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Factors Associated with Unplanned Conversion to Open in Nephrectomy for Kidney Cancer

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Background

Minimally invasive surgery (MIS) has been adopted as an approach in kidney surgery. Laparoscopic kidney surgery has been introduced in the 1990s with robotics emerging a decade after.[1,2] The minimally invasive approach has been technically feasible and has been shown to be noninferior with preserved oncology standards to open surgery.[3] The ubiquitous use of MIS for kidney cancer has been standard of practice; however, unplanned conversion to open kidney surgery has been characterized at 4.9% for laparoscopic radical nephrectomy compared to 6.0% in robotic radical nephrectomy.[4] Another analysis of 54,246 patients undergoing partial nephrectomy for kidney cancer observed an unplanned open conversion rate of 2.87% for cT1 renal masses. Furthermore, the unplanned conversion to open radical or partial nephrectomy after an attempted minimally invasive approach has been an independent predictor of increased risk of 30-day hospital readmission.[5] Currently, the relative risk factors to predict unplanned conversion to open surgery has not been well characterized. Greater understanding of risk factors for unplanned open conversion has clinical implications to reduce intraoperative and postoperative outcomes. The early recognition of nationwide risk and predictors may aid in identifying patients for planned open kidney surgery. We aim to use the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) database to identify predictors and outcomes in a contemporary cohort.

Methods

The 2019 and 2020 NSQIP data was analyzed in a retrospective cohort study of radical cystectomy patients. A total of 14,186 patients were evaluated and 4,862 patients met the inclusion criteria of nephrectomy performed for kidney cancer. The groups were then subcategorized to planned MIS only (endoscopic, laparoscopic, other MIS, and robotic) (n=4756) and unplanned conversion to open starting as either robotic, laparoscopic, or endoscopic (n=106). Wilcoxon signed-rank test was utilized for continuous variables as the data was not normally distributed. For categorical variables, Fisher's exact test was performed and Chi-squared analysis where more than two categories were evaluated. Statistical significance was set at P-value < 0.05.
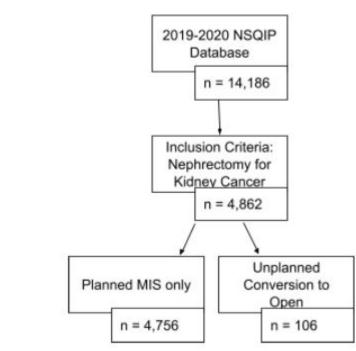
Figure 1. CONSORT flow diagram illustrates the composition of the cohort.

Tables

Table 1. *Patient Characteristics, Unplanned Conversion to Open Nephrectomy*

	Total Cohort n = 4862		Unplanned Conversion to Open n = 106		Minimally Invasive Surgery n = 4756		P Value
Patient Demographics							
Mean Age (Range)	61.28	(19 – 89)	62.58	(32 – 88)	61.25	(19 – 89)	
Male Gender (%)	3170	65.20%	72	67.92%	3098	65.14%	
Non-Caucasian Race (%)	1580	32.50%	39	36.79%	1541	32.40%	
Hispanic Ethnicity (%)	353	7.26%	4	3.77%	349	7.34%	
Preoperative Considerations:							
Admitted from Other Than Home (%)	23	(0.4%)	2	(1.9%)	21	(0.4%)	
Preoperative ASA Classification Greater than 3 (%)	3008	(61.9%)	80	(75.4%)	2928	(61.6%)	P < 0.01
Preoperative Non-Functional Health Status (%)	40	(0.82%)	0	(0.0%)	40	(0.8%)	
> 10% Decrease in Body Weight in 6 Months (%)	66	(1.4%)	4	(3.8%)	62	(1.3%)	P = 0.02
Preoperative Mechanical Bowel Prep (%)	754	(15.5%)	11	(10.4%)	743	(15.6%)	
Preoperative Oral Antibiotic Prep (%)	70	(1.4%)	1	(0.9%)	69	(1.5%)	
Prior Pelvic Surgery (%)	1608	(33.1%)	41	(38.7%)	1567	(32.9%)	
Prior Pelvic Radiotherapy (%)	75	(1.5%)	0	(0.0%)	75	(1.6%)	
Chemotherapy (within 90 days of surgery) (%)	103	(2.1%)	3	(2.8%)	100	(2.1%)	
ASA Classification:							
Class 1 (%)	62	(1.3%)	1	(0.9%)	61	(1.3%)	
Class 2 (%)	1792	(36.9%)	25	(23.6%)	1767	(37.2%)	P < 0.01
Class 3 (%)	2834	(58.3%)	71	(67.0%)	2763	(58.1%)	
Class 4 (%)	171	(3.5%)	8	(7.5%)	163	(0.04%)	P = 0.02
TNM Classification:							
T1, T1a, T1b (%)	3481	(71.6%)	57	(53.8%)	3424	(72.0%)	P < 0.01
T2, T2a, T2b (%)	334	(6.9%)	8	(7.5%)	298	(6.3%)	
T3, T3a, T3b, T3c (%)	1042	(21.4%)	32	(30.2%)	1010	(21.2%)	P = 0.03
T4 (%)	33	(0.7%)	9	(8.5%)	24	(0.2%)	P < 0.01
Nx (%)	4199	(86.4%)	74	(69.8%)	4125	(86.7%)	P < 0.01
N0 (%)	472	(9.7%)	21	(19.8%)	451	(9.5%)	P < 0.01
N1 (%)	64	(1.3%)	4	(3.8%)	57	(1.2%)	P = 0.02
M0 (%)	2196	(45.2%)	44	(41.5%)	2152	(45.2%)	P < 0.01
M1 (%)	67	(1.4%)	5	(4.7%)	62	(1.3%)	P < 0.01
Pre-Operative Lab Values:							
Elevated Creatinine (Greater than 1.6 mg/dL) (%)	337	(6.9%)	15	(14.2%)	322	(6.8%)	P < 0.01
Elevated BUN (Greater than 21 mg/dL) (%)	1155	(23.8%)	33	(31.1%)	1122	(23.6%)	
Elevated PTT (Greater than 36 seconds) (%)	233	(4.8%)	13	(12.3%)	220	(4.6%)	P < 0.01
Elevated INR (Greater than 1.16) (%)	271	(5.6%)	12	(11.3%)	259	(5.5%)	P < 0.01
Decreased Platelet Count (Less than 149 x 10⁹/Liter) (%)	567	(11.7%)	17	(16.0%)	550	(11.6%)	
Comorbidities:							
Transfusion within 72 hours of Surgery (%)	15	(0.3%)	2	(1.9%)	13	(0.3%)	P < 0.01
Currently on Hemodialysis (%)	124	(2.6%)	8	(7.5%)	116	(2.4%)	P < 0.01
Current Smoker (within past year) (%)	789	(16.2%)	13	(12.3%)	776	(16.3%)	
Diabetes Mellitus Treated with Insulin (%)	342	(7.0%)	8	(7.5%)	334	(7.0%)	
Diabetes Mellitus Treated with Oral Medication (%)	754	(15.5%)	18	(17%)	736	(15.5%)	
Disseminated Cancer (%)	155	(3.2%)	10	(9.4%)	145	(3.0%)	P < 0.01
History of Severe COPD (%)	184	(3.8%)	2	(1.9%)	182	(3.8%)	
Hypertension (Treated with Medication) (%)	2984	(61.4%)	69	(65.1%)	2915	(61.3%)	
Steroid Use for Chronic Medical Condition (%)	195	(4.0%)	5	(4.7%)	190	(4.0%)	
Dyspnea (%)	285	(5.9%)	12	(11.3%)	273	(5.8%)	P = 0.03
Bleeding Disorder (%)	124	(2.6%)	6	(5.7%)	118	(2.55)	P = 0.04

P Value represents T-test for continuous variables or Chi-Square for categorical variables.
ASA = American Society of Anesthesiologists, COPD = Chronic Obstructive Pulmonary Disorder, BUN: Blood urea nitrogen

Table 2. *Postoperative Outcomes Frequency Table, Unplanned conversion to open*

	Total Cohort n = 4862		Unplanned Conversion to Open n = 106		Minimally Invasive Surgery n = 4756		P Value
Outcome Variables							
Readmission to Hospital (%)	227	(4.7%)	17	(16.0%)	210	(4.4%)	P < 0.01
Pt Requiring Bleeding Transfusion (%)	189	(3.9%)	35	(33.0%)	154	(3.2%)	P < 0.01
Mean Total Operating Time in Minutes (Range)	176.4	(4 – 769)	255.08	(66 – 732)	174.7	(4 – 769)	P < 0.01
Mean Length of Hospital Stay (Range)	2.4	(0 – 36)	5.07	(1 – 27)	2.3	(0 – 36)	P < 0.01
Mean Days from Operation to Discharge (Range)	2.1	(0 – 30)	0.85	(0 – 21)	2.2	(0 – 30)	P < 0.01
Superficial Incisional Surgical Site Infection (%)	62	(1.3%)	3	(2.8%)	59	(1.2%)	
Deep Incisional Surgical Site Infection (%)	7	(0.1%)	2	(1.9%)	5	(0.1%)	P < 0.01
Organ Space Incisional Surgical Site Infection (%)	27	(0.6%)	6	(5.7%)	21	(0.4%)	P = 0.02
Sepsis (%)	20	(0.4%)	2	(1.9%)	18	(0.4%)	
Septic Shock (%)	10	(0.2%)	1	(0.9%)	9	(0.2%)	
Urinary Tract Infection (%)	52	(1.1%)	0	(0.0%)	52	(1.1%)	
Acute Renal Failure (%)	15	(0.3%)	4	(3.8%)	11	(0.2%)	P < 0.01
Pneumonia (%)	54	(1.1%)	1	(0.9%)	53	(1.1%)	
CVA/Stroke with Neurological Deficit (%)	6	(0.1%)	0	(0.0%)	6	(0.1%)	
Cardiac Arrest Requiring CPR (%)	16	(0.3%)	1	(0.9%)	15	(0.3%)	
Myocardial Infarction (%)	26	(0.5%)	1	(0.9%)	25	(0.5%)	
Pulmonary Embolism (%)	24	(0.5%)	3	(2.8%)	21	(0.4%)	P < 0.01
DVT/Thrombophlebitis (%)	26	(0.5%)	4	(3.8%)	22	(0.5%)	P < 0.01
Discharge to SNF (%)	119	(2.5%)	11	(10.4%)	108	(2.3%)	
Discharge to Home (%)	4743	(97.6%)	95	(89.6%)	4648	(97.7%)	
Rectal Injury (%)	3	(0.1%)	0	(0.0%)	3	(0.1%)	
Unplanned Intubation (%)	18	(0.4%)	0	(0.0%)	18	(0.4%)	
Wound Disruption (%)	17	(0.4%)	4	(3.8%)	13	(0.3%)	P < 0.01
On Ventilator Greater than 48 Hours (%)	17	(0.3%)	2	(1.95)	15	(0.3%)	P < 0.01
Clostridium Difficile Colitis (%)	10	(0.2%)	1	(0.9%)	9	(0.2%)	
Prolonged NPO or NGT Use (%)	82	(1.7%)	13	(12.3%))	69	(1.5%)	P < 0.01
Lymphocele/Lymphatic Leak (%)	82	(1.7%)	6	(5.7%)	76	(1.6%)	P < 0.01
Unplanned Reoperation (%)	85	(1.7%)	10	(10.9%)	75	(1.6%)	P < 0.01

P Value represents T-Test for continuous variables and Chi-Square for categorical variables.
UTI = Urinary Tract Infection, PNA = Pneumonia, DVT = Deep Vein Thrombosis, SNF = Skilled Nursing Facility, NPO = Nothing by mouth, NGT = Nasogastric Tube

Results

The unplanned conversion to open rate was 2.2%. The age (mean (SD)) of the cohort was 62.6 (11.2) and 61.3 (12.2) for the unplanned and the planned group. There was a baseline difference with preoperative labs including BUN, creatinine, PTT, and INR. An increased incidence of T3 and T4 (30.2% and 8.5%) in the unplanned group compared to the (21.2% and 0.50%) in the planned group was noted. ASA classification 4 also favored the unplanned group vs. planned group (Table 1). The outcome variables were also compared between the unplanned and the planned group (Table 2).

Discussion

Based on our study, multiple factors were associated with conversion to open in nephrectomy. Higher tumor stage, ASA classification, kidney function, and PT/INR were all predictive factors of conversion to open in nephrectomies. The open group had worse clinical outcomes including length of hospital stay, discharge to nursing care, prolonged NPO/NGT, and lymph leak.

Limitations

This study was performed retrospectively and, therefore, no causality can be drawn from these findings. Another limitation is surgeon preference when converting to open nephrectomy. In these cases, each urological surgeon may have a different threshold for open conversion, and this variable cannot be controlled for. Although we performed a multivariable statistical regression, unaccounted for confounding variables, other than primary surgeon, could potentially influence the data.

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