Age-stratified perioperative mortality after urological surgeries

Brendan Wallace, MD[1]; Rodney H. Breau, MD[1,2]; Sonya Cnossen, MSc[1]; Christopher Knee, MD[1]; Daniel McIsaac, MD[2,3]; Ranjeeta Mallick, PhD[2]; Ilias Cagiannos, MD[1]; Christopher Morash, MD[1]; Luke T. Lavallée, MD[1,2]

[1]Division of Urology, Department of Surgery, The Ottawa Hospital, University of Ottawa; [2]Clinical Epidemiology Program, Ottawa Hospital Research Institute; [3]Department of Anesthesiology & Pain Medicine, The Ottawa Hospital, University of Ottawa; Ottawa, ON, Canada

Cite as: *Can Urol Assoc J* 2018;12(8):256-9. http://dx.doi.org/10.5489/cuaj.5022

Published online April 6, 2018

Abstract

Introduction: More elderly patients are presenting for surgical consultation. Understanding the risk of mortality by age group after urological surgery is important for patient selection and counselling.
Methods: A historical cohort study of The American College of Surgeons National Surgical Quality Improvement Program (NSQIP) database from 2006–2015 was performed. Current procedural terminology (CPT) codes for similar surgical procedures were grouped for analyses. Urological procedures commonly performed in elderly patients were identified and stratified by patient age and surgical approach (open vs. laparoscopic/robotic). The primary outcome was the absolute risk of death by 30 days stratified by age for each surgical procedure. The secondary outcome was risk of death by surgical approach (open vs. laparoscopic/robotic).
Results: Twelve urological procedures were reviewed including 124 262 patients. A total of 1011 (0.8%) deaths occurred by 30 days after surgery. The procedure with the highest incidence of mortality by 30 days was open nephroureterectomy (2.9 %). In patients 80 years and over, the procedure with the highest incidence of death was open radical nephrectomy (5.32%). There was an increased risk of mortality with increasing age group for all procedures. Unadjusted risk of mortality was consistently higher in patients who receive open compared to laparoscopic surgery.
Conclusions: There is an increasing risk of mortality with age and with open surgical approach in urology. Knowledge regarding the absolute risk of mortality in patients receiving common urological surgeries may improve patient selection and counselling.

Introduction

Life expectancy in North America is increasing and more elderly patients are presenting for surgical consultations.[1] Patient selection for surgery and optimal counselling requires data about procedure-specific risks and benefits. Age is a key variable for risk stratification, as older patients tend to experience more postoperative adverse events than younger patients.

Previous reports characterized morbidity and mortality of urological procedures by age, with many focusing on outcomes of octogenarians because these patients may be considered ineligible for surgery by some providers on the basis of age alone.[2-6] However, most of these studies are small, from a single centre, and examine only one procedure. Therefore, it is difficult to generalize their findings and find data that are broadly applicable and readily accessible in a clinical setting. A study by Patel et al[7] used the American College of Surgeons National Surgical Quality Improvement Program (NSQIP) database to examine the relationship between age and morbidity in several urological procedures; however, they did not completely characterize the association between age and mortality for each procedure.[7] Crude mortality rates are a common starting point for risk discussions with individual patients. Therefore, describing and understanding the association between age and mortality risk for specific urological procedures will help urologists counsel patients about their risk of death from surgery.

The primary objective of this study was to determine the risk of death at 30 days after common urological procedures by age group. The secondary objective was to compare mortality for open and laparoscopic surgical approaches.

Methods

This was a historical cohort study of patients receiving urological surgery captured in NSQIP. NSQIP is a prospective, multicentre, international quality improvement program and contains data from over 700 hospitals. NSQIP records patient characteristics, treatment characteristics, details of surgery, and perioperative morbidity and mortality up to 30 days postoperatively. Trained clinical abstractors at each participating site compile NSQIP data and previous audits have reported high reliability of the data.[8]

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This study examined urological surgeries commonly performed in elderly patients from January 2006 to December 2015. Current Procedural Terminology (CPT) codes were used to identify and group common procedures. The procedures selected for the study were nephroureterectomy (open: CPT 50234, 50236; and laparoscopic: CPT 50548), radical cystectomy with diversion (CPT 51570, 51575, 51580, 51585, 51590), percutaneous nephrolithotomy (PCNL) (CPT 50060, 50065), radical nephrectomy (open: CPT 50220, 50225, 50230; and laparoscopic: CPT 50545, 50546), partial nephrectomy (open: CPT 50240; and laparoscopic: CPT 50543), prostatectomy (open: CPT 55840, 55842, 55845; and laparoscopic/robotic: CPT 55866), transurethral resection of the prostate (TURP) (CPT 52601, 52630), and transurethral resection of bladder tumour(s) (TURBT) (CPT 52243, 52235, 52240). Patients had to be >18 years of age; no other exclusion criteria were applied. The number and proportion of patients receiving each procedure who died of any cause by 30 days postoperatively was determined.

Mortality rates were stratified by age group; <50, 50–59, 60–69, 70–79, and ≥80 years. Mortality was also stratified by surgical approach when applicable (open vs. laparoscopic).

Interaction analyses were performed to determine if the effect of age category on mortality varied by procedure and surgical approach (laparoscopic vs. open). Multiplicative interaction terms agexprocedure and agexlaparoscopy were included in two separate binomial regression models using logit link.

NSQIP contains detailed risk-modifying information for patient characteristics, including International Classification of Disease (ICD) coded diagnosis, medical comorbidities, body mass index, renal function, previous treatments (e.g., chemotherapy, radiotherapy, etc.), and surgical factors (e.g., operating time, type of anesthesia, etc.). This study purposefully did not adjust for these factors because the objective was to provide estimates of overall mortality based on age alone. NSQIP does not include tumour factors, such as stage or grade. Procedures that had less than 20 patients for a given age group are not reported because the small sample size may produce results that are not generalizable. Institutional ethics board approval was obtained from the Ottawa Hospital Research Ethics Board. SAS software version 9.4 for Windows was used for analyses (Cary, NC, U.S.). NSQIP hospitals are the source of data used in this analysis; however, NSQIP has not reviewed the methodology of this study and is not responsible for its content.

Results

From 2006–2015, there were 124 262 eligible urological procedures identified in NSQIP (Table 1). The most common procedure was laparoscopic/robotic radical prostatectomy, with 31 234 cases. Overall, 36% of patients were over 70 years of age and 12% were 80 years and over. For some procedures, a small proportion of patients were 80 years and over. For example, patients 80 years and over comprised approximately 2.7% and 3.3% of laparoscopic and open partial nephrectomy cases, respectfully, and 0.5% and 1.3% of laparoscopic and open radical prostatectomy cases, respectfully. For other procedures, including TURBT, TURP, and laparoscopic nephroureterectomy, patients 80 years and over comprised 30%, 25%, and 21% of cases, respectively. These differences are likely owing to the natural history of the disease being treated and the perceived risk associated with the procedure. No risk of mortality was reported for PCNL because the frequency of this procedure in NSQIP was low, rendering the data on mortality unreliable.

A total of 1011 (0.80%) patients died across all procedures by 30 days postoperatively. The procedure with the highest overall risk of mortality was open nephroureterectomy at 2.90% (Table 2). The procedure with the lowest overall risk of mortality was laparoscopic/robotic prostatectomy (0.13%). In patients 80 years and over, the proce-

Table 1. Frequency of urological procedures by age

Procedure	Frequency n	<50 n (%)	50–59 n (%)	60–69 n (%)	70–79 n (%)	≥80 n (%)
Lap radical prostatectomy	31234	1324 (4.2)	9667 (31.0)	15565 (49.8)	4512 (14.5)	166 (0.5)
TURP	25269	314 (1.2)	2131 (8.4)	7382 (29.2)	9242 (36.6)	6200 (24.5)
TURBT	15873	634 (4.0)	1695 (10.7)	3929 (24.8)	4846 (30.5)	4769 (30.0)
Lap radical nephrectomy	11501	2232 (19.4)	2637 (22.9)	3279 (28.5)	2381 (20.7)	972 (8.5)
Lap partial nephrectomy	9290	2053 (22.1)	2469 (26.6)	2929 (31.5)	1584 (17.1)	255 (2.7)
Radical cystectomy with diversion	8011	465 (5.8)	1269 (15.8)	2385 (29.8)	2808 (35.1)	1084 (13.5)
Open radical prostatectomy	7617	244 (3.2)	2018 (26.5)	3889 (51.1)	1366 (17.9)	100 (1.3)
Open radical nephrectomy	7113	1364 (19.2)	1813 (25.5)	2136 (30.0)	1349 (19.0)	451 (6.3)
Open partial nephrectomy	5046	1093 (21.7)	1328 (26.3)	1532 (30.4)	929 (18.4)	164 (3.3)
Lap nephroureterectomy	2249	211 (9.4)	310 (13.8)	546 (24.3)	713 (31.7)	469 (20.9)
Open nephroureterectomy	861	114 (13.2)	114 (13.2)	245 (28.5)	245 (28.5)	143 (16.6)
Percutaneous nephrolithotomy	198	67 (33.8)	60 (30.3)	42 (21.2)	26 (13.1)	3 (1.5)

Procedures are arranged by frequency of procedure. Lap: laparoscopic; TURBT: transurethral resection of bladder tumour; TURP: transurethral resection of prostate.

Table 2. Absolute risk of mortality with urological procedures stratified by age

Procedure	Total mortality n (%)	<50 n (%)	50–59 n (%)	60–69 n (%)	70–79 n (%)	≥80 n (%)	p
Lap partial nephrectomy	25 (0.27)	2 (0.10)	2 (0.08)	7 (0.24)	10 (0.63)	4 (1.57)	<0.01
Lap radical nephrectomy	68 (0.59)	1 (0.04)	10 (0.38)	18 (0.55)	22 (0.92)	17 (1.75)	<0.01
Lap radical prostatectomy	40 (0.13)	0 (0)	11 (0.11)	17 (0.11)	9 (0.20)	3 (1.81)	<0.01
Lap nephroureterectomy	35 (1.56)	0 (0)	3 (0.97)	8 (1.47)	12 (1.68)	12 (2.56)	0.12
Open partial nephrectomy	28 (0.55)	2 (0.18)	3 (0.23)	8 (0.52)	9 (0.97)	6 (3.66)	<0.01
Open radical nephrectomy	128 (1.80)	13 (0.95)	20 (1.10)	30 (1.40)	41 (3.04)	24 (5.32)	<0.01
Open radical prostatectomy	19 (0.25)	0 (0)	3 (0.15)	8 (0.21)	6 (0.44)	2 (2.00)	<0.01
Open nephroureterectomy	25 (2.90)	1 (0.88)	1 (0.88)	5 (2.04)	11 (4.49)	7 (4.90)	0.09
Radical cystectomy with diversion	189 (2.36)	4 (0.86)	17 (1.34)	39 (1.64)	78 (2.78)	51 (4.70)	<0.01
TURBT	283 (1.78)	5 (0.79)	16 (0.94)	30 (0.76)	59 (1.22)	173 (3.63)	<0.01
TURP	166 (0.66)	0 (0)	4 (0.19)	23 (0.31)	40 (0.43)	99 (1.60)	<0.01

Lap: laparoscopic; TURBT: transurethral resection of bladder tumour; TURP: transurethral resection of prostate.

dures with the highest risk of mortality were open radical nephrectomy (5.32%), open nephroureterectomy (4.90%), and radical cystectomy with diversion (4.70%). By comparison, each of these procedures had mortality rates under 1% in patients less than 50 years of age. Overall there was a trend of increasing mortality by age category in all urological procedures examined (Table 2).

Use of a laparoscopic surgical approach was consistently associated with a lower risk of mortality compared to the same open procedure (Fig. 1). For example, an open nephroureterectomy was associated with almost double the overall risk of mortality compared to laparoscopic nephroureterectomy (2.9% vs. 1.56%, respectively). This trend was observed over all age categories.

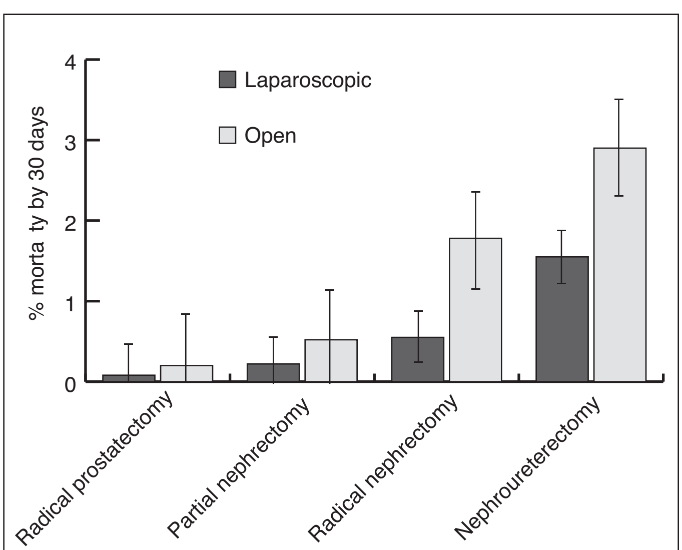

Fig. 1. Absolute risk of mortality for common urological procedures using open and laparoscopic approaches. For each procedure, the risk of death after surgery is lower in the patient population undergoing laparoscopic surgery (p<0.05). Note: y-axis extends from 0–4% only.

Tests for effect modification of age category by procedure and age category by surgical approach (laparoscopic vs. open) were not significant (p>0.05). This indicates the effect of age category on mortality did not vary significantly based on the type of surgery or surgical approach used.

Discussion

This study used data from NSQIP to examine absolute mortality rates at 30 days for urological procedures commonly performed in elderly patients. As anticipated, a trend of increased mortality after surgery with increasing age category was identified: in all 11 procedures studied, mortality rates were highest in people 80 years and older. A lower risk of mortality for procedures performed laparoscopically was also demonstrated when compared to open.

Common sense suggests that the risk of all-cause mortality after surgery should increase with age. Indeed, this and other studies have reported increased mortality after surgery by age in both urological and non-urological surgeries.[9,10] A plethora of patient- and surgery-specific data are available in NSQIP for risk adjustment. Data for risk adjustment are important for comparing outcomes across hospitals, surgeons, and studies. This study purposefully did not adjust the risk of death using patient data available in NSQIP because the objective was to report crude mortality rates by age group. These data, as presented, could be rapidly used by clinicians as a starting point when having a discussion about mortality risk with their patients. It may be assumed that very healthy patients have lower mortality risks than their age category and patients with many comorbidities have higher risk of mortality than their age group if other surgical and disease factors remain equal. In appropriate circumstances, the clinician could then use patient-specific data and a platform such as the NSQIP Surgical Risk Calculator to personalize risk estimates (https://riskcalculator.facs.org/RiskCalculator/).[11]

These data indicate that the mortality rate for almost all procedures increases significantly after age 80. In many cases, the risk of death in patients 80 years and over is double the risk for patients age 70–79. Even less invasive procedures, such as TURBT and TURP, were associated with a high risk of mortality at 30 days in patients 80 years and over (3.63% and 1.60%, respectively). These rates are comparable to open radical procedures, such as cystectomy and nephrectomy in younger age groups. These data underscore the importance of counselling patients about risk because no surgical procedure should be approached lightly in elderly patients.

Patient selection for surgery by age differed significantly by procedure. For example, over 20% of patients receiving laparoscopic nephroureterectomy were 80 years and over. This is likely because upper tract urothelial malignancy is aggressive and no alternate curative treatment option exists. In contrast, only 3% and 1% percent of patients receiving partial nephrectomy and radical prostatectomy, respectively, are 80 years and over. This is likely because tumours treated by these procedures are more indolent or alternative treatments, such as radiotherapy for prostate cancer, are available.

A consistent decreased risk of mortality was observed across procedures when a laparoscopic approach was used. This observation may be explained by several factors. First, it is likely that, on average, tumours amenable to a laparoscopic approach are smaller (lower stage) and more easily resected than tumours requiring an open approach. Second, patients receiving open surgery may have other comorbidities or other disease factors precluding laparoscopy, such as previous radiation or surgery, which could make the dissection more challenging and increase mortality risk. Third, although laparoscopy is now a widely used technique for urologists, it is possible that surgeons performing laparoscopy work in different hospital settings than surgeons performing open surgery and that surgeon or system differences account for some differences in mortality. Therefore, these data do not prove that laparoscopy lowers the risk of death after surgery, but rather the patient population with tumour, disease, and treatment factors that result in laparoscopic surgery have lower death rates than those receiving open surgery.

Strengths of this study include the large sample size and multi-institutional data source, rendering outcomes generalizable. Most importantly, this study provides summary tables for quick access to mortality outcomes by age group and procedure that can be used in a clinical setting. Currently, most available data are from single high-volume institutions and report on one or a few procedures.

This study has several limitations. First, a 30-day postoperative window for mortality is a relatively short followup and some deaths related to surgery are not accounted for in the data. Second, an important limitation of the summary tables is that tumour grade/stage and patient comorbidities/previous treatments are not adjusted for, and these factors very likely have an impact on mortality risk. Therefore, urologist may use these data as a starting point for counselling patients and refine risk estimate using additional patient/tumour/treatment data.

Conclusion

There is an increasing risk of mortality with age and with open surgical procedures in urology. These data can serve as a starting point to help urologists educate their patients about mortality risk with surgery.

Competing interests: Dr. Cagiannos has received fees from AbbVie, Ferring, and Janssen. Dr. Morash has attended advisory boards for AbbVie, Astellas, Ferring, Janssen, and Sanofi; and has participated in clinical trials supported by AbbVie (CRONOS II). Dr. Lavallée has received grants from Sanofi and personal fees from Sanofi and Ferring. The remaining authors report no competing personal or financial interests.

This paper has been peer-reviewed.

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Correspondence: Dr. Luke T. Lavallée, Division of Urology, Department of Surgery, The Ottawa Hospital, University of Ottawa, Ottawa, ON, Canada; lulavallee@toh.ca