Charting Postoperative Trajectories in Patients With Cancer: Perspectives From a Resource-Constrained Setting in Northeast India

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ABSTRACT

PURPOSE Perioperative monitoring in critical care facility is a major determinant of postoperative outcome. However, critical care resources are finite and expensive. Thus, identifying those most likely to benefit is of great importance in resource-constrained settings. Hence, this study aims to identify prognostic factors predicting postoperative mortality and morbidity for patients in surgical units. This may help in identifying high-risk patients and developing an approach to reduce mortality.

METHODS This was a cohort study involving secondary data of all patients with cancer age 18 years and older and admitted to the critical care. Preoperative, intraoperative, and postoperative parameters were extracted in Excel from the cloud physician electronic database. Descriptive analysis and log-binomial regression were used to analyze the data using STATA version 12. 1. Poor postoperative outcomes were defined as the occurrence of morbidity (unplanned postoperative course) or mortality.

RESULTS The study included 421 patients with a mean age of 58.02 years (SD, 12.85). The majority of the patients were in the age range of 41-60 years (53%), 29% were older than 60 years, and 88% were found to use tobacco. Of all patients, 287 (68%) had significant postoperative morbidity and 13 patients (3%) died. Acute Physiology and Chronic Health Evaluation (APACHE-II) score >15 (adjusted relative risk [RR], 4.5 [95% CI, 1.48 to 14.01]), surgeon's experience <10 years (adjusted RR, 1.7 [95% CI, 1.06 to 2.94]), and blood loss more than 100 ml (adjusted RR, 2.42 [95% CI, 1.43 to 4.10]) were found to be significant predictors of poor postoperative outcomes.

CONCLUSION Higher APACHE-II scores, significant blood loss, and operated by less experienced surgeon were the major determinants of poor postoperative outcomes and necessitate postoperative monitoring in critical care facilities.

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INTRODUCTION

Cancer prevalence and its associated mortality are increasing in low-income and middle-income countries (LMICs) and account for more than 70% of the global cancer burden.[1] Surgery is one of the main modalities for cancer treatment. A significant number of early-stage solid tumors can be cured with surgery along with adjuvant radiation therapy and/or chemotherapy depending on the stage and type of cancer.[1] Approximately 80% of individuals diagnosed with cancer require surgical intervention, and several factors influence the resulting outcome. The key factors determining the postoperative outcomes are the surgeon's expertise, the presence of a critical care unit, the competence of the surgical and intensive care teams, and the implementation of evidence-based perioperative practices. Perioperative mortality is disproportionately greater in LMICs, which contributes to significantly worse cancer survival.[2] Postoperative monitoring in a critical care facility and adherence to perioperative protocols is a major determinant of the surgical outcomes. Postoperative death after surgery remains a major cause of death worldwide, and account for 7.7% of total deaths globally.[3] In addition, critical care admission after a major surgery is considered a standard of care in many health care systems. However, critical care resources are expensive. Thus, identifying those most likely to benefit is of great importance in a resource-constrained setting.[3]

CONTEXT

Key Objective
Do all patients undergoing elective surgeries for cancer require admission to intensive care unit (ICU) postoperatively in a resource-constrained setting.

Knowledge Generated
In our study, we observed that routine postoperative ICU admission is not necessary for all patients; rather, it should be tailored on the basis of the identification of high-risk factors such as the high APACHE-II score, the amount of blood loss, and the surgeon's experience.

Relevance
Identifying high-risk patients after elective cancer surgery is crucial for optimizing ICU resources, especially in resource-constrained settings.

Identifying prognostic factors that are predictive of postoperative mortality and morbidity for patients in surgical units may help identify high-risk patients and tailor admission to critical care in a resource-constrained setting.[4]

Global data suggest a mortality rate of 0.5%-5% and a complication rate of 16% after surgery.[5] Interplay of various factors, such as patient factors, clinical parameters, and laboratory parameters, influence the postoperative outcomes.[6]

This operational study was conducted to identify various predictive factors for poor postoperative outcomes (morbidity and mortality) after elective surgery among patients admitted to the critical care of Cachar Cancer Hospital and Research Centre (CCHRC), Silchar (May 2022-April 2023), to enable judicious use of the critical care facility.

METHODS

Study Design

This cohort study involved secondary data.

Setting

General Setting

CCHRC is a tertiary care hospital located in Silchar in the state of Assam in Northeast India. The hospital serves an underserved and economically impoverished community of patients from the Barak Valley and other districts of Assam state, as well as the states of Tripura, Manipur, and Mizoram. At the institute, patients with cancer are treated. There were 5,405 new patients registered in 2021, of whom 2,347 (43.4%) were diagnosed with cancer.[7] Around 85% of these patients are the beneficiaries of various government schemes.

Specific Setting

On average, 400 elective surgical procedures are performed per year. Around 30-40 patients undergo elective surgeries each month, after which they are routinely admitted to the critical care unit for postoperative cloud-based remote monitoring. The hospital is a resource-constrained facility with 141-bed capacity and a critical care unit with 15-bed capacity. Cloud-based intensive care unit (ICU) is defined as a platform for coordinated patient management. The CCHRC team manages overall care, including surgery, long-term management, internal medicine, and medical oncology. The virtual team (Cloudphysician) provides augmented monitoring and critical care input, and maintains the patient medical data in the Cloudphysician database. The 15-bedded ICU at CCHRC is based on a centralized monitoring model involving a technical hub in Bengaluru, which involves real-time collection and delivery of continuous (24/7) clinical data streams, including vital signs, laboratory reports, scans, and ventilator management. The Cloudphysician team augments bedside monitoring with high-definition cameras (n = 4-5). The virtual nursing team collaborates with bedside nursing team to augment care. Data are processed by an intensivist-led team (n = 3-4, including doctors and nurses) at Cloudphysician who provide inputs on critical care.

As there is no separate surgical ICU or stepdown ICU, after elective surgeries, all patients are monitored in the critical care postoperatively. Due to the unavailability of a dedicated surgical or step-down ICU, postoperative monitoring for all the patients following elective surgeries is conducted in the critical care unit.

Patients are monitored in critical care according to their surgical risk, complexity of surgeries, comorbid illness, and Acute Physiology and Chronic Health Evaluation (APACHE-II) scoring.[8] Those patients with low risk are started on a diet after 6 hours and are discharged the next morning.

After major surgeries, patients are monitored for 48-72 hours and moved to the postoperative ward on the basis of the progress of their recovery and discharged on postoperative day 6 or 7.

Study Population

All patients admitted into the critical care (age ≥18 years) postoperatively after elective surgeries were included. All pediatric patients were excluded (age <18 years).

Data Variables and Sources of Data

The following variables were extracted in Excel format from the cloud physician electronic database: Postoperative parameters APACHE-II scoring, need for ionotropic/ventilatory support, readmission to the critical care within 48 hours, re-exploration, duration of stay in critical care, postoperative pneumonia, and need for higher antibiotics. Variables, such as sociodemographic parameters, namely patient name, MRN number (patient ID), age, sex, comorbid illness (diabetes mellitus, hypertension, ischemic heart disease, and chronic kidney disease), Eastern Cooperative Oncology Group (ECOG) score, behavioral factors (smoking, tobacco chewing, and alcoholism), preoperative clinical parameters, ECOG score, site of cancer, stage of cancer, intent of surgery (curative/palliative), CBC, liver function test, renal function test, and ECG, and intraoperative parameters, namely duration of surgery, surgeon experience, blood loss, and intraoperative complications, were collected from the health management system and entered into Epicollect.

Poor Postoperative Outcomes

Both morbidity and mortality were considered as poor postoperative outcomes.

Postoperative Morbidity

Any deviation from the normal course of recovery of the postoperative patient, which will increase the need for higher antibiotics (carbapenems, vancomycin, and tigecycline), ionotropic support, and prolong stay in critical care (beyond the expected duration as per preoperative counseling), prolonged ventilatory support, readmission to the critical within 48 hours, and re-exploration will be taken as postoperative morbidity.

Data Analysis

Data were extracted in Microsoft Excel format and analyzed using EpiData version 2.2.2.183 for analysis (EpiData Association, Odense, Denmark) and STATA (version 12.1, copyright 1985-2011 StataCorp LLC, College Station, TX, serial number: 30120504773). Descriptive analysis was performed in the form of proportions (for categorical variables such as sociodemographic factors, clinical factors, comorbidities, postoperative morbidities, deaths etc) wherever appropriate. Statistical differences between means of quantitative variables concerning sociodemographic factors and postoperative morbidities and deaths were calculated using the log-binomial regression. The associations between postoperative morbidity and mortality and clinical-sociodemographic risk factors were expressed as odds ratios (unadjusted with 95% CI). Adjusted risk ratios were obtained for variables with a crude P value of <.2 using log-binomial regression in Statistical Package for the Social Sciences version 17.0. $P < .05$ was considered statistically significant.

Ethics Issues

Ethics approval was obtained from Institutional Ethics Committee, CCHRC, Silchar, India on 13/04/2024 (File No.: CCHRC/IRB/04/2024). As the study involved a review of patient records (electronic secondary data), a waiver for informed consent was approved by the ethics committee.

RESULTS

Baseline Characteristics

The sociodemographic profile of patients is summarized in Table 1. A total of 421 patients were admitted with female preponderance (51.5%) and mean age of 58.02 years (standard deviation, 12.85).[9] Majority of the patients (53%) in our study were age 41-60 years, and 29% of our patients were older than 60 years. Of 421 patients, 370 (87.9%) consumed tobacco in some form and 65 (15.4%) consumed alcohol.

TABLE 1. Sociodemographic Parameters of Patients Admitted to Critical Care After Elective Cancer Surgery Between April 2022 to May 2023 in CCHRC, Silchar (N = 421)

Characteristic	No. (%)
Age, years	
≤40	77 (18.3)
41-60	223 (53)
>60	121 (28.7)
Sex	
Male	204 (48.5)
Female	217 (51.5)
Education	
Literate	260 (61.8)
Illiterate	161 (38.2)
Tobacco use	
Yes	370 (87.9)
No	51 (12.1)
Alcohol use	
Yes	65 (15.4)
No	317 (75.3)
Not recorded	39 (9.3)

Abbreviation: CCHRC, Cachar Cancer Hospital and Research Centre.

TABLE 2. Clinical Parameters of Patients Admitted to Critical Care After Elective Cancer Surgery Between April 2022 to May 2023 in CCHRC, Silchar (N = 421)

Characteristic	No. (%)
Preoperative parameters	
ECOG score	
0-1	392 (93.1)
2	23 (5.5)
3-4	6 (1.4)
Comorbid illness	
Hypertension	47 (11.2)
Diabetes mellitus	24 (5.7)
COPD	5 (1.2)
Others	54 (12.8)
None	290 (68.9)
Hemoglobin, g/dL	
≤10	173 (41.1)
>10	248 (58.9)
Albumin, g/dL	
≤3.5	100 (23.8)
>3.5	321 (76.2)
Creatinine, mg/dL	
≤1.2	397 (94.3)
>1.2	24 (5.7)
Site of cancer	
Head and neck	163 (38.7)
GI	86 (20.4)
Breast	82 (19.5)
Gyne-oncology	24 (5.7)
Others	66 (15.7)
Histology	
SCC	150 (35.6)
Adenocarcinoma	134 (31.8)
Others	137 (32.5)
Stage of cancer	
Nonmetastatic	399 (94.7)
Metastatic	22 (5.2)
Previous neoadjuvant treatment	
Yes	150 (35.6)
No	271 (64.4)
Intent of surgery	
Curative	397 (94.3)
Palliative	24 (5.7)
Intraoperative parameters	
Surgeon experience	
≤10 years	215 (51)
>10 years	206 (48)
Intraoperative blood loss	
Less than 100 mL	119 (28.3)
More than 100 mL	302 (71.7)
Postoperative parameters	
APACHE-II score	
≤15	400 (94.8)
>15	21 (5.2)
Need for higher antibiotics	
Yes	36 (8.5)
No	385 (91.4)
Need for ventilatory support	
Yes	18 (4.2)
No	403 (95.7)
Need for ionotropic support	
Yes	19 (4.5)
No	402 (95.4)
Anastomotic leak	
Yes	4 (0.95)
No	417 (99.0)
Need for re-exploration	
Yes	12 (2.8)
No	409 (97.1)
Postoperative pneumonia	
Yes	5 (1.1)
No	416 (98.8)
Duration of stay in critical care unit	
Expected duration	308 (73.2)
Prolonged duration	113 (26.8)
Readmission to critical care within 48 hours	
Yes	6 (1.4)
No	415 (98.5)
Paralytic ileus	
Yes	5 (1.1)
No	416 (98.8)

(continued in next column)

TABLE 2. Clinical Parameters of Patients Admitted to Critical Care After Elective Cancer Surgery Between April 2022 to May 2023 in CCHRC, Silchar (N = 421) (continued)

Abbreviations: APACHE-II, Acute Physiology and Chronic Health Evaluation; COPD, chronic obstructive pulmonary disease; ECOG, Eastern Cooperative Oncology Group; SCC, squamous cell carcinoma.

Patient Characteristics

Various clinical parameters (preoperative, intraoperative, and postoperative) of 421 patients are summarized in Table 2. Approximately 11% (47) of patients in our study were hypertensive. Hypoalbuminemia with an albumin level of <3.5 g per dl was seen in 100 patients (23.8%). Head and neck cancer (38.7%) was the most common primary site in patients presenting to our hospital, followed by GI cancer (20.4%) and breast cancer (19.5%). Of the 421 patients, 399 (94.7%) had nonmetastatic cancer and 22 (5.2%) had metastatic.

Our study included 215 (51%) patients operated on by surgeons with an experience of more than 10 years, and 206

(48%) patients were operated on by surgeons with an experience of <10 years.

Intraoperative and Postoperative Patient Characteristics

The APACHE-II score was >15 in 21 (5.2%) patients, 36 (8.5%) patients needed higher antibiotics, 18 (4.2%) patients required postoperative ventilatory support, and 19 (4.5%) patients required ionotropic support postoperatively. Intraoperative blood loss during the surgery was >100 mL in 302 (71.7%) patients. Approximately 113 (26.8%) patients in our study had a prolonged postoperative stay in the critical care unit, 13 (3.08%) patients died in the critical care postoperatively, 12 (2.8%) patients required re-exploration, six (1.4%) patients were readmitted to the critical care facility within 48 hours, five (1.1%) patients developed postoperative pneumonia, and four (1%) patients developed an anastomotic leak.

Postoperative Morbidity and Mortality

Figure one depicts the poor postoperative outcomes in patients admitted to the ICU. Of 421 patients admitted to the critical care unit, 134 (31.8%) patients had no postoperative morbidity and the remaining 287 (68.1%) had significant postoperative morbidity. Among patients with no postoperative morbidity, only one patient died due to postoperative hemorrhage, whereas 12 (4.1%) of 287 patients died in the patients with significant postoperative morbidity. Of the 287 patients with postoperative morbidity, 36 (12.5%) required higher antibiotics, 19 (4.5%) required ionotropic support, 18 (6.2%) required ventilatory support, 12 (4.1%) patients underwent re-exploration, five (1.7%) patients developed postoperative pneumonia, and four (1.3%) patients developed anastomotic leak. Figure 1 depicts the postoperative outcomes in patients admitted to critical care after elective surgery.

Predictors of Poor Postoperative Outcome

The predictors of poor postoperative outcomes among patients admitted to critical care after elective cancer surgery are summarized in Table 3. Various factors were analyzed to determine their association with poor postoperative outcomes. On univariate analysis, there was a significant association for age, sex, site of cancer, histology of cancer, APACHE-II score, surgeon experience, and blood loss. In those factors that had an association, adjusted risk ratios were obtained using multivariate analysis, and significant association was noted in APACHE-II score >15 (adjusted relative risk [RR], 4.5 with 95% CI, 1.48 to 14.01, $P = .008$), surgeon's experience (adjusted RR 1.7 with 95% CI, 1.06 to 2.94, $P = .029$), and blood loss (adjusted RR 2.42 with 95% CI, 1.43 to 4.10, $P = .001$).

DISCUSSION

Our research is the most extensive single-center study conducted in the northeastern region of India, and it offers valuable insights into the outcomes of critical care units as well as the diverse factors that influence those outcomes. In our study, one in three patients were elderly and the overall postoperative mortality rate was 3%. APACHE II score, intraoperative blood loss, and surgeon experience were strong predictors of unfavorable postoperative outcomes. The primary strength of our study is that it was conducted in a high-volume surgical oncology setting, which provided data on postoperative outcomes from the real world as our study involved record review involving secondary data, and all patients admitted to the ICU after elective surgery were included in the study population. The limitations of our study were missing data on the weight loss during neoadjuvant therapy, lack of record on the duration of smoking cessation before surgery, and the lack of generalizability, as it is based on real-world data from a resource-constrained setting, which may not reflect conditions in other contexts. The total fatality rate in our study was 3.1%, which is comparable with the 7.7% of global standard.[3] This finding may be the result of the high quality of care delivered in the surgical oncology unit and the presence of active hybrid ICU in the context of limited resources and competent intensive care team.

In our study, nine of 10 patients consumed tobacco and four of 10 were patients with head and neck cancer. This was higher than the rates reported in the literature. The Southeast Asian Region recorded the highest tobacco usage prevalence globally in 2020 at approximately 27.9%.

According to the Global Adult Tobacco Survey, 28.6% (266.8 million) of adults in India age 15 years and older now use tobacco in any form.

According to a systematic analysis,[10] the overall pooled prevalence estimate for the tobacco consumption reported was found to be 44.71% in the northeastern states.

The high incidence of head and neck cancer could be due to high rates of consumption of tobacco in the northeast region and the presence of a strong surgical oncology team with expertise in head-neck surgery. There might be a referral bias where most patients are offered surgery instead of chemoradiotherapy in situations where both have equivalent outcome.

Intraoperative blood loss was independently associated with poor postoperative outcomes,[7] which was also a significant observation in our study. Majority of the surgeries conducted were major surgeries with an average duration of 4-6 hours.

A high APACHE-II score was associated with higher chances of mortality in our patients. These findings are globally uniform and are used to predict the risk of mortality in patients admitted to critical care.[8]

Surgeon experience is a major determinant of good postoperative outcome.[11] Studies have revealed that patients

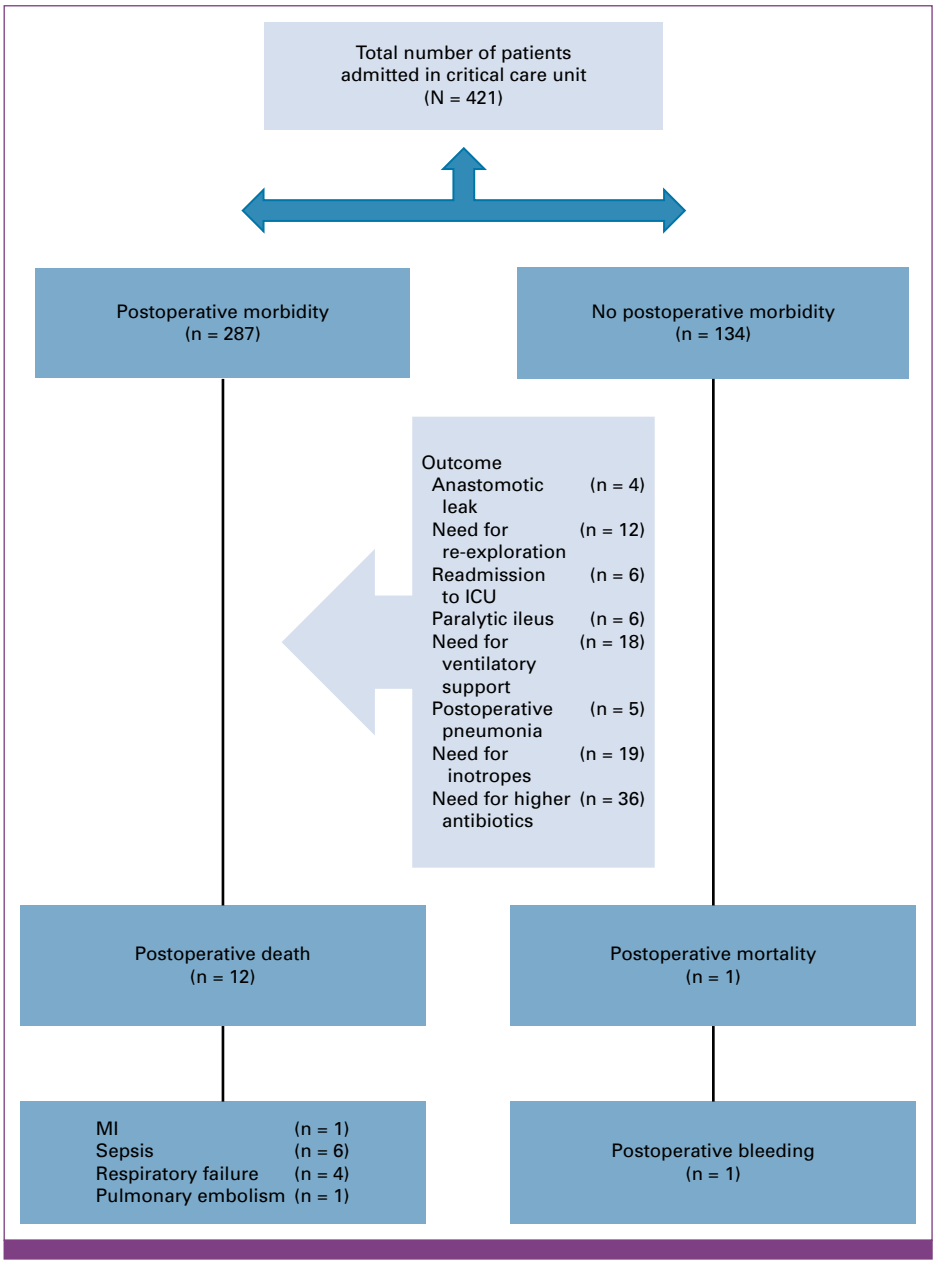

FIG 1. Flowchart depicting the postoperative outcome of patients among patients admitted to critical care after elective cancer surgery between April 2022 to May 2023 in CCHRC, Silchar (N = 421). Poor postoperative outcomes—morbidity and mortality. Postoperative morbidity—unplanned postoperative course. CCHRC, Cachar Cancer Hospital and Research Centre; ICU, intensive care unit; MI, myocardial infarction.

treated by the specialist surgeons had an overall 10-year survival benefit of 8%.[8]

In our study, we noticed significant association between preoperative albumin and postoperative recovery ($P = .000$), and we did not find any association between neoadjuvant chemotherapy and postoperative recovery ($P = .703$).

In conclusion, we recommend that all postoperative patients who had an APACHE score exceeding 15, intraoperative blood loss surpassing 100 mL, and are operated on by less experienced surgeons should be considered high risk. These patients should be given priority for critical care admission as they require intensive monitoring throughout the immediate postoperative period. Our findings necessitate validation in a comprehensive prospective study to confirm their accuracy. Additionally, we need to establish a prediction score using the findings of our study to categorize patients according to their risk for critical care admission.

TABLE 3. Predictors of Poor Postoperative Outcomes Among Patients Admitted to Critical Care After Elective Cancer Surgery Between April 2022 to May 2023 in CCHRC, Silchar (N = 421)

	Unadjusted			Adjusted		
Variables	RR	95% CI	*P*	RR	95% CI	*P*
Age group, years						
≤40		Reference				
41-60	2.038	1.03 to 4.00	.039	2.378	1.10 to 5.12	.027
>60	1.405	0.74 to 2.64	.0294	1.628	0.79 to 3.35	.186
Sex						
Male	1.63	1.08 to 2.46	.02	0.795	0.47 to 1.36	.401
Female		Reference				
Education						
Literate		Reference				
Illiterate	1.01	0.66 to 1.54	.95			
Tobacco use						
Yes	0.78	0.41 to 0.51	.47			
No		Reference				
Alcohol use						
Yes	1.14	0.64 to 2.01	.64			
No		Reference				
ECOG score						
0-1		Reference				
2	0.53	0.09 to 2.9	.45			
>2	0.53	0.08 to 3.27	.49			
Albumin, g/dL						
<3.5	0.41	0.26 to 0.66	.00	0.988	0.54 to 1.77	.968
>3.5		Reference				
Creatinine, mg/dL						
<1.2		Reference				
>1.2	1.14	0.46 to 2.82	.77			
Site of cancer						
Head and neck		Reference				
GIT	1.002	0.53 to 0.88	.99	0.897	0.35 to 2.24	.817
Breast	4.618	2.30 to 9.23	.00	3.55	1.63 to 7.73	3.55
Gynecologic	0.94	0.26 to 0.33	.00	0.100	0.026 to 0.380	.100
Others	1.484	0.55 to 3.96	.43	1.22	0.40 to 3.72	.716
Histology of cancer						
SCC		Reference				
Adenocarcinoma	2.009	1.16 to 3.47	.013	1.43	0.61 to 3.33	.401
Others	3.642	2.00 to 5.98	.00	1.73	0.84 to 3.43	.137
APACHE II score						
<15	7.948	2.75 to 22.92	.000	4.557	1.48 to 14.01	.008
>15		Reference			Reference	
Surgeon's experience						
<10 years	1.985	1.26 to 3.11	.003	1.767	1.06 to 2.94	.029
>10 years		Reference			Reference	
Blood loss						
>100	2.504	1.56 to 4.00	.000	2.424	1.43 to 4.10	.001
>100		Reference			Reference	

Abbreviations: APACHE-II, Acute Physiology and Chronic Health Evaluation; GIT, gastrointestinal tract; RR, relative risk; SCC, squamous cell carcinoma.

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AUTHORS' DISCLOSURES OF POTENTIAL CONFLICTS OF INTEREST

The following represents disclosure information provided by authors of this manuscript. All relationships are considered compensated unless otherwise noted. Relationships are self-held unless noted. I = Immediate Family Member, Inst = My Institution. Relationships may not relate to the subject matter of this manuscript. For more information about ASCO's conflict of interest policy, please refer to www.asco.org/rwc or ascopubs.org/go/authors/author-center.
Open Payments is a public database containing information reported by companies about payments made to US-licensed physicians (Open Payments).

No potential conflicts of interest were reported.

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