COMPLICATIONS IN THE POST-ANESTHESIA CARE UNIT, RISK FACTORS AND NURSING INTERVENTIONS: AN INTEGRATIVE REVIEW

Complicações na sala de recuperação anestésica, fatores de riscos e intervenções de enfermagem: revisão integrativa

Complicaciones en la sala de recuperación anestésica, factores de riesgos y intervenciones de enfermado: revisión integrativa

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ABSTRACT: Objectives: To identify complications and risks that patients can develop in the immediate postoperative period and to propose an instrument that addresses the complications, risks and individualized nursing interventions. **Methods:** We conducted an integrative review of the literature between March and October 2015 in PubMed databases (digital archive produced by the National Library of Medicine) and Virtual Health Library (*Biblioteca Virtual em Saúde - BVS*). We used the following descriptors in our search: recovery room / *sala de recuperação* / *sala recuperación*; postoperative complications / *complicações pós-operatórias* / *complicaciones pós-operatórias*; and nursing care / *cuidados de enfermagem* / *atención de enfermeira*. **Results:** The search strategy allowed the analysis of 15 articles. Complications, risks and interventions were identified and categorized as follows: hypothermia, hypoxemia and apnea; acute pulmonary edema, tremors, nausea and vomiting; urinary retention and degree of dependence on care; cardiac dysrhythmias and general complications; complications in the elderly and surgical positioning. **Conclusion:** The resulting complications, risks and interventions were the basis for the construction of our instrument.
Keywords: Post-anesthesia care unit. Intraoperative complications. Nursing care

RESUMO: Objetivos: Identificar as complicações e os riscos que os pacientes possam desenvolver no pós-operatório imediato e propor um instrumento que contenha as complicações, riscos e intervenções de enfermagem individualizadas. **Método:** Revisão integrativa da literatura realizada entre março e outubro de 2015 nas bases de dados PubMed (arquivo digital produzido pela *National Library of Medicine*) e Biblioteca Virtual em Saúde (BVS). Para o levantamento dos artigos foram utilizados os descritores: sala de recuperação, complicações e cuidados de enfermagem. **Resultados:** A estratégia de busca permitiu a análise de 15 artigos. As complicações, riscos e intervenções foram identificadas e assim categorizadas: hipotermia, hipoxemia, apneia; edema agudo de pulmão, tremores, náuseas e vômitos; retenção urinária, grau de dependência de cuidados; disritmias cardíacas, complicações gerais; complicações com idosos e posicionamento cirúrgico. **Conclusão:** As complicações e riscos levantados, assim como as intervenções, foram a base para a construção do instrumento.
Palavras-chave: Sala de recuperação. Complicações intraoperatórias. Cuidados de enfermagem.

RESUMEN: Objetivos: Identificar las complicaciones y los riesgos que los pacientes pueden desarrollar en el período posoperatorio inmediato y proponer un instrumento que aborde las complicaciones, los riesgos y las intervenciones individualizadas de enfermería. **Métodos:** Realizamos una revisión integrativa de la literatura entre marzo y octubre de 2015 en las bases de datos de PubMed (archivo digital producido por la Biblioteca Nacional de Medicina) y la Biblioteca Virtual en Salud (BVS). Utilizamos los siguientes descriptores en nuestra búsqueda: *recovery room* / *sala de recuperação* / sala de recuperación; *postoperative complications* / *complicações pós-operatórias* / complicaciones pós-operatórias; *y nursing care* / *cuidados de enfermagem* / atención de enfermería. **Resultados:** La estrategia de búsqueda permitió el análisis de 15 artículos. Las complicaciones, los riesgos y las intervenciones se identificaron y categorizaron de la siguiente manera: hipotermia, hipoxemia y apnea; edema agudo de pulmón, temblores, náuseas y vómitos; retención urinaria y grado de dependencia de la atención; disrritmias cardíacas y complicaciones generales; complicaciones en ancianos y posicionamiento quirúrgico. **Conclusión:** Las complicaciones, riesgos e intervenciones resultantes fueron la base para la construcción de nuestro instrumento.
Palablas clave: Sala de recuperación. Complicaciones intraoperatorias. Atención de enfermería.

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INTRODUCTION

A post-anesthesia care unit (PACU) is an area designed to receive patients in the immediate postoperative period to prevent possible complications resulting from the surgical anesthetic act. In order to provide quality assistance, specialized human resources and differentiated materials are required.[1]

The work of the nursing team is fundamental in this period of instability, in which risks can trigger problems. Therefore, the stability of the level of consciousness and vital signs of the patient are of great importance.[2]

Nursing care in this period should be planned from admission until the patient is discharged from the PACU. The systematization of nursing care is one of the strategies for a safe process.[3]

Different scales are used for patient's evaluation and patient's care plan in the PACU. However, many were elaborated and validated by doctors, such as the Aldrete and Kroulick scoring system[4] among others. Although this scale from 1970 is still the most used one in PACUs, it fails to evaluate complications and risks. To date, there is no instrument that meets the needs of nursing care, which are provided full time to the patient.[1]

Considering the importance of patient safety in the immediate postoperative period, we believe it is necessary to identify the complications and risks to which patients are subject and to propose an instrument suggesting a nursing intervention for each complication.

Thus, we decided to carry out an integrative review on the complications that may occur in the PACU in order to survey the aforementioned risks. We hope that the present study will contribute to professional practice by providing survey results and evidence.

OBJECTIVES

One of the objectives of the present study is to identify complications and risks that may affect patients in the post-anesthesia care unit.

Another objective is to propose an instrument that addresses these complications and risks and proposes appropriate individualized nursing interventions.

METHOD

We carried out an integrative review and analyzed complications and risks occurring in the PACU that would be used in the construction of our assessment instrument. We adopted a six-step methodological reference:

1. problem formulation;
2. establishment of the inclusion and exclusion criteria;
3. selection of data to be extracted from the text;
4. evaluation of the data collected;
5. data analysis and interpretation; and
6. presentation of results.[5]

The following guiding question was used for the problem formulation: what complications and risks are found in the literature involving patients in the PACU? Data collection took place from March to October 2016.

Articles published in Portuguese, English and Spanish indexed in PubMed (digital archive produced by the National Library of Medicine) and Virtual Health Library (VHL) were selected. These databases provide a great variety of scientific material from different health fields. The descriptors used were: recovery room / *sala de recuperação* / *sala recuperación*; postoperative complications / *complicações pós-operatórias* / *complicaciones pós-operatórias*; and nursing care / *cuidados de enfermagem* / *atención de enfermeira*.

Our search for references started with articles published in 1979. The long period — extended from 1979 to 2016 — was justified by the scarce production related to PACU in relation to nursing care provided. We considered only articles reporting complications experienced by adult patients in the PACU for our analysis and as an exclusion criteria articles that reporting complications with children.

A flow chart of data collection and the number of articles that composed the final sample is presented in Figure 1.

For data collection, we prepared a table with the following information: study, reference, database or portals, type of study, results and level of evidence. For a better classification of the levels of evidence of the articles, we used a scale from I to VI[6] as follows:

- level 1: evidence from the meta-analysis of multiple randomized controlled trials;
- level 2: evidence obtained from individual studies with experimental design;
- level 3: evidence from quasi-experimental studies;
- level 4: evidence from descriptive (non-experimental) studies or studies with a qualitative approach;
- level 5: evidence from case or experience reports;
- level 6: evidence based on expert opinions.[6]

This classification is a recommendation for review studies, since it enriches and strengthens conclusions of the researched topic.

The results are descriptively presented in a table, with the main characteristics and implications of each study.

RESULTS

Chart 1 shows the main characteristics of the selected studies in the integrative review.

Fifteen articles answered the research question and met the inclusion criteria.

Among the included articles for the evaluation of postoperative complications, 11 were cross-sectional observational studies (level IV of evidence), 2 were review studies (level V) and 2 were case studies (level V). The most frequent publication years were 2010 (4 publications) and 2012 (2 publications). The remaining articles were published between 1979 and 2008.

Thirteen studies were published in Brazilian Portuguese, one in English and one in Spanish.

After the critical analysis of the articles, complications, risks and interventions were identified and categorized as follows: hypothermia, hypoxemia, apnea, acute pulmonary edema, tremors, nausea and vomiting, urinary retention, degree of dependence on nursing care, cardiac dysrhythmias, general complications and complications with the elderly, and surgical patient positioning.

Our research revealed a shortage of instruments to measure complications and risks pertinent to the problems that patients can develop in the post-operatory period, as well as the nursing services required in these contexts. Based on this finding, we elaborated an evidence-based scale according to the complications reported in the articles, the risks pertinent to each problem and the required type of nursing service. The collected data were submitted to statistical analysis for viability and authenticity check.

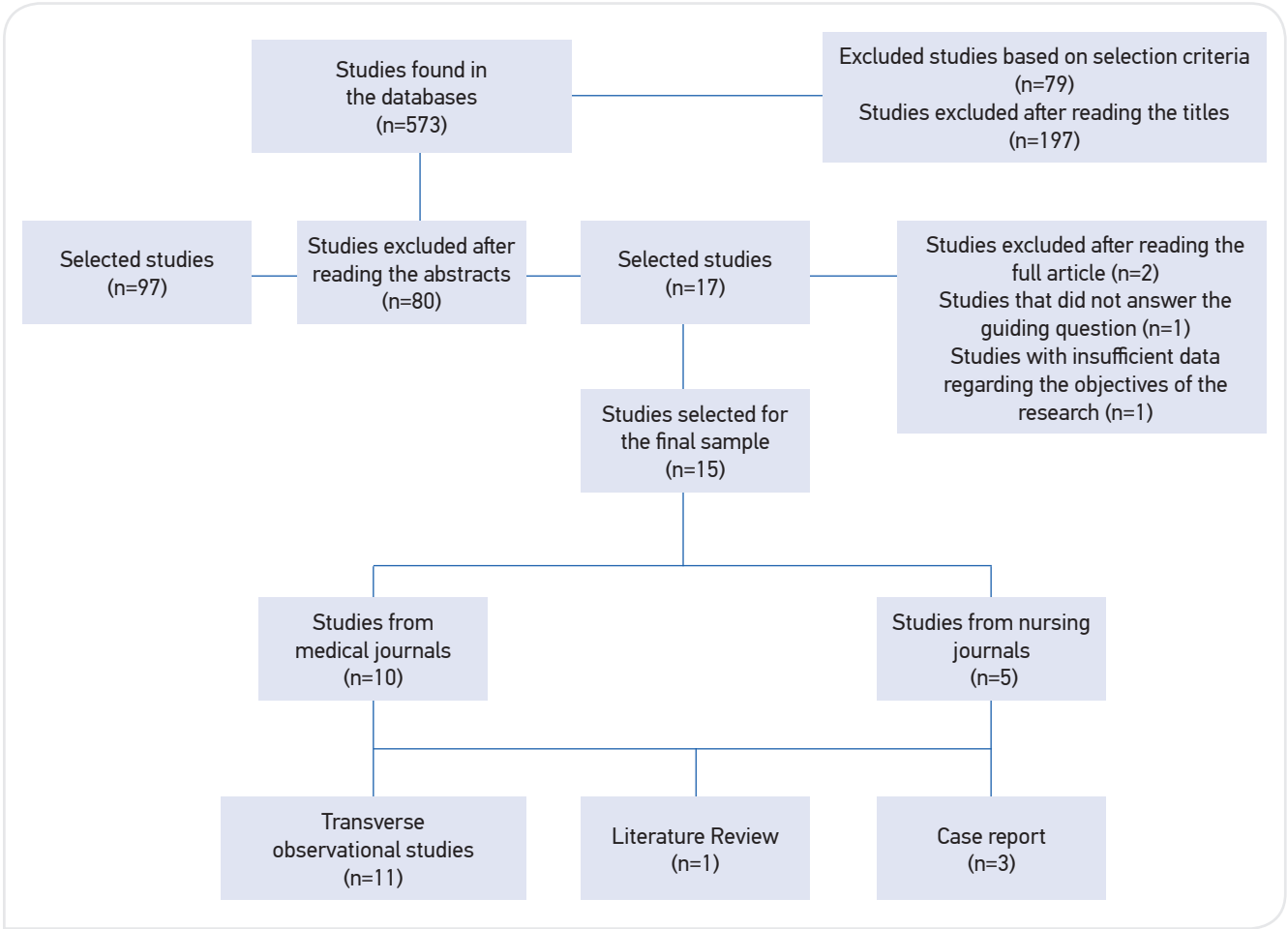

Figure 1. Flowchart of the process of our scientific study survey.

Chart 1. Synthesis of studies found regarding complications in the post-anesthetic care unit.

Study	Reference	Database and portals	Origin	Type of study	Results	Level of evidence
S1	Mattia et al. (2012)[8]	SciELO	Brazil	Exploratory, descriptive	The results showed that 80.0% of the patients remained hypothermic until 30 minutes after admission to the PACU, with an axillary temperature between 35.1 and 35.9º C. Clinical manifestations of hypothermia included hypoxemia, tremors, pallor and arterial hypertension.	IV
S2	Zappelini et al. (2008)[10]	LILACS	Brazil	Analitical, observational	The mean temperature in the PACU was 34.5° C. The risk factors were: patients with 60 years presented with less 0.5ºC in relation to the mean temperature in the PACU; also in abdominal surgeries with surgical time of 180 minutes; general inhalation anesthesia associated with spinal anesthesia, which caused hypothermia in the PACU.	IV
S3	Amante et al. (2012)[9]	LILACS	Brazil	Quantitative	The variables measured were: body temperature during and immediately after surgery; age of the patient; time, type of surgery and type of anesthesia. The need for a safe and effective evaluation of the thermal regulation of these patients is reaffirmed, so that intervention in the period of perioperative hypothermia reduces the incidence of complications in this period.	IV
S4	Marcondes et al. (2006)[11]	SciELO	Brazil	Observational delineation	There was a higher incidence of moderate/severe hypoxemia during transport of female patients and ASA II and III patients submitted to cardiothoracic, gastroproctological and head and neck surgeries. General anesthesia had the highest incidence for hypoxemia.	IV
S5	Oliveira Filho et al. (2001)[12]	LILACS	Brazil	Observational delineation	Forty-nine patients presented with SpO2 lower than 92% during the observation period. Hypoxemia factors included age greater than 55 years, preoperative SpO2 less than 95%, general anesthesia and detected clinically hypoventilation. SBP and HR were significantly higher in hypoxemic patients.	IV
S6	Rezende (2003)[15]	SciELO	Brazil	Case report	The patient was extubated, obeyed the commands to breathe and cooperated in the passage to the stretcher, being transported to the PACU where she arrived conscious. Minutes later, she presented with apnea, cyanosis and unconsciousness. Manual ventilation with 100% oxygen was performed, followed by injection of naloxone (0.2 mg) intravenously, with return of spontaneous ventilation and consciousness.	V
S7	Bisinotto et al. (2008)[14]	SciELO	Brazil	Case report	After extubation, the patient presented with laryngospasm and decreased oxygen saturation. She was stabilized. In the PACU, shortly after admission, she presented with acute pulmonary edema with elimination of secretion. The patient received oxygen support.	V
S8	Mago et al. (2010)[18]	SciELO	Brazil	Observational delineation	The criteria to characterize urinary retention was: bladder volume equal to or greater than 600 mL associated with inability to spontaneous urination 30 minutes after diagnosis. Urinary retention occurred in 19 patients. The independent predictive factors identified were urinary volume equal to or greater than 360 mL on admission to the PACU.	IV
S9	Albergaria et al. (2007)[16]	SciELO	Brazil	Review article	Tremors are, along with nausea and vomiting, causes of intense discomfort in the PACU, and potentially harmful for generating increased metabolic demand.	V

Continue...

Chart 1. Continuation.

Study	Reference	Database and portals	Origin	Type of study	Results	Level of evidence
S10	Lages et al. (2005)[17]	SciELO	Brazil	Review article	There are several strategies for the management of PONV. However, we highlight the guidelines issued by Gan in 2003, suggesting that patients with a previous history of nausea and vomiting should be medicated before, during and after surgery.	V
S11	Lima et al. (2010)[1]	SciELO	Brazil	Prospective cross-sectional	The results indicate that patients have a degree of dependence between intermediate and semi-intensive. There was a significant relationship between degree of dependence and ASA classification.	IV
S12	Nascimento Júnior et al. (2000)[19]	LILACS	Brazil	Observational delineation	Preoperative electrocardiography was performed and 33.6% of the patients in the PACU presented with dysrhythmias. The most common were sinus tachycardia and sinus bradycardia, and most of the time there was some event prior to these alterations. The incidence of these dysrhythmias was equivalent in all age groups.	IV
S13	Eltringham (1979)[20]	PubMed/ Medline	The United States	Observational delineation	Patients were divided into three groups, according to the duration of their stay in the PACU. Cardiovascular complications are divided into respiratory and other, although some patients revealed more than one complication.	IV
S14	Mendoza e Peniche (2010)[3]	SciELO	The Caribean	Descriptive, retrospective	There was a predominance of male (56.4%), hypertensive (32.7%) and as ASA II (60%) patients. Regarding the intraoperative period, patients underwent abdominal surgery (53.6%), received general anesthesia (50.9%) in the dorsal decubitus position (81.8%) with a surgical time of less than 3 hours (62.7%).	IV
S15	Popov e Peniche (2009)[2]	SciELO	Brazil	Exploratory, retrospective	The prevalent complications were pain and hypothermia, complications that showed a statistically significant relationship with nursing interventions.	IV

PACU: post-anesthesia care unit; SBP: systemic blood pressure; HR: heart rate; PONV: postoperative nausea and vomiting; ASA: American Society of Anesthesiologists; UL: upper limbs; HR: heart rate; RR: respiratory rate; BP: blood pressure.

We identified 14 complications associated with risk factors that may occur in the PACU. These factors were then transformed into simple and short yes/no questions. We assumed that each "yes" answer would have a set value of 1 and each "no" answer would have a score of 0.

The identification of low, medium and high risks of possible complications in the PACU was obtained by the sum of the "yes" answers to each risk factor that patients were exposed to.

Some complications have only three risk factors. However, others have nine. Thus, the risk factor sum ranged from 0-9.

Therefore, we adopted a colored numerical scale for the classification of the degree of risk, which was divided into three equal parts:

- the first third (0-3) was considered low risk (green);
- the second third (4-6) was considered medium risk (yellow); and
- the third third (7-9) was considered high risk (red).

Coupled to this numerical scale are the nursing interventions according to the complication found (based on NANDA, NOC, and NIC linkages: Nursing Diagnoses, Outcomes and Interventions).[7]

Although the scale presents 14 complications and their corresponding risks, not necessarily will the patient develop all of them, as this depends on their history and associated diseases.

Chart 2 shows the complication scale, the questionnaire for risk classification and the corresponding nursing interventions.

DISCUSSION

Our literature review revealed that most of the articles are observational cross-sectional studies, case reports and reviews. Based on the methodological framework adopted, these types of study fit into levels IV and V of evidence.[6]

Chart 2. An instrument for the evaluation of complications, risks and nursing interventions in the anesthetic recovery room.

Hypothermia	**Yes**	**No**	0	1	2	3	4	5	6	7
Major/medium-size surgeries?										
Reduced amount of adipose tissue?			Low risk			Medium risk			High risk	
General anesthesia or general anesthesia combined with blockade			**Interventions**							
Infusion of unheated fluids			Install and regulate adequate heating devices							
Prolonged abdominal surgeries?			Heating infusion fluids							
Advanced age?			Monitoring skin color and temperature (reflective blankets, heated blankets)							
Carbon dioxide retention			Monitoring onsets such as tremors, confusion							
			Monitoring respiratory and cardiac condition (mainly bradycardia)							

Hypothermia	**Yes**	**No**	0	1	2	3	4	5	6	7	8	9
ASA II and III physical status?												
age over 55 years?			Low risk				Médio risco			High risk		
Chronic obstructive pulmonary disease?			**Interventions**									
Diabetes mellitus?			Install oximetry and register changes in the patient's oxygen saturation									
Preoperative SpO2 lower than 95%			Open the airway using the chin-lift maneuver or the jaw-thrust maneuver, as appropriate									
Surgeries: head and neck/cardiothoracic/ gastroproctological?			To monitor the restlessness and shortness of breath of the patient; institute respiratory therapies (ex. nebulizer/ humidifier)									
Nutritional deficit?			To observe the presence of secretions									
Female gender?			Airway clearance									
General anesthesia												

Pulmonary edema	**Yes**	**No**	0	1	2	3	4	5	6
Is the patient young?									
Male?			Low risk			Medium risk		High risk	
Muscular type?			**Interventions**						
Short neck with history of apnea?			Respiratory auscultation, observing reduced or absent ventilation areas, and presence of adventitious sounds.						
Smoker?			To regulate the intake of fluids to optimize hydric balance						
History of laryngospasm?			To position the patient to relieve dyspnea (lift dorsum)						
			To maintain the respiratory condition and oxygenation by installing noninvasive support						

Sleep apnea?	**Yes**	**No**	0	1	2	3
Use of opioids?						
Surgeries such as thyroidectomy, parathyroidectomy?			Low risk		Medium risk	High risk
Sleep apnea?			**Interventions**			
			To place the patient in a semifowler position			
			To monitor the onset of symptoms indicating the increasing respiratory function (increased CF, RF and BP FR)			
			To place the noninvasive device ensuring good adjustment and preventing major air loss			

Tremores	**Yes**	**No**	0	1	2	3	4	5	6	7	8
Coronary disease?											
Prolonged surgery time?			Low risk			Medium risk			High risk		
Male gender?			**Interventions**								
Altered physical status? (high ASA)?			To install heating devices (thermal blanket, blankets)								
Blood administration?			To install oxygen therapy								
Advanced age?			To monitor vital signs								
Central or peripheral hypothermia?											
Orthopedic procedure (endoprosthesis) using bone cement?											

Continue...

Chart 2. Continuation.

Nausea and vomit	**Yes**	**No**	0	1	2	3	4	5	6	7	8	9
Female?												
No smoking?			Low risk				Medium risk			High risk		
History of PONV?			**Interventions**									
Nausea and vomit with movement?			Position to prevent aspiration (lift dorsum)									
Inhalation anesthetics?			Provide a vomit bag									
Use of N2O in anesthesia?			Promote oral hygiene									
intra and postoperative opioids?			Maintain permeable airway									
Surgery time superior to 30 minutes (increasing risk in 60%)?			Identify risk factors (medications and procedures)									
Surgeries such as: neurosurgery, correction of strabismus, plastic surgery, laparotomy?												

Urinary retention	**Yes**	**No**	0	1	2	3	4	5
			Low risk		Medium risk		High risk	
Previous history of urinary retention?			**Interventions**					
Use of opioids?			Provide privacy for output					
Advanced age?			Stimulate the reflex bladder, putting cold on the abdome, massaging the internal side of the thigh, or running water					
Excessive fluids administered in the transoperational period?			To perform the Credé's maneuver if indicated					
			Perform urinary catheterization when necessary					

Changes in heart rate	**Yes**	**No**	0	1	2	3	4	5	6	7	8
General anesthesia?											
Local anesthesia?			Low risk			Medium risk			High risk		
Tracheal extubation?			**Interventions**								
Pain when waking up?			To monitor changes in blood pressure								
Nausea and vomit?			To observe signs and symptoms of reduced cardiac output								
Hyperthermia?			To monitor the respiratory condition								
Agitation when waking up?			To monitor the abdome at the indication of reduced perfusion								
Advanced age?			To provide antiarrhythmic therapy according to the protocol of the institution								
			To collect laboratorial tests and analyze values (cardiac enzymes)								

Systemic arterial hypertension	**Yes**	**No**	0	1	2	3	4	5	6
Advanced age?									
Pain?			Low risk			Medium risk		High risk	
Bladder distention?			**Interventions**						
Prolonged surgery time?			To monitor the occurrence of central and peripheral cyanosis						
Occlusive dressings?			To monitor and control pain						
Association of drugs?			To administrate diuretics, when adequate						
			To monitor laboratorial results that are relevant to water retention (hematocrit, sodium, urine osmolality)						

Hypotension	**Yes**	**No**	0	1	2	3
Anesthetic blockades?						
Bloos loss?			Low risk		Medium risk	High risk
Action of anesthetic drugs?			**Interventions**			
			To place the patient in the trendelenburg position			
			To monitor blood loss			
			To administrate medication according to prescription			

Continue...

Chart 2. Continuation.

Obstruction and respiratory depression	**Yes**	**No**	0	1	2	3	4	5
Tongue fall?								
Excessive saliva			Low risk		Medium risk		High risk	
Blood?			**Interventions**					
Vomit?			To open the airway using the chin-lift maneuver or the jaw-thrust maneuver, as appropriate					
Use of opioids?			To place the patient lying on the side, as indicated to prevent aspiration					
			To register thoracic movements observing the existence of symmetry, use of accessory muscles and retraction of					
			supraclavicular and intercostal muscles					
			To monitor the occurrence of noisy breathing, such as shrill hissing, snorring and dyspnea					
			To determine the need for aspiration					

Bleeding	**Yes**	**No**	0	1	2	3
Coagulopathies?						
Problems of hemostasis?			Low risk		Medium risk	High risk
Abdominal surgeries?			**Interventions**			
			To monitor signs of bleeding			
			To contain active bleeding if possible, to apply compression dressing			
			To monitor vital signs, mental status and urine output			
			To monitor platelet count, including coagulation tests			
			To prepare the intubation material			
			To provide bags of blood components for transfusion			
			To book a surgery room in case of reoperation			

Pain	**Yes**	**No**	0	1	2	3
Occlusive dressings?						
Anxiety?			Low risk		Medium risk	High risk
Medium/major tissue lesion?			**Interventions**			
			Application of hot/cold massage			
			Application of therapeutic touch			
			Music therapy for relaxation			
			Comfortable position			
			Nausea control			
			Assistance to patient-controlled analgesia			
			Vital sign control (breathing) at the use of opioids			

Surgical position	**Yes**	**No**	0	1	2	3	4	5
Malnutrition?								
Diabetes mellitus ?			Low risk		Medium risk		High risk	
Bony landmarks?			**Interventions**					
Hyperextension			To place the patient considering the adequate body alignment					
Greater upper limb abduction causing damage to the brachial plexus?			To minimize the friction and shear stress when placing and turning the patient					
			To verify skin integrity; to apply lotions and dressings if necessary					
			To verify the peripheral circulation					

ASA: American Society of Anesthesiologists; PONV: postoperative nausea and vomit; CF: cardiac frequency; RF: respiratory frequency; BP: blood pressure.

Despite the fragility of the studies, they have important concepts and information that respond to our guiding question and, after statistical evaluation, served as a basis for the development of our instrument.

The main themes identified in our critical analysis and their implications are presented and discussed in the sequence.

Hypothermia

In all three articles,[8-10] general anesthesia was the most used technique, followed by combined anesthesia (general anesthesia / neuraxial blockade), which involves a greater risk of unintentional perioperative hypothermia, since regional anesthesia decreases the cutaneous vasoconstriction threshold and, when associated with the general anesthesia, has its effect somatized.

Hypothermia interferes in the cardiac rate and rhythm causing dysrhythmias and surgical site infection.[8-10]

With regard to operative time, the highest frequency of mild and moderate hypothermia is found in the period between 61 minutes (minimum) and 240 minutes (maximum).[9] The absence of preventive measurements against hypothermia (such as warming systems) in the operating room was the cause of temperature below 35° C in the patients during the intraoperative period. When admitted to the PACU, these patients remained hypothermic for 30 minutes.[8]

Adipose tissue amounts in the patient and the concomitant use of anesthetic medications can alter the temperature gradient between the central and peripheral compartments, leading to hypothermia.[10]

The main risks for hypothermia include:

- major and medium-size surgeries (greater risk of hypothermia);
- amount of adipose tissue;
- general anesthesia or general anesthesia combined with blockade;
- infusion of unheated fluids;
- prolonged operative time;
- abdominal surgeries in which there is greater loss of heat;
- advanced age; and
- carbon dioxide retention.

Hypoxemia

Two studies revealed that patients who received general anesthesia — due to the residual effect of anesthetic drugs — presented with higher levels of postoperative hypoxemia.[11,12]

Another variable that may lead to hypoxemia in the PACU and the American Society of Anesthesiologists (ASA)[13] classification, which classifies patients by the absence or presence of diseases associated with the surgical problem. The higher the score (1-6), the greater the possibility of developing hypoxemia.

Cardiothoracic, gastroproctological and head and neck surgeries in cancer patients associated with physical and nutritional weakness are factors that can lead to hypoxemia.[11]

Elderly patients have nutritional deficits and decreased respiratory reserve. Therefore, they are more exposed to the risk of hypoxemia in the PACU.[12]

Variables that may lead to hypoxemia include:

- ASA II and III physical status;
- age over 55 years;
- COPD;
- diabetes mellitus;
- preoperative SpO2 lower than 95%;
- nutritional deficit;
- female patients; and
- general anesthesia.

Apnea and acute pulmonary edema

Patients with laryngospasm in the PACU can progress to acute pulmonary edema.[14]

In these cases, the use of oxygen therapy is indicated mainly after general anesthesia. In cases of head and neck procedures, another risk factor for apnea in the PACU is thyroidectomy surgery.[15]

Patients who have laryngospam in the PACU may evolve into acute pulmonary edema[14].

Some risk factors for acute pulmonary edema include:

- young age,
- male predisposition,
- well-built bodies,
- short neck,
- history of apnea,
- smoking and laryngospasm.

On the other hand, some risk factors for apnea include:

- use of opioids,
- surgeries (such as thyroidectomy and
- parathyroidectomy) and sleep apnea.

Tremors, nausea, vomiting and urinary retention

Patients with coronary disease are more susceptible to tremors in the PACU.[16] Some risk factors for tremors include:

- coronary disease due to increased oxygen consumption;
- long-term surgical interventions;
- male predisposition;
- altered physical status (high ASA scores);
- blood transfusion;
- advanced age;
- central or peripheral hypothermia;
- orthopedic procedure (endoprosthesis) with bone cement (there is a risk for postoperative tremors. One explanation could be the release of cytosine stimulated by the use of bone cement).[16]

Postoperative nausea and vomiting (PONV) may be triggered more frequently in specific groups of patients. After an exhaustive review of the literature, we were able to define patients with a higher incidence of risks:[17]

- females;
- non-smoking;
- with a history of nausea and vomiting;
- reporting nausea and movement-related vomiting;
- subjected to inhalational anesthetics;
- treated with nitrous oxide (N2O);
- using intra and postoperative opioids;
- subjected to operative time greater than 30 minutes (increases risk by 60%);
- undergoing neurosurgery, strabismus surgery, plastic surgery and laparotomy.[17]

In relation to urinary output, independent predictive factors upon admission to the PACU included surgery on the lower limbs and urinary volume equal to or greater than 360 mL postoperatively, as well as the age of the patient and administration of opioids.[18]

Some risk factors:

- anorectal surgeries;
- inguinal herniorrhaphy;
- previous history of urinary retention;
- opioids;
- advanced age;
- excess fluid delivered in the transoperative period.

Degree of dependence on nursing care and cardiac dysrhythmias

Intensive care patients in the PACU need hemodynamic and even invasive monitoring, ventilatory support, measurement of urine output drainage catheters and drains, among other activities, which make bed turnover difficult to perform.[1]

Patients with previous cardiovascular disease and those aged over 60 years are more likely to present with dysrhythmias in the PACU.[19]

Sinus tachycardia is the most frequent cardiovascular alterations in the PACU, followed by sinus bradycardia, ventricular and atrial extrasystoles.[19]

Risk factors for sinus tachycardia include:

- general anesthesia (drug such as atropine sulfate);
- tracheal extubation;
- pain when waking up;
- nausea and vomiting; and
- hyperthermia.

Risk factor for sinus bradycardia is a:

- general anesthesia.

For ventricular and atrial extrasystoles, risk factors are

- tracheal extubation and
- agitation upon awakening.

With the variation of one or two risks, we were unable to make the scale, since it requires at least three variables to be classified into low, medium and high. Therefore, we decided to draw up a scale that addresses the complications and risks involved in relation to heart rate changes.

General complications in the elderly and interventions in the PACU

The main complications reported were: hypotension due to anesthetic blockade and respiratory depression (mostly caused by the action of drugs that depress the neuromuscular blockade).[20]

In another study, the following complications were described: pain, agitation, anxiety, hypotension, tremors and chills, nausea, vomiting, bleeding and hypoxemia. General anesthesia was the most frequent and the most common comorbidity was systemic arterial hypertension (SAH).[2]

In the elderly population, the most common complications in the PACU were: hypothermia followed by pain, increased blood pressure, nausea and vomiting, dyspnea, tachypnea and bradycardia.[3]

In elderly patients, operative time is another risk factor. The higher it is, the greater the chance of cardiac and respiratory events.[3,20]

The following are risk factors according to each complication:

- systemic arterial hypertension: advanced age; pain; bladder distension; prolonged operative time; occlusive dressings; combination of drugs;
- hypotension: anesthetic blocks; blood loss; effects of anesthetic drugs;
- bradycardia: regional anesthesia; bleeding;
- tachycardia: agitation; advanced age (over 60 years);
- respiratory obstruction: tongue falling back; saliva; blood and vomiting;
- respiratory depression: opioid medications;
- bleeding: coagulopathies; problems in hemostasis; abdominal surgeries;
- pain: occlusive dressings; anxiety; trauma.

Patient positioning

Patient positioning can cause gravitational effects in the cardiorespiratory system and has as risk factors:[3]

- malnutrition;
- diabetes mellitus;
- bony points;
- hyperextension;
- greater range of abduction of the upper limbs causing damage to the brachial plexus.

Study limitations

This integrative review has some limitations, such as the reduced number of studies on nursing care provided to patients in the PACU.

International articles written by nurses are not our reality, since most of the work is focused on drug action and not on the nursing care provided.

Another limitation is the fact that the studies and publications provided didactic references based on types of studies with weak levels of evidence (levels V and VI).

CONCLUSION

Our literature review revealed the following complications in the PACU as triggering factors for complications in the immediate postoperative period: hypothermia, hypoxemia, pulmonary edema; apnea, tremors, nausea and vomiting; urinary retention, changes in heart rhythm, arterial hypertension; hypotension, respiratory depression; bleeding; pain; and surgical positioning.

After investigating the complications, we surveyed the risks, which served as the basis for the construction of our questionnaire. The questionnaire was designed with yes/no questions (1 and 0 point, respectively). The total sum of all answers defines a scale that classifies the risk to develop a given complication into low, medium and high probability.

Our proposed scale of complications, risks and nursing interventions should be validated with its practical application. Therefore, we hope our instrument will help nurses prevent complications and perform safer nursing care with an early risk assessment.

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