database

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Abstract

Objective: To investigate whether patients requiring dialysis are a higher risk surgical population and would experience more peri-operative adverse events even when undergoing a perceived less invasive operation as a laparoscopic radical nephrectomy (LRN). LRN is generally a well-tolerated surgical procedure with minimal morbidity and mortality. Prior to transplantation, dialysis patients will often have to undergo a LRN to remove a native kidney with a suspicious mass.

Materials and Methods: Patients in the American College of Surgeons National Surgical Quality Improvement Program who underwent a laparoscopic radical nephrectomy between 2011 and 2016 were included. Patients were stratified by the need for pre-operative dialysis two weeks prior to surgery, and peri-operative outcomes were compared. A multivariable logistic regression analysis was performed to test the association between the need for pre-operative dialysis and peri-operative risk.

Results: There were 8,315 patients included in this analysis of which 445 (5.4%) patients required pre-operative dialysis. Patients who required pre-operative dialysis had more minor ($p < .0001$) and major ($p=.0025$) complications, a higher rate of return to the operating room ($p=0.002$), and a longer length of stay (LOS) ($p < 0.0001$) than those patients not requiring pre-operative dialysis. In a multivariate analysis, the need for pre-operative dialysis was independently associated with adverse peri-operative outcomes (OR=1.45, CI=1.08-1.95, $p=.015$).

Conclusions: Patients requiring pre-operative dialysis were more likely to experience a peri-operative complication and have a longer LOS. For LRNs performed prior to transplantation, further risk stratification is needed, and treatment sequencing may need to be reconsidered.

Introduction

Surgery is the cornerstone of treatment for localized renal tumors suspected to be renal cell carcinoma.[1] Whether radical or partial nephrectomy, excision of localized renal masses results in very high cure rates with low patient morbidity and mortality.[2] End-stage renal disease is a risk factor for the development of renal cancer in patients' native kidneys, however studies have shown that these tumors, often acquired cystic kidney cancer,[3] have an indolent course.[4-5] Often, patients undergoing a renal transplantation evaluation will be found to have tumors in their native kidneys,[6] and the clinical challenge will arise as to whether these tumors should be removed prior to, at the time of, or after transplantation. Some transplant centers will require that the native kidney with a tumor be removed prior to transplantation to establish a histologic diagnosis in order to risk stratify the patient's cancer, if present.

Chronic kidney disease has been shown to have significant negative health consequences in many settings.[7-10] Peri-operatively, chronic kidney disease and/or end-stage renal disease has been correlated with adverse surgical outcomes.[11-12] Furthermore, the negative health correlation between increasing age and end-stage renal disease is quite dramatic.[13] Although minimally-invasive surgery is often considered to be almost "risk-free", there is evidence demonstrating that laparoscopic procedures can carry a significant risk for complications in vulnerable populations, such as patients with end-stage renal disease.[14-15] Thus, there may exist a false sense of security in performing laparoscopic radical nephrectomies in patients with localized renal masses who have end-stage renal disease requiring renal replacement therapy.

In this study, we sought to evaluate the effect of the need for pre-operative dialysis on patients undergoing laparoscopic radical nephrectomy (LRN). We hypothesized that although a relatively well-tolerated and low complication surgery, the need for pre-operative dialysis would have a significant impact on peri-operative outcomes and hospital length of stay on patients undergoing a LRN.

Methods

Data for this study were obtained from the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP). The NSQIP database collects information from patients' post-surgery from participating institutions. Post-operative complications, preoperative health data, and demographic information are collected to allow for complete analysis and outcome assessment. For this study, patients between the years 2011 to 2016 were identified by the Current Procedural Terminology code for laparoscopic nephrectomy (50545). Demographic information, health status, and outcomes information for these patients were collected. Study patients were stratified by the need for pre-operative dialysis, a variable captured in NSQIP as the status of renal function at least 2 weeks prior to surgery. Due to the uncertainty whether their renal failure was due to surgical complications or unresolved previous health concerns, patients who reported renal failure requiring dialysis within 30 days post-operatively were excluded from the study. After exclusions for missing data, the total study population that was analyzed was 8,315.

For patients undergoing a laparoscopic nephrectomy during the study period, information was collected on patient demographics, comorbidities, American Society of Anesthesiologists (ASA) score, smoking history, functional status and BMI. The age of patients was then divided into different age categories (<40, 40-49, 50-59, ≥60) as well as BMI (<18.5 = underweight, 18.5–25= normal weight, 25–30 = overweight, and obese = >30). Estimated GFR was also calculated and recorded for non-dialysis patients. Patient demographic data were then evaluated

for significance against status of pre-operative dialysis using the Chi-square test of association or Fischer's exact test.

The outcomes of interest for this study were reported complications that occurred within 30 days or less after surgery, length of postsurgical hospital stay, and return to operating room within 30 days of surgery. Each complication was grouped uniformly into a grade of severity based on the Clavien-Dindo classification as either minor (I-II), major (III-IV), or death (V). ACS-NSQIP reported complications include: superficial incisional skin infection, pneumonia, pulmonary embolus, urinary tract infection (UTI), transfusion, deep vein thrombosis (DVT), deep incisional skin infection, wound infection, re-intubation, failure to wean off ventilator more than 48 hours post operation, cardiovascular accident (CVA), cardiac arrest, myocardial infarction (MI), sepsis, and death. Fischer's Exact test was used to determine statistical significance of each complication against dialysis status. To further assess for univariate differences in complication rates among patients stratified by dialysis status and grouped into severity levels, the Cochran-Armitage test for trends was applied.

After adjusting for comorbidity burden, a multivariate ordinal regression analysis was performed to test for association between pre-operative dialysis status and complication severity, hospital length of stay, and return to operating room within 30 days. A p-value of less than 0.05 was considered statistically significant. All statistical analysis was performed using SAS version 9.4 software.

Results

8,315 patients were included in this analysis. Of the total cohort, 61.2% of the patients were male, and 85.9% were Caucasian. Stratified by the pre-operative variable of needing dialysis two weeks prior to surgery, there were 445 (5.4%) patients who required pre-operative dialysis while the remaining 7,870 (94.6%) patients did not.

Significant differences existed between the two populations. (Table 1) Patients who were dialysis-dependent were more likely to be male ($p < 0.0001$), younger than 60 years of age ($p < 0.0001$), and non-Caucasian ($p < .0001$). Also, dialysis patients had higher pre-operative rates of diabetes, hypertension, and CHF (all $p < 0.0001$), expected co-morbidities which are causative of and often co-exist with end-stage renal disease. The dialysis dependent group also had a higher rate of ASA scores above 3 ($p < .0001$) compared to the non-dialysis group. There was no statistically significant difference in the rates of smoking, functional status, or COPD between groups. Median baseline eGFR for patients not on dialysis was 77.5 mL/min (IQR=62.1 – 92.8 mL/min).

Tables 2 and 3 collate the type and frequency, stratified by Clavien grade, of post-operative complications between the two groups. In the dialysis group, 17.5% of patients had a minor complication, and 7.6% of patients had a major complication. 5 (1.1%) patients in this group died within 30 days of surgery. In the non-dialysis group, 9.9% and 3.0% of patients had a minor and major complication, respectively. 35 (0.4%) patients in this group died within the 30 days of surgery. The most common minor and major complications in the two groups were the need for a blood transfusion (12.1% in pre-operative dialysis group v. 5.8% in no pre-operative dialysis

group) and unplanned reintubation (2.0% in the pre-operative dialysis group and 0.74% in the no pre-operative dialysis group) (both complications had p-values < 0.05). Patients who required pre-operative dialysis had more minor ($p < .0001$) and major ($p=.0025$) complications than those patients not requiring pre-operative dialysis. The death rate between the two groups approached statistical significance ($p=0.06$), i.e, patients requiring pre-operative dialysis had a statistically higher likelihood of dying post-operatively when compared to those not requiring pre-operative dialysis.

Finally, 17 (3.8%) patients in the pre-operative dialysis group had an unplanned return to the OR within 30 days after surgery compared to 131 (1.7%) patients in the non-dialysis group ($p=0.002$). The median and mean length of stay in patients requiring pre-operative dialysis were 3 and 4.2 days (range=0-44 days); and, the median and mean length of stay in patients not requiring pre-operative dialysis were 3 and 3.3 days (range=0-73 days), respectively. The mean LOS was significantly longer in patients requiring pre-operative dialysis ($p < 0.0001$). Also, patients who required pre-operative dialysis were more likely to have a length of stay greater than 4 days than those patients not needing pre-operative dialysis (27.2% versus 16.5%, $p < .0001$).

The results of the multivariable logistic regression analysis identifying factors associated with peri-operative outcomes are displayed in Table 4. The presence of diabetes, CHF, ASA score above 3,, and pre-operative dialysis were all associated with an increasing risk of complications post-operatively. Patients needing pre-operative dialysis had a higher likelihood of having an adverse peri-operative event

than those not requiring dialysis (OR=1.45, CI=1.08-1.95, p=0.015). Interestingly, being obese appeared to have an independently protective effect against peri-operative events in this analysis (OR=0.68, CI=0.55-1.43, p=0.002).

Discussion

Our study of 8,315 patients who underwent a LRN revealed that patients needing pre-operative dialysis had higher rates of adverse peri-operative events compared to those patients not requiring pre-operative dialysis. Statistically significant higher rates of minor and major complications were noted in the dialysis dependent group. We also found higher rates of blood transfusions, unplanned re-intubations, and unplanned return to the operating room in the 30-day post-operative period for the LRN group. Length of stay was also significantly longer for the dialysis dependent group as compared to the control group, however this post-operative outcome may be inherently biased since many dialysis patients may have required longer stays in the hospital due to their dialysis requirements or schedule.

Our findings are well supported by the literature on this topic. A study utilizing NSQIP data from 2005 to 2008 looked at over 165,000 patients who underwent major general surgeries. Of these patients, 1506 or 0.9% were dialysis dependent. The dialysis dependent patients had higher overall complications, higher rates of return to the operating room, and longer lengths of stay. These complications were broken down into higher rates of pulmonary complications including pneumonia, unplanned intubation, and ventilator dependence as well as higher rates of death.[16]

With all the aforementioned complications and adverse outcomes in this patient population, one may question must justify the need for performing LRN. in this patient population. Research suggests that ESRD patients have higher rates of

renal masses, however these masses seem to appear to have a more indolent course than renal tumors in non-dialysis patients. In a study of 1,250 patients with renal cell carcinoma (RCC), T stage, metastatic disease, nodal invasion, and Fuhrman nuclear grade were all statistically significantly lower in the ESRD patient population compared to non ESRD patient population. Finally, cancer-specific mortality rates were lower in the ESRD patient population.[17]

Traditionally, the predominant histologic subtype in the ESRD population has been reported as papillary RCC. However, a recent study of 27 patients with ESRD who underwent a radical nephrectomy between 1994 and 2008 found lower rates of papillary RCC. This study found the most common tumor type to be acquired cystic disease (ACD)-associated RCC accounting for 44% of the tumors. Papillary RCC was identified in only 11% of the tumors.[18] A separate study of 66 renal masses in ESRD patients revealed papillary RCC to constitute only 18% (12/66) of the tumors while ACD-associated RCC comprised 36% (24/66) of the tumors.[19]

Others have looked at the clinical significant of ACD-associated RCC. In a recent study of forty patients with ACD-associated RCC, clinical follow up was available for 36 patients with a mean follow-up length of 27 months. The vast majority 32/36 (89%) had no evidence of disease on follow-up. This included 24 patients (67%) who were alive with no evidence of disease recurrence, 4 patients (11%) who were deceased from other causes, and 4 patients (11%) who had died of unknown causes. Four patients did have recurrences with 2 patients (6%) having local recurrences and 2 patients (6%) developing metastases. Of

the four patients with recurrence, 3 out of 4 were staged at pT3a. Three of four tumors were ISUP grade 3 while the remaining tumor was ISUP grade 4.[20] While the true nature of ACD-associated RCC necessitates further study, the low metastatic potential of renal masses found in the ESRD patient population seems well-supported.[21] Nevertheless, given the data suggesting that ESRD patients have a biologically less aggressive form of kidney cancer, it is important to remember that many patients will develop papillary and clear cell tumors that will act in a similar manner to the non-ESRD population.

Given the known higher mortality and morbidity rate of operating on the dialysis dependent patient as well as lower T stage and Fuhrman grade noted in those found to have a renal mass, some urologists may question the necessity of or timing of treatment. Data are lacking as to the long-term outcomes of active surveillance in the small renal mass dialysis dependent patient population. A recent survey of active transplant centers in the United States revealed that 59% of participants felt that the preferred treatment entailed a radical nephrectomy followed by active surveillance in 21.3% of the respondents. Of the correspondents whose institutions did not allow active surveillance, 77.4% would monitor small renal masses following transplantation if shown safety of active surveillance.[22]

There are several limitations to our study. The NSQIP database collects patient information up to thirty days following surgery. Complications, including deaths, which occur after this period are not collected, potentially under-estimating adverse events. In addition, there is no pathologic variables abstracted thus

limiting our ability to comment on the indolence versus aggressiveness or types of tumors seen in this patient population as well as the indications for surgery. Finally, there is an inherent limitation in all large, administrative databases in that we are dependent on the accurate and reliable input of the data. Nevertheless, despite these acknowledged limitations of the data, the size of this dataset and the unique clinical variables collected allow for the examination of clinical scenarios as presented in this manuscript.

Conclusions

Our study of over 8,000 patients appears to demonstrate that the dialysis-dependent patient population is complex and faces higher morbidity and mortality rates when compared to non-dialysis dependent patients undergoing a LRN. The true aggressiveness of ACD-associated RCC has not been well defined but seems to be more indolent in nature compared to spontaneous renal masses in the non-ESRD population. With the higher surgical risks and possibly more indolent nature of renal masses in this patient population, the role of active surveillance or delayed nephrectomy until after successful renal transplantation may be a more prudent approach.

References

1. Bex A, Jonasch E, Kirkali Z, et al. Integrating Surgery with Targeted Therapies for Renal Cell Carcinoma: Current Evidence and Ongoing Trials. *Eur Urol*. 2010;58(6):819-828. doi:10.1016/j.eururo.2010.08.029
2. Pierorazio PM, Johnson MH, Patel HD, et al. Management of Renal Masses and Localized Renal Cancer: Systematic Review and Meta-Analysis. *J Urol*. 2016;196(4):989-999. doi:10.1016/j.juro.2016.04.081
3. Kuroda N, Yamashita M, Kakehi Y, Hes O, Michal M, Lee G-H. Acquired cystic disease-associated renal cell carcinoma: an immunohistochemical and fluorescence in situ hybridization study. *Med Mol Morphol*. 2011;44(4):228-232. doi:10.1007/s00795-010-0496-1
4. Truong LD, Choi Y-J, Shen SS, Ayala G, Amato R, Krishnan B. Renal cystic neoplasms and renal neoplasms associated with cystic renal diseases: pathogenetic and molecular links. *Adv Anat Pathol*. 2003;10(3):135-159.
5. Sassa N, Hattori R, Tsuzuki T, et al. Renal cell carcinomas in haemodialysis patients: does haemodialysis duration influence pathological cell types and prognosis? *Nephrol Dial Transplant Off Publ Eur Dial Transpl Assoc - Eur Ren Assoc*. 2011;26(5):1677-1682. doi:10.1093/ndt/gfq529
6. Klein JA, Gonzalez SA, Fischbach BV, et al. Routine ultrasonography surveillance of native kidneys for renal cell carcinoma in kidney transplant candidates. *Clin Transplant*. 2016;30(8):946-953. doi:10.1111/ctr.12769
7. Ozel L, Krand O, Ozel MS, et al. Elective and Emergency Surgery in Chronic Hemodialysis Patients. *Ren Fail*. 2011;33(7):672-676. doi:10.3109/0886022X.2011.589940
8. Schneider CR, Cobb W, Patel S, Cull D, Anna C, Roettger R. Elective surgery in patients with end stage renal disease: what's the risk? *Am Surg*. 2009;75(9):790-793; discussion 793.
9. Arulkumaran N, Annear NMP, Singer M. Patients with end-stage renal disease admitted to the intensive care unit: systematic review. *Br J Anaesth*. 2013;110(1):13-20. doi:10.1093/bja/aes401
10. Iwagami M, Yasunaga H, Matsui H, et al. Impact of end-stage renal disease on hospital outcomes among patients admitted to intensive care units: A retrospective matched-pair cohort study: End-stage renal disease in intensive care units. *Nephrology*. 2017;22(8):617-623. doi:10.1111/nep.12830
11. Ito T, Maekawa H, Sakurada M, et al. Risk factors for postoperative complications in patients on maintenance hemodialysis who undergo abdominal surgery. *Asian J Surg*. 2016;39(4):211-217. doi:10.1016/j.asjsur.2015.03.013
12. Currie A, Malietzis G, Askari A, et al. Impact of chronic kidney disease on postoperative outcome following colorectal cancer surgery. *Colorectal Dis*. 2014;16(11):879-885. doi:10.1111/codi.12665
13. Hallan SI, Matsushita K, Sang Y, et al. Age and Association of Kidney Measures With Mortality and End-stage Renal Disease. *JAMA*. 2012;308(22):2349. doi:10.1001/jama.2012.16817

14. Ekici Y, Tezcaner T, Aydoğan C, Karakayalı FY, Moray G. Outcomes of Laparoscopic Cholecystectomy in Patients with End-Stage Renal Disease. *Int J Clin Med*. 2014;05(20):1300-1305. doi:10.4236/ijcm.2014.520165
15. Shimomura A, Obi Y, Fazl Alizadeh R, et al. Association of pre-operative estimated GFR on post-operative pulmonary complications in laparoscopic surgeries. *Sci Rep*. 2017;7(1). doi:10.1038/s41598-017-06842-4
16. Gajdos C, Hawn MT, Kile D, Robinson TN, Henderson WG. Risk of Major Nonemergent Inpatient General Surgical Procedures in Patients on Long-term Dialysis. *JAMA Surg*. 2013;148(2):137. doi:10.1001/2013.jamasurg.347
17. Neuzillet Y, Tillou X, Mathieu R, et al. Renal Cell Carcinoma (RCC) in Patients With End-Stage Renal Disease Exhibits Many Favourable Clinical, Pathologic, and Outcome Features Compared With RCC in the General Population. *Eur Urol*. 2011;60(2):366-373. doi:10.1016/j.eururo.2011.02.035
18. Nouh MAAM, Kuroda N, Yamashita M, et al. Renal cell carcinoma in patients with end-stage renal disease: relationship between histological type and duration of dialysis. *BJU Int*. 2010;105(5):620-627. doi:10.1111/j.1464-410X.2009.08817.x
19. Tickoo SK, dePeralta-Venturina MN, Harik LR, et al. Spectrum of epithelial neoplasms in end-stage renal disease: an experience from 66 tumor-bearing kidneys with emphasis on histologic patterns distinct from those in sporadic adult renal neoplasia. *Am J Surg Pathol*. 2006;30(2):141-153.
20. Przybycin CG, Harper HL, Reynolds JP, et al. Acquired Cystic Disease-associated Renal Cell Carcinoma (ACD-RCC): A Multiinstitutional Study of 40 Cases With Clinical Follow-up. *Am J Surg Pathol*. May 2018:1. doi:10.1097/PAS.0000000000001091
21. Denton MD, Magee CC, Ovuworie C, et al. Prevalence of renal cell carcinoma in patients with ESRD pre-transplantation: A pathologic analysis. *Kidney Int*. 2002;61(6):2201-2209. doi:10.1046/j.1523-1755.2002.00374.x
22. Beksac AT, Paulucci DJ, Sfakianos JP, et al. Trends in management of the small renal mass in renal transplant recipient candidates: A multi-institutional survey analysis. *Urol Oncol Semin Orig Investig*. 2017;35(8):529.e17-e529.e22. doi:10.1016/j.urolonc.2017.03.012

Table 1: Pre-operative descriptive characteristics of study population		
	Dialysis	

	Yes (n=445) *n (%)*	No (n=7,870) *n (%)*	P-value
Sex			
Male	312 (70.1)	4,776 (60.7)	<.0001
Female	133 (29.9)	3,094 (39.3)	
***Age**			
<40	27 (6.1)	411 (5.3)	<.0001
40-49	64 (14.4)	784 (10.0)	
50-59	134 (30.1)	1,845 (23.6)	
≥60	220 (49.4)	4,787 (61.2)	
***Race**			
Caucasian	202 (48.8)	5,924 (88.2)	<.0001
African American	186 (44.9)	588 (8.8)	
Asian	19 (4.6)	162 (2.4)	
Other	7 (1.7)	42 (1.7)	
***ASA Scores**			
≤3	253 (57)	7,474 (95)	<.0001
4	191 (43)	383 (4.9)	
5	0	1 (<0.1)	
Median estimated GFR	N/A	**77.5 mL/min (IQR = 62.1-92.8)	--
Diabetes	141 (31.7)	1,637 (20.8)	<.0001
COPD	24 (5.4)	440 (5.6)	1.00
CHF	14 (3.1)	56 (0.7)	<.0001
Hypertension	378 (84.9)	5,045 (64.1)	<.0001
Smoking	73 (16.4)	1,568 (19.9)	0.076
Functional Status			
Independent	430 (96.6)	7,714 (98.0)	0.100
Partially Independent	11 (2.5)	119 (1.5)	
Totally dependent	2 (0.5)	9 (0.1)	
Unknown	2 (0.5)	28 (0.4)	
***BMI**			
Underweight	8 (1.8)	77 (1.0)	0.006
Normal Weight	100 (22.5)	1,392 (17.8)	
Overweight	160 (36.0)	2,724 (34.8)	
Obese	176 (39.6)	3,643 (46.5)	

**eGFR reported as median (Q_1-Q_3). Students t-test used to test for significance for baseline eGFR in non-dialysis patients. Mean eGFR = 79.1.

TABLE 2: COMPLICATIONS CAPTURED BY NSQIP BY PROCEDURE			
	DIALYSIS		
COMPLICATION GRADE BY CALVIEN-DINDO INDEX	**Yes** ***n (%)***	**No** ***n (%)***	**P-value**
MINOR			
SUPERFICIAL INCISIONAL INFECTION	8 (1.8)	81 (1.0)	0.147
PNEUMONIA	10 (2.2)	64 (0.8)	0.006
PULMONARY EMBOLUS	NA	25 (0.3)	0.642
UTI	3 (0.7)	114 (1.5)	0.216
BLOOD TRANSFUSION	54 (12.1)	457 (5.8)	<.0001
DEEP VEIN THROMBOSIS	3 (0.7)	36 (0.5)	0.464
TOTAL	78	777	
MAJOR			
DEEP INCISIONAL INFECTION	NA	6 (0.1)	1.00
ORGAN SPACE WOUND INFECTION	4 (0.9)	27 (0.3)	0.081
WOUND DEHISCENCE	3 (0.7)	31 (0.4)	0.427
REINTUBATION	9 (2.0)	58 (0.7)	0.009
VENTILATOR >48 HOURS	3 (0.7)	27 (0.3)	0.215
CARDIOVASCULAR ACCIDENT	2 (0.5)	11 (0.1)	0.151
CARDIAC ARREST	5 (1.1)	12 (0.2)	<.0001
MYOCARDIAL INFARCTION	6 (1.4)	31 (0.4)	0.013
SEPSIS	2 (0.5)	34 (0.4)	0.719
TOTAL	34	237	
DEATH	5 (1.1)	35 (0.4)	0.061

**Only highest grade complication accounted for per patient*

TABLE 3: COMPLICATION ACCORDING TO STATUS OF DIALYSIS			
	DIALYSIS		
COMPLICATION GRADE	**Yes** ***n (%)***	**No** ***n (%)***	**P-value**
NONE	355 (79.8)	7,028 (89.3)	<.0001
MINOR	65 (14.6)	639 (8.1)	<.0001
MAJOR	20 (4.5)	168 (2.1)	0.0025
DEATH	5 (1.1)	35 (0.4)	0.0605

TABLE 4: MULTIVARIATE REGRESSION			
	Odds Ratio	**95% CI**	**P-value**
SEX			
FEMALE	1.00	--	--
MALE	0.86	1.01 – 1.35	0.051
AGE			
<40	1.00	--	--
40-49	1.03	0.66 – 1.53	0.990
50-59	0.88	0.60 – 1.28	0.487
≥60	1.09	0.77 – 1.56	0.626
RACE			
CAUCASIAN	1.00	--	--
AFRICAN AMERICAN	0.93	0.73 – 1.19	0.557
ASIAN	0.88	0.54 – 1.43	0.601
OTHER	0.82	0.32 – 2.09	0.672
PRE-OPERATIVE RENAL FAILURE	1.45	1.08 – 1.95	0.015
DIABETES	1.29	1.08 – 1.54	0.006
CHF	2.38	1.36 – 4.16	0.002
HYPERTENSION	1.17	0.98 – 1.40	0.083
ASA STATUS			
≤3	1.00	--	--
4	2.19	1.71 – 2.80	<.0001
5	N/A	N/A	N/A
SMOKING	0.83	0.68 – 1.02	0.075
FUNCTIONAL STATUS			
INDEPENDENT	1.00	--	--
PARTIALLY INDEPENDENT	2.82	1.84 – 4.33	<.0001
TOTALLY DEPENDENT	N/A	N/A	N/A
BMI			
NORMAL	1.00	--	--
UNDERWEIGHT	0.55	0.24 –	0.144

		1.23	
OVERWEIGHT	0.90	0.73 – 1.10	0.298
OBESE	0.68	0.55 – 1.43	0.002