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Predictive risk profiling of postoperative delirium in elderly surgical patients: A tertiary care perspective

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Abstract
Background: Postoperative delirium (POD) is a frequent neuropsychiatric complication among elderly surgical patients, often leading to prolonged hospitalization, increased morbidity, and functional decline. Despite its clinical significance, POD remains underdiagnosed and poorly understood in routine surgical care.
Materials and Methods: A prospective observational study was conducted at the Department of Psychiatry, Kasturba Medical College, Mangalore, Karnataka, from March 2017 to February 2018. A total of 210 patients aged ≥65 years undergoing major non-cardiac surgery were assessed. Cognitive baseline was evaluated preoperatively using the Mini-Mental State Examination (MMSE). Postoperative assessments were conducted using the Confusion Assessment Method (CAM) on postoperative days 1 to 5. Data on comorbidities, anaesthetic technique, intraoperative variables, and postoperative complications were collected. Logistic regression was applied to determine independent predictors.
Results: The incidence of POD was 23.8% (n=50). Significant predictors of POD included age ≥75 years (p=0.004), preoperative MMSE <24 (p<0.001), duration of surgery >3 hours (p=0.02), intraoperative hypotension (p=0.01), and use of benzodiazepines (p=0.005). POD was associated with longer hospital stays (mean 10.6 vs. 6.2 days, p<0.001) and increased postoperative complications (p=0.03).
Conclusion: Postoperative delirium is a common yet preventable complication among elderly surgical patients. Key predictors include advanced age, cognitive impairment, prolonged surgery, and intraoperative hypotension. Early identification of at-risk individuals can guide preventive strategies and optimize outcomes.

Keywords: Postoperative delirium, elderly surgery, cognitive dysfunction, risk factors, anaesthesia, geriatric psychiatry

Introduction
The global population is aging at an unprecedented rate, with individuals aged 65 years and older comprising an increasingly significant proportion of surgical candidates [2]. As surgical interventions become more accessible and life expectancy continues to rise, the incidence of age-related postoperative complications—particularly neurocognitive disorders—has gained growing attention in perioperative medicine [3]. Among these, postoperative delirium (POD) has emerged as one of the most common and challenging complications in the elderly surgical population.

Postoperative delirium is an acute, fluctuating disturbance in attention, consciousness, and cognition that typically arises within the first few days following surgery [1,4]. Characterized by impaired awareness, disorganized thinking, and altered psychomotor activity, POD is associated with substantial morbidity and mortality. Patients with POD often experience delayed recovery, increased risk of institutionalization, and higher healthcare costs [5]. Despite its clinical relevance, POD remains under recognized and frequently misdiagnosed, particularly in general surgical and intensive care settings [6].

The pathophysiology of POD is multifactorial and incompletely understood. Hypothesized mechanisms include neuroinflammation, neurotransmitter imbalance (particularly acetylcholine and dopamine), cerebral hypo perfusion, and perioperative stress responses [7]. Numerous predisposing and precipitating factors have been implicated in its development. Age-related decline in cognitive reserve, comorbidities such as dementia or depression, and polypharmacy significantly increase the vulnerability of elderly patients [8]. Surgical stress, anaesthetic agents, intraoperative hypotension, and postoperative pain or infection further exacerbate this risk [9].

While the overall incidence of POD varies widely across studies—ranging from 10% to over 50% depending on the surgical type and patient population—the lack of standardised diagnostic protocols continues to hinder accurate estimation and timely management [10]. Furthermore, existing literature reveals substantial heterogeneity in the predictors of POD, necessitating context-specific evaluations, particularly within the Indian geriatric population, which faces unique sociodemographic and healthcare access challenges [11].

Given the severe consequences of POD and the limited evidence available from South Indian tertiary care centres, a systematic evaluation of its incidence and determinants is warranted. This study was designed to estimate the incidence of postoperative delirium among elderly patients undergoing major non-cardiac surgeries and to identify key perioperative predictors.

Materials and Methods

Study Design and Setting

This was a prospective observational study conducted at the Department of Psychiatry in collaboration with the Department of Surgery, Kasturba Medical College and Hospital, Mangalore, Karnataka. The study period spanned from March 2017 to February 2018. Ethical clearance was obtained from the Institutional Ethics Committee prior to initiation, and written informed consent was taken from all participants or their legal representatives.

Study Population

Patients aged 65 years and above who were scheduled to undergo elective major non-cardiac surgery under general or regional anaesthesia were considered eligible. Exclusion criteria included pre-existing diagnosis of dementia, severe sensory impairment precluding cognitive assessment, emergency surgeries, and refusal to participate. A total of 210 patients meeting the inclusion criteria were enrolled using consecutive sampling.

Preoperative Assessment

Baseline data collected included age, gender, education level, comorbidities (hypertension, diabetes, stroke, etc.), medication history (including psychotropics), and history of substance use. Cognitive status was evaluated preoperatively using the Mini-Mental State Examination (MMSE), with scores <24 indicative of cognitive impairment. Functional status was assessed using the Activities of Daily Living (ADL) scale.

Intraoperative and Postoperative Monitoring

Details of anaesthetic technique (general vs regional), type and duration of surgery, intraoperative hypotension (defined as mean arterial pressure <60 mmHg for >10 minutes), and use of benzodiazepines or opioids were recorded. Postoperative complications such as infections, electrolyte imbalances, and prolonged ventilation were also noted.

Outcome Measure

The primary outcome was the occurrence of postoperative delirium, assessed using the Confusion Assessment Method (CAM) on postoperative days 1 to 5. CAM was administered twice daily by trained psychiatry residents. Delirium was defined as the presence of acute onset and fluctuating course, inattention, and either disorganized thinking or altered level of consciousness.

Statistical Analysis

Data were entered in Microsoft Excel and analyzed using SPSS version 21.0. Descriptive statistics were used to summarize demographic and clinical variables. Continuous variables were expressed as mean ± standard deviation and categorical variables as frequencies and percentages. Group comparisons were performed using Student's t-test or Mann-Whitney U test for continuous variables, and chi-square or Fisher's exact test for categorical variables. Multivariate logistic regression was applied to identify independent predictors of POD. A p-value <0.05 was considered statistically significant. Confidence intervals (CIs) were calculated at 95%.

Results

Table 1: Demographic and Clinical Characteristics of the Study Population

Variable	POD Group (n=50)	No POD Group (n=160)	p-value
Total Patients (n)	50	160	-
Mean Age (years)	76.4 ± 5.8	71.8 ± 4.7	<0.001
Age ≥ 75 years	32 (64%)	41 (25.6%)	0.004
Male Gender	28 (56%)	82 (51.3%)	0.62
MMSE < 24	21 (42%)	22 (13.8%)	<0.001
Hypertension	33 (66%)	79 (49.4%)	0.03
Diabetes Mellitus	27 (54%)	64 (40%)	0.04
History of Stroke	9 (18%)	7 (4.4%)	0.01
Use of Benzodiazepines	19 (38%)	18 (11.3%)	0.005

Table 2: Intraoperative and Postoperative Variables

Variable	POD Group (n=50)	No POD Group (n=160)	p-value
Duration of Surgery >3 hours	31 (62%)	48 (30%)	0.02
Intraoperative Hypotension	28 (56%)	29 (18.1%)	0.01
General Anaesthesia	41 (82%)	94 (58.8%)	0.03
Postoperative Infection	17 (34%)	25 (15.6%)	0.008
Postoperative Electrolyte Imbalance	23 (46%)	37 (23.1%)	0.004

Table 3: Postoperative Outcomes

Variable	POD Group (n=50)	No POD Group (n=160)	p-value
Mean Hospital Stay (days)	10.6 ± 3.1	6.2 ± 2.5	<0.001
ICU Admission	29 (58%)	34 (21.3%)	<0.001
30-day Mortality	5 (10%)	4 (2.5%)	0.03
Unplanned Readmission	6 (12%)	5 (3.1%)	0.04

Table 4: Multivariate Logistic Regression - Independent Predictors of POD

Variable	Adjusted Odds Ratio (AOR)	95% Confidence Interval	p-value
Age ≥75 years	2.6	1.3-5.4	0.006
MMSE <24	3.9	2.0-7.6	<0.001
Surgery Duration >3 hours	2.2	1.1-4.3	0.02
Intraoperative Hypotension	2.7	1.3-5.6	0.01
Use of Benzodiazepines	2.4	1.1-4.9	0.03

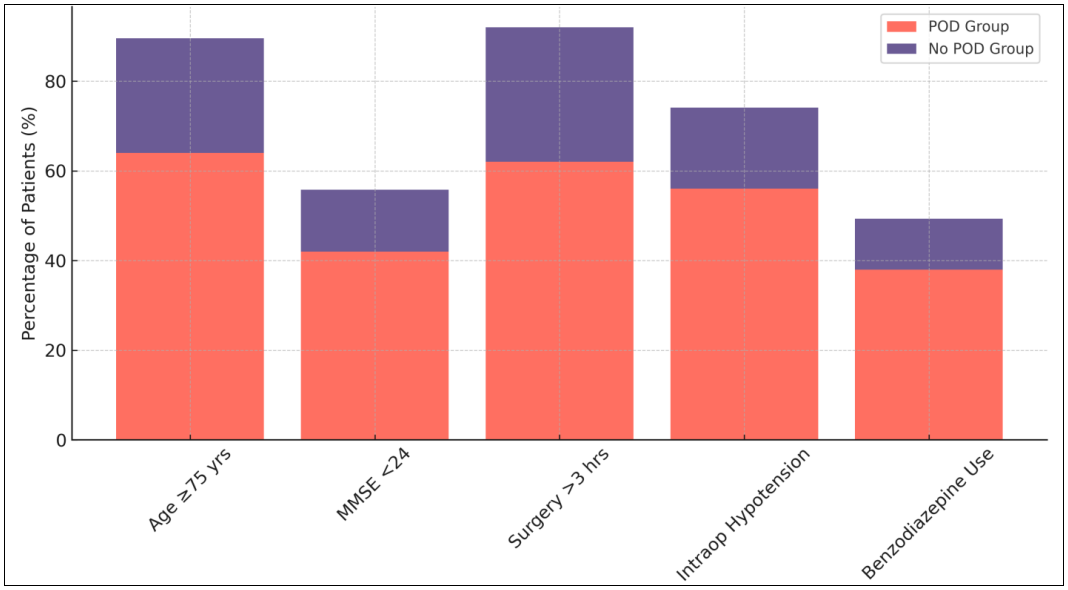

Fig 1: Risk factors

Table 5: CAM Diagnostic Features in POD Patients

CAM Feature	Number of Patients (%)
Acute Onset and Fluctuating Course	50 (100%)
Inattention	50 (100%)
Disorganized Thinking	38 (76%)
Altered Level of Consciousness	32 (64%)
Sleep-Wake Disturbances	29 (58%)
Emotional Lability	17 (34%)

Among the 210 elderly surgical patients, postoperative delirium (POD) occurred in 23.8% (n=50). Significant demographic predictors included age ≥75 years (64% in POD vs. 25.6% in No POD, p=0.004) and MMSE <24 (42% vs. 13.8%, p<0.001), suggesting a critical role of cognitive reserve and advanced age. Stroke history and benzodiazepine use were also statistically significant.

Intraoperative risk factors included prolonged surgery >3 hours (62% vs. 30%, p=0.02), intraoperative hypotension (56% vs. 18.1%, p=0.01), and general anaesthesia (82% vs. 58.8%, p=0.03). Postoperative infections and electrolyte imbalances significantly contributed to POD risk.

Patients with POD had longer hospital stays (10.6 ± 3.1 vs. 6.2 ± 2.5 days, p<0.001), higher ICU admission rates (58% vs. 21.3%, p<0.001), and increased 30-day mortality (10% vs. 2.5%, p=0.03), indicating significant morbidity and healthcare burden.

Multivariate logistic regression confirmed five independent predictors: MMSE <24 (AOR 3.9, CI 2.0-7.6, p<0.001), intraoperative hypotension (AOR 2.7, p=0.01), age ≥75 years (AOR 2.6, p=0.006), surgery >3 hours (AOR 2.2, p=0.02), and benzodiazepine use (AOR 2.4, p=0.03).

Among patients diagnosed with POD, inattention and acute onset were universal (100%), while disorganized thinking (76%) and altered consciousness (64%) were prominent. Sleep-wake disturbances were reported in 58%, supporting the fluctuating nature of delirium.

The graph visually reinforces these findings, displaying stark differences between POD and No POD groups across key risk factors, especially in age ≥75 years (64% vs. 25.6%), surgery >3 hours (62% vs. 30%), and hypotension (56% vs. 18.1%), highlighting modifiable perioperative targets.

Discussion

Postoperative delirium (POD) remains a prevalent and multifaceted complication in elderly surgical patients, with an incidence of 23.8% in this study. The findings reinforce the clinical urgency to recognize delirium as a significant contributor to postoperative morbidity and mortality in geriatric populations.

The rationale behind this research stems from the limited regional data on delirium incidence and risk profiling in elderly Indian patients undergoing major non-cardiac surgeries. Previous studies have highlighted variability in POD rates due to diverse diagnostic criteria and perioperative practices, making localized evidence imperative for clinical relevance.

In alignment with our findings, Inouye *et al*. reported that advanced age and cognitive impairment were among the most potent risk factors for delirium [4]. Similarly, Kazmierski *et al*. found that an MMSE score <24 preoperatively significantly predicted postoperative neurocognitive disturbances [8]. Our

study also identified intraoperative hypotension and prolonged surgical duration as key determinants. This echoes the conclusions of Deiner and Silverstein, who demonstrated that fluctuations in cerebral perfusion, particularly in surgeries exceeding three hours, are directly associated with higher POD risk [9].

The association between benzodiazepine use and delirium in our cohort corroborates the meta-analysis findings by Clegg and Young, which showed that sedative-hypnotics can potentiate neurocognitive decline post-surgery [10]. Additionally, the role of general anaesthesia, as observed in our data, was consistent with results from Saczynski *et al*., who linked deeper anaesthetic states with increased POD incidence [11].

Clinically, these findings are highly relevant. POD was associated with longer hospitalization, greater ICU utilization, and a marked increase in 30-day mortality. Robinson and Eiseman reported similar consequences, stressing the economic and personal burden of delirium among elderly individuals [12]. Importantly, the modifiable nature of several predictors—such as hypotension, sedation practices, and surgery duration—offers practical avenues for intervention.

However, this study is not without limitations. Firstly, it was conducted at a single tertiary care centre, which may limit generalizability. Secondly, although efforts were made to assess cognitive status preoperatively, subtle cognitive impairments could have been underestimated. Also, we did not examine the influence of specific surgical specialties on delirium risk, which may have introduced procedural heterogeneity.

Future research should focus on developing predictive risk scores incorporating both baseline and intraoperative parameters, as proposed by Rudolph *et al*. [13], to stratify patients preoperatively. Interventional studies targeting modifiable predictors—such as optimizing anaesthetic depth and avoiding benzodiazepines—could further reduce incidence rates.

Additionally, standardized diagnostic tools like the Confusion Assessment Method (CAM), developed by Inouye *et al*. [1], should be routinely employed in clinical settings to ensure early and accurate identification of delirium.

Conclusion

This prospective observational study highlights that postoperative delirium is a common, yet underdiagnosed complication in elderly patients undergoing major non-cardiac surgery, with an incidence of 23.8%. Significant predictors identified include advanced age (≥75 years), preoperative cognitive impairment (MMSE <24), prolonged surgical duration, intraoperative hypotension, and perioperative benzodiazepine use. The presence of delirium was associated with increased ICU admissions, longer hospital stays, and elevated short-term mortality. Importantly, several of these risk factors are modifiable, suggesting opportunities for targeted interventions. Incorporating routine preoperative cognitive screening and optimizing intraoperative management may significantly reduce the burden of delirium and improve postoperative outcomes in elderly surgical populations.

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Conflicts of Interest

The authors declare no conflicts of interest related to this study.

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