Perioperative outcomes following radical prostatectomy for patients with disseminated cancer: An analysis of the National Surgical Quality Improvement Program database

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Abstract

Introduction: We sought to determine whether patients undergoing radical prostatectomy (RP) in the context of disseminated cancer have higher 30-day complications.

Methods: We conducted a retrospective cohort study of the National Surgical Quality Improvement Program (NSQIP) database. Men undergoing RP (from January 1, 2005 to December 31, 2014) for prostate cancer were identified and stratified by presence (n=97) or absence (n=27 868) of disseminated cancer. The primary outcome was major complications (death, re-operation, cardiac or neurologic events) within 30 days of surgery. Secondary outcomes included pulmonary, infectious, venous thromboembolic, and bleeding complications; prolonged length of stay; and concomitant procedures (bowel-related, cystectomy, urinary diversion, and major ureteric reconstruction). Odds ratios (OR) for each complication were calculated using univariable logistic regression.

Results: We did not identify a difference in major complication rates (OR 2.26, 95% confidence interval [CI] 0.71–7.16). Patients with disseminated cancer had increased risk of venous thromboembolic events (OR 3.30, 95% CI 1.04–10.48) and transfusion (OR 2.45, 95% CI 1.18–5.05), but similar odds of pulmonary and infectious complications and length of stay. Bowel procedures were rare, however, a significantly higher proportion of patients with disseminated cancer required bowel procedures (2.1% vs. 0.3%; p=0.03). Patients with disseminated cancer undergoing RP had greater comorbidities and higher predicted probability of morbidity and mortality. This study is limited by its retrospective design, lack of cancer-specific variables, and prostatectomy-specific complications.

Conclusions: RP in the context of disseminated cancer may be associated with increased perioperative complications. Caution should be exercised in embarking on this practice outside of clinical trials.

Introduction

Population-based studies from the U.S. have shown a survival benefit for patients undergoing cytoreductive radical prostatectomy (CRP) for metastatic prostate cancer (mPCa).[1,2] Two large multi-institutional trials (NCT01751438, NCT00268476) evaluating this approach are underway. Nevertheless, multiple centres are currently performing CRP off-trial.[3,4]

Details of perioperative morbidity following CRP are sparse, limited by the retrospective nature of data collection and inherent selection and reporting biases. To date, the results of CRP from 129 patients have been reported in the literature, representing the experience from centres of excellence.[3,4] Granular, systems-based, postoperative complication data, as well as the occurrence of concomitant procedures with CRP (e.g., repair of rectal injury) remain unknown.

The American College of Surgeons (ACS) National Surgical Quality Improvement Program (NSQIP) is a large, multi-institutional, validated registry that has been shown to perform better than administrative databases or institutional series in capturing intraoperative and postoperative complications.[5-7] Further, it has excellent data quality owing to data abstraction directly from medical records by trained personnel[8,9] and rich data on patients' medical status to facilitate risk adjustment. Disseminated cancer status, defined as metastasis to a major organ, is collected in NSQIP and has been shown to impact perioperative outcomes, including mortality.[10-12] We, therefore, sought to determine the effect of disseminated cancer on the risk of perioperative complications in patients undergoing RP for PCa.

Methods

The Sunnybrook Health Sciences Research Ethics Board approved this study, which was conducted and reported according to the recommendations of the RECORD statement.[13]

Study subjects

Participant use files of ACS NSQIP from January 1, 2005 to December 31, 2014 were used to identify patients undergoing open or minimally invasive RP using CPT codes (55840, 55842, and 55845 for open and 55866 for minimally-invasive) with a principal postoperative diagnosis of prostate cancer (ICD-9 code 185). We did not include perineal prostatectomy or prostatic procedures for benign prostatic hyperplasia (BPH). We identified a total of 28 266 patients and then excluded 301: gender coded as "female" or "null" (n=94); missing information on important covariates (n=154); missing information on length of stay (n=1); and cases coded as emergent (n=52).

Outcomes

The primary outcome was the occurrence of a major complication, defined as mortality, unplanned reoperation (return to the operating room [OR]), cardiac event (myocardial infarction or cardiac arrest), or neurologic event (cerebrovascular accident or coma >24 hours) within 30 days of surgery. Secondary outcomes included pulmonary (re-intubation or prolonged ventilation [>48 hours]), infectious (including surgical site infections [superficial, deep incisional, or organ space], pneumonia, urinary tract infection, or sepsis), venous thromboembolic (deep vein thrombosis or pulmonary embolism), and bleeding complications (the requirement for one or more transfusions). Prolonged length of stay was defined as greater than two days between the date of operation and discharge, the median in this cohort.

We further characterized the operative complexity associated with RP in patients with metastatic disease by analyzing concomitant procedures, performed by the primary urological operative team or consulting surgeons. We comprehensively reviewed all concomitant procedures identified by CPT codes (Appendix A) while blinded to clinical characteristics, including disseminated cancer status. We classified concomitant procedures as bowel-related (minor and major), cystectomy (partial or complete, with or without urinary diversion), urinary diversion alone, major ureteric reconstruction, and major vascular repair (Appendix B). We did not capture surgical procedures that were concomitant but unrelated to the complexity of RP (i.e., hernia repair).

Exposure

The primary exposure was disseminated cancer at the time of RP, defined by NSQIP as a primary cancer that has metastasized to a major organ (American Joint Committee on Cancer Stage IV).[14] Patients with isolated lymphatic metastases were excluded.[14] A probabilistic matching algorithm linking colorectal cancer patients to the National Cancer Database showed that this variable has agreement with metastatic stage (Cohen kappa coefficient, 0.454).[11]

Covariates

We abstracted demographic, clinical, and operative information. Demographic information included age, race, and body mass index (BMI). Clinical data included American Society of Anesthesiology (ASA) physical status classification, cardiac disease (previous congestive heart failure, myocardial infarction, angina within 30 days, cardiovascular surgery, or percutaneous coronary intervention), neurological disease (previous cerebrovascular accident, paraplegia, hemiplegia, or quadriplegia), chronic obstructive pulmonary disease, diabetes (requiring oral agent or insulin), current smoking (active smoker within one year), chronic steroid use, and functional status prior to surgery (independent, partially dependent, totally dependent, or unknown). We also collected data on the use of minimally invasive surgical (MIS) technique.

Statistical analysis

Temporal trends in the proportion of annual cases performed on patients with disseminated cancer over time were examined using the Cochrane-Armitage test for trend.[15] Baseline demographic characteristics were examined using frequencies and proportions for categorical variables and medians and interquartile ranges (IQR) for continuous variables. We compared proportions and medians between patients with disseminated cancer and those without using the Chi-squared test (Fisher's exact test, where appropriate) and Wilcoxon rank sum test, respectively.

We examined the rates of complications for each our pre-specified categories and compared these for patients with and without disseminated disease using Fisher's exact test. Odds ratios (OR) and 95% confidence intervals (CI) for each complication category were calculated using univariable logistic regression. We were unable to perform multivariable regression due to the lack of events.

Finally, we compared the proportions for patients undergoing a pre-specified concomitant procedure and assessed differences by disseminated cancer status using Chi-squared test and Fisher's exact test, as appropriate.

Results

We identified 27 965 patients undergoing RP who met the inclusion and exclusion criteria. Of these, 97 patients (0.4%) had evidence of disseminated cancer at the time of surgery and 27 868 (99.6%) did not. We did not identify a statistically significant change in the proportion of patients undergoing RP who had disseminated disease over time (Cochran-Armitage trend test p=0.12).

A greater proportion of patients with disseminated cancer used steroids chronically and were in ASA categories 3 and 4 (Table 1). MIS techniques were used in a lower proportion of patients with disseminated cancer (Table 1).

The NSQIP-derived probability of 30-day morbidity and mortality was available for 17 921 patients in our cohort. The median estimated morbidity and mortality were higher among patients with disseminated disease (5.7%, 95% CI 4.1–7.0% and 0.4%, 95% CI 0.2–0.7%, respectively) than those without disseminated cancer (4.3%, 95% CI 3.4–5.7% and 0.1%, 95% CI 0.06–0.2, respectively; p<0.0001 for each).

The primary outcome (major complications) was not different for men with disseminated disease undergoing RP (Table 2; OR 2.26, 95% CI 0.71–7.16) compared to those without. Similarly, perioperative mortality rates were not statistically different (0.1% in non-disseminated and 1.0% in disseminated; p=0.09). We did not identify a difference in the odds of pulmonary complications (OR 4.68, 95% CI 0.64–34.04), infectious complications (OR 1.05, 95% CI 0.33–3.32), or prolonged length of stay (OR 1.20, 95% CI 0.72–2.00). Median length of stay was two days (IQR 1–2 days) for patients with disseminated cancer and one day (IQR 1–2 days) for patients without disseminated cancer. Patients with disseminated cancer had increased odds of venous thromboembolic events (OR 3.30, 95% CI 1.04–10.48) and bleeding requiring transfusion (OR 2.45, 95% CI 1.18–5.05) than those without disseminated cancer.

Concomitant bowel procedures during RP were rare among all patients (Table 3). However, a significantly higher proportion of patients with disseminated cancer required bowel procedures (2.1% vs. 0.3%; p=0.03), cystectomy (2.1% vs. 0.03%; p=0.0006), and urinary diversions (2.1% vs. 0.02%; p=0.0003) (Table 3). Ureteral reconstruction and major vascular repair were not identified among the disseminated group.

Discussion

In this study, patients undergoing RP who have disseminated cancer had greater comorbidities than those without disseminated disease and while the odds of major complications were higher, this did not reach statistical significance. We found these patients were at increased risk of receiving

Table 1. Demographic parameters of patients undergoing isolated radical prostatectomy, stratified by presence of disseminated cancer at time of surgery

	Non-disseminated n=27 868	Disseminated n=97	p value
Age, median (IQR)	62.0 (57.0–67.0)	63.0 (58.0–68.0)	0.20
Race, n (%)			
Caucasian	21,140 (75.9)	73 (75.3)	0.99
African-American	2804 (10.1)	10 (10.3)	
Other/Unknown	3924 (14.1)	14 (14.4)	
BMI, median (IQR)	28.3 (25.8–31.5)	28.0 (25.5–30.9)	0.27
ASA category, n (%)			
1	1072 (3.9)	2 (2.1)	0.01
2	17 437 (62.6)	47 (48.5)	
3	9163 (32.9)	47 (48.5)	
4	196 (0.7)	1 (1.0)	
Cardiac history, n (%)	658 (2.4)	4 (4.1)	0.30
Neurologic history, n (%)	210 (0.8)	2 (2.1)	0.17
History of COPD, n (%)	528 (1.9)	2 (2.1)	0.71
Diabetes, n (%)	3172 (11.4)	13 (13.4)	0.53
Active smoking, n (%)	3414 (12.3)	14 (14.4)	0.51
Chronic steroid use, n (%)	329 (1.2)	6 (6.2)	0.001
Functional status prior to surgery			
Independent	27 735 (99.5)	96 (99.0)	0.20
Partially dependent	52 (0.2)	1 (1.0)	
Totally dependent	2 (0.01)	0	
Unknown	79 (0.3)	0	
Minimally invasive modality, n (%)	22 874 (82.1)	71 (73.2)	0.02

ASA: American Society of Anesthesiology; BMI: body mass index; COPD: chronic obstructive pulmonary disease; IQR: interquartile range.

Table 2. Crude counts of patients experiencing complications following radical prostatectomy

	Non-disseminated n=27 868	Disseminated n=97	p value
Major complication, n (%)	389 (1.4)	3 (3.1)	0.16
Mortality, n (%)	26 (0.1)	1 (1.0)	0.09
Reoperation, n (%)	307 (1.1)	2 (2.1)	0.29
Cardiac complication, n (%)	61 (0.2)	2 (2.1)	0.02
Neurologic complication, n (%)	29 (0.1)	0	1.00
Pulmonary complication, n (%)	62 (0.2)	1 (1.0)	0.20
Infectious complication, n (%)	824 (3.0)	3 (3.1)	0.76
Sepsis, n (%)	206 (0.7)	0	1.00
Pneumonia, n (%)	70 (0.3)	0	1.00
Urinary tract infection, n (%)	451 (1.6)	1 (1.0)	1.00
Surgical site infection (SSI), n (%)	274 (1.0)	2 (2.1)	0.25
Organ space SSI, n (%)	108 (0.4)	1 (1.0)	0.32
Deep incisional SSI, n (%)	14 (0.1)	1 (1.0)	0.05
Superficial SSI, n (%)	154 (0.6)	0	1.00
Venous thromboembolism, n (%)	267 (1.0)	3 (3.1)	0.07
Deep vein thrombosis, n (%)	177 (0.6)	2 (2.1)	0.12
Pulmonary embolism, n (%)	131 (0.5)	3 (3.1)	0.01
Bleeding requiring transfusion, n (%)	990 (3.6)	8 (8.3)	0.02
Prolonged length of stay, n (%)	4459 (16.0)	18 (18.6)	0.49

concomitant bowel-related procedures (2.1% vs. 0.3%), experiencing a venous thromboembolic event (3.1% vs. 1.0%), and bleeding requiring a transfusion (8.3% vs. 3.6%).

In contrast to previous reports from institutions[3] or multi-institutional collaboratives,[4] our data suggest there are specific (bowel, thrombolic, and bleeding) and potentially worse perioperative outcomes in performing RP in patients with disseminated cancer. Heidenreich et al reported a single institution series of 23 patients with low-volume mPCa that underwent RP with minimal blood loss (mean 335 cc) and, while two patients developed thromboembolic events, there were no Clavien Grade 4–5 complications.[3] A recent multi-institutional report of 106 RPs in patients with mPCa found a single case of iatrogenic ureteral injury and a 14% blood transfusion rate.[4] These data from retrospective chart review likely represent highly selected patients, as evidenced by the low comorbidity scores[4] compared to the generally higher comorbidities seen in our cohort of patients with disseminated cancer. Apart from patient-level factors, these excellent outcomes are also achieved through a combination of meticulous staging, case selection for surgical resectability, and expertise of each respective institution.

The use of NSQIP to extrapolate outcomes from cancer surgery has inherent limitations. While NSQIP has detailed and validated comorbidity and perioperative data, ASA classification is a somewhat crude measure of comorbidity with significant within-group heterogeneity. Further, patients with disseminated cancer may be given a higher classification on the basis of their cancer disease status, rather than their true functional status. In addition, NSQIP lacks cancer-specific variables, such as staging information, and the disseminated cancer variable does not necessarily imply that it is PCa that has metastasized. To improve this likelihood, we restricted our analysis to all men with the primary diagnosis of PCa, although it remains possible (but unlikely) that the disseminated cancer was a secondary, metastatic malignancy. Further, NSQIP lacks pathological information (e.g., margin status), complications that are unique to prostatectomy (e.g., anastomotic leaks or lymphoceles), or grading of the severity of complications, such as the commonly used Clavien-Dindo scale. Though our report is strengthened by an extensive review of concomitant surgical procedures, we are unable to determine whether concomitant procedures were planned or imperative due to an intraoperative complication. That is, a cystectomy may be planned for palliation and local control or may be necessitated intraoperatively based on under-staging of locally advanced disease or by an intraoperative complication. Additionally, the low event rate for complications did not permit multivariable analysis to determine if disseminated cancer independently accounts for the differences observed or if there may be underlying confounders (e.g., the higher comorbidity of these patients may account for the differences observed). Lastly, the mor-

Table 3. Occurrence of concomitant or other procedures during radical prostatectomy

	Non-disseminated n=27 868	Disseminated n=97	p value
Bowel procedures, n (%)	81 (0.3)	2 (2.1)	0.03
Minor bowel procedures, n (%)	44 (0.2)	1 (1.0)	0.14
Major bowel procedures, n (%)	40 (0.1)	1 (1.0)	0.13
Cystectomy with or without urinary diversion, n (%)	9 (0.03)	2 (2.1)	<0.001
Urinary diversion, n (%)	6 (0.02)	2 (2.1)	<0.001
Major ureteral reconstruction, n (%)	110 (0.4)	0	1.00
Major vascular repair, n (%)	5 (0.02)	0	1.00

bidity observed with RP on univariable analysis could be attributable to performing extended pelvic lymph node dissection, as is likely done in these high-risk patients, and not necessarily the prostate extirpation itself.

Biological and mechanistic hypotheses, such as the concept of a pre-metastatic niche, have been cited in rationalizing a survival benefit from cytoreduction in mPCa.[16,17] However, the biological processes governing metastasis remains poorly understood and enthusiasm must be tempered by the observation that metastasis can occur from one deposit to another.[18] If indeed the case, the most important space may be the oligometastatic stage and the appropriate selection of optimal candidates must be balanced with the risks of surgery.

As the landscape of PCa shifts away from early-stage cancer[19] and to more advanced presentations, surgeons will face greater instances of the ethical dilemma of offering CRP outside of clinical trial settings. Taken together with the multiple barriers that surgical, randomized, controlled trials already face, particularly in accrual, a candid and cautionary consent process with patients will be required for off-trial CRP.[20] The belief and bias held by surgeons that surgery is beneficial must be tempered with adequate support of other modalities, including radiation therapy in this setting.[21] Our data present information that can be used in the consent process. RP in the setting of mPCa may be at greater perioperative risk regardless of what is driving the risk (patient factors or tumour factors). Caution should be exercised from adopting the results by centres of excellence, where selected patients appear to have adequate outcomes. Selection bias, undefined inclusion criteria, clinician-derived, subjective decision on benefit, and lastly, potential under-reporting necessitate that these reports must not be extrapolated widely.

Conclusion

RP in the context of disseminated cancer was associated with increased perioperative complications; however, this observation may be driven by confounders of this relationship. This investigational therapy should be considered in the context of a clinical trial wherein morbidity, as well as functional and oncological outcomes can be closely monitored.

Competing interests: The authors report no competing personal or financial interests.

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Appendix A. Procedural definitions by CPT codes	
CPT	**Procedure**
Lymphadenectomy	
a) Limited pelvic lymphadenectomy	
38562	Limited lymphadenectomy for staging (separate procedure); pelvic and para-aortic
38564	Limited lymphadenectomy for staging (separate procedure); retroperitoneal (aortic and/or splenic)
38570	laparoscopy, surgical with retroperitoneal lymph node sampling, single or multiple
38571	laparoscopy, surgical, with bilateral total pelvic lymphadenectomy
38589	Unlisted laparoscopy procedure, lymphatic system
38770	Pelvic lymphadenectomy, including external iliac, hypogastric, and obturator nodes (separate procedure)
38999	Unlisted procedure, hemic or lymphatic system
55842	Prostatectomy, retropubic radical, with or without nerve sparing; with lymph node biopsy(s) (limited pelvic lymphadenectomy)
b) Extended lymphadenectomy	
38572	Laparoscopy, surgical; with bilateral total pelvic lymphadenectomy and peri-aortic lymph node sampling (biopsy), single or multiple
38760	Inguinofemoral lymphadenectomy, superficial, including Cloquets node (separate procedure)
38765	Inguinofemoral lymphadenectomy, superficial, in continuity with pelvic lymphadenectomy, including external iliac, hypogastric, and obturator nodes (separate procedure)
38780	Retroperitoneal transabdominal lymphadenectomy, extensive, including pelvic, aortic, and renal nodes (separate procedure)
55845	Prostatectomy, retropubic radical, with or without nerve sparing; with bilateral pelvic lymphadenectomy, including external iliac, hypogastric, and obturator nodes
Bowel procedures	
a) Minor bowel procedures	
44020	Enterotomy, small intestine, other than duodenum; for exploration, biopsy(s), or foreign body removal
44238	Unlisted laparoscopy procedure, intestine (except rectum)
44602	suture of small intestine (enterrhaphy) for injury
44603	Suture of small intestine (enterorrhaphy) for perforated ulcer, diverticulum, wound, injury, or rupture; multiple perforation
44604	Suture of large intestine (colorrhaphy) for perforated ulcer, diverticulum, wound, injury, or rupture; without colostomy
44605	Suture of large intestine (colorrhaphy) for perforated ulcer, diverticulum, wound, injury, or rupture; with colostomy
44620	closure of enterostomy, large or small intestine
45499	Unlisted laparoscopy procedure, rectum
45999	Unlisted procedure, rectum
b) Major bowel procedures	
44110	Excision of one or more lesions of small or large intestine not requiring anastomosis, exteriorization, or fistulization; single enterotomy
44120	Enterectomy, resection of small intestine; single with anastamosis
44121	Enterectomy, resection of small intestine;
44125	Enterectomy, resection of small intestine; with enterostomy
44130	Enteroenterostomy, anastomosis of intestine, with or without cutaneous enterostomy (separate procedure)
44140	Colectomy, partial; with anastomosis
44144	Colectomy, partial; with resection, with colostomy or ileostomy and creation of mucofistula
44145	Colectomy, partial; with coloproctostomy (low pelvic anastomosis)
44187	Laparoscopy, surgical; ileostomy or jejunostomy, non-tube
44188	Laparoscopy, surgical, colostomy or skin level cecostomy
44204	Laparoscopy, surgical; colectomy, partial, with anastomosis
44205	Laparoscopy, surgical; colectomy, partial, with removal of terminal ileum with ileocolostomy
44227	Laparoscopy, surgical, closure of enterostomy, large or small intestine, with resection and anastomosis
CPT	**Procedure**
44310	Ileostomy or jejunostomy, non-tube
45111	Proctectomy; partial resection of rectum, transabdominal approach
45395	Laparoscopy, surgical; proctectomy, complete, combined abdominoperineal, with colostomy
45562	Exploration, repair, and presacral drainage for rectal injury

Appendix A (cont'd). Procedural definitions by CPT codes	
Cystectomy	
51550	Cystectomy, partial; simple
51555	Cystectomy, partial; complicated (eg, postradiation, previous surgery, difficult location)
51565	Cystectomy, partial, with reimplantation of ureter(s) into bladder (ureteroneocystostomy)
51570	Cystectomy, complete; (separate procedure)
51575	Cystectomy, complete; with bilateral pelvic lymphadenectomy, including external iliac, hypogastric, and obturator nodes
51580	Cystectomy, complete, with ureterosigmoidostomy or ureterocutaneous transplantations;
51590	Cystectomy, complete, with ureteroileal conduit or sigmoid bladder, including intestine anastomosis;
51595	Cystectomy, complete, with ureteroileal conduit or sigmoid bladder, including intestine anastomosis; with bilateral pelvic lymphadenectomy, including external iliac, hypogastric, and obturator nodes
51596	Cystectomy, complete, with continent diversion, any open technique, using any segment of small and/or large intestine to construct neobladder
Urinary diversion	
50815	Ureterocolon conduit, including intestine anastomosis
50820	Ureteroileal conduit (ileal bladder), including intestine anastomosis (Bricker operation)
50825	Continent diversion, including intestine anastomosis using any segment of small and/or large intestine (Kock pouch or Camey enterocystoplasty)
50845	Cutaneous appendico-vesicostomy
50860	Ureterostomy, transplantation of ureter to skin
Major ureteral reconstruction	
50605	Ureterotomy for insertion of indwelling stent, all types
50715	Ureterolysis, with or without repositioning of ureter for retroperitoneal fibrosis
50760	Ureteroureterostomy
50780	Ureteroneocystostomy; anastomosis of single ureter to bladder
50782	Ureteroneocystostomy; anastomosis of duplicated ureter to bladder
50783	Ureteroneocystostomy; with extensive ureteral tailoring
50785	Ureteroneocystostomy; with vesico-psoas hitch or bladder flap
50840	Replacement of all or part of ureter by intestine segment, including intestine anastomosis
50900	Ureterorrhaphy, suture of ureter (separate procedure)
50770	Transureteroureterostomy, anastomosis of ureter to contralateral ureter
50947	Laparoscopy, surgical; ureteroneocystostomy with cystoscopy and ureteral stent placement
50948	Laparoscopy, surgical; ureteroneocystostomy without cystoscopy and ureteral stent placement
50949	Unlisted laparoscopy procedure, ureter
Major vessel repair	
35221	Repair blood vessel, direct; intra-abdominal
35226	Repair blood vessel, direct; lower extremity
35251	Repair blood vessel with vein graft; intra-abdominal
35256	Repair blood vessel with vein graft; lower extremity
35281	Repair blood vessel with graft other than vein; intra-abdominal
35286	Repair blood vessel with graft other than vein; lower extremity

Appendix B. Classification of concomitant procedures

	Concomitant procedure	Description
1	Lymphadenectomy categorized as "not performed," "limited pelvic," or "extended"	Noting that receipt of lymphadenopathy is captured as part of the primary CPT code, the intent of this variable was to explore occurrence of extended template lymphadenectomy and not necessarily capture the receipt of lymph node dissection.
2	Bowel-related procedures, including small and large bowel resection, repair or diversion	This was further sub-divided into minor bowel procedure (bowel repair) and major bowel procedure (bowel resection or diversion).
3	Cystectomy	Includes partial or complete.
4	Urinary diversion	Includes any form (continent or incontinent) urinary diversion.
5	Major ureteric reconstruction	Ureteric re-implantation, uretero-ureterostomy, ureterostomy for stent insertion, ureteric replacement with bowel segment, or ureteric repair. We excluded cystoscopy and ureteric stent insertion, as this may represent a planned preoperative maneuver and does not overall result in significant patient morbidity.
6	Major vascular repairs	Direct repair of major vessels or replacement with vein or other graft.