

FREQUENCY OF POST-OPERATIVE DELIRIUM OBSERVED IN POST-OPERATIVE ANESTHESIA CARE UNIT DURING EMERGENCE OF PATIENTS FROM GENERAL ANESTHESIA

Original Article

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Conflict of Interest: None

Grant Support & Financial Support: None

Acknowledgment: The authors acknowledge the cooperation of all patients and PACU staff who facilitated data collection.

ABSTRACT

Background: Postoperative delirium (POD) is an acute neurocognitive disturbance that commonly occurs during recovery from general anesthesia and is traditionally associated with older age. However, younger adults may also be vulnerable due to perioperative physiological stress, anesthetic exposure, and surgical complexity. Early identification of POD in the Post-Anesthesia Care Unit (PACU) is essential, as undetected delirium is linked to prolonged recovery, postoperative complications, and increased healthcare utilization. Despite this, data on POD during emergence in younger adult populations remain limited.

Objective: To determine the incidence of postoperative delirium during the emergence phase from general anesthesia among adults aged 18–55 years and to evaluate its association with selected perioperative factors.

Methods: A descriptive cross-sectional study was conducted in the PACU involving 120 adult patients undergoing elective or emergency surgery under general anesthesia. Delirium assessment was performed within 10–15 minutes of extubation using validated screening tools, including the Richmond Agitation-Sedation Scale (RASS), 4 A's Test (4AT), 3-Minute Diagnostic Confusion Assessment Method (3D-CAM), and the Nursing Delirium Screening Scale (Nu-DESC). Demographic variables, American Society of Anesthesiologists (ASA) physical status, type of surgery, and anesthesia-related characteristics were recorded. Statistical analysis was performed using SPSS, with chi-square testing applied to assess associations between POD and relevant variables.

Results: Postoperative delirium was identified in 11 out of 120 patients, yielding an incidence of 9.2% during the emergence phase. Delirium occurrence increased significantly with advancing age within the study range, with the highest frequency observed in patients aged 50–55 years ($p = 0.001$). A greater proportion of delirium cases occurred in patients classified as ASA III compared with ASA I and ASA II. Male patients accounted for a higher number of delirium cases, although gender was not statistically associated with POD. Delirium was disproportionately more frequent following cardiac and other high-risk surgeries compared with lower-risk procedures.

Conclusion: Postoperative delirium occurs in a meaningful proportion of younger adults during emergence from general anesthesia. Routine delirium screening in the PACU using validated tools should be incorporated into standard perioperative care, particularly for patients undergoing high-risk procedures, to support early recognition and improved postoperative outcomes.

Keywords: Anesthesia, General; Delirium, Post-Anesthesia Care Unit, Postoperative Complications, Risk Factors, Surgical Procedures, Young Adult.

INTRODUCTION

Postoperative delirium (POD) and emergence delirium (ED) are increasingly recognized as clinically significant neurocognitive complications following surgical procedures performed under general anesthesia. These conditions are characterized by acute and fluctuating disturbances in attention, awareness, and cognition that occur in the immediate postoperative period. POD typically manifests as confusion, disorientation, impaired perception, and altered consciousness, often emerging in the post-anesthesia care unit (PACU) and persisting for hours to days. Although usually reversible, POD is associated with serious adverse outcomes, including prolonged hospitalization, increased morbidity and mortality, higher healthcare utilization, and an elevated risk of long-term cognitive decline, making it a critical concern in perioperative medicine (1,2). Emergence delirium represents an early and often abrupt manifestation of delirium that occurs during or immediately after recovery from anesthesia. Clinically, ED may present as agitation, restlessness, irritability, hallucinations, or aggressive behavior, while hypoactive forms are characterized by lethargy, reduced responsiveness, and inattention. The latter subtype is frequently underrecognized, despite being associated with equally poor outcomes. ED is increasingly viewed not merely as a transient behavioral disturbance but as a potential precursor to sustained POD, highlighting the importance of early identification and intervention during the emergence phase (3,4). The pathogenesis of POD and ED is complex and multifactorial, reflecting an interaction between patient vulnerability and perioperative stressors. Predisposing factors include advanced age, baseline cognitive impairment, frailty, substance use disorders, psychiatric illness, and comorbid conditions such as hypertension and diabetes (5). These vulnerabilities are compounded by precipitating factors related to surgery and anesthesia, including surgical stress, depth and duration of anesthesia, use of psychoactive medications, postoperative pain, dehydration, metabolic disturbances, and sensory or environmental disruptions within the PACU. At a biological level, delirium is thought to arise from disrupted cerebral homeostasis involving impaired cerebral perfusion, altered glucose and oxygen delivery, neuroinflammation, dysregulation of neurotransmitters such as acetylcholine and dopamine, and activation of the stress response mediated by cortisol and inflammatory cytokines, collectively lowering the brain's resilience to perioperative insults (6,7).

Epidemiologically, POD represents a substantial global burden, with reported incidence rates ranging from 10% to as high as 70%, depending on patient characteristics, surgical type, and diagnostic criteria. While the condition has been extensively studied in geriatric populations, where rates commonly exceed 15–30%, emerging evidence suggests that delirium is not exclusive to older adults. Studies report ED incidence in adult PACU settings ranging from approximately 4.7% to 22.2%, and although younger and healthier populations generally exhibit lower rates, delirium remains clinically relevant in these groups. Variability across studies reflects differences in assessment timing, patient selection, and the use of screening instruments, underscoring the need for standardized evaluation tools such as CAM-ICU, RASS, 4AT, and Nu-DESC to improve detection across diverse surgical settings (8,9). In younger adults, risk factors for POD and ED may differ in prominence from those seen in elderly cohorts. Conditions such as obstructive sleep apnea, elevated body mass index, substance use, major trauma, prolonged or complex surgical procedures, and exposure to psychoactive or anticholinergic medications have been shown to significantly increase delirium risk. Importantly, the consequences of POD extend well beyond transient cognitive disturbance. Delirium has been linked to longer hospital stays, higher rates of postoperative complications including infections and thromboembolic events, increased readmission rates, and markedly higher mortality. Longitudinal studies further suggest that delirium is an independent predictor of long-term cognitive impairment and reduced survival, even years after the initial surgical event (10,11).

Beyond its clinical impact, POD imposes a substantial economic and societal burden. In the United States alone, healthcare costs attributable to postoperative delirium are estimated to exceed tens of billions of dollars annually, driven by prolonged hospitalizations, increased intensive care utilization, rehabilitation needs, and long-term care requirements. These figures highlight delirium as not only a medical complication but also a major public health issue. Preventive and early management strategies—including optimization of anesthetic depth, multimodal analgesia, judicious medication use, maintenance of hemodynamic stability, early reorientation, and pharmacologic interventions such as dexmedetomidine or melatonin—have demonstrated promise in reducing delirium incidence and improving postoperative recovery, emphasizing the value of proactive perioperative care (12,13). Despite growing awareness, a critical gap remains in the literature regarding the prevalence and characteristics of POD and ED in younger adult populations, as most existing research predominantly focuses on elderly patients. This underrepresentation limits the development of age-appropriate screening and prevention strategies and may contribute to underdiagnosis in younger individuals who are often perceived as low risk. Therefore, the objective of the present study is to determine the prevalence of postoperative delirium during the emergence phase from general anesthesia in younger adults, with the rationale of addressing this evidence gap and informing targeted perioperative interventions aimed at improving patient outcomes and optimizing postoperative care.

METHODS

This study was conducted using a quantitative, descriptive cross-sectional design to determine the prevalence of postoperative delirium (POD) during the emergence phase from general anesthesia in the Post-Anesthesia Care Unit (PACU). The study was carried out over a period of approximately four to six months in the PACU of a tertiary-care hospital. A total of 120 adult patients aged 18 to 55 years who underwent elective or emergency surgical procedures under general anesthesia were recruited through non-probability convenience sampling. This sampling approach was selected due to the continuous flow of eligible patients in the PACU and the time-bound nature of the study. Participants were included if they were hemodynamically stable at emergence, able to be assessed immediately post-anesthesia, and had undergone surgery under general anesthesia. Patients were excluded if they had a documented history of cognitive impairment, dementia, psychiatric illness, substance dependence, or neurological disorders, as well as those receiving regional or local anesthesia, those requiring postoperative mechanical ventilation, or those who developed significant intraoperative or immediate postoperative hemodynamic instability that precluded delirium assessment. These criteria were applied to minimize confounding and ensure accurate evaluation of postoperative mental status. Data collection was performed using a structured and pretested proforma designed to capture demographic characteristics, surgical details, anesthetic techniques, and intraoperative variables obtained from medical records and anesthesia charts. Assessment of delirium during the emergence phase was conducted in real time in the PACU using validated screening instruments. The Richmond Agitation-Sedation Scale (RASS) was first applied to determine the level of arousal and ensure that patients were suitable for delirium assessment. Patients meeting the appropriate RASS threshold were subsequently evaluated using the 3D Confusion Assessment Method (3D-CAM) and the Nursing Delirium Screening Scale (Nu-DESC) to identify the presence and type of delirium (14-16). These tools were selected for their established validity, reliability, and feasibility in acute postoperative settings. The primary outcome measure was the prevalence of postoperative delirium observed during the emergence phase. Secondary outcomes included the exploration of associations between POD and selected demographic, surgical, and anesthetic variables. Data were entered and analyzed using Statistical Package for the Social Sciences (SPSS). Descriptive statistics were used to summarize patient characteristics and prevalence rates, while inferential analysis was performed using the chi-square test to assess associations between categorical variables. A p-value of less than 0.05 was considered statistically significant. Ethical considerations were strictly adhered to throughout the study. Approval was obtained from the Institutional Review Board or Ethical Review Committee of the participating institution prior to data collection. Written informed consent was obtained from all participants or their legally authorized representatives before enrollment. Confidentiality was maintained by anonymizing patient data and restricting access to study records. The study procedures were designed to ensure minimal interference with routine patient care and posed no additional risk to participants.

RESULTS

A total of 120 adult patients who underwent surgery under general anesthesia were included in the final analysis, with complete data available for all variables. The cohort demonstrated a slight male predominance, with 67 males (55.8%) and 53 females (44.2%). The majority of patients were classified as having relatively low perioperative risk, with 59 patients (49.2%) categorized as ASA physical status I, 37 (30.8%) as ASA II, and 24 (20.0%) as ASA III. The age distribution reflected a young to middle-aged adult population, with participants evenly spread across age categories from 20 to 55 years. Orthopedic procedures accounted for the largest proportion of surgeries (23.3%), followed by cardiac, general, and thoracic surgeries (16.7% each), with smaller representations from neurosurgical, urogenital, and ENT procedures. The overall incidence of postoperative delirium during the emergence phase in the PACU was 9.2%, with delirium identified in 11 of the 120 patients, while 109 patients (90.8%) did not exhibit delirium. Descriptive analysis showed that delirium occurred more frequently in males, with 8 of the 11 delirium cases (72.7%) observed in male patients and 3 cases (27.3%) in females, whereas the non-delirium group demonstrated a more balanced gender distribution. A clear gradient was observed with respect to preoperative physical status. Patients classified as ASA III accounted for 45.5% of all delirium cases, despite representing only one-fifth of the total sample, while ASA I patients contributed 27.3% of delirium cases and constituted nearly half of the cohort. Most patients without delirium belonged to the ASA I category, indicating a higher burden of systemic disease among those who developed postoperative delirium.

The incidence of delirium varied substantially across surgical specialties. Cardiac surgery demonstrated the highest proportion of delirium, with 5 of 20 patients (25%) affected. Neurosurgical and thoracic procedures each contributed 2 delirium cases (18.2% each among delirium cases), while general and orthopedic surgeries accounted for one case each (9.1%). No delirium was observed following

ENT or urogenital surgeries. These findings indicate an uneven distribution of delirium across surgical types, with higher rates observed in procedures associated with greater physiological stress. Age-wise analysis revealed a strong association between increasing age and postoperative delirium. No cases of delirium were observed in patients younger than 30 years. Delirium onset was first noted in the 30–35 and 35–40 year age groups, with one case each. The highest burden was observed in patients aged 50–55 years, who accounted for 6 of the 11 delirium cases (54.5%), despite comprising only 11.7% of the study population. Inferential testing confirmed a statistically significant association between age category and postoperative delirium, with the Pearson chi-square test demonstrating strong significance ($p = 0.001$), supported by exact tests and a significant linear-by-linear association ($p < 0.001$), indicating a progressive increase in delirium risk with advancing age. Analysis of anesthesia duration showed a mean exposure time of approximately 168 minutes, with longer procedures exhibiting a higher concentration of delirium cases. Although the overall distribution of anesthesia duration approximated normality, delirium was more frequently observed among patients undergoing prolonged surgeries, suggesting a temporal relationship between extended anesthetic exposure and early postoperative cognitive disturbance.

Table 1: Descriptive Statistics of Patient Demographic and Clinical Characteristics

Statistics		Gender Patient	of ASA Status	Physical Delirium	Postoperative Delirium	Age Classification	Surgery Type	Duration anesthesia (min)	of
N	Valid	120	120		120	120	120	120	
	Missing	0	0		0	0	0	0	
Mean		1.44	1.71		.09	3.92	4.05	167.73	
Median		1.00	2.00		.00	4.00	4.00	155.00	
Mode		1	1		0	2	5	120	
Std. Deviation		.499	.782		.290	1.964	1.882	79.318	
Variance		.249	.612		.084	3.859	3.544	6291.323	

Table 2: Gender Distribution and Postoperative Delirium Status of Study Participants

Gender of Patient	Total n (%)	No Delirium n (%)	Delirium n (%)	% Within Delirium
Male	67 (55.8%)	59 (54.1%)	8 (72.7%)	72.7%
Female	53 (44.2%)	50 (45.9%)	3 (27.3%)	27.3%
Total	120 (100%)	109 (100%)	11 (100%)	100%

Table 3: ASA Physical Status Distribution and Postoperative Delirium Occurrence

ASA Physical Status	Total n (%)	No Delirium n (%)	Delirium n (%)	% Within Delirium
ASA I	59 (49.2%)	56 (51.4%)	3 (27.3%)	27.3%
ASA II	37 (30.8%)	34 (31.2%)	3 (27.3%)	27.3%
ASA III	24 (20.0%)	19 (17.4%)	5 (45.5%)	45.5%
Total	120 (100%)	109 (100%)	11 (100%)	100%

Table 4: Surgical Specialty Distribution and Postoperative Delirium Occurrence

Surgical Specialty	Total n (%)	No Delirium n (%)	Delirium n (%)	% Within Delirium
Cardiac	20 (16.7%)	15 (13.8%)	5 (45.5%)	45.5%
ENT	6 (5.0%)	6 (5.5%)	0 (0.0%)	0.0%
General	20 (16.7%)	19 (17.4%)	1 (9.1%)	9.1%
Neuro	16 (13.3%)	14 (12.8%)	2 (18.2%)	18.2%
Ortho	28 (23.3%)	27 (24.8%)	1 (9.1%)	9.1%
Thoracic	20 (16.7%)	18 (16.5%)	2 (18.2%)	18.2%
Urogenital	10 (8.3%)	10 (9.2%)	0 (0.0%)	0.0%
Total	120 (100%)	109 (100%)	11 (100%)	100%

Table 5: Age Distribution and Postoperative Delirium Occurrence

Age Classification (years)	Total n (%)	No Delirium n	Delirium n
20–25	16 (13.3%)	16	0
25–30	20 (16.7%)	20	0
30–35	18 (15.0%)	17	1
35–40	17 (14.2%)	16	1
40–45	16 (13.3%)	14	2
45–50	19 (15.8%)	18	1
50–55	14 (11.7%)	8	6
Total	120 (100%)	109	11

Table 6: Incidence of Postoperative Delirium During Emergence

Age Classification: Postoperative Delirium		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No Delirium	109	90.8	90.8	90.8
	Delirium	11	9.2	9.2	100.0
	Total	120	100.0	100.0	

Table 7: Chi-Square Test Results: Age Group vs. Delirium Incidence

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact (2-sided)	Sig. (1-sided)	Exact	Sig.	Point Probability
Pearson Chi- Square	23.781a	6	.001		.001			
Likelihood Ratio	19.187	6	.004		.004			
Fisher-Freeman- Halton Exact Test	15.276				.001			
Linear-by-Linear Association	12.459b	1	.000		.000		.000	.000
N of Valid Cases	120							

a. 7 cells (50.0%) have expected count less than 5. The minimum expected count is 1.28.

b. The standardized statistic is 3.530.

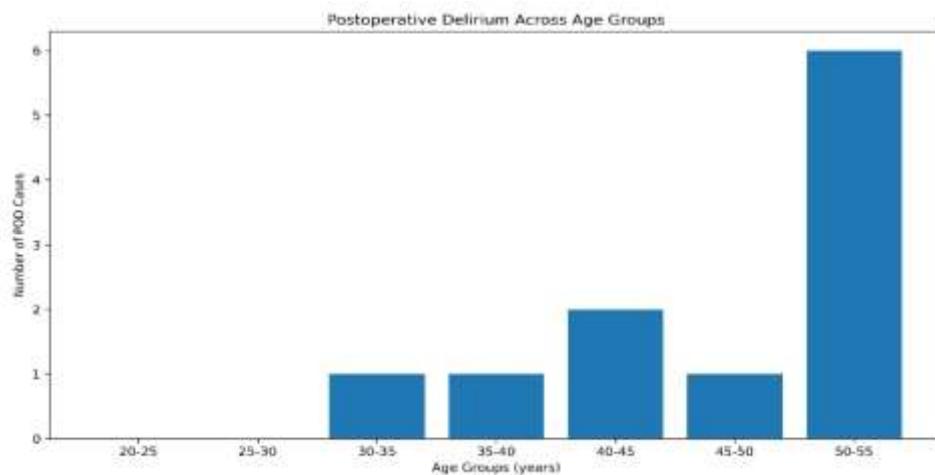


Figure 2 Postoperative Delirium Across Age Groups

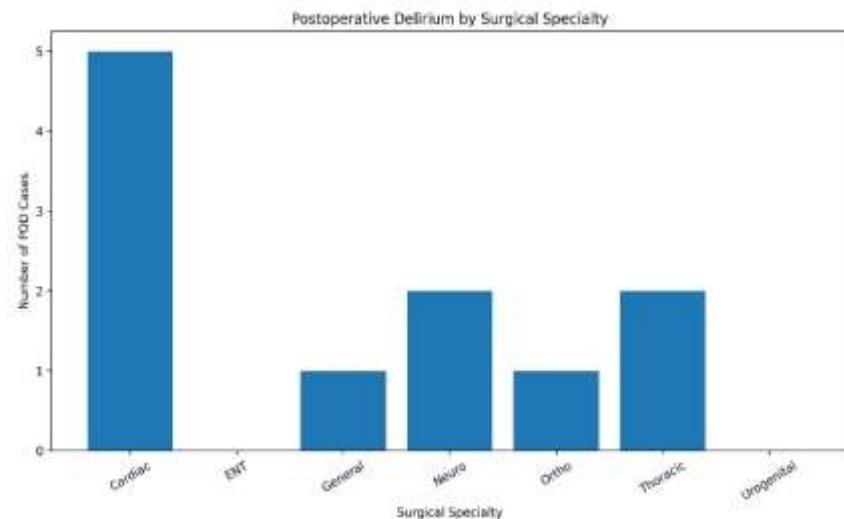


Figure 1 Postoperative Delirium by Surgical Specialty

DISCUSSION

Postoperative delirium represents an acute and clinically meaningful neurocognitive disturbance, and the present findings demonstrated that even among younger adults aged 18–55 years, delirium during the emergence phase from general anesthesia was not uncommon. An overall incidence of 9.17% was observed in the PACU, which, although lower than rates reported in geriatric surgical populations, remains clinically relevant. Large-scale studies in older adults consistently report POD rates ranging from 15% to 30%, with similarly elevated figures observed in elderly patients undergoing high-risk procedures such as cardiac and major noncardiac surgeries (12). The comparatively lower incidence observed in this cohort is plausibly attributable to the younger age cutoff, given that advancing age is widely established as the strongest and most consistent predictor of postoperative delirium (12,13). The age-related trend observed in this study aligns closely with existing literature. Delirium was absent in patients younger than 30 years and increased progressively with advancing age, with the highest burden observed in individuals aged 50–55 years. This pattern mirrors evidence from individual-patient meta-analyses demonstrating a stepwise increase in delirium risk with age, wherein patients aged 66–85 years were several-fold more likely to develop POD than those aged 65 years or younger, and the risk rose exponentially beyond 85 years (10,14). Across pooled analyses, patients who develop delirium are consistently older than those who do not, reinforcing the biological vulnerability associated with aging brains and reduced cognitive reserve (14). The use of validated, rapid delirium screening instruments constituted a notable strength of this study. Delirium assessment was conducted using a multimodal approach incorporating the 4AT, 3D-CAM, RASS, and Nu-DESC, allowing for accurate detection across hyperactive and hypoactive presentations. Prior systematic evaluations of PACU screening tools have identified the 4AT and 3D-CAM as among the most sensitive instruments available, with reported sensitivities approaching or exceeding 95%, outperforming more traditional tools that may miss subtle or hypoactive cases (15,16). This rigorous assessment strategy likely enhanced case detection and reduced misclassification, particularly during the brief and dynamic emergence window.

Surgical specialty emerged as an important determinant of delirium risk. Cardiac surgery accounted for a disproportionate share of delirium cases in this cohort, despite the relatively young age of the patients. This finding is consistent with extensive evidence identifying cardiac procedures as among the highest-risk surgeries for POD, largely due to factors such as cardiopulmonary bypass, systemic inflammation, cerebral microembolization, and perioperative hemodynamic fluctuations (17,18). Neurosurgical and thoracic procedures also demonstrated elevated delirium rates compared with general and orthopedic surgeries, aligning with prior reports that operations involving direct neural manipulation or substantial physiological stress confer heightened risk (18). These findings suggest that surgical complexity and organ-specific vulnerability may partially offset the protective effect of younger age. Duration of anesthesia appeared to play a contributory role in the development of delirium. Patients who developed POD were more likely to have undergone longer surgical and anesthetic exposure, supporting prior evidence of a dose–response relationship between operative duration and delirium risk. Large meta-analyses have demonstrated that each additional hour of surgery is associated with a measurable increase in delirium odds, independent of age and comorbidity burden (19). Prolonged anesthesia may exacerbate neuroinflammatory responses, metabolic stress, and cerebral exposure to anesthetic agents, thereby increasing susceptibility to acute cognitive dysfunction (20). Importantly, operative duration represents a potentially modifiable risk factor, highlighting opportunities for targeted prevention strategies. Gender differences were less pronounced in this study. Although a higher proportion of delirium cases occurred in males, the overall difference was modest. This observation aligns with broader literature suggesting a slight male predominance in POD risk, though the magnitude of this association is small compared with age or surgical factors and remains inconsistent across studies (21,22). Biological explanations, including hormonal influences or differences in brain reserve, have been proposed, but current evidence does not support strong sex-based stratification in delirium prevention strategies (23). Accordingly, delirium risk assessment should remain inclusive of both sexes, guided primarily by clinical and procedural risk profiles.

Several limitations warrant consideration. The single-center design and relatively small sample size limit the generalizability of the findings. The restriction of the study population to adults younger than 55 years, while intentional, precludes extrapolation to older and higher-risk populations. Additionally, delirium assessment was confined to the early emergence phase in the PACU, raising the possibility that delayed-onset delirium occurring later in the postoperative course was not captured. Prior studies employing serial assessments have reported higher cumulative incidence rates, suggesting that repeated evaluations may better reflect the dynamic nature of POD (24). Furthermore, perioperative medication use, including sedatives and analgesics, was not analyzed in detail, despite their known influence on delirium risk. Despite these limitations, the study provides valuable insight into an understudied population and establishes a baseline estimate of emergence delirium in working-age adults. The findings underscore that delirium is not exclusively a geriatric complication and can affect younger patients, particularly those undergoing complex or prolonged procedures. Future research

should incorporate multicenter designs, larger samples, serial delirium assessments, and multivariable modeling to identify independent predictors and clarify causal pathways. Interventional trials targeting modifiable risk factors, including anesthesia duration and perioperative sedation practices, are also warranted. Overall, the results reinforce the importance of routine delirium screening in the PACU across adult age groups. Although the observed incidence was lower than that reported in elderly cohorts, a near 9% rate represents a meaningful clinical burden, particularly in high-risk surgical contexts such as cardiac and neurosurgical procedures. Early recognition and targeted prevention strategies may therefore improve postoperative outcomes and reduce the broader cognitive and healthcare consequences associated with postoperative delirium.

CONCLUSION

This study demonstrated that postoperative delirium can occur during the emergence phase from general anesthesia even in younger adult patients, challenging the common perception that delirium is primarily a geriatric complication. By systematically assessing patients in the PACU using validated screening tools, the study highlighted that delirium is a clinically relevant issue in this age group, particularly following high-risk surgical procedures. These findings underscore the importance of routine, early delirium screening in the PACU and the need for heightened vigilance in susceptible surgical populations. Incorporating structured assessment into standard perioperative care may facilitate timely recognition, reduce preventable complications, and improve recovery trajectories, while future longitudinal research is essential to strengthen prevention strategies and optimize patient-centered outcomes.

AUTHOR CONTRIBUTIONS

Author	Contribution
Tayyab Ghaffar	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Muhammad Zeeshan Khan*	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published

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