ORIGINAL RESEARCH

Postoperative Outcomes Following Elective Surgery in India

Vandana Agarwal[1], Radhakrishnan Muthuchellappan[2], Bhagyesh A Shah[3], Pallavi P Rane[4], Atul P Kulkarni[5], International Surgical Outcomes Study (ISOS) Collaborators for India

Abstract

Introduction: The incidence of complications and mortality in patients undergoing elective surgery in India are unknown. We contributed Indian data to ISOS. Since there were fewer than ten centers, Indian data were not included in the primary analysis. We report postoperative outcomes in the Indian data set of patients following elective surgery.

Materials and methods: In this prospective 7-day observational study, after obtaining a waiver of informed consent, data were collected for 30 days from consecutive patients >18 years undergoing elective surgery. The primary outcome was in-hospital postoperative complications. The secondary outcomes were in-hospital all-cause mortality, the relationship between postoperative complications and admission to critical care, and the duration of hospital stay. Complications were graded as mild, moderate, and severe. Failure to rescue was defined as mortality in patients admitted to an intensive care unit (ICU) for the treatment of complications.

Results: Complications occurred in 57 (27.5%) patients, who were older (53 vs 47 years, $p < 0.001$) and had American Society of Anaesthesiologists grades III and IV physical status ($p = 0.029$). One hundred and thirty-eight (65.7%) patients underwent a major surgical procedure of which 132 (62.8%) procedures were done for malignancy. Postoperative complications were significantly higher (41.5% vs 22.7%) in patients electively admitted to ICU. The overall mortality rate was 2.4%, whereas the mortality rate was 8.8% in those who developed complications.

Conclusion: We found that 28% of patients developed postoperative complications. The overall mortality was 2.4% but was higher (8.8%) in those who developed complications. Age and complex surgical procedures independently predicted complications, while lower preoperative hemoglobin appeared to be protective.

Study Registration: ISRCTN51817007

Keywords: American Society of Anaesthesiologists physical status, Elective surgery, Failure to rescue, International Surgical Outcomes Study, Indian dataset of ISOS study, Postoperative mortality, Postoperative complications, Postoperative outcomes.

Indian Journal of Critical Care Medicine (2021): 10.5005/jp-journals-10071-23807

Introduction

More than 97% of the population in South Asia have no access to health care.[1] In a spatial analytic study, Dare et al. attempted to quantify age-standardized deaths from surgical conditions from 1.1 million representative households in India. They found in most cases mortality occurred at home (71%) and in the rural area (87%).[2] If one lived more than 50 km from a well-resourced hospital, the odds of being included in the high mortality cluster were very high [odds ratio (OR) = 4.4, 99% confidence interval (CI) = 3.2–6.0]. This is true for many low-income countries across the world. The vision of a Lancet Commission on global surgery is universal access when needed to affordable, safe, surgical treatment, and anesthesia care. Initial steps have been taken in some of these countries, including India (https://www.lancetglobalsurgery.org/india). Consequently, this will lead to an increased number of surgical procedures and their complications, need for intensive care, costs, and impact on quality of life. European Surgical Outcomes Study (EuSOS), an international epidemiological European study, assessed the outcomes after noncardiac surgery, which found a higher than anticipated overall crude mortality rate of 4%. However, EuSOS did not study postoperative complications and the length of stay (LOS).[3] International Surgical Outcomes Study (ISOS) was designed to evaluate the global incidence of complications, associated risk factors, and mortality following elective inpatient surgery.[4] Since there were fewer than ten participating centers from India, Indian data was not incorporated in the primary analysis. Currently, there is no literature on clinical outcomes following elective surgery in India. We present unpublished Indian data as a comparative analysis of characteristics and postoperative outcomes in patients who developed and did not develop complications, and patients who were and were not electively admitted to ICU after surgery.

[1,5]Department of Anaesthesia, Critical Care and Pain, Tata Memorial Centre, Homi Bhabha National Institute, Mumbai, Maharashtra, India

[2]Department of Neuroanaesthesia and Neurocritical Care, National Institute of Mental Health and Neurosciences (NIMHANS), Bengaluru, Karnataka, India

[3]Department of Intensive Care Medicine, CIMS Hospital, Care Institute of Medical Sciences, Ahmedabad, Gujarat, India

[4]Clinical Research Secretariat, Tata Memorial Centre, Advanced Centre for Treatment, Research and Education in Cancer (ACTREC), Navi Mumbai, Maharashtra, India

Corresponding Author: Atul P Kulkarni, Division of Critical Care Medicine, Department of Anaesthesia, Critical Care and Pain, Tata Memorial Hospital, Homi Bhabha National Institute, Mumbai, Maharashtra, India, Phone: +91 9869077526, e-mail: kaivalyaak@yahoo.co.in

How to cite this article: Agarwal V, Muthuchellappan R, Shah BA, Rane PP, Kulkarni AP, et al. Postoperative Outcomes Following Elective Surgery in India. Indian J Crit Care Med 2021;25(5):528–534.

Source of support: International Surgical Outcomes Study (ISOS) was funded by an unrestricted research grant from Nestlé Health Science SA. The funder had no role in study design, conduct, data collection, data analysis, reporting, or interpretation of the results.

Conflict of interest: None

© Jaypee Brothers Medical Publishers. 2021 Open Access This article is distributed under the terms of the Creative Commons Attribution 4.0 International License (https://creativecommons.org/licenses/by-nc/4.0/), which permits unrestricted use, distribution, and non-commercial reproduction in any medium, provided you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made. The Creative Commons Public Domain Dedication waiver (http://creativecommons.org/publicdomain/zero/1.0/) applies to the data made available in this article, unless otherwise stated.

Materials and Methods

This was a 7-day observational cohort study of complications following elective in-patient surgery. Institutional Ethics Committees of all participating centers approved the study with a waiver of informed consent. All adult patients aged ≥18 years undergoing elective surgery during the 7-day study period, with a planned overnight stay, were included. Patients undergoing emergency surgery, planned day-case surgery, or radiological procedures were excluded. The individual centers chose a 7-day period between April and June 2014 for data collection. Patients were followed up until 30 days after surgery. The primary outcome measure was in-hospital postoperative complications from any cause (censored at 30 days). Secondary outcomes were in-hospital all-cause mortality, relationship between intensive care admission and postoperative complications, and the duration of primary hospital stay. Baseline demographics, American Society of Anaesthesiologists (ASA) grade, comorbidities, preoperative laboratory parameters, the severity of the surgical procedure, type of surgery, use of surgical checklist, elective ICU admission, postoperative complications, and mortality data were collected for all patients. ICU was defined as a facility capable of admitting patients requiring invasive ventilation overnight. Failure to rescue was defined as mortality in patients admitted to ICU for the treatment of complications. Complications were graded as mild, moderate, and severe according to predefined criteria. For definitions of postoperative complications and grades, refer to supplementary material.

Statistics

Continuous variables are described as mean and standard deviation (if normally distributed) or median and interquartile range (if not normally distributed) and are compared using an independent t-test or Mann–Whitney U test as applicable. Categorical variables are described as proportions and compared using chi-square or Fisher's exact test. Univariate logistic regression analysis was performed for all variables to identify the factors associated with postoperative complications and in patients electively admitted to ICU versus those who were not. Factors entered into the models were based on their univariate relation to postoperative complications ($p < 0.2$) and biological plausibility. Multivariable logistic regression analysis was performed by backward stepwise selection of variables to identify factors independently associated with postoperative complications and to adjust for differences in confounding factors. Results of logistic regression are reported as adjusted OR with 95% CIs. P value of <0.05 was considered statistically significant. IBM® SPSS® Statistics version 20 was used for statistical analysis.

Results

Three Indian centers participated and collected the data, recruiting 209 patients. Results are reported for 207 patients, and two patients were excluded from analysis because of missing data. To evaluate the characteristics of postoperative complications and the relationship between elective ICU admission and postoperative complications, results are described between patients with and without complications and between patients who were electively admitted and not to ICU immediately after surgery, respectively. Centers 1, 2, and 3 recruited 116 (56%), 53 (25.6%), and 38 (18.4%) patients, respectively. Complications occurred in 57 (27.5%) patients (Table 1). The median age of the patients was 49 (18–80) years. Patients who developed complications were significantly older (53 vs 47 years, $p < 0.001$) and had ASA Grade III and IV physical status ($p = 0.029$). There was no difference in the gender, comorbidities, and proportion of smokers between patients who developed and did not develop complications. Patients with complications had significantly higher hemoglobin level. Other preoperative laboratory parameters were similar. Major surgical procedure was performed in 138 (65.7%) patients. Head and neck surgery was performed in 68 (31.9%) patients. Centre 1 contributed majority of the cancer patient's 110/116 (94.8%), center 2 contributed all the cardiac surgery patients 21/53 (39.6%), and center 3 contributed head and neck 27/38 (71%) and orthopedic cases. Complications were more common in patients who had undergone head and neck, gastrointestinal, urological, and thoracic surgeries. Sixty-three percent of patients ($n = 132$) underwent cancer surgery. Overall compliance with the surgical checklist was 80.7%. There was no association between checklist compliance and morbidity and mortality (2.4% vs 2.5%, $p = 1.000$). Patients electively admitted to ICU had significantly higher compliance with the checklist. There was no difference in anesthesia technique between the groups.

Twenty-five percent of patients were electively admitted to ICU postoperatively. They were significantly older, with ASA grade III and IV physical status, and underwent major surgical procedures for cardiac, abdominal, and cancer conditions (Table 1).

Postoperative Outcomes

Complications occurred in 57 (27.5%) patients. There was no difference in the time spent in the postanesthesia care unit (PACU) between patients with and without complications. Infectious complications occurred in 19.8% of patients, of these 9.7% patients had superficial surgical site infection and 5% developed pneumonia. Ten (4.8%) patients developed cardiovascular complications such as myocardial infarction, arrhythmias, pulmonary edema, pulmonary embolism, and cardiac arrest. Three patients developed neurological complications. Acute kidney injury (AKI) occurred in 8 (3.9%) patients and was associated with significantly high mortality (50% vs 0.5%, $p < 0.001$). Patients with complications needed blood transfusion and/or drug therapy (47.4%) and surgical or radiological interventional (28%) procedures (Tables 2, 3).

Overall 18 patients (31.6%) required ICU admission for the treatment of complications (Table 3). The overall mortality rate was 2.4% and 8.8% in those with complications (failure to rescue). One of the centers had a protocol of caring for postoperative cardiothoracic patients in the ICU for 48 to 72 hours, and another center cared for neurosurgery patients in the ICU until a bed was available in the ward. Consequently, these patients were cared for in the ICU despite not developing complications. Postoperative complications were associated with significantly increased ICU and postoperative LOS.

Postoperatively 53 patients (25.6%) were electively admitted to ICU. Patients who were not electively admitted to ICU after surgery spent significantly more time in PACU (Table 3). Postoperative complications were significantly higher (41.5% vs 22.7%) in patients electively admitted to ICU. There was a trend toward increased cardiovascular (9.4% vs 3.2%, $p = 0.07$) and infectious (28.3% vs 16.9%, $p = 0.072$) complications in these patients (Table 3). They required significantly more blood transfusions, drug therapy, and interventional procedures and developed AKI (9.4% vs 1.9%). There was no difference in mortality between the elective admission groups. Patients who were electively admitted to ICU had significantly longer ICU and postoperative hospital stay. There

Table 1: Baseline demographics and characteristics of patients with and without complications and patients electively admitted or not to ICU after surgery

Variables	*All patients N = 207 (%)*	*No complications N = 150 (%)*	*Complications N = 57 (%)*	*P value*	*Elective ICU—no N = 154 (%)*	*Elective ICU—yes N = 53(%)*	*P value*
Age (years)*	49 (18–80)	47 (18–73)	52 (25–80)	0.029	45.5 (18–76)	55 (19–80)	0.001
Male, *N* (%)	119 (57.5)	86 (57.3)	33 (57.9)	0.942	81 (52.6)	38 (71.7)	0.015
Female, *N* (%)	88 (42.5)	64 (42.7)	24 (42.1)		73 (47.4)	15 (28.3)	
Smoker, *N* (%)	14 (6.8)	10 (6.7)	4 (7)	0.928	9 (5.8)	5 (9.4)	0.369
ASA grade, *N* (%)							
I	91 (44)	72 (48)	19 (33)	0.029	82 (53.2)	9 (17)	<0.001
II	91 (44)	64 (42.7)	27 (47.4)		67 (43.5)	24 (45.3)	
III	23 (11)	14 (9.3)	9 (15.8)		5 (3.2)	18 (34)	
IV	2 (1)	–	2 (3.5)		–	2 (3.8)	
Comorbid diseases, *n* (%)							
Ischemic heart disease	27 (13)	21 (14)	6 (10.5)	0.507	5 (3.2)	22 (41.5)	<0.001
Heart failure	4 (1.9)	3 (2)	1 (1.8)	1.000	1 (0.6)	3 (5.7)	0.052
Diabetes mellitus	40 (19.3)	27 (18)	13 (22.8)	0.434	23 (14.9)	17 (32.1)	0.006
Metastatic cancer	5 (2.4)	3 (2)	2 (3.5)	0.617	2 (1.3)	3 (5.7)	0.107
Stroke	1 (0.5)	1 (0.7)	–	1.000	–	1 (1.9)	0.256
COPD/asthma	6 (2.9)	5 (3.3)	1 (1.8)	1.000	4 (2.6)	2 (3.8)	0.647
Other	59 (28.2)	38 (25.3)	21 (36.8)	0.101	38 (24.7)	21 (39.6)	0.038
Laboratory parameters, median (range)							
Hb (g %)*	12.3 (7–16.4)	11 (7–16.4)	11.7 (8–15.6)	0.002	12.3 (7.2–16.4)	12.3 (7–16)	0.831
White cell count (10^9/L)*	8 (2.5– 27)	8 (2.5–23.4)	8.4 (2.5–27)	0.354	7.9 (2.5–24)	8.9 (2.5–27)	0.033
Sodium (mEq/L)*	137 (121–154)	137 (125–144)	138 (121–154)	0.300	138 (128–144)	137 (121–154)	0.799
Creatinine (mg/dL)*	0.9 (0.4–5.2)	0.8 (0.4–5.2)	0.9 (0.4–3.6)	0.101	0.89 (0.4–5.2)	0.9 (0.4–3.6)	0.098
Severity of surgery, *N* (%)							
Minor	18 (8.7)	15 (10)	3 (5.3)	0.098	16 (10.4)	2 (3.8)	0.003
Intermediate	53 (25.6)	43 (28.7)	10 (17.5)		47 (30.5)	6 (11.3)	
Major	138 (65.7)	92 (61.3)	44 (77.2)		91 (59.1)	45 (84.9)	
Surgical procedures, *N* (%)							
Orthopedic	24 (11.6)	22 (14.7)	2 (3.5)	0.008	22 (14.3)	2 (3.8)	<0.001
Breast	23 (11.1)	18 (12)	5 (8.8)		22 (14.3)	1 (1.9)	
Obstetrics and gynecology	12 (5.8)	9 (6)	3 (5.3)		10 (6.5)	2 (3.8)	
Urology and kidney	21 (10.1)	15 (10)	6 (10.5)		15 (9.7)	6 (11.3)	
Gastrointestinal	13 (6.3)	5 (3.3)	8 (14)		7 (4.5)	6 (11.3)	
Hepatobiliary	9 (4.3)	6 (4)	3 (5.3)		4 (2.6)	5 (9.4)	
Vascular	2 (1)	2 (1.3)	–		1 (0.6)	1 (1.9)	
Head and neck	68 (31.9)	50 (33.3)	16 (28.1)		61 (39.6)	5 (9.4)	
Plastics and cutaneous	6 (2.9)	3 (2)	3 (5.3)		5 (3.2)	1 (1.9)	
Cardiac	21 (10.1)	17 (11.3)	4 (7)		–	21 (39.6)	
Thoracic	8 (3.9)	2 (1.3)	6 (10.5)		6 (3.9)	2 (3.8)	
Other	2 (1)	1 (0.7)	1 (1.8)		1 (0.6)	1 (1.9)	
Other details, *N* (%)							
Laparoscopic surgery	7 (3.4)	3 (2)	4 (7)	0.093	5 (3.2)	2 (3.8)	1.000
Cancer surgery	132 (62.8)	91 (60.7)	39 (68.4)	0.302	112 (72.7)	18 (34)	<0.001
Surgical check list	167 (80.7)	117 (78)	50 (87.7)	0.114	116 (75.3)	51 (96.2)	<0.001
Anesthesia, *N* (%)							
General	204 (98.6)	147 (98)	57 (100)	0.282	151 (98.1)	53 (100)	0.306
Spinal	2 (1)	2 (1.3)	–	1.000	2 (1.3)	–	1.000
Epidural	23 (11.1)	14 (9.3)	9 (15.8)	0.187	13 (8.4)	10 (18.9)	0.037
Sedation/local	1 (0.5)	1 (0.7)	–	1.000	1 (0.6)	–	1.000

* Values are expressed as median (range); elective ICU—no: patients not admitted electively postoperatively in ICU; elective ICU—yes: patients admitted electively postoperatively in ICU; N: number of patients

Table 2: Type and severity of postoperative complications (*N* = *57*)

Variables	*All patients N = 207 (%)*	*Mild N (%)*	*Moderate N (%)*	*Severe N (%)*
Infectious complications: 41 (19.8%)				
Superficial surgical site	18 (9.7)	11 (5.3)	3 (1.4)	4 (1.9)
Deep surgical site	9 (4.4)	6 (2.9)	2 (1)	1 (0.5)
Body cavity	4 (1.9)	1 (0.5)	2 (1)	1 (0.5)
Pneumonia	11 (5.3)	–	6 (2.9)	5 (2.4)
Urinary tract	6 (2.9)	2 (1)	3 (1.4)	1 (0.5)
Bloodstream	6 (2.9)	1 (0.5)	3 (1.4)	2 (1)
Cardiovascular complications: 10 (4.8%)				
Myocardial infarction	2 (1)	1 (0.5)	1 (0.5)	–
Arrhythmia	1 (0.5)	–	–	1 (0.5)
Pulmonary edema	1 (0.5)	1 (0.5)	–	–
Pulmonary embolism	1 (0.5)	–	1 (0.5)	–
Stroke	3 (1.5)	1 (0.5)	2 (1)	–
Cardiac arrest	5 (2.4)	–	–	5 (2.4)
Other complications: 31 (14.9%)				
AKI	8 (3.9)	1 (0.5)	4 (1.9)	3 (1.4)
Postoperative bleed	6 (2.9)	–	6 (2.9)	–
ARDS	1 (0.5)	–	–	1 (0.5)
Anastomotic leak	1 (0.5)	–	–	1 (0.5)
All others	15 (7.2)	9 (4.3)	6(2.9)	

All data expressed as *n* (%) number (%); ARDS, acute respiratory distress syndrome

Table 3: Postoperative outcomes in patients with and without complications and patients electively admitted or not to ICU after surgery

Variables	*All patients N = 207*	*No complications N = 150 (%)*	*Complications N = 57 (%)*	*P value*	*Elective ICU—no N = 154 (%)*	*Elective ICU—yes N = 53(%)*	*P value*
Elective ICU admission	53 (25.6)	31 (20.7)	22 (38.6)	0.008	–	53 (100)	
Postoperative time in PACU (hours)	2 (0–36)	2 (0–35)	2 (0–36)	0.679	2 (0–36)	0 (0–35)	<0.001
Complications yes	57 (27.5)	–	57 (100)		35 (22.7)	22 (41.5)	0.008
ICU admission for complications	18 (8.7)	–	18 (31.6)	<0.001	5 (3.2)	13 (24.5)	<0.001
CVS complications	10 (4.8)	–	10 (17.5)	<0.001	5 (3.2)	5 (9.4)	0.070
Postoperative AKI	8 (3.9)	–	8 (14)	<0.001	3 (1.9)	5 (9.4)	0.028
Infectious complications	41 (19.8)	–	41 (71.9)	<0.001	26 (16.9)	15 (28.3)	0.072
Blood transfusion/drug therapy	27 (13)	–	27 (47.4)	<0.001	9 (5.8)	18 (34)	<0.001
Interventional procedures (surgery/radiology)	16 (7.7)	–	16 (28.1)	<0.001	8 (5.2)	8 (15.1)	0.020
Mortality	5 (2.4)	–	5 (8.8)	<0.001	4 (2.6)	1 (1.9)	1.000
ICU LOS days, median (range)	0 (0–30)	0 (1–19)	6 (1–30)	<0.001	0 (0–7)	4 (0–30)	<0.001
Hospital LOS days, median (range)	5 (1–30)	4 (1–30)	9 (1–30)	<0.001	4 (1–28)	7 (1–30)	<0.001

Elective ICU—no: patients not admitted electively postoperatively in ICU; elective ICU—yes and elective ICU admission: patients admitted electively in ICU immediately after surgery; N: number of patients; PACU, postoperative anesthesia care unit; AKI, acute kidney injury; CVS, cardiovascular; LOS, length of stay (postoperative)

was no significant difference in failure to rescue rate between the patient groups after elective admission to ICU.

Age, preoperative hemoglobin level, and major surgical procedure were identified as independent predictors for postoperative complications on multivariate analysis (Table 4). The risk of complication increased by 3% for every 1-year increase in age. The odds of developing complications increased by 2.5 times following major surgery, whereas lower hemoglobin appears protective.

Table 4: Independent predictors of postoperative complications on multivariate analysis

Variables in equation	*Odds ratio*	*95% CI*	*P value*
Age	1.031	1.006–1.058	0.016
Preoperative hemoglobin	0.722	0.617–0.846	<0.001
ASA grades III and IV	2.366	0.892–6.279	0.084
Severity of surgery: major	2.525	1.166–5.469	0.019

Reference group in multivariate analysis for ASA grades and severity of surgery were I/II and minor/intermediate grade, respectively

Discussion

This prospective cohort subset of international study has given us insights into patient characteristics, morbidity, and mortality following elective surgery in India. The observed complication and mortality rate following surgery in the Indian subset were 27.5% and 2.4%, respectively. This is considerably higher, compared to 19.8% and 0.5% in high-income countries (HICs) and 11% and 0.4% in low- and middle-income countries (LMICs), respectively.[4] African Surgical Outcomes Study (ASOS) included data from 25 African countries undergoing all surgical procedures. They observed 13.4% complication and 1% mortality rate after elective surgery. However, surgical patients in ASOS were younger and had lower ASA grade.[5] Therefore, LMICs and ASOS data should be interpreted with caution, as their patients were younger and healthier (ASA grade I and II). Hackett et al. evaluated the ability of ASA physical status to predict the postoperative complications and mortality in over 22 million patients in the American College of Surgeons ACS National Surgical Quality Improvement Program (ACS-NSQIP) in the 2012 database. They found that ASA physical status was a strong and independent predictive metric for predicting postoperative morbidity and mortality, across all types of surgeries. As the ASA physical status increased, so did the morbidity and mortality.[6]

The overall mortality in LMICs is similar to HICs despite low-risk patients, suggesting scarcity of resources in caring for the sick low-risk patients after developing complications. South African Surgical Outcomes Study (SASOS) replicated the EuSOS study and observed a crude mortality rate of 3.1% and included elective, urgent, and emergency procedures.[7] Failure to rescue the patients after the development of complications in the Indian subset was 8.8%, which is considerably higher compared to 2.6%, 3.3%, and 4.8% in observed HICs, LMICs, and African nations, respectively.[4,8] Failure to rescue is a well-accepted measure of postoperative quality of care.[8] However, it should be interpreted with caution, especially when comparing data from different nations with varied health-care systems and case mix. Apart from a higher proportion of ASA grade III and IV patients, the Indian data set had a higher number ($n = 132$, 62.8% vs 20.3%) of cancer patients.[4] Leeds et al. analyzed the 2005–2015 NSQIP data set of a gastrointestinal data set for the outcomes of patients undergoing surgeries for malignant versus benign lesions. They found that there was an increased likelihood of 30-day mortality (OR = 1.18, 95% CI = 1.10–1.28), complication rate (OR = 1.09, 95% CI = 1.07–1.11), and the total number of complications (OR = 1.08, 95% CI = 1.06–1.11) in patients undergoing surgery for cancer compared to benign lesions.[9] More patients in the Indian subset underwent major surgical procedures (65.7% vs 36%), and this may have been an additional factor associated with increased complication rate. Indian patients with complications were older, with ASA grade III and IV physical status, and underwent major surgeries, which are known risk factors for postoperative complications. SASOS found age, ASA grade ≥II, major surgery, and infective etiology as an independent predictor of mortality.[7] Another difference observed was a lower proportion of smokers in the Indian subset (6.8% vs 17.8%) compared to global data.[4]

In the Indian subset, 25% of patients were electively admitted to ICU postoperatively, compared to the 11.4%, 6.9%, and 7.8% observed in HICs, LMICs, and African nations, respectively.[4,5] The higher rate observed in this subset may have been secondary to surgical unit protocols of caring for postoperatively in the ICU for 48 to 72 hours and/or until the availability of ward beds. Despite a higher rate of complications, 8.7% of patients were admitted to ICU for the treatment of complications compared to 3.2%, 2%, and 13.8% in HICs, LMICs, and African nations, respectively.[4,5]

Kahan et al. evaluated the ISOS data to study the impact of elective ICU admission on postoperative outcomes of patient, hospital, and national income levels. After adjusting for known confounders and exclusion of missing relevant data, they observed the rate of admission to ICU after complications increased to 15% and 17%, respectively, in both HICs and LMICs compared to that reported in the initial analysis.[4,10] The observed mortality was higher in patients admitted to ICU compared to those managed on the wards (2% vs 0.3%). They attribute this difference to some residual confounders. At the hospital level, they found no association between mortality and elective ICU admission, ICU admission to treat complications. They report no survival benefit of elective postoperative admission to ICU.[10] On the contrary, in the Indian subset, patients who were electively admitted to ICU were significantly older, a greater proportion had ASA grade III and IV physical status, underwent major surgery, and a higher proportion underwent cardiac and abdominal surgery. We observed that significantly more patients with elective admission developed complications (41.5% vs 22.7%). However, mortality in patients who developed complications was higher in patients who were not electively admitted to ICU [4/35 (11.4%) vs 1/22 (4.5%)]. Overall, there was no difference in mortality between the elective admission groups (2.6% vs 1.9%). The above results seem to justify the decision for elective postoperative admission of these patients to ICU. Conversely, intensive care beds are precious and limited resource in any hospital. Judicious use of this resource can help in lowering the failure to rescue rate. One aspect in the Indian context is the scarcity of trained nurses on the wards to care for these complex patients and therefore the need for establishment of protocols for elective postoperative ICU admission for 48–72 hours or longer based on surgical preference. Higher failure to rescue rate in the Indian subset may have been due to the patient and surgical factors and a possibility of nonavailability of critical care beds for critically ill patients, due to surgical protocols of caring for elective patients postoperatively irrespective of their risk stratification.

Abbott et al. reported the use of surgical checklist in 89.8% of patients in the ISOS data set. They found that exposure to surgical checklist was favorably associated with reduced mortality, but no difference in complications.[11] In the Indian subset, surgical checklist compliance was 80.7%. Similar to Abbott et al., there was no significant difference in complications despite increased compliance with surgical checklist in patients who developed complications.[11] In contrast to Abbott et al., we did not find any association between surgical checklist compliance and mortality.[11] These differences may have occurred due to patient characteristics such as older age, ASA grade II and IV, and major surgical procedures performed in our patients. The infection rate in our data set was more than twice the global rate (19.8% vs 8.9%), suggesting considerable scope for improvement and need for strengthening perioperative infection control measures. Chaudery et al. analyzed global ISOS data and reported 2% incidence of AKI in all patients and 4% following major surgery. We observed postoperative AKI was twice the global rate (3.9% vs 2%) for all patients and following major surgery (8.8% vs 4%).[12] This difference may have been due to older patients, with ASA grade III and IV, and different surgical case mix in the Indian subset compared to the global ISOS population. Similarly, we observed significantly higher mortality in patients who developed AKI. Cardiovascular complications were similar to the global rate (4.8% vs 4.5%).[4] We identified preoperative hemoglobin as one of the independent predictors of complications, i.e., low hemoglobin was associated with a better outcome. We believe this to be a chance finding.

Based on the current study, one in three patients is likely to develop complications after elective surgery, and one in 11 patients is likely to die if they develop complications. These results are dismal compared to global data where one in six patients is likely to develop complications after elective surgery, and one in 35 patients is likely to die if they develop complications.[4] Comparing data with other countries can help in setting benchmarks; however, various confounding factors such as case mix, ethnicity, differences in health-care systems, genetic predisposition, disease patterns, and access to health care should be taken into consideration. Surgery is a global health priority as per Lancet's global surgery initiative (https://www.lancetglobalsurgery.org/india). Involvement of international organizations with national policymakers is likely to increase the surgical volumes in India. It is essential that future research should be directed in studying nationwide postoperative morbidity and mortality rates following elective surgery to establish a baseline and set benchmarks for improving outcomes and quality of care delivered.

There are certain limitations in the present study. Firstly, only three centers participated in this study, as a consequence Indian data was not analyzed for the primary outcome in the original study. Three centers cannot be considered to be representative of a nation like India with very diverse healthcare programs at the state level, availability of necessary facilities, skills and expertise, and access to health care in both government-funded and private hospitals. Nevertheless, it does give us some insights into patient characteristics and outcomes. Secondly, the data set collected limits our understanding of various other confounding factors within each hospital, type of institution (public or private), funded, or otherwise. Since much of healthcare expenditure is borne by the patients, there is a possibility that this can be an additional confounding factor for increased complications observed.

Conclusion

Based on the current study, one in three patients is likely to develop complications after elective surgery, and one in 11 patients is likely to die if they develop complications. These patients were older, had higher ASA grade (III and IV), and underwent complex surgical procedures. Future research should be directed toward creating at least a minimum national data for various surgical procedures and outcomes not only to establish national baseline and benchmarks but also more importantly to improve the quality of care delivered.

International Surgical Outcomes Study (ISOS) Collaborators from India

Tata Memorial Hospital, Mumbai, Maharashtra, India.

1. Atul Prabhakar Kulkarni
2. Vandana Agarwal
3. JV Divatia
4. Sukhada Savarkar
5. Martin Thomas
6. Ganesh Nimje
7. Swati Pande
8. Aditi Shrivastava
9. Shashikant Yegnaram
10. Anjana Shrivastava

National Institute of Mental Health and Neurosciences (NIMHANS), Bengaluru, Karnataka, India

1. Radhakrishnan Muthuchellappan
2. Prabhuraj AR

Care Institute of Medical Sciences, Ahmedabad , Gujarat, India

1. Bhagyesh Shah
2. Shuchi Kaushik
3. Dhiren Shah
4. Sanjay Shah

Orcid

Vandana Agarwal https://orcid.org/0000-0002-3593-0414
Radhakrishnan Muthuchellappan https://orcid.org/0000-0002-1123-1379
Bhagyesh A Shah https://orcid.org/0000-0002-9120-2876
Pallavi P Rane https://orcid.org/0000-0002-9120-2876
Atul P Kulkarni https://orcid.org/0000-0002-5172-7619
JV Divatia https://orcid.org/0000-0001-7384-4886
Ganesh Nimje https://orcid.org/0000-0001-5034-6681
Swati Pande https://orcid.org/0000-0002-6075-0298
Sukhada Savarkar https://orcid.org/0000-0002-0282-0841
Aditi Shrivastava https://orcid.org/0000-0002-0863-0387
Martin Thomas https://orcid.org/0000-0002-3533-2860
Shashikant Yegnaram https://orcid.org/0000-0002-9974-7256
Prabhu Raj https://orcid.org/0000-0002-5986-1521
Shuchi Kaushik https://orcid.org/0000-0002-8525-7520
Dhiren Shah https://orcid.org/0000-0003-0333-6717
Sanjay Shah https://orcid.org/0000-0003-1876-6058
Anjana Shrivastava https://orcid.org/0000-0002-5984-1790

Acknowledgment

Rupert M. Pearse, Professor of Intensive Care Medicine, Queen Mary University of London, UK EC1M 6BQ.

References

1. Alkire BC, Raykar NP, Shrime MG, Weiser TG, Bickler SW, Rose JA, et al. Global access to surgical care: a modelling study. Lancet Glob Health 2015;3(6):e316–e323. DOI: 10.1016/S2214-109X(15)70115-4.
2. Dare AJ, Ng-Kamstra JS, Patra J, Fu SH, Rodriguez PS, Hsiao M, et al. Deaths from acute abdominal conditions and geographical access to surgical care in India: a nationally representative spatial analysis. Lancet Glob Health 2015;3(10):e646–e653. DOI: 10.1016/S2214-109X(15)00079-0.

3. Pearse RM, Moreno RP, Bauer P, Pelosi P, Metnitz P, Spies C, et al. Mortality after surgery in Europe: a 7 day cohort study. Lancet 2012;380(9847):1059–1065. DOI: 10.1016/S0140-6736(12)61148-9.
4. International Surgical Outcomes Study Group. Global patient outcomes after elective surgery: prospective cohort study in 27 low-, middle- and high-income countries. Br J Anaesth 2016;117(5):601–609. DOI: 10.1093/bja/aew316.
5. Biccard BM, Madiba TE, Kluyts H-L, Munlemvo DM, Madzimbamuto FD, Basenero A, et al. Perioperative patient outcomes in the African Surgical Outcomes Study: a 7-day prospective observational cohort study. Lancet 2018;391(10130):1589–1598. DOI: 10.1016/S0140-6736(18)30001-1.
6. Hackett NJ, De Oliveira GS, Jain UK, Kim JYS. ASA class is a reliable independent predictor of medical complications and mortality following surgery. Int J Surg 2015;18:184–190. DOI: 10.1016/j.ijsu.2015.04.079.
7. Biccard BM, Madiba TE, Surgical Outcomes Study Investigators O Behalf of the SA. The South African Surgical Outcomes Study: a 7-day prospective observational cohort study. S Afr Med J 2015;105(6):465. DOI: 10.7196/samj.9435.
8. Ahmad T, Bouwman RA, Grigoras I, Aldecoa C, Hofer C, Hoeft A, et al. Use of failure-to-rescue to identify international variation in postoperative care in low-, middle- and high-income countries: a 7-day cohort study of elective surgery. Br J Anaesth 2017;119(2):258–266. DOI: 10.1093/bja/aex185.
9. Leeds IL, Canner JK, Efron JE, Ahuja N, Haut ER, Wick EC, et al. The independent effect of cancer on outcomes: a potential limitation of surgical risk prediction. J Surg Res 2017;220:402–409. DOI: 10.1016/j.jss.2017.08.039.
10. The International Surgical Outcomes Study (ISOS) Group, Kahan BC, Koulenti D, Arvaniti K, Beavis V, Campbell D, et al. Critical care admission following elective surgery was not associated with survival benefit: prospective analysis of data from 27 countries. Intensive Care Med 2017;43(7):971–979. DOI: 10.1007/s00134-016-4633-8.
11. Abbott TEF, Ahmad T, Phull MK, Fowler AJ, Hewson R, Biccard BM, et al. The surgical safety checklist and patient outcomes after surgery: a prospective observational cohort study, systematic review and meta-analysis. Br J Anaesth 2018;120(1):146–155. DOI: 10.1016/j.bja.2017.08.002.
12. Chaudery H, MacDonald N, Ahmad T, Chandra S, Tantri A, Sivasakthi V, et al. Acute kidney injury and risk of death after elective surgery: prospective analysis of data from an International Cohort Study. Anesth Analg 2019;128(5):1022–1029. DOI: 10.1213/ANE.0000000000003923.