

Risk factors for postoperative delirium in adults in intensive care: a scoping review

Fatores de risco para delirium pós-operatório em adultos na terapia intensiva: revisão de escopo Factores de riesgo del delirio postoperatorio en adultos bajo cuidados intensivos: revisión de alcance

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ABSTRACT

Objective: to map the risk factors for postoperative delirium among adults in intensive care. **Method:** a scoping review conducted in six databases as recommended by the Joanna Briggs Institute during December 2024 and with no language restrictions. **Results:** a total of 53 studies that evidenced risk factors in perioperative phases were included. The factors were related to individual characteristics, anesthetic-surgical procedures and postoperative care. Advanced age was the most consistent factor. Male gender and comorbidities were relevant in the preoperative period. Urgent surgeries, transfusions and type of anesthesia stood out in the intraoperative period. In turn, the following were emphasized in the postoperative period: severity, mechanical ventilation and elevation of inflammatory markers. **Conclusion**: the mapping of risk factors showed predominance of immutable conditions during the preoperative period, while surgical procedures and the postoperative phase presented modifiable factors. Thus, this review favors early identification of risk factors and conditions subject to Nursing interventions in different perioperative phases.

Descriptors: Critical Care Nursing; Postoperative Care; Delirium; Risk Factors; Review.

RESUMO

Objetivo: mapear os fatores de risco para delirium pós-operatório em adultos nas terapias intensivas. **Método:** revisão de escopo realizada conforme preconizado pelo Joanna Briggs *Institute*, em seis bases de dados, em dezembro de 2024 e sem restrição idiomática. **Resultados:** foram incluídos 53 estudos que evidenciaram fatores de risco em fases perioperatórias. Os fatores estão relacionados as características individuais, procedimentos anestésico-cirúrgicos e cuidados pós-operatórios. A idade avançada foi o fator mais consistente. No pré-operatório, sexo masculino e comorbidades foram relevantes. No intraoperatório, cirurgias urgentes, transfusões e tipo de anestesia se destacam. Já no pós-operatório foram enfatizados: gravidade, ventilação mecânica e elevação de marcadores inflamatórios. **Conclusão**: o mapeamento dos fatores de risco evidenciou predomínio de condições imutáveis durante o pré-operatório, enquanto procedimentos cirúrgicos e fase pós-operatória apresentaram fatores modificáveis. Assim, esta revisão favorece a identificação precoce dos fatores de risco e condições passíveis de intervenções de enfermagem em fases perioperatórias distintas.

Descritores: Enfermagem de Cuidados Críticos; Cuidados Pós-Operatórios; Delirium; Fatores de Risco; Revisão.

RESUMEN

Objetivo: identificar los factores de riesgo de delirio postoperatorio en adultos bajo cuidados intensivos. **Método:** revisión de alcance realizada de acuerdo con las recomendaciones del *Instituto Joanna Briggs*, en seis bases de datos, en diciembre de 2024, sin restricciones de idioma. **Resultados:** Se incluyeron 53 estudios que demostraron factores de riesgo en fases perioperatorias. Los factores se relacionan con características individuales, procedimientos anestésico-quirúrgicos y cuidados postoperatorios. La edad avanzada fue el factor más consistente. En el preoperatorio fueron relevantes el sexo masculino y las comorbilidades. En el período intraoperatorio se destacan cirugías urgentes, transfusiones y tipo de anestesia. En el postoperatorio se enfatizó: severidad, ventilación mecánica y elevación de marcadores inflamatorios. **Conclusión**: el mapeo de factores de riesgo mostró predominio de condiciones inmodificables durante el período preoperatorio, mientras que los procedimientos quirúrgicos y la etapa postoperatoria presentaron factores modificables. De esta forma, esta revisión favorece la identificación temprana de factores de riesgo y condiciones pasibles de intervención de enfermería en diferentes etapas perioperatorias.

Descriptores: Enfermería de Cuidados Críticos; Cuidados Posoperatorios; Delirium; Factores de Riesgo; Revisión.

INTRODUCTION

Postoperative Delirium (POD) consists of an acute confusional state that progresses with disorientation and fluctuating consciousness, usually with a wide variety of clinical manifestations and cognitive impairments. Although the etiology of POD is multifactorial, anesthesia has been identified as one of the main conditioning factors¹. It is also suggested that the condition develops from precipitating factors associated with inflammatory mechanisms induced by surgery, which interact with the patients' predisposing vulnerability².

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Described as frequent in intensive care units, delirium can affect 80% of all critically-ill patients, depending on the population segment under study and on the diagnostic criteria used. It is also independently associated with a 10% increase in the mortality rate for each day and, in surgical patients, its incidence is estimated at 20%³ and the risk of death is 2.4 times higher⁴. Considered an undesirable event for patients and their families, POD can favor the persistence of cognitive deficit for months or years after hospital discharge, leading to a reduction in quality of life and to impairments in exercising social and economic roles⁵.

Delirium is a nosological entity represented by the Nursing diagnosis called "Acute confusion", defined by reversible disturbances in consciousness, attention, cognition and perception that develop in a short period of time⁶. Although delirium results from organic alterations, it manifests itself through behavioral changes identified by nurses, who act by planning and implementing Nursing interventions aimed at ensuring cognitive preservation, nutritional conditions, sleep hygiene, sensory stimulation, pain management, fluid intake, infection control and management of the therapeutic regime⁶.

In this context, available guidelines recommend identifying individuals at high risk of developing delirium during the postoperative period, with the objective of implementing preventive measures⁷. Adopting multi-component and non-pharmacological measures provides a reduction in the incidence of POD by up to 40%⁸. However, given that it is not feasible to their preventive and indiscriminate implementation of such measures⁷, the importance of identifying risk factors in order to determine priorities and implement systematic actions is corroborated⁹.

However, elucidating the risk factors for delirium in surgical patients is a difficult task in intensive care. This obstacle may be associated with the dynamics required for the surgical assistance to be provided to critically-ill patients, in addition to the absence of institutional protocols encouraging the detection of individuals at greater risk of the outcome⁷.

The literature is in agreement when it is highlighted that there is a higher probability of developing PDB in older individuals¹⁰. However, there is no consensus regarding the impact of anesthetic-surgical events on development of delirium. While some articles highlight that PDB is associated with anemia and low cognitive reserve¹¹, others attribute it to low Body Mass Index, correlating it with protein malnutrition and with the consequent reductions in serum albumin concentration. It is also suggested that sociocultural factors such as illiteracy may be associated¹² and there is disagreement regarding prolonged surgical time as a triggering factor for PDB^{4,12}.

Considering the diversity of conflicting primary studies and the existence of numerous reviews on the subject matter, a preliminary search was carried out in the MEDLINE, Cochrane Database of Systematic Reviews and JBI Evidence Synthesis databases, finding no comprehensive reviews on the topic. Thus, the objective was to map the risk factors for postoperative delirium among adults in intensive care.

METHOD

This is a scoping review based on the Joanna Briggs Institute (JBI) method using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) instrument, carried out in five stages: 1) Identification of the research question; 2) Identification of relevant studies; 3) Selection of studies; 4) Data analysis; and 5) Data grouping, synthesis and presentation¹³.

Using the PCC acronym (Population: adult surgical patients; Concept: risk factors for developing delirium; and Context: intensive care), the following research question was structured: "Which are the risk factors associated with the occurrence of delirium among adult surgical patients in intensive care?"

A search was carried out in the PUBMED, EMBASE, SCOPUS, CINAHL, LILACS and BDTD databases on October 10th, 2022, correlating the following descriptors: Delirium, Risk Factors, Critical Care, Intensive Care, Intensive Care Units, Postoperative Period, Postoperative Care, Postoperative Cognitive Complications, and synonymous free terms, with the objective of finding scientific evidence to answer the research question proposed in the current study. To identify the search terms, the controlled vocabularies of the Descriptors in Health Sciences (*Descritores em Ciências da Saúde*, DeCs), MeSH (Medical Subject Headings) and Emtree (Embase Subject Headings) were consulted. No date, language and/or study design filters were applied. The authors registered the protocol for this review in the Open Science Framework Platform, through identifier DOI: 10.17605/OSF.IO/K4P7Z¹⁴.

The search strategy was updated on December 5th, 2024, to include more recent publications, covering the period from October 11th, 2022, to December 5th, 2024. Development of the strategy (including all descriptors) was adapted for each database, as can be seen in Figure 1, with its complementary search strategy regarding the update of the studies presented. It is noteworthy that the descriptors and Boolean operators used in the CINAHL and BDTD databases remained unchanged even after their updates due to the fundamental characteristics of these databases and their operational structure.





	Search strategies	n*
PUBMED	(Delirium[mh] OR Delirium*[tiab] OR Delirious[tiab]) AND (Risk Factors[mh] OR Risk Factor*[tiab] OR Risk Score*[tiab] OR Atropine[ti] OR Fentanyl[ti] OR Midazolam[ti] OR Bupivacaine[ti] OR Ketamine[ti] OR Naloxone[ti] OR Flumazenil[ti] OR Cisatracurium[ti] OR Anesthetic*[ti] OR Catheter*[ti] OR Tobacco[ti] OR Alcohol[ti] OR Dementia[ti]) AND (Critical Care[mh] OR Intensive Care Units[mh] OR Critical Care*[tiab] OR Intensive Care*[tiab] OR ICU[tiab] OR GICU[tiab] OR ICUS[tiab] OR GICUS[tiab]) AND (Postoperative Period[mh] OR Postoperative Care[mh] OR Postoperative Cognitive Complications[mh] OR Postoperat*[tiab] OR Postsurg*[tiab]) NOT (Cardiac*[ti] OR Heart*[ti] OR Cardio*[ti] OR Intracrani*[ti] OR Child*[ti] OR Adolescent*[ti] OR Infant*[ti] OR Teen*[ti] OR Pediatric*[ti] OR Symposium[ti] OR Letter*[ti]) AND ("2022/10/11"[PDAT] : "2024/12/05"[PDAT])	282 88
EMBASE	('delirium'/exp OR 'delirious':ti,ab OR 'delirium':ti,ab) AND ('risk factor'/exp OR 'risk factor*':ti,ab OR 'risk score*':ti,ab OR 'atropine':ti OR 'fentanyl':ti OR 'midazolam':ti OR 'bupivacaine':ti OR 'ketamine':ti OR 'naloxone':ti OR 'flumazenil':ti OR 'cisatracurium':ti OR 'anesthe*':ti OR 'catheter*':ti OR 'tobacco':ti OR 'alcohol':ti OR 'dementia':ti) AND ('intensive care'/exp OR 'critical care':ti,ab OR 'intensive care':ti,ab OR 'postoperative period'/exp OR 'postoperat*':ti,ab OR 'postsurgery':ti,ab OR 'postsurgical':ti,ab OR 'postoperative care'/exp OR 'postoperative dysfunction'/exp NOT ('cardiac':ti OR 'heart':ti OR 'cardio*':ti OR 'infant*':ti OR 'toR 'critical Care':ti,ab OR 'pediatric*':ti) AND [embase]/lim NOT ([embase]/lim AND [medline]/lim) AND ('article'/it OR 'review'/it) AND [11-10-2022]/sd NOT [06-12-2024]/sd	71
SCOPUS	TITLE(Delirium* OR Delirious) AND TITLE-ABS-KEY("Risk Factor*" OR "Risk Score*" OR Atropine OR Fentanyl OR Midazolam OR Bupivacaine OR Ketamine OR Naloxone OR Flumazenil OR Cisatracurium OR Anesthetic* OR Catheter* OR Tobacco OR Alcohol OR Dementia) AND TITLE-ABS-KEY("Critical Care*" OR "Intensive Care*" OR ICU OR GICU OR ICUS OR GICUs) AND TITLE("Postoperative Period" OR "Postoperative Care" OR "Postoperative Cognitive Complications" OR Postoperat* OR Postsurg*) AND NOT TITLE(Cardiac* OR Heart* OR Cardio* OR Intracrani* OR Cranio* OR Child* OR Adolescent* OR Infant* OR Teen* OR Pediatric* OR Symposium OR Letter*) AND (LIMIT-TO(DOCTYPE, "ar") OR LIMIT-TO(PUBYEAR,2022) OR LIMIT-TO(PUBYEAR,2023) OR LIMIT-TO(PUBYEAR,2024)) AND (LIMIT-TO(DOCTYPE, "re"))	188
CINAHL	(Delirium* OR Delirious) AND ("Risk Factor*" OR "Risk Score*" OR Atropine OR Fentanyl OR Midazolam OR Bupivacaine OR Ketamine OR Naloxone OR Flumazenil OR Cisatracurium OR Anesthetic* OR Catheter* OR Tobacco OR Alcohol OR Dementia) AND ("Critical Care*" OR "Intensive Care*" OR ICU OR GICU OR ICUs OR GICUs) AND ("Postoperative Period" OR "Postoperative Care" OR "Postoperative Cognitive Complications" OR Postoperat* OR Postsurg*) NOT (Cardiac* OR Heart* OR Cardio* OR Intracrani* OR Cranio* OR Child* OR Adolescent* OR Infant* OR Teen* OR Pediatric* OR Symposium OR Letter*)	40 09
LILACS	(Delirium* OR Delirious OR Delirio) AND ("Risk Factor" OR "Risk Factors" OR "Risk Score" OR "Risk Scores" OR "Fator de Risco" OR "Fatores de Risco" OR "Factor de Riesgo" OR "Factores de Riesgo" OR Atropine OR Fentanyl OR Midazolam OR Bupivacaine OR Ketamine OR Naloxone OR Flumazenil OR Cisatracurium OR Anesthetic* OR Catheter* OR Tobacco OR Alcohol OR Dementia OR Tabagismo OR Alcool OR Demencia) AND ("Critical Care" OR "Intensive Care" OR "Cuidado Critico" OR "Cuidados Críticos" OR "Cuidado Intensivo" OR "Cuidados Intensivos" OR "Terapia Intensiva" OR ICU OR GICU OR UTI) AND ("Postoperative Period" OR "Postoperative Care" OR "Postoperative Cognitive Complications" OR Postoperat* OR Postsurg* OR "Pos- Operatório" OR "Pós-Cirurgia") AND NOT (Cardiac* OR Heart* OR Cardio* OR Intracrani* OR Cranio* OR Child* OR Adolescent* OR Infant* OR Teen* OR Pediatric*) AND (db:("LILACS")) AND (year cluster:[2022 TO 2024])	03
BDTD	(Delirium* OR Delirious OR Delirio) AND ("Risk Factor" OR "Risk Factors" OR "Risk Score" OR "Fator de Risco" OR "Fatores de Risco") AND ("Critical Care" OR "Intensive Care" OR "Cuidado Critico" OR "Cuidados Críticos" OR "Cuidado Intensivo" OR "Cuidados Intensivos" OR "Terapia Intensiva" OR ICLI OR GICLI OR UTI) AND	05
	(Postoperat* OR Postsurg* OR "Pos-Operatório" OR "Pós-Cirurgia"	01
Note: *n – Nu	nber of articles	

Figure 1: Explanatory chart of databases, descriptors and initial/ updated search strategies. Rio de Janeiro, RJ, Brazil, 2024.

According to the Joanna Briggs Institute (JBI), the following levels of evidence are assigned to the studies consulted: Level 1 – Experimental research designs; Level 2 – Quasi-experimental designs; Level 3 – Observational and analytical designs; Level 4 – Observational and descriptive studies; and Level 5 – Experts' opinions¹⁵. In this context and considering that despite its comprehensive nature, this summary aims at supporting the professional practice, it was decided to map studies whose methodological conduction allows obtaining higher levels of evidence, adopting the following inclusion criteria: Systematic Reviews, with or without Meta-Analysis; and Randomized Clinical Trials or Cohort Studies addressing risk factors for delirium in surgical patients, thus excluding studies classified as levels 4 and 5. There





were no language or time restrictions and studies on surgical delirium in pediatric patients or that did not address the intensive care context were not included.

The articles found were exported to the EndNote Web reference manager and were made available through the Rayyan[®] (Intelligent Systematic Review Rayyan) reference manager after removing duplicates, with the objective of ensuring a systematic evaluation carried out by two independent reviewers, who considered the titles and abstracts of the studies considered according to the inclusion criteria. Those deemed eligible were assessed in full and any and all disagreements were analyzed by a third reviewer. The reasons for exclusion based on the full reading and not meeting the inclusion criteria were recorded and reported in this review.

The data were extracted by two independent reviewers using a structured instrument developed by the researchers, and the adaptation possibility was adopted according to the reading procedures. At the end of the process, the following information was obtained for the studies considered eligible: author, publication year, country of origin, study design, objectives, number of participants, risk factors detected for postoperative delirium, method used to detect delirium and incidence of postoperative delirium.

RESULTS

After the initial database searches, 639 records were identified and exported to the EndNote Web reference manager, with 177 duplicates removed, resulting in 462 records. After updating the search strategies, another 281 records were identified and exported, removing 61 duplicates and totaling 220 new records.

Thus, the updated search strategy identified 920 records, removing 238 duplicates and resulting in 682 records to analyze their titles and abstracts. The citations were transferred to the Rayyan software. After applying the eligibility criteria, two reviewers selected 83 studies for independent and full reading. In the end, 53 studies were included in this review.

The reasons for exclusion consisted in study protocols or materials not answering the research question. The results of the updated search and study inclusion process were presented in an extension flowchart according to the recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-analyses extension for Scoping Reviews (PRISMA-ScR), as shown in Figure 2.



Figure 2: Flowchart showing the study selection process adapted from PRISMA-ScR.Rio de Janeiro, RJ, Brazil, 2024.





As shown in Figures 3, 4, 5 and 6, this review included 24 prospective cohort studies^{16-35;60,61,63,64} (45.3%), fifteen retrospective cohort studies^{36-48;66,67} (28.3%), ten systematic reviews with or without meta-analysis⁴⁹⁻⁵⁸ (18.8%), two case-control studies^{62.68} (3.7%) and two controlled clinical trials^{59,65} (3.7%). Regarding the country of origin of the studies, the United States stood out with 16 publications (30.1%), followed by China and Germany with 12 (22.6%) and eight (15.1%), respectively, the Netherlands with five (9.4%), Japan with four (7.5%), Switzerland with two (3.7%) and other countries (Brazil, Canada, Poland, Iran, Korea and Portugal) with one publication each (1.8%). A substantial number of studies (n=15) were published in the last three years and only seven (12.9%) dated back from more than ten years, which adds a current and relevant characteristic to the topic.

Article	Publication	Study		Incidence	Detection	
code	year/country	design	n	of delirium	method	Risk factors identified in studies
A16 ³¹	2020	Prospective	154	22%-49.4%	CAM	Preoperative mild cognitive impairment, surgery
	China	Cohort				duration>80 min and segmentectomy/lobectomy
						resection identified as independent risk factors for
						postoperative delirium
A19 ³⁴	2021	Prospective	319	26.6%	CAM-ICU	Age, anesthesia method, Mini-Mental State
	China	Cohort				Examination score, hypoxia during surgery, presence of
						family members during ICU hospitalization, serum IL-6
						concentration above 9 ng/ml and severe hemorrhage
A20 ³⁵	2019	Prospective	206	22.3%	CAM	Plasma cholinesterase, age, APACHE II score,
	China	Cohort				lower acetylcholinesterase and butyrylcholinesterase activity
A35 ⁵⁰	2021	Systematic	3,533	24%	CAM-ICU	Older patients who have undergone non-cardiac
	China	Review				surgeries, with preoperative risk factors such as advanced
						age and cognitive impairment
A36 ⁵¹	2022	Meta-	2,673	29%	CAM-ICU	Preoperative Vitamin D deficiency, but not
	China	Analysis of				insufficiency, increased the risk of POD
		Cohort				
		Studies				
A3853	2017	Meta-	386	Not	Not	Midazolam use resulted in an increased risk of postoperative
	China	Analysis of		reported	reported	delirium, dexmedetomidine use was significantly lower
		Controlled				
		Clinical				
		Trials				
A39 ⁵⁴	2022	Systematic	6,720	15.5%	CAM-ICU	Advanced age, male gender, alcohol consumption, APACHE-II
	China	Review with				score, mechanical ventilation use in the ICU and its
		Meta-				duration and use of sedative medications
		Analysis				
A43 ⁵⁸	2020	Systematic	55 <i>,</i> 907	Not	DSM, DRS-R-	Perioperative sleep disturbances were significantly
	China	Review with		reported	98, CAM-	associated with the occurrence of POD in
		Meta-			ICU, ICD-10,	observational groups
		Analysis			NEECHAM,	
					CAM	
A46 ⁶¹	2022	Prospective	364	25.5%	3D-CAM	Age, history of alcohol consumption, diabetes,
	China	Cohort				anemia, peripheral vascular disease, preoperative cardiac
						function class, left ventricular ejection fraction,
						albumin, glycosylated hemoglobin, intraoperative blood
						transfusion, acid-base imbalance and electrolyte disturbance
A47 ⁶²	2024	Case-	105	Not	ICDSC	Smoking, thoracic surgeries and vascular surgeries
	China	Control		reported		
A48 ⁶³	2023	Prospective	208	15.4%	CAM-ICU	Previous coronary heart disease and postoperative use of
	China	Cohort				sedatives
A53 ⁶⁸	2024	Case-	200	Not	CAM-ICU	Age, propofol dosage, duration of surgery,
	China	Control		reported		infusion volume and cognitive dysfunction

Key: n: Number of participants; EEG: Electroencephalogram; CAM: Confusion Assessment Method; CAM-ICU: Confusion Assessment Method for the Intensive Care Unit; 3D-CAM: Chinese version of the 3-minute Diagnostic Confusion Assessment Method; ICDSC: Intensive Care Delirium Screening Checklist; NEECHAM: Neelon and Champagne Confusion Scale; DRS-R-98: Delirium Rating Scale-R-98; DSM: Diagnostic and Statistical Manual of Mental Disorders; ICD: International Statistical Classification of Diseases and Related Health Problems.

Figure 3. Characteristics of the studies included in the review published in China. Rio de Janeiro, RJ, Brazil, 2024.





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Article	Publication	Study		Incidence	Detection	
code	year/country	design	n	of delirium	method	Risk factors identified in studies
A2 ¹⁷	2017	Prospective	618	26%	CAM-ICU	Increased intraoperative EEG suppression
	USA	Cohort				
A318	2017	Prospective	1,040	39%	RBANS	Lower baseline schooling level, worse global cognition
	USA	Cohort				associated with longer duration of hospital delirium
A7 ²²	2020	Prospective	178	12.3%-	CAM-ICU	Patients classified as frail or prefrail and with lower
	USA	Cohort		22.1%		baseline cognitive scores
A10 ²⁵	2016	Prospective	431	34%	CAM	Male gender, age, dementia, Parkinson's disease and
	USA	Cohort				ASA classification
A13 ²⁸	20207	Prospective	163	26%	CAM	Frail patients, using 3 medications, with at least
	USA	Cohort				3 comorbidities, longer hospitalization time
A23 ³⁸	2020	Retrospectiv	4,424	41%	Not	Preoperative use of renin-angiotensin system inhibitors
	USA	e cohort			reported	is not associated with reduced POD
A24 ³⁹	2022	Retrospectiv	319	6.3%	Not	Mini-Cog [©] is not independently associated with
	USA	e Cohort			reported	postoperative delirium. Only age remains as an
						independent risk factor for developing POD when
						controlling for other preoperative variables
A26 ⁴¹	2 022	Retrospectiv	702	24.6%	CAM-ICU	Advanced age, diabetes, lower pre and postoperative
	USA	e Cohort			DOSS	hemoglobin, higher ASA grade, greater surgery magnitude
						and higher postoperative pain scores
A27 ⁴²	2016	Retrospectiv	727	26%	CAM-ICU	EEG suppression is an independent risk factor for
	USA	e Cohort				postoperative delirium: the longer its duration,
						the higher the incidence
A2843	2020	Retrospectiv	7,792	47%	CAM-ICU	Patients with obstructive sleep apnea had a slightly
	USA	e Cohort				lower prevalence of postoperative delirium in the ICU,
						with no significant association
A3045	2020	Retrospectiv	1,083	35%	CAM-ICU	Intra- and postoperative hypotension are associated with
	USA	e Cohort				delirium in postoperative intensive care patients
A3247	2022	Retrospectiv	324	2.1%-8.1%	CAM-ICU	Aged patients, not admitted to the ICU, undergoing
	USA	e Cohort				elective surgeries, with incontinence
A34 ⁴⁹	2021	Systematic	1,008	7%-56%	CAM-ICU	Older surgical patients with preoperative frailty had
	USA	Review with			ICDSC	a significantly higher risk of developing POD
		Meta-				
		Analysis				<u> </u>
A3752	2016	Systematic	3,817	23.4%	CAM	ASA scores>2, renal insufficiency, previous stroke, history
	USA	Review with			NEECHAM	of neurological comorbidity, male gender, older age, lower
		Meta-			DSM	preoperative hemoglobin levels and longer intensive care
		Analysis			DOS	unit hospitalization times
				2.524	DRS	
A45⁰	2023	Prospective	152	26%	CAM-ICU	Baseline cognitive impairment, depression and
	USA	Cohort	400	22 = 21	and Nudesc	increased surgical complexity
A51ºº	2022	Retrospectiv	136	23.5%	CAM-ICU	Higher Body Mass Index, increased intraoperative lactate,
	USA	e Cohort				prolonged surgery

Key: n: Number of participants; USA: United States of America; EEG: Electroencephalogram; CAM: Confusion Assessment Method; CAM-ICU: Confusion Assessment Method for the Intensive Care Unit; 3D-CAM: Chinese version of the 3-minute Diagnostic Confusion Assessment Method; ICDSC: Intensive Care Delirium Screening Checklist; DOSS: Delirium Observation Screening Scale; DOS: Delirium Observation Scale; RBANS: Repeatable Battery for the Assessment of Neuropsychological Status; NEECHAM: Neelon and Champagne Confusion Scale; DSM: Diagnostic and Statistical Manual of Mental Disorders; ASA: American Society of Anesthesiology; Mini-Cog©: tool for cognitive assessment.

Figure 4. Characteristics of the studies included in the review published in the United States. Rio de Janeiro, RJ, Brazil, 2024.





code year/country design n of delirium method Nisk factors identified in studies A1 ¹⁶ 2022 Prospective 301 14.6% Nubbecs Reduction in thalamus volume A4 ¹⁹ 2013 Prospective 627 10% CAM Real and cognitive impairment, ASA scores3, active smoking, ICU admission, red blood cell transfusion and colorectal cancer diagnosis A5 ²⁰ 2013 Prospective 113 36% CAM Elevated preoperative and postoperative cortisol levels A6 ²¹ 2021 Prospective 202 21.7% ICCSC Demention, heart failure and polypharmacy, pneumonia and segmany A9 ²⁴ 2011 Prospective 72 22.7% CAM-ICU Age, hysical state, ASA classification, NYHA classification, ASA classi	Article	Publication	Study		Incidence	Detection	
A1 ⁴⁶ 2022 Prospective 301 14.6% NuDesc Reduction in thalamus volume Germany Cohort CAM Renal and cognitive impairment, ASA score23, active A5 ³⁰ 2013 Prospective 113 36% CAM Elevated preoperative and postporative A5 ³⁰ 2013 Prospective 123 36% CAM Elevated preoperative and postporative A87 ³⁰ 2021 Prospective 9.78 22.28% CAM-ICU Age, physical state, ASA classification, surgital risk and short cognitive assessment A11 ⁴⁵ 2011 Prospective 1.02 4.2%*/1.0% NuDesc Reveal on orbitities, physical disability degree, renal failure, elevated C-reactive protein, NYHA classification A14 ⁴⁵⁰ Cohort 27% DOS Increased comorbitities, physical disability degree, renal failure, elevated C-reactive protein, ASA classification A14 ⁴⁷⁹ 2012 Prospective 1.00 2.8% CAM-ICU Thiogenetive analgesic A14 ⁴⁷⁹ 2012 Prospective 4.33 3.3%-4.9% CAM-ICU The incindere of delirium in the postanesthesia care unit was	code	year/country	design	n	of delirium	method	Risk factors identified in studies
Advis Description Description <thdescription< th=""> <thdescription< th=""> <thde< td=""><td>A1¹⁶</td><td>2022 Germany</td><td>Prospective Cohort</td><td>301</td><td>14.6%</td><td>NuDesc</td><td>Reduction in thalamus volume</td></thde<></thdescription<></thdescription<>	A1 ¹⁶	2022 Germany	Prospective Cohort	301	14.6%	NuDesc	Reduction in thalamus volume
Netherlands Cohort Low Low Maximum A570 2013 Prospective 113 36% CAM Elevated preoperative and postoperative A873 2021 Prospective 21.7% ICOSC Dementa, heart failure and polypharmacy, pneumonia and brain inflammation, mechanical ventilation use or duration A974 2011 Prospective 21.2% CAM-ICU Age, physical state, ASA classification, WTA classification, Germany A1176 2011 Prospective 1.002 4.2%-11.0% Surgerative and postoperative assessment A1176 2011 Prospective 1.002 4.2%-11.0% Nubesc Preoperative fluid fasting duration and choice Germany Cohort 203 Prospective 1.002 2.8% CAM-ICU Thiopentone was significantly own in patients under the new no-sedative premedication policy A1428 2012 Prospective 423 33%-49% CAM-ICU Thiopentone was significantly wassociated with an eight-fold increased risk of delinium when compared to propori A1590 2022 Prospective 433 USA CAM-ICU The incide	Δ419	2019	Prospective	627	10%		Renal and cognitive impairment ASA score>3 active
Asia Description Concepting and the second	~-	Netherlands	Cohort	027	10/0	CAM	smoking ICU admission red blood cell transfusion and
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Key: n: Number of participants; CAM: Confusion Assessment Method; CAM-ICU: Confusion Assessment Method for the Intensive Care Unit; 3ICDSC: Intensive Care Delirium Screening Checklist; DOS: Delirium Observation Scale; APA: American Psychiatric Association criteria; RBANS: Repeatable Battery for the Assessment of Neuropsychological Status; NEECHAM: Neelon and Champagne Confusion Scale; DSM: Diagnostic and Statistical Manual of Mental Disorders; ASA: American Society of Anesthesiology; SOFA: Sequential Organ Failure Assessment; NYHA: *New York Heart Association*. **Figure 5.** Characteristics of the studies included in the review published in Europe. Rio de Janeiro, RJ, Brazil, 2024.



Article	Publication	Study		Incidence	Detection	
code	year/country	design	n	of delirium	method	Risk factors identified in studies
A6 ²¹	2016	Prospective	561	20%	NuDesc	Age, low physical activity, hearing impairment, heavy
	Korea	Cohort				alcoholism, history of previous delirium, admission to
						Intensive Care Unit, emergency surgery, open surgery
						and increased preoperative C-reactive protein
A21 ³⁶	2020	Retrospectiv	8,878	49.9%	ICDSC	Age, gender, APACHE II score, Glasgow Coma Scale score
	Canada	e Cohort			CAM-ICU	on admission, SOFA, Charlson's index, use of vasoactive
						drugs within 24 hours of intensive care admission,
						preexisting neuropsychiatric disorder, continuous renal
						replacement therapy and mechanical ventilation use
						within 24 hours of intensive care admission
A25 ⁴⁰	2021	Retrospectiv	5,112	3.56%	Not	Intraoperative use of indwelling urinary catheters
	Japan	e Cohort			reported	increases the risk of postoperative altered mental state,
						urinary tract infection and prolonged hospitalization
A31 ⁴⁶	2020	Retrospectiv	250	31%	DSM-5	Discontinuation of benzodiazepine receptor agonists
	Japan	e Cohort			criteria	showed a higher incidence rate for delirium
A33 ⁴⁸	2012	Retrospectiv	306	50%	Not	Advanced age, male gender, use of additional
	Japan	e Cohort			reported	flunitrazepam for sedation in surgical ICU, time on
						mechanical ventilation after surgery and ICU
						hosptialization time are associated with delirium
A49 ⁶⁴	2024	Prospective	157	28%	CAM-ICU	Age, duration of surgery, use of crystalloids, non-
	Brazil	Cohort				administration of anti-emetics, sufentanil, anti-
						inflammatories and intraoperative transfusion
A5065	2024	Controlled	90	Not	DOSS	Mannitol in cardiac surgery with cardiopulmonary
	Iran	Clinical Trial		reported		bypass reduces the incidence of POD
A5267	2022	Retrospectiv	87	36%	CAM-ICU	Aortic valve opening area, inhalational anesthetic,
	Japan	e Cohort				prolonged surgery, cognitive dysfunction, frailty

Key: n: Number of participants; CAM: Confusion Assessment Method; CAM-ICU: Confusion Assessment Method for the Intensive Care Unit; ICDSC: Intensive Care Delirium Screening Checklist; DOS: Delirium Observation Scale; APA: American Psychiatric Association criteria; RBANS: Repeatable Battery for the Assessment of Neuropsychological Status; NEECHAM: Neelon and Champagne Confusion Scale; DSM: Diagnostic and Statistical Manual of Mental Disorders; ASA: American Society of Anesthesiology; SOFA: Sequential Organ Failure Assessment.

Figure 6. Characteristics of the studies included in the review published in other countries. Rio de Janeiro, RJ, Brazil, 2024.

The number of participants identified in the studies ranged from 87 to 55,907 individuals, thus denoting a heterogeneous characteristic in relation to the sample populations. Most of the studies (n=28) used the Confusion Assessment Method for Intensive Care Unit (CAM-ICU) to detect delirium, seven (13.2%) in association with other methods, such as the Intensive Care Delirium Screening Checklist (ICDSC) and the Nursing Delirium Scale (NuDesc). In turn, in another five publications (9.4%), the use of a validated instrument to assess confusional states was not identified.

The incidence of delirium in the studies ranged from 2.1% to 50%, with the majority (n=44; 83%) estimated at up to 30%. It was also observed that the factors associated with POD identified in the studies were related to the individuals' predisposing and precipitating conditions, evidenced in different perioperative phases. Therefore, this scope established that risk factors should be categorized into three axes, as shown in Figure 7.



Risk factors identified during the perioperative period in critically-ill adult patients
Preoperative
Individual characteristics: advanced age ^{21,24,25,32,34,35,39,41,44,48,50,52,53,56,57,61,64,68} ; gender ^{25,43,44,48,52,53} ; Body Mass Index ⁶⁶ ; schooling ^{18,22,26}
Laboratory alterations: preoperative hemoglobin ^{41,50,52,57,61} ; TSH ⁴⁴ ; plasma cholinesterase ³⁵ ; glycosylated hemoglobin ⁶¹ ; increased
C-reactive protein ^{21,26,33} : Interleukin-6 ³⁴ : plasma corticosteroid ²⁰ : Vitamin D deficiency ⁵¹
Comorbidities: ASA ^{19,24,26,32,41,52} ; diabetes <i>mellitus</i> ^{33,41,44,57,61} ; dementia ^{23,25} ; depression ⁶⁰ ; systemic arterial hypertension ²³ ;
stroke ^{33,52} ; Parkinson's disease ²⁵ , peripheral vascular disease ⁶¹ ; coronary disease ⁶³ ; heart failure ^{23,24,61} ; neuropsychiatric disorder ³⁶ ;
renal failure ^{19,26,36,52,57} ; alcoholism ^{21,54,56,61} ; smoking ^{19,33,63} ; hearing impairment ^{21,43,57} ; colorectal cancer ¹⁹ ; pneumonia ²³ ; Charlson's
Comorbidity Index ³⁶
Structural: reduction in thalamic volume ¹⁶
Medications: anticholinergics ⁴⁰ and polypharmacy ^{23,28}
Frailty ^{22,26,28,37,38,43,44,47,48,49,67} and cognitive dysfunction ^{18,22,24,31,34,37,39,44,50,56,57,60,67,68}
Sleep disorder ^{34.50}
Prolonged liquid fasting ²⁷
Intraoperative
Medications: sufentanil ⁶⁴ ; anti-inflammatory drugs ⁶⁴ ; not administering anti-emetics ⁶⁴ ; infusion volume ⁶⁸ ; crystalloids ⁶⁴ ; propofol
dosage ⁶⁸ , opioids ²⁷ ; flunitrazepam ⁴⁸ ; thiopentone ²⁹
Clinical complications: hypotension ⁴⁵ ; hypoxia ³⁴ ; bleeding with or without transfusion ^{19,32,33,34,57,61,64}
Surgical characteristics: urgency ^{21,22,32,44,57} ; surgical complexity ⁶⁰ ; invasive/open ²¹ ; prolonged duration ^{31,41,44,64,67,68} ; thoracic
surgery ⁶² with segmentectomy/lobectomy ²¹ ; open aortic vascular surgery ⁶² or amputation ^{33,57} ; number of spinal levels addressed
during lumbar fusion procedure ⁴¹ ; aortic valve opening area ⁶⁷ ; inhalational anesthesia ⁶⁷ ; type of anesthesia used ^{30,34,55,59}
Devices: indwelling urinary catheter ⁴⁰
Monitoring: increased suppression in electroencephalogram ^{17.42}
Laboratory alterations: increased lactate ⁶⁶
Postoperative
Hemodynamic changes: hypotension ⁴⁵ , use of vasoactive drugs ³⁶ ; pain ^{24,41}
Severity of the clinical/surgical condition: APACHE II ^{17,35,36,68}
Blood biomarkers: plasma cortisol ²⁰ ; cholinesterase ³⁵ ; C-reactive protein ^{21,26,33}
Laboratory alterations: cortisol ²⁰ ; acid-base imbalances ⁶¹ ; electrolyte disturbance ⁶¹
Invasive devices: mechanical ventilation ^{23,36,48,53,68} ; indwelling urinary catheter ⁴⁰
Medications: sedatives ^{63,68} , midazolam ⁵³

Figure 7: Risk factors associated with postoperative delirium identified in the studies included in the review. Rio de Janeiro, RJ, Brazil, 2024.

DISCUSSION

The differences in sample sizes and methods used to identify POD may explain the different incidence rates found in the studies. The frequency with which POD assessments are performed influences its detection, as delirium is an acute and oscillating confusional state that should be evaluated at least once a day using a validated tool for a minimum of 3 days, starting in the recovery room or in the postanesthesia care unit on the surgery day, or on the first postoperative day at the latest².

Understanding the evidence-based guidelines, which recommend evaluating the preoperative physical, cognitive, mental and social states of patients undergoing anesthetic-surgical procedures and, with the objective of quantifying their risk of POD and determining interventions targeted at the pre, intraoperative and postoperative periods², we sought to structure this review in order to favor the identification of risk factors in different perioperative phases.

Risk factors identified during the preoperative period

The most studied predisposing risk factors commonly associated with POD were as follows: age, comorbidities, assessment according to the American Society of Anesthesiology criteria, gender, previous cognitive dysfunction and frailty, and laboratory alterations.

Advanced age was the most consistent triggering factor in the literature. Its correlation with cognitive disorders and frailty stands out, adding a higher risk of complications during the intra- and postoperative periods in the elderly, as well as the decreased capacity to adapt to hemodynamic changes caused by surgery and postanesthetic recovery⁴⁴.





Review Article Artigo de Revisão Artículo de Revisión

Presence of comorbidities was mainly evidenced by specific chronic diseases, with emphasis on renal and neuropsychiatric involvement and Charlson's Comorbidity Index, as well as number of comorbid conditions and variety of medications in use. Applied during the preoperative period, when high, the American Society of Anesthesiologists (ASA) score corroborates the impact of comorbidities on the development of POD and the consequent organic repercussions in individuals undergoing anesthetic-surgical procedures^{24,26}.

Regarding gender, there is predominance of studies presenting statistical significance for men who develop POD^{25,43,44,48,52,53}. This relationship seems to derive from a worse general condition found in the male population, consistent with the literature that indicates a higher ASA classification and higher incidence of postoperative complications for this population group. However, although some studies indicate that the male population has a better C-reactive protein response and, as it is suggested that inflammation plays a relevant role in the pathogenesis of delirium, biological plausibility is not fully elucidated²⁵.

A number of studies suggest an increased risk of POD in smokers^{19,33,63}, considering that nicotine (an active component found in tobacco) mimics the acetylcholine function by binding to specific nicotinic cholinergic receptors, leading to the release of neurotransmitters. However, the literature lacks population definitions, such as whether the group referenced in the studies consists in active or non-active smokers. Therefore, one case-control study highlighted a significant association between former smokers and incidence of delirium (OR=1.82; 95%CI: 1.17-2.83), although this relationship was not observed in active smokers (OR=1.05, 95%C: 0.55-2.0)⁶³, corroborating that the neuropharmacological impact of nicotine is not fully understood, especially its short- and long-term implications for critically-ill patients.

Cognitive dysfunction was assessed using different methods across the reviews and was a consolidated risk factor for POD in several studies^{18,22,24,31,34,37,39,44,50,56,57,60,60,67,68}. Thus, asessing cognitive impairment proved to be a useful strategy for estimating POD. However, it is still unclear which scales and respective components would drive this relationship.

This finding was also observed with the frailty condition, defined as a state marked by vulnerability to physiological ailments, characterized both as a phenotype and as a state of accumulated deficits in the elderly⁴⁹. A meta-analysis of studies targeting aged patients undergoing elective surgeries showed a significant association between preoperative frailty and POD (OR: 2.14, 95%CI: 1.43-3.19)⁴⁹. Even when using validated tools to assess the the frailty state, it is noteworthy that the instruments employed are countless in the literature^{26,47}, which may result in different outcomes or incidence values for POD.

POD may also be associated with poor sleep quality due to changes in neurotransmitter activity and brain samage due to hypoxia and hypoperfusion⁵⁸. Sleep disorders are also common in the perioperative period and affect postoperative cognitive function, thus representing an important risk factor for POD⁵⁸. However, no association between obstructive sleep apnea and delirium was found during the postoperative period in patients admitted to intensive care units⁴³.

Furthermore, the literature indicates medications used during the preoperative period as factors associated with POD. Acetylcholine plays an important role in memory, learning and selective attention. Therefore, using anticholinergics during the preoperative period has been shown to be independently associated with delirium⁵⁹.

Although the use of benzodiazepines in the intraoperative period (flunitrazepam)⁴⁸ or postoperatively (midazolam)⁵³ is associated with POD, resorting to this medication prior to the anesthetic-surgical procedure did not achieve statistical significance³⁰. Midazolam as a sedative medication with the objective of reducing preoperative anxiety and sympathetic activation was widely used³⁰. However, its refutation or recommendation requires further studies that consider individualized indications and differentiated dosages, as well as the protective effect against delirium from using Angiotensin Converting Enzyme Inhibitors (ACEIs)³⁸.

Among the laboratory alterations identified, hemoglobin deficiency also predisposes to POD due to the impairment in oxygen transport to the tissues, thus altering the cerebral oxidative system. Therefore, some studies recommend correcting the hemoglobin levels according to recommended transfusion criteria during the perioperative period^{41,52,57}.

Development of delirium after myocardial revascularization associated with a mean preoperative plasma cortisol concentration of 353.55 nmol/l (OR: 3.41; 95%CI: 0.55-0.76) stands out²⁰. In another study, also aimed at patients undergoing cardiac surgeries without extracorporeal circulation, it was shown that changes in glycosylated hemoglobin are an independent risk factor for POD, recommending its adjustment during the presurgical period because it is related to a reduction in microvascular risk⁶¹.





Understanding that POD arises from multiple causes (including excessive oxidative stress and neuroinflammation), Vitamin D deficiency can exert a significant impact by resulting in excessive production of reactive oxygen species. In this context, a meta-analysis of observational studies revealed that preoperative Vitamin D deficiency increases the risk of POD. However, further studies are required to assess causality, as well as the effects of dosage on the occurrence of delirium⁵¹.

Risk factors related to anesthetic-surgical procedures

The main extrinsic risk factor related to anesthetic-surgical procedures is magnitude of surgery, including urgent nature and prolonged surgeries. In elective procedures, patients can be compensated and optimized for surgery in a timely and desirable manner, which is not possible in emergency situations²⁸. In a model developed to predict POD, emergency surgeries and open surgical techniques were relevant predictor variables²¹.

Especially when over 80 minutes, surgery duration was linked to delirium³¹, with each surgical minute possibly increasing by 0.4% the chances of delirium. However, in a study on the identification of risk factors in patients undergoing head and neck surgery, there was no association between POD and surgery time⁴⁴. As a possible reason, it is worth noting that the surgical team followed the standard practice of having two surgeons perform the surgical procedure in order to reduce surgical time. Therefore, it is warranted to conduct further studies aimed at evaluating the effectiveness of this recommendation, in order to corroborate the benefit of this approach for POD prevention⁴⁴.

Although the literature does not determine its duration, prolonged liquid fasting was also shown to be an independent risk factor²⁷. Its consequences for POD are not well established, but it correlates with another study that reports low blood pressure levels during the intraoperative period associated with delirium, as it is an event that drives cerebral hypoperfusion⁴⁵.

In this context, the literature seeks to identify strategies to optimize fluid replacement during the intraoperative period. Using crystalloids for fluid replacement has been identified as a risk factor for the development of Postoperative Delirium (POD), especially when compared to colloids⁶⁴. Crystalloids favor reductions in plasma colloid osmotic pressure, easing fluid displacements to the third space⁶⁴. A controlled clinical trial suggests that adding mannitol to prepare for extracorporeal circulation may be effective in reducing the incidence of delirium after a surgery⁶⁵.

The hypothesis set forth in the aforementioned study relates therapeutic effects of mannitol in controlling increased intracranial pressure and decreasing cerebral perfusion pressure⁶⁵. However, the pathophysiology of POD associated with decreased cerebral perfusion and increased cerebral edema has not been elucidated, as a retrospective cohort study did not identify any association between POD and jugular venous congestion during the intraoperative phase of lung transplantation. However, the study states limitations in only assessing delirium during the first 48 hours after surgery, possible selection biases and having used exclusively central venous pressure as a jugular venous congestion indicator⁶⁵.

Furthermore, defined as SpO_2 (oxygen saturation) below 90% at any time during the intraoperative period, intraoperative hypoxia and severe hemorrhage represented by a total loss of more than 400 ml of blood, were variables that were part of a model with excellent predictive potential for POD (AUC: 0.80; 95%CI: 0.67-0.93)⁵⁸. In another prospective cohort study with 157 participants, 53% of those who received blood transfusions during the intraoperative period had delirium, which reflects a 281% increase in the chance of delirium⁶⁴.

Although lower hemoglobin levels have proved to be a relevant risk factor for the development of POD, small variations in relation to the baseline level have not been shown to exert significant clinical effects. Therefore, large blood loss or transfusion amounts should be avoided, especially in frail patients undergoing vascular surgeries³³; in addition, precautions should be taken to avoid the need for transfusion as much as possible, optimizing the preoperative hemoglobin levels¹⁹.

Among the medications used as anesthetic induction agents, the association with barbiturates (especially thiopentone) stands out regardless of the dose administered²⁹. Flunitrazepam use also represents an additional risk for POD, which implies caution regarding benzodiazepines during the anesthetic-surgical procedure⁴⁸. In addition, the choice of opioids for pain control during the intraoperative period was also related to delirium (OR=2.27; 95%Cl=1.0-5.1)²⁷.

During intraoperative management, ondansetron (a serotonin antagonist specific for the 5-HT3 receptor) is routinely used to control nausea and vomiting. Not using this drug during the intraoperative period was associated



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with a 198% increase in the chance of delirium. Therefore, this finding is relevant because it provides support for the relational hypothesis of the neurotransmitters that trigger delirium, especially serotonin⁶⁴.

Using halogenated gases (such as isoflurane and sevoflurane) employed for anesthetic maintenance did not show neurocognitive changes during the postoperative period²⁹. There are studies that indicate no evidence of the protective effect of anesthetic administration guided by electroencephalogram monitoring⁵⁵, while others do show benefits^{17,42}, and general anesthesia may not be significant for long-term cognitive impairment after major non-cardiac surgeries¹⁸.

Although the implications of the anesthetic techniques are controversial, a systematic review with meta-analysis showed that regional anesthesia (epidural or spinal) exerts a protective effect when compared to other anesthetic modalities (local or general) for the development of POD (OR: 0.60; 95%CI: 0.37-0.96; p-value=0.003)⁵⁷. The discrepancy between the anesthetic impact evidenced in the studies can be justified by the differences in sample size and substantial heterogeneity. Therefore, it is necessary to verify the impact of vrious anesthesia methods in further research through bias control.

Risk factors identified during the postoperative period

As well as hospitalization time, directioning postoperative care to the intensive care environment is a risk factor consolidated in the literature for the development of POD, understanding that, in addition to physical and social confinement, this environment is intended for patients with worse clinical deterioration and hemodynamic instability⁴⁰.

In this context, the score obtained in the severity classification within intensive care units according to the Acute Physiology and Chronic Health Evaluation II (APACHE II) has been associated with delirium. Patients with high APACHE II scores (median: 4.84; 95%CI: 4.54-5.15) had a 33.9% increase in delirium and 3.2 more days of ICU hostpialization time²¹.

Regarding the invasive devices used during the postoperative period, a prospective cohort with 2,026 patients stands out, which showed mechanical ventilation as a substantial trigger for the risk of POD, both in terms of its use (OR: 32.21; 95%CI: 21.27-48.78) and its duration (OR: 67.22; 95%CI: 33.8-133.71)²³. Indwelling bladder catheters (IBCs) are devices usually indicated to assess urinary output, as an ideal blood pressure indicator and a postoperative acute kidney injury predictor. In a retrospective cohort study conducted with 5,112 postsurgical patients, it was reported that those using IBCs had a higher risk of altered mental state (OR: 1.97; 95%CI: 1.50-2.59)⁴⁰.

Some studies have stood out for measuring blood biomarkers to determe presence of delirium. The serum measurement of corticosteroid levels at a mean dose of 994.10 nmol/l (OR: 4.38; 95%CI: 0.63-0.82)²⁴, as well as the plasma cholinesterase measurement after non-cardiac surgeries in aged Chinese individuals, is associated with POD²⁰. Cholinesterase terminates the acetylcholine action by hydrolyzing this neurotransmitter to produce inactive products. In this context, serum cholinesterase measurements indicate that its concentration is significantly lower in patients that develop POD²⁰. The increase in plasma C-reactive protein has been evidenced in studies and raises the importance of inflammatory responses as an integral part of the POD genesis^{21,26,33}.

Hemodynamic changes may predispose to delirium, especially when there is a need to use amines in the first 24 hours in intensive care³⁶. In a study on risk factors in aged patients undergoing lumbar spinal fusion, when pain was investigated using the Visual Analogue Scale (VAS), it was significantly correlated with delirium on the first postoperative day (p<0.001) and it was found that absence of effective pain management increases the risk of POD²⁴.

Regarding the use of sedatives during the postoperative period, a systematic review with meta-analysis stands out. This review analyzed 6 studies which, despite presenting significant publication bias and statistical heterogeneity, evidenced that the risk of POD in dexmedetomidine users is significantly lower when compared to patients on midazolam (RR: 0.20; 95%CI: 0.09-0.47; p<0.05)⁵³.

Study limitations

As this is a scoping review, the limitations include the fact that the methodological quality of the literature consulted was not analyzed, as well as having resorted to a single Gray Literature source (BDTD). However, conducting this review based on scientific productions whose study designs indicated higher levels of evidence provided access to more robust primary studies.





Although this review highlighted diversity of factors associated with POD, subsequent studies are required to validate interventions as effective measures to reduce the risk for POD, as correlation does not consolidate causality. It is also necessary to conjecture that the associated factors may be related to an underlying cause not yet elucidated in the literature.

CONCLUSION

This review was a comprehensive approach to risk factors for postoperative delirium among adults in intensive care units, based on studies with higher levels of evidence, and categorized its identification into different perioperative stages. Predominance of factors related to each person's characteristics was observed; these factors are not subject to modification but were timely evidenced during the preoperative period. Nevertheless, modifiable factors do prevail in the anesthetic-surgical procedure, ranging from hemodynamic control to choice of anesthetic techniques. Commonly added to highly complex postoperative care in intensive care units, invasive devices and pharmacological therapies can also be determinants for the occurrence of delirium.

However, it was found that postoperative delirium is a condition that lacks scientific elucidation, and that publications seek to provide support regarding the identification of risk factors. Thus, mapping the risk factors for delirium can provide an opportunity for effective and individualized interventions, with the objective of minimizing the risk of its development or favoring early identification. By recognizing and mitigating these factors, nurses can promote safer care environments and gain support for implementing the Nursing Process aimed at critically-ill surgical patients, especially for individuals at risk of acute confusion.

The social contribution of this study is also postulated by addressing a nosological entity relevant to the panorama of population aging, permeated by peculiar and poorly established care needs. Therefore, it is expected to provide subsidies for future publications regarding the determination of effective measures for preventing and managing postoperative delirium and to encourage the implementation of innovative care technologies and evidence-based practices.

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Author's contributions

Conceptualization, D.M.M., T.V.C.V., D.S.B.A., V.B.S. and E.R.M.; methodology, D.M.M., T.V.C.V., D.S.B.A., V.B.S. and E.R.M.; software, D.M.M., V.B.S. and E.R.M.; validation, D.M.M., T.V.C.V., D.S.B.A., V.B.S., E.R.M. and E.P.F; formal analysis, D.M.M., T.V.C.V., D.S.B.A., V.B.S. and E.R.M.; investigation, D.M.M., T.V.C.V., D.S.B.A., V.B.S. and E.R.M.; data curation. D.M.M., T.V.C.V., D.S.B.A., V.B.S., e.R.M. and E.P.F.; manuscript writing, D.M.M., T.V.C.V., D.S.B.A., V.B.S. and E.R.M.; review and editing, D.M.M., T.V.C.V., D.S.B.A., V.B.S., E.R.M. and E.P.F.; visualization, D.M.M., T.V.C.V., D.S.B.A., V.B.S. and E.R.M.; review and editing, D.M.M., T.V.C.V., D.S.B.A., V.B.S., E.R.M. and E.P.F.; visualization, D.M.M., T.V.C.V., D.S.B.A., V.B.S., E.R.M. and E.P.F.; supervision, D.M.M., T.V.C.V. and D.S.B.A.; project administration, D.M.M., T.V.C.V. and D.S.B.A. All authors read and agreed with the published version of the manuscript.

Use of artificial intelligence tools

The authors declare that no artificial intelligence tools were used in the composition of the manuscript "Risk factors for postoperative delirium in adults in intensive care: a scoping review".

