

A Study to Evaluate the Reasons and the Risk Factors for Postoperative ICU Admissions: An Observational StudyUma Shankar Kumar¹, Prashant Kumar Gupta²¹Consultant, Department of Anesthesiology and Critical Care, Bodhi Hospital, Patna, Bihar, India²Senior Resident, Department of Anaesthesia, Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar, India

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Conflict of interest: Nil

Abstract**Aim:** The aim of the present study was to evaluate the reasons and the risk factors for postoperative ICU admissions in a tertiary care hospital in Bihar region.**Methods:** This case-control study was conducted at Department of Anesthesiology and Critical Care for the period of 12 months. A total of 100 patients were included in our study and 50 patients as cases and 100 patients as controls. Cases were defined as the patients who required postoperative ICU admission within 24 h after surgery during the study period. Controls were the patients who did not require ICU admission following a surgical procedure during the same study period.**Results:** Among cases, 45 (90%) patients had GA followed by 4 regional blocks/neuraxial blocks and one sedation only. Among controls, 85 (85%) patients had GA followed by 7 cases of regional, 6 neuraxial block and two sedation only. 38 (76%) of cases were known hypertensive vs. 40 (40%) in controls. 35 (70%) of cases were diabetic vs 46 (46%) among controls. 11 (22%) of cases had respiratory diseases vs. 43 (43%) in controls. 14 (28%) of the patients among cases were ventilated in ICU. The most common reasons for ICU admission among cases was for neuro-observation 18 (36%) cases followed by requirement for cardiovascular monitoring 14 (28%), sepsis 10 (20%), intraoperative cardiac events 3 (6%), prolonged surgery 2 (4%), intraoperative arrest 1 (2%), Diabetic ketoacidosis 1 (2%) and increased Oxygen requirement postoperatively 1 (2%). In univariate analysis, the risk factors for ICU admission included age, ASA class, hypertension, DM, IHD, respiratory disease, renal dysfunction, neurological abnormality. We then constructed a final multivariate logistic regression; we found ASA and presence of neurological disease or abnormality as risk factors for postoperative ICU admission.**Conclusion:** In conclusion, ASA class and perioperative neurological abnormalities are most significantly associated with ICU admission in the postoperative period.**Keywords:** Risk factors; ICU; ICU admission; Postoperative period; ASA statusThis is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.**Introduction**

In developed countries, patients undergoing high-risk, noncardiac surgery constitute a significant part of intensive care unit (ICU) admissions. [1,2] Although some scoring systems such as POSSUM and P-POSSUM were used to identify patients who required ICU admission following surgery, it is difficult to determine accurately which postoperative patients are at high risk of complications or death. [3-5] Even though the high-risk surgical population comprises a small part of the population that undergoes surgical procedures, the majority of postoperative complications and deaths are observed among high-risk surgical patients, and only one-third of these cases are admitted to the ICU after surgery. [6]

Postoperative outcomes are related to patient factors and the nature of the surgery. [5,7] Previous studies

suggest that postoperative care in the ICU may substantially reduce postoperative morbidity and mortality due to the early recognition and proper management of postoperative complications. [5-8] ICU beds are a scarce hospital resource, and various factors affect the decision to admit a patient to the ICU, including severity of co-existing disease, need for ICU-specific interventions, or bed availability. [5,9] There are several guidelines for ICU admissions, but no universally accepted criteria for admitting surgical patients to the ICU. [8]

Intensive care unit delirium (ICUD) is a particularly common complication among hospitalized elderly patients. The cumulative incidence is reportedly >75% when combined with stupor and coma following high-risk procedures (e.g., invasive mechanical ventilation [IMV]). [10,11] ICUD is

associated with decreased preoperative cognitive reserve. [12] Brain atrophy is not markedly associated with the high incidence of ICUD in elderly patients without dementia. [13] Although delirium is an acute, multifaceted neuropsychiatric phenomenon characterized by universal impairments in attention and cognition, [14,15] it has been implicated in perpetual cognitive impairment and dementia. [16] The pathogenesis of delirium and the mechanisms associated with these incapacitating consequences are still unknown. [17] During critical illness, delirium is caused by various insults that may be interrelated and yet separately contribute to perpetual cognitive impairment. [17,18]

The aim of the present study was to evaluate the reasons and the risk factors for postoperative ICU admissions in a tertiary care hospital in Bihar region.

Materials and Methods

This case-control study was conducted at Department of Anesthesiology and Critical Care, Bodhi Hospital, Patna, Bihar, India for the period of 12 months. A total of 150 patients were included in our study and 50 patients as cases and 100 patients

as controls. Cases were defined as the patients who required postoperative ICU admission within 24 h after surgery during the study period. Controls were the patients who did not require ICU admission following a surgical procedure during the same study period. We excluded patients who came to operating room (OR) from ICU and pediatric patients (aged under 16 y). Data were identified and collected by retrospective review of OR list, ICU admission sheets and anesthesia charts electronically. Data included demographics of the patients, the type of anesthesia, surgical procedure, duration of surgery, ASA classification and associated medical co-morbidities. All data were entered and analyzed in SPSS version 26.

Numerical data are represented as mean and categorical data are represented as percentages. Univariate analysis was done to assess individual risk factors for postoperative ICU admission. We then constructed a final model where multivariate logistic regression was used to assess risk factors for postoperative ICU admission. A $p < 0.05$ was considered as significant.

Results

Table 1: Comparison of risk factors for ICU admission

Variable	Cases =50	Controls =100
GA	45 (90)	85 (85)
Regional blocks/neuraxial blocks	4 (8)	13 (13)
Sedation only	1 (2)	2 (2)
Hypertension	38 (76)	40 (40)
Diabetes	35 (70)	46 (46)
Respiratory diseases	11 (22)	43 (43)
Mechanical ventilation	14 (28)	

A total of 150 patients were included in our study. Among them, 50 were cases vs. 100 as controls. Among cases, 45 (90%) patients had GA followed by 4 regional blocks/neuraxial blocks and one sedation only. Among controls, 85 (85%) patients had GA followed by 7 cases of regional, 6 neuraxial

block and two sedation only. 38 (76%) of cases were known hypertensive vs. 40 (40%) in controls. 35 (70%) of cases were diabetic vs 46 (46%) among controls. 11 (22%) of cases had respiratory diseases vs. 43 (43%) in controls. 14 (28%) of the patients among cases were ventilated in ICU.

Table 2: Common reasons for postop ICU admission

Reason for admission	N (%)
Neuro-observation	18 (36)
Cardiovascular monitoring	14 (28)
Sepsis	10 (20)
Intraoperative cardiac events	3 (6)
Prolonged surgery	2 (4)
Intraoperative arrest	1 (2)
Diabetic ketoacidosis	1 (2)
Increased O ₂ requirement postoperatively	1 (2)

The most common reasons for ICU admission among cases was for neuro-observation 18 (36%) cases followed by requirement for cardiovascular monitoring 14 (28%), sepsis 10 (20%), intraoperative cardiac events 3 (6%), prolonged surgery 2 (4%), intraoperative arrest 1 (2%), Diabetic ketoacidosis 1 (2%) and increased Oxygen requirement postoperatively 1 (2%).

Table 3: Multivariate logistic regression for risk factors of post-operative ICU admission

Characteristics	Unadjusted odds ratio	Adjusted odds ratio	P Value
ASA	4.08 (2.28-7.22)	3.28 (1.13-9.41)	0.022
Hypertension	4.38 (2.00-9.49)	1.78 (0.57-5.40)	0.34
Diabetes	2.59 (1.23-5.48)	0.69 (0.22-2.12)	0.55
Congestive heart failure	6.49 (0.65-64.29)	3.75 (0.26-51.90)	0.34
Respiratory distress	0.36 (0.16-0.84)	0.38 (0.14-1.12)	0.07
Neurological disease	6.08 (2.45-15.03)	3.87 (1.34-10.99)	0.015
Surgical severity	0.76 (0.17-3.53)	0.78 (0.09-6.45)	0.84

In univariate analysis, the risk factors for ICU admission included age, ASA class, hypertension, DM, IHD, respiratory disease, renal dysfunction, neurological abnormality. We then constructed a final multivariate logistic regression; we found ASA and presence of neurological disease or abnormality as risk factors for postoperative ICU admission.

Discussion

Patients with high risk co-morbidities or who undergo high risk surgical procedures, represent a substantial proportion of intensive care unit (ICU) admissions in most of the developed countries. [19] There are multiple perioperative factors which contribute to morbidity or mortality in this group of patients. The priority for admission to an ICU needs to be given to the patients who will get the most benefit from the highest level of perioperative care. [20] Appropriate decisions regarding admission of potential patients after having surgery are therefore, considered very important for the patient care, although to identify such patients very accurately might not be easy.

There are several risk scoring systems like P-POSSUM (Physiological and Operative Severity Score for the enumeration of Mortality and Morbidity), SORT (Surgical outcome risk tool) or ACS NSQIP (American college of surgeons National Surgical Quality Improvement Program) which help to predict morbidity or mortality in the postoperative period. However, these scores do not predict the severity of postoperative complications, and therefore, the required level of care. [21,22] Among cases, 45 (90%) patients had GA followed by 4 regional blocks/neuraxial blocks and one sedation only. Among controls, 85 (85%) patients had GA followed by 7 cases of regional, 6 neuraxial block and two sedation only. 38 (76%) of cases were known hypertensive vs. 40 (40%) in controls. 35 (70%) of cases were diabetic vs 46 (46%) among controls. 11 (22%) of cases had respiratory diseases vs. 43 (43%) in controls. 14 (28%) of the patients among cases were ventilated in ICU.

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Diabetic ketoacidosis 1 (2%) and increased Oxygen requirement postoperatively 1 (2%). In univariate analysis, the risk factors for ICU admission included age, ASA class, hypertension, DM, IHD, respiratory disease, renal dysfunction, neurological abnormality. We then constructed a final multivariate logistic regression; we found ASA and presence of neurological disease or abnormality as risk factors for postoperative ICU admission. In one systematic review [23] age, anaemia, ASA class, Body mass index (BMI), male gender, obstructive sleep apnoea, bleeding and duration of surgery were shown to be independent risk factors for unplanned ICU admission. Nadal et al [24] in their study also showed that age significantly affects the likelihood of ICU admission in the postoperative period as was the case in univariate analysis in our study although age was not found to be a significant risk factor in our multivariate logistic regression model. Harrison et al²⁵ in their study demonstrated that age, female gender, ASA class, presence of cardiac co-morbidities, intraoperative bleeding and length of surgery were associated with an increased likelihood of ICU admission in the postoperative period. Our study also found ASA class and the presence of neurological abnormality as major significant risk factors for postoperative ICU admission.

Conclusion

In conclusion, ASA class and perioperative neurological abnormalities are most significantly associated with ICU admission in the postoperative period.

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