SAFETY IN SURGERY CARE: WHERE ARE WE?

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The subject of safety in surgery has emerged as the second global patient safety challenge launched by the World Alliance for Patient Safety, World Health Organization (WHO), between 2007 and 2008, whose landmark is the "Safe Surgery Saves Lives" campaign. This campaign aimed to encourage hospital managers and health-care providers to mobilize efforts in listing a pattern of practices that promotes safety in surgery, is applicable anywhere in the world and in different surgical scenarios, and allows the measurement of indicators aimed at promoting epidemiological surveillance. From these efforts emerged surgical care protocols and checklists applicable during surgery. The best-known checklist is "Time Out," and its use is one of the requirements of various accreditation institutions, among them the Joint Commission, which created its universal protocol. The satisfactory results of the application of Time Out are undeniable, and every day, more health professionals involved in the surgical setting are changing their habits and taking a time to go through the checklist and confirming if the patient undergoing surgery is the right patient, if the procedure to be performed is the correct one, and if the surgical site to be addressed is the right one, among other important information. However, other activities related to surgical anesthesia that do not occur at the beginning of the surgery are of paramount importance for the promotion of patient safety and should be valued. We can highlight the management of environmental cleanliness, cost management, proper processing of health-care products, proper sizing of staff in the surgery room, ongoing training of the nursing staff on new technologies, nursing care in anesthetic recovery, and communication between the teams. Although the "Safe Surgery Saves Lives" global challenge was launched 8 years ago, there is still a long way to go in promoting safety in surgery and, more than just completing the checklist, the professionals involved in the surgical/anesthetic act must get in touch with the roots of their humanistic and ethical education. This is a task for all those involved in the process: professionals, educators, researchers, patients, and managers. I suggest a simple question, to measure how much are we contributing to this process: "If I ever needed an anesthetic/surgical procedure, how safe would I feel about undergoing the procedure in my own workplace?"

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COMPLICATIONS IN ELDERLY PATIENTS IN THE POST-ANESTHETIC CARE UNIT (PACU)*

Complicações em idosos em Sala de Recuperação Pós-Anestésica (SRPA)

Las complicaciones en los pacientes de edad avanzada en la Sala de Recuperación

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ABSTRACT: Objective: To analyze complications in the elderly in the Post-Anesthetic Care Unit (PACU). **Method:** A prospective, exploratory study with quantitative method, performed in a large university hospital in Belo Horizonte. The sample consisted of 50 subjects aged 60 years or older who underwent elective surgery and were classified according to the American Society of Anesthesiologists (ASA) as I or II. Data were collected through a semi-structured guide. **Results:** Hypothermia was the most frequent complication, followed by hypoxemia, delirium and altered level of consciousness, especially in the 60–69 years old age group. Pain, nausea and vomiting showed no significant values. **Conclusion:** The control and monitoring of complications presented are key activities of the nursing team in preventing the worsening of the health status of elderly patients in the anesthetic recovery period (ARP).
Keywords: Perioperative nursing. Recovery room. Aged. Postoperative complications.

RESUMO: Objetivo: Analisar complicações em idosos na Sala de Recuperação Pós-Anestésica (SRPA). **Método:** Estudo prospectivo, exploratório, com método quantitativo, realizado em um hospital universitário de grande porte da cidade de Belo Horizonte. A amostra foi composta por 50 sujeitos com idade maior ou igual a 60 anos submetidos à cirurgia eletiva e classificados de acordo com a *American Society Anesthesiologists* (ASA) como I ou II. Os dados foram coletados por meio de um roteiro semiestruturado. **Resultados:** A hipotermia foi a complicação com maior frequência, seguida de hipoxemia, *delirium* e alteração do nível de consciência, principalmente na faixa etária de 60 a 69 anos. Dor, náusea e vômito não apresentaram valores expressivos. **Conclusão:** O controle e o monitoramento das complicações apresentadas são atividades fundamentais da equipe de Enfermagem na prevenção do agravamento do estado de saúde do paciente idoso no período de recuperação anestésica (RA).
Palavras-chave: Enfermagem perioperatória. Sala de recuperação. Idoso. Complicações pós-operatórias.

RESUMEN: Objetivo: Analizar las complicaciones en las personas mayores en la Unidad de Recuperación Pos-Anestésica. **Método:** Estudio prospectivo y exploratorio con el método cuantitativo, desarrollado en un gran hospital de Belo Horizonte. La muestra consistió en 50 sujetos con edades mayores o iguales a 60 años, sometidos a cirugía electiva y clasificados de acuerdo con la Sociedad de Anestesiólogos Americanos (ASA) I o II. Los datos fueron recolectados a través de un guión semiestructurado. **Resultados:** La hipotermia fue la complicación más frecuencia, seguido por hipoxemia, *delirio* y alteración del nivel de conciencia, especialmente en el grupo de edad de 60–69 años. El dolor, las náuseas y los vómitos no mostraron valores significativos. **Conclusión:** El control y seguimiento de las complicaciones que se presentan son las actividades clave del equipo de enfermería en la prevención de un empeoramiento del estado de salud de los pacientes ancianos en período de recuperación de la anestesia.
Palabras clave: Enfermería perioperatoria. Sala de recuperación. Anciano. Complicaciones postoperatorias.

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INTRODUCTION

Studies show that complications in the Post-Anesthetic Care Unit (PACU) are related to respiratory, cardiovascular and central nervous system (CNS) disorders, which results in hypothermia, pain, hypoxemia, nausea, vomiting, urinary retention and anxiety[1].

Changes related to senescence and comorbidities predispose the elderly, those aged over 60 years, to complications associated with the surgery. The aging process causes physiological changes in all systems, which can bring increased risks to the elderly undergoing surgery, due to reduced ability to maintain fluid balance, maintenance of body temperature, decreased lung compliance, circulatory impairment related to atherosclerotic processes, and aggravating comorbidities of the general health status of the elderly, such as systemic hypertension (SM) and *diabetes mellitus* (DM)[2].

Although the occurrence of complications is greater in older patients, there is evidence that the age is not itself an independent risk factor, i.e., morbidity and mortality rates are more related to the patient's clinical condition than chronological age[3].

Considering that elderly patients may be at increased risk of complications in the anesthetic recovery period (ARP), due to having a more vulnerable clinical condition, we raise the question: what are the most frequent complications in elderly patients in the ARP period?

Given the above, this study aimed to analyze the most frequent complications in elderly patients in the ARP.

OBJECTIVE

To analyze the complications of elderly patient in the PACU.

METHODS

Prospective, exploratory study, with quantitative method, performed in a large federal hospital of the Unified Health System network (SUS) in the city of Belo Horizonte (MG).

The research field was the PACU, which has nine beds. The study period was from June to September 2013.

The research project was approved by the Research Ethics Committee of Universidade Federal de Minas Gerais (CEP-UFMG), compliant to Resolution No. 466/2012 of the National Health Council, under protocol nos. CEP-UFMG 274,655 and CAAE 14887213.4.0000.5149.

The Informed Consent (IC) was signed by all participants after being informed by the researcher about the study and its objectives. Clarifications and the signing of the consent were carried out in the patients' rooms, when they were still in the preoperative phase.

The sample consisted of 50 subjects and was defined according to the number of predictor variables initially proposed, using 10 subjects for each of the variables. The predictive variables were age, elective surgery, classification according to the scale by the American Society of Anesthesiologists (ASA) as I and II, and minimum duration of anesthesia and surgery of one hour.

Inclusion criteria were subjects aged 60 years or over undergoing all kinds of anesthesia, except for regional anesthesia, with a minimum duration of one hour, elective surgery, with a minimum duration of one hour, and physical classification according to the scale ASA (I and II).

For data collection, a structured instrument was elaborated with the characterization of the patient, of the anesthetic-surgical procedure and of the complications in the ARP.

The characterization of the patient and of the anesthetic-surgical procedure was obtained with data such as gender, age, type of surgery, surgery time, anesthesia time, physical scale according to the ASA classification, preexisting comorbidities and preoperative systolic blood pressure (SBP), to enable comparisons with blood pressure levels in the PACU.

For analysis of the complications presented in the ARP, vital signs were checked, the Aldrete-Kroulik Index (AKI) was applied and patients were observed for the presence of pain, nausea, vomiting and delirium.

In the assessment of vital signs, hypotension or hypertension were considered if the basic SBP was 20% lower or higher than the pre-anesthetic SBP level[4]. For heart rate (HR), bradycardia or tachycardia were considered if the value was lower than 60 or higher than 100 beats per minute, respectively. Concerning the axillary body temperature, hypothermia was considered if values were lower than 36°C, and hyperthermia if values were higher than 37,8°C[5].

The respiratory rate (RR) was considered within the normal range for adults when the values were between 12 and 22 breaths per minute, and bradypnoea and tachypnea when values are below 12 and above 22 breaths per minute, respectively[6].

As for the AKI, in the muscle activity parameter, it assesses the patient's ability to move limbs, spontaneously or on command, and allows the assessment of patients with subarachnoid or epidural blocks and evaluates residue of muscle relaxants[7].

Breath tests the ability to take a deep breath and to cough, whether dyspnea is apparent and if there is hypopnea and hyperpnea. Circulation, although difficult to evaluate, checks the differences of patients' basic SBP regarding pre-anesthetic blood pressure levels, allowing the analysis of complications such as hypotension and hypertension. Consciousness assesses alertness, spontaneous or on command, analyzing changes in level of consciousness[4,7].

Peripheral oxygen saturation (SpO_2) enables the evaluation of the percentage of peripheral oxygenation. This parameter determines complications such as hypoxemia[5].

From the verbal report by the elderly, pain, nausea, vomiting, delirium (by incongruous speech), temporal-spatial disorientation and difficulty in concentrating were analyzed.

The data were evaluated upon arrival of the elderly to the PACU, considered as moment 0 minutes, and after that, every 15 minutes, up to 60 minutes.

Data were stored in Microsoft Office Excel 2007 and processed in Statistical Package for Social Sciences (SPSS), version 14.0. Categorical variables were demonstrated by absolute and relative frequencies, and continuous variables were expressed as minimum, maximum, mean and standard deviation.

RESULTS

The results are shown with the characterization of the patient, of the anesthetic-surgical procedure, and of the complications in the ARP.

The characterization of the patient and of the anesthetic-surgical procedure consisted of gender, age, classification according to the ASA scale, comorbidities, type of surgery, type of anesthesia, duration of anesthesia and duration of surgery.

Table 1 shows that the women had the highest rate, with 28 elderly (66.0%), and 25 elderly (50.0%) aged between 60 to 69 years old, and 4 (8.0%) aged over 80.

With regard to the ASA classification, 45 (90.0%) were ASA II, the most common comorbidities were hypertension, 17 (34.0%), and hypertension associated with DM, 9 (18.0%). It is noteworthy that 10 of the elderly (20.0%) showed no comorbidity, and other comorbidities were identified in 12 patients: dyslipidemia, obesity, depression and smoking (24.0%).

The most common type of anesthesia was general, 21 (42.0%), followed by regional associated with sedation, 12 (24.0%). In regional anesthesia, the epidural and spinal were considered; in other anesthetics, the plexus and field blocks were considered.

Table 1. Frequency distribution of the elderly, according to sociodemographic, clinical and surgical data. Belo Horizonte, 2013.

Variables	Gender				Total	
	Male		Female			
	n	%	n	%	n	%
Age (years)						
60–69	10	45.5	15	53.6	25	50.0
70–79	10	45.5	11	39.3	21	42.0
≥80	2	9.0	2	7.1	4	8.0
ASA*						
I	5	22.7	0	0.0	5	10.0
II	17	77.3	28	100.0	45	90.0
Comorbidities						
SM	6	27.3	11	39.3	17	34.0
DM	0	0.0	2	7.1	2	4.0
SM and DM	4	18.1	5	17.9	9	18.0
Other	6	27.3	6	21.4	12	24.0
None	6	27.3	4	14.3	10	20.0
Type of anesthesia						
General	9	18.0	12	24.0	21	42.0
General+regional	3	6.0	1	2.0	4	8.0
Regional	2	4.0	6	12.0	8	16.0
Regional+sedation	5	10.0	7	14.0	12	24.0
Other	3	6.0	2	4.0	5	10.0
Time of anaesthesia (min)						
60–120	5	22.7	12	42.9	17	34.0
121–180	7	31.8	7	25.0	14	28.0
≥181	10	45.5	9	32.1	19	38.0
Duration of surgery (min)						
60–120	11	50.0	19	67.8	30	60.0
121–180	7	31.8	5	17.9	12	24.0
≥181	4	18.2	4	14.3	8	16.0

*Classification according to the American Society of Anestesiology (ASA).
SH: systemic hypertension; DM: *diabetes mellitus*.

The time of anesthesia over 180 minutes and the time of surgery between 60 and 120 minutes were the most frequent, 19 (38.0%) and 30 (60.0%), respectively.

Regarding the type of anesthesia and surgical procedures, inguinal hernia repair was performed in 11 (22.0%), and gynecological procedures in 10 (20.0%) (Table 1).

Complications presented by the elderly were analyzed by AKI, vital signs, demonstration or report of pain, nausea, vomiting and delirium. These values were analyzed from the time of entry, considered as minute 0, up to one hour of stay in the PACU, i.e., 60 minutes.

Table 2 shows the distribution of AKI values according to the length of stay in the PACU.

It is observed that, after 60 minutes of PACU stay, although most have obtained grade 2 in 5 physiological signals, that a considerable percentage of elderly had grade 1, 18 of them (38.3%) for SpO_2, 16 (34.0%) for level of consciousness, 14 (29.7%) for circulation, 10 (21.2%) for activity and 3 (6.3%) for breath. Muscle activity with note 1 at 60 minutes can be explained by regional anesthesia and sedation, only regional and others, with, respectively, 4 (8.4%), 3 (6.4%) and 3 (6.4%) of the total of 10 elderly, respectively.

The physiological signs activity and breathing did not have grade 0 at any moment for the level of consciousness; 1 elderly obtained grade 0 up to 15 minutes of stay in the PACU.

For circulation, over the 60 minutes of stay, 2 elderly had grade 0, and, after 60 minutes, 1 of these still remained with this assessment, that is, with 50% of difference in their basic blood pressure.

As for SpO_2, 1 elderly was admitted to the PACU with grade 0, also presenting this grade at 30 minutes; at 60 minutes, no patient had grade 0 in SpO_2 (Table 2).

Table 2. Frequency distribution of the elderly according to the values of the Aldrete-Kroulik Index and the length of stay in the Post-Anesthetic Care Unit. Belo Horizonte, 2013.

AKi	Time									
	0		15		30		45		60	
	n	%	n	%	n	%	n	%	n	%
Consciousness										
0	1	2.0	1	2.0	0	0.0	0	0.0	0	0.0
1	18	36.0	19	38.0	24	48.0	21	42.8	16	34.0
2	31	62.0	30	60.0	26	52.0	28	57.1	31	65.9
Activity										
0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
1	19	38.0	17	34.0	13	26.0	11	22.4	10	21.2
2	31	62.0	33	66.0	37	74.0	38	77.5	37	78.7
Breathing										
0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
1	7	14.0	6	12.0	4	8.0	3	6.1	3	6.3
2	43	86.0	44	88.0	46	92.0	46	93.8	44	93.6
Circulation										
0	2	4.0	1	2.0	2	4.0	1	2.0	1	2.1
1	14	28.0	15	30.6	14	28.0	15	30.6	14	29.7
2	34	68.0	33	67.3	34	68.0	33	67.3	32	68.0
Oxygen saturation										
0	1	2.0	0	0.0	1	2.0	0	0.0	0	0.0
1	21	42.0	26	52.0	21	42.0	21	42.8	18	38.3
2	28	56.0	24	48.0	28	56.0	28	57.1	29	61.7

AKI: Aldrete-Kroulik Index.

Table 3 shows the variation of the vital signs regarding the mean, standard deviation and minimum and maximum values.

At 60 minutes, changes were observed in minimum values for SBP, diastolic blood pressure (DBP), HR, RR and body temperature; as for the maximum values, only DBP and body temperature showed no changes.

Over time, significant variations in the minimum and maximum values were also observed, such as SBP at 202 mmHg at 0 minute, DBP at 32 mmHg at 30 minutes, HR at 40 bpm at 15 minutes, RR at 6 and 25 at 30 and 15 minutes, respectively, and body temperature at 32°C upon admittance to the PACU (Table 3).

Table 4 shows the distribution of values of changes in vital signs in the elderly along their PACU stay. It was observed that, after 60 minutes of stay in the PACU, changes in vital signs were still present.

The greatest frequency of change was for body temperature, with 37 hypothermic elderly (74.0%), followed by bradycardia, with 9 (18.0%), and hypotension and hypopnea with 8 elderly (16.0%).

Regarding high blood pressure, tachycardia and tachypnea, after 60 minutes of stay, 4 (8.0%), 3 (6.0%) and 2 (4.0%) subjects presented these complications, respectively, and no elderly presented hyperthermia. At 45 and 60 minutes, 1 and 3 subjects had been discharged from the PACU, with 98.0 and 94.0% of the total sample, respectively (Table 4).

Delirium was identified in 17 elderly (34.0%), of which 4 had pain upon entry to the PACU. With respect to pain, 8 elderly subjects (16.0%) showed that complaint upon entry. Other complications presented were rash, tremors and bladder distention, 1 elderly (2.0%) with each condition, respectively.

Table 3. Characterization of the range of values of vital signs, according to the time spent in the Post-Anesthetic Care Unit. Belo Horizonte, 2013.

Vital signs	Time				
	0	15	30	45	60
SBP					
Mean (SD)	124.9 (23.44)	124.9 (24.71)	122.4 (23.08)	124.5 (24.91)	123.7 (23.29)
Minimum	83	70	71	68	83
Maximum	202	194	199	182	178
DBP					
Mean (SD)	69.6 (13.82)	68.2 (14.94)	68.1 (15.25)	69.0 (13.81)	69.8 (14.23)
Minimum	42	36	32	35	40
Maximum	107	104	103	98	99
HR					
Mean (SD)	72.9 (12.90)	70.8 (12.30)	70.4 (13.0)	71.5 (13.48)	71.2 (14.64)
Minimum	43	40	39	41	45
Maximum	98	97	101	102	105
RR					
Mean (SD)	14.3 (3.73)	14.5 (4.02)	14.4 (3.80)	14.4 (3.52)	14.9 (4.02)
Minimum	7	7	6	7	7
Maximum	23	25	23	23	26
Axillary temperature					
Mean (SD)	34.3 (0.96)	34.7 (0.88)	34.8 (0.82)	35.1 (0.78)	35.2 (0.80)
Minimum	32.0	32.2	33.1	33.2	33.2
Maximum	36.1	36.0	36.3	36.5	36.4

DP: standard deviation; SBP: systolic blood pressure; DBP: diastolic blood pressure; HR: heart rate; RR: respiratory rate.

Table 4. Distribution of elderly according to alterations in vital sign values during the time spent in the Post-Anesthetic Care Unit. Belo Horizonte, 2013.

Alterations in vital signs	Time									
	0		15		30		45		60	
	n	%	n	%	n	%	n	%	n	%
SBP										
(<20%) Hypotension	11	22.0	10	20.0	11	22.0	9	18.0	8	16.0
(>20%) Hypertension	5	10.0	6	12.0	3	6.0	4	8.0	4	8.0
HR										
(<60) Bradycardia	7	14.0	10	20.0	9	18.0	8	16.0	9	18.0
(>100) Tachycardia	0	0.0	0	0.0	1	2.0	2	4.0	3	6.0
RR										
(<12) Bradypnea	10	20.0	12	24.0	12	24.0	8	16.0	8	16.0
(>22) Tachypnea	1	2.0	2	4.0	2	4.0	1	2.0	2	4.0
Axillary temperature										
(<36.0°C) Hypothermia	48	96.0	49	98.0	47	94.0	45	90.0	37	74.0
(>37.8°C) Hyperthermia	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Total	50	100.0	50	100.0	50	100.0	49	98.0	47	94.0

SBP: systolic blood pressure; HR: heart rate; RR: respiratory rate.

As for the nausea symptom, 2 (4.0%) reached the PACU with such a complaint, and only one old presented vomiting in the length of stay.

DISCUSSION

The results of this study demonstrated greater frequency of decreased body temperature, with 37 hypothermic elderly (74.0%), oxygen saturation level in 18 hypoxemic elderly (38.3), delirium in 17 elderly (34.0%), level of consciousness, with 16 (34%), bradycardia, with 9 (18.0%), hypotension, bradypnoea and pain in 8 (16.0%), respectively, in the 60 minute period of stay in the PACU. Other evident changes were hypertension, tachycardia, tachypnea, nausea and vomiting, less frequently.

The temperature drop situation is inherent to the surgical process in the elderly, due to alterations in the thermoregulatory system, caused by drugs, or by anesthesia, and factors such as positioning, operating room temperature, infusion of cold solutions in cavities or intravenously, exposure of cavities, duration of surgery, type of surgery and ventilation with non-heated gases[3,7].

When the general and regional anesthesia are combined, there is a greater risk of unintentional perioperative hypothermia. Hypothermia triples the incidence of myocardial adverse events, increases the risk of surgical site infections, bleeding, and is associated with increased length of hospital stay and health care costs. It also alters the pharmacokinetics and pharmacodynamics of most anesthetics, prolonging anesthesia recovery[8,9].

The patient develops hypothermia in the Operating Room (OR), and maintains this situation during ARP, triggering unwanted clinical manifestations. Perioperative warming of surgical patients is effective in reducing pain and surgical site infection, as well as the tremors. Systemic warming is also associated with less perioperative blood loss, preventing hormonal changes, increased catecholamines and coagulopathy[10,11].

Several studies show that prevention methods used in the OR are heated intravenous infusion (heated fluids), thermal blanket, common blanket and bandaging of limbs with orthopedic cotton. The heated infusion method used alone does not prevent the complications related to intraoperative hypothermia[11].

Nurses play an important role in the implementation of preventive measures for hypothermia in the OR, avoiding the complications it causes in the ARP. The importance of vigilant monitoring of the patient's temperature, especially the elderly, throughout the anesthetic-surgical process is essential to ensure that such patients maintain normothermia, reducing complications and providing comfort to the patient[9,11].

Hypoxemia was the second most frequent complication in this study. It is defined as the reduction in arterial oxygen content and is diagnosed by reduced SpO_2 (below 95% or decrease higher than 5% of the initial value), being identified by the elderly who received grade 1 according to the AKI.

Studies show that the risk factors for hypoxemia are age over 55 years, preoperative pulmonary function, the residual effect of the anesthetic used, the surgical field involved in the procedure and the duration of anesthesia. Studies show that there is a higher incidence of hypoxemia in patients classified as II and III according to ASA scale, which supports the present study, in which 90% of the elderly were classified as ASA II[12,13].

The hypoxemia frequency at time 0 was higher in the elderly who received general anesthesia or associated with local anesthesia, with 12 (24.0%) and 4 (8.0%), respectively.

A study conducted in a university hospital in São Paulo that evaluated the impact of changes in the O_2 saturation during the transportation of the patient from the OR to the PACU without the use of oxygen therapy showed that, out of 737 patients (83.5%) who underwent anesthesia, usually with or without regional block, 98 had statistically higher incidence of hypoxia compared with those who received exclusively regional block or associated with sedation[12].

In assessing the airways of the patient admitted to the PACU, the American Society of PeriAnesthesia Nurses (ASPAN) recommends observation of patency, administration of humidified oxygen and placement of pulse oximetry as hypoxemia prevention methods[14].

A study aimed to analyze the use of pulse oximetry during the perioperative period as a means to identify, prevent and intervene in complications related to hypoxemia points out that the use of this monitoring system substantially reduced the extent of perioperative hypoxemia, allowing the detection and treatment of related complications. In contrast, the study questions whether oximetry can protect the patient from postoperative complications against human negligence, that is, if only monitoring oxygen levels does not prevent complications, but, facing the findings, warns professionals related to the care of surgical patients to take the appropriate conduct[15].

Delirium was the third most frequent complication, and 17 elderly (34.0%) showed this condition upon admittance to the PACU. These results had association with the time and type of anesthesia. Of these 17 elderly, 9 (52.9%) remained for a longer time than 180 minutes in the anesthetic process, and 13 elderly subjects (76.4%) received general anesthesia or associated regional anesthesia.

The elderly are susceptible to developing delirium as a result of a variety of organic factors such as hypokalemia, hyponatremia and/or toxicity arising from the anesthetic medication. One hypothesis for the etiology of delirium is a decrease in cholinergic activity. The suppression of cholinergic cells is partly one of the mechanisms responsible for anesthesia, so general anesthesia has been implicated as a risk factor for postoperative delirium[16].

The altered level of consciousness was analyzed by AKI, assigning grade 1 to those who awakened if requested. After 60 minutes of stay in the PACU, 16 elderly (34.0%) showed this condition, more frequently in the specialty of gynecological surgery. However, studies show that this complication is associated with sedative, anesthetic residue, hypoxemia, pain or anxiety[17].

Hypotension and hypertension conditions were analyzed from the circulation parameter from the AKI, in which the elderly who were graded 1 or 0 if they presented a blood pressure with 20 to 49 or 50%, respectively, of difference from the preanesthetic value. Also, 14 elderly (28%) were graded 1 at moment 0, and that number remained after 60 minutes of stay in the PACU, 2 elderly (4%) were graded 0 upon admission to the PACU and 1 elderly remained with this grade after 60 minutes.

Several studies show that the factors that contribute to increased blood pressure in the ARP are age, anxiety, surgical anesthesia, catecholamine release, extubation, basic hypertension, as well as those associated with pain, fear of taking deep breaths, bandages and combinations of drugs[13].

Regional anesthesia promotes dilation of resistance and capacitance vessels, which results in decreased venous return, the filling pressure of the right heart chambers, systemic vascular resistance and debit[18].

Muscle activity was evaluated by AKI, and 19 elderly (38.0%) were graded 1 upon admittance to the PACU, that is, those patients moved only 2 limbs. From the results, it can be seen that such a framework is related to the type of anesthesia: isolated

regional anesthesia or associated with sedation. This complication is associated with the residual effect of muscle relaxants, leading to muscle weakness in the ARP[7,13].

Bradycardia and tachycardia showed a lower frequency upon admittance to the PACU, with 7 elderly (14.0%) presenting bradycardia and no elderly with tachycardia; however, over the 60 minutes spent in the PACU, there was an increase in the number of elderly people presenting such changes, in the 70–79 years age group, and with regional anesthesia or associated with sedation.

Studies show that bradycardia is related to neuraxial anesthesia, to the anesthetic technique used, to the classification according to the ASA scale, I and II, and to age higher than or equal to 61 years. As for tachycardia, it is related to stress, prolonged surgical time, pain and sympathomimetic and parasympatholytic drugs[18].

As for the HR upon admission to the PACU, 10 elderly (20.0%) had bradypnoea and only 1 (2.0%) had tachypnea; at 60 minutes of permanence, 2 elderly (4.0%) showed tachypnea.

The bradypnoea condition is related to the residual effect of opioids, neuromuscular blockers and fear associated with breathing due to pain and hypothermia. Tachypnea can be explained by an accumulation of carbon dioxide as a result of tremors and, sometimes, by the excitement of waking up from anesthesia (anxiety), this manifestation is a form of compensation for the elimination of carbon dioxide[13].

Dyspnea was analyzed by the AKI, in which patients received grade 1, wherein 7 elderly (14.0%) showed this complication at moment 0 of the ARP. In the elderly, this complication, as well as being closely associated with the factors mentioned above, such as bradypnoea, tachypnea, pain and anxiety, has the functional loss of age, lung and comorbidities such as smoking and obstructive pulmonary disease. This complication can lead to other consequences, such as decreased level of consciousness and hypoxemia.

Collaborating further to respiratory changes are the naturally shallower breathing of the elderly, reduction in muscle tone of the diaphragm and accessory muscles of respiration, hardening of the costal cartilages and increased respiratory dead space, dilation of the tracheobronchial tree, and worst alveolar ventilation[2,3].

Pain was one of the less frequent complications, with 8 elderly (16.0%) presenting such complaint upon admittance to the PACU. Pain in the immediate postoperative period is not only related to the surgical incision, but also to the nerve stimulation by chemicals released during surgery, occurrence of ischemia in certain areas due to pressure, vasospasm, muscle spasm, edema and surgical positioning, factors that interfere with the blood supply to the tissues, causing acute pain[19].

Besides being an unpleasant experience, the pain is linked to negative consequences such as the development of chronic pain syndrome, discomfort and delayed recovery. Because it is a subjective experience, its approach should involve the patient. Visual and numerical scales have been used for evaluation; however, these tools may fail if the patient is still sedated. In such cases, other clinical data, such as changes in the HR and blood pressure, have been used as a pain assessment parameter[20].

Currently there is a variety of pharmacological treatments for pain in the postoperative period; yet, the pain remains one of the complications that require observation and special care in the PACU. The choice of the best treatment is up to anesthesiologists and nurses in the PACU, providing assessment, prevention and monitoring and relief measures of pain conditions during that period[3].

Studies show that nausea and vomiting are also common complications in the ARP: even with new anesthetics and antiemetic agents, nausea and vomiting persist in 20-30% of patients[14]. However, in this study only 2 elderly (4.0%) had nausea and 1 (2.0%) showed vomiting.

Despite the different types of treatment, these symptoms are still present in patients in the ARP, which requires the creation of mechanisms to ensure the reduction of such occurrences, whether using conventional therapies or seeking new resources to improve patient comfort.

In São Paulo, nurses already have a legislation that regulates the use of Complementary Therapy, Law No. 13.717, of January 8, 2004, which provides for the use of therapies such as aromatherapy, reflexology, flower essences, etc., and therefore, nurses have another resource to use in their care plan[3,13].

CONCLUSION

In this study, the most frequent complications, evidenced by the results, were hypothermia, hypoxemia, delirium and altered level of consciousness.

Among age groups, elderly aged 60-69 years were the ones who showed changes in the PACU. This result shows that age is not precisely an independent indicator, i.e., morbidity and mortality are more closely related to the patient's clinical situation than to chronological age.

Over 60 minutes, the number of elderly people with complications (such as hypotension, bradycardia, tachycardia and tachypnea) had increased or remained the same; however, muscle activity, changes in respiration, SpO_2 and changes in consciousness presented a decrease. Although it showed a decrease in the ARP, hypothermia reached 74% of the elderly.

Elderly patients, in turn, require a continuous care from the nursing staff and other professionals in the ARP, because such conduct has a positive impact in the early detection and decrease of complications that are frequent after the anesthetic-surgical procedure, as evidenced in the present study, enabling the recovery of the elderly.

The nurse's role is essential in the PACU in the prevention of postoperative complications, which are planned in the preoperative period. Whereas the elderly population grows every year in quantity and complexity, an individualized and well-planned nursing care is necessary to reduce the damage in the postoperative period.

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INSTRUMENTAL IN SURGICAL BOXES: COST EVALUATION*

Instrumentais nas caixas cirúrgicas: avaliação de custo

Instrumentos quirúrgicos: evaluación de los costos

Julierme Rodrigo de Almeida Paula[1], Rita de Cássia Rodrigues da Silva[2], Cleuza Aparecida Vedovato[3], Ana Paula Boaventura[4]

ABSTRACT: Objective: To evaluate the number of instruments in surgical boxes, which are not used during a surgery in a hospital in the state of São Paulo. **Method:** Data collection resulted from the direct observation of the instruments used in surgery, recording the actual number of instruments in the box, the number of instruments used in surgery, and the number of unused ones. **Results:** On an average, about 52% of existing materials in surgical boxes are not used, generating high costs for the institution. Calculating the losses, we obtained an average worth US$ 2.90 (R$ 8.00) per surgical box used, mounting up to the value of U$ 566 (R$ 1,584.17) per month. **Conclusions:** We conclude that there is a waste of materials, which are sterilized and not used in surgical procedures, directly reflecting the quality and the cost management of the sterilized material center.

Keywords: Surgical instruments. Costs and cost analysis. Surgical procedures, operative.

RESUMO: Objetivo: Avaliar o número de instrumentais das caixas cirúrgicas que não são utilizados durante as cirurgias, em um hospital do interior do Estado de São Paulo. **Método:** A coleta de dados resultou da observação direta dos instrumentais utilizados nas cirurgias, registrando o número real de instrumentais na caixa, número de instrumentais utilizados na cirurgia e número de não utilizados. **Resultados:** Em média, cerca de 52% dos materiais existentes nas caixas cirúrgicas não são utilizados, gerando custos elevados para a instituição. Calculando o desperdício, foi obtida uma média no valor de R$ 8,00 (oito reais) por caixa cirúrgica utilizada, podendo chegar ao valor de R$ 1.584,17 por mês. **Conclusões:** Conclui-se que há um desperdício de materiais que são esterilizados e não são utilizados nos procedimentos cirúrgicos, refletindo diretamente na qualidade e nos custos do gerenciamento do centro de material e esterilização.

Palavras-chave: Instrumentos cirúrgicos. Custos e análise de custo. Procedimentos cirúrgicos operatórios.

RESUMEN: Objetivo: Evaluar el número de instrumentos de cajas quirúrgicas que no se utilizan durante la cirugía en un hospital de una ciudad de la provincia de São Paulo. **Método:** La recolección de datos resultó de la observación directa de los instrumentos utilizados en la cirugía, registrando el número real de instrumentos, el número de los instrumentos utilizados en la quirugía, número no utilizado y no utilizado. **Resultados:** En promedio no se utilizan al rededor del 52% de los materiales existentes en las cajas quirúrgicas, generando altos costos para la institución. Calculando el desperdicio se obtuvo un promedio de valor de € 2,7 por caja quirúrgica utilizada, alcanzando el valor de €528) mensuales. **Conclusiones:** Se concluye que ocurre un desperdicio de material es que se esterilizan y no se utilizan en procedimientos quirúrgicos colocados en las cajas quirúrgicas influyendo directamente en la calidad y los costes de gestión de la Central de material y esterilización.

Palabras clave: Instrumentos quirúrgicos. Costos y análisis de costo. Procedimientos quirúrgicos operativos.

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INTRODUCTION

The Surgical Center (SC) is the space in a hospital where high-, medium-, and low complexity surgery is performed. This space is a complex environment and requires well-trained and qualified staffs. It is recommended that the SC be situated near to the Intensive Care Unit, to the post-anesthetic recovery room, and to the emergency room to facilitate an emergency response; it should also be close to the Sterilized Materials Center (SMC) to facilitate the flow of sterilized materials[1,2].

The SMC should be a clean, dry site, which has a restricted access to skilled personnel, and should also have a controlled environment for temperature and humidity, being in the range of 25°C and a relative humidity around 30 to 60%. These two parameters are not proven accurate, but the maintenance of an average of temperature and relative humidity is proven indispensable, not only to maintain the sterility of the material but also to prevent bacterial growth and deterioration of sterile materials[3,4].

From the moment in which the material is used in surgery, it is considered contaminated and is routed to the SMC to undergo processing and again become sterile (i.e., free of any microbial organism, infectious or not)[5].

The sterilization process is complex and subdivided into several techniques, some of which are as follows: saturated steam under pressure, ethylene oxide, hydrogen peroxide plasma, ionizing radiation, low-temperature steam, and formaldehyde[6].

To ensure the quality of these methods and verify the actual death of microorganisms at a value of 10^{-6} per unit of filter paper, there are specific assessments aimed at verifying physical, chemical, and biological parameters, human or mechanical error, materials involved in the sterilization process, and critical parameters of each process in physical control. For chemical control, there are chemical indicators, and for biological control, there are growth mediums, which assess the growth of spores, ensuring a greater safety and a lower surgical infection rate[7]. Surgical instruments are subject to such sterilization and assessments.

There is a vast collection of surgical instruments that have evolved along with the surgical techniques. With the emergence of new clinical and surgical procedures, came the need for tools that facilitate the surgical procedure, resulting in the creation and even in the adaptation of various instruments[3]. Surgical instruments serve the purpose of helping, facilitating, and promoting accuracy in the surgical acts.

The instruments are also divided into special and basic or common groups according to their use and functions during each time in surgery. The special ones are used rarely only in certain surgeries, i.e., they are specific instruments for a surgery. The common group includes the basic surgical instruments in all the surgical boxes used in any type of intervention, with the function of promoting dieresis, hemostasis, gripping, separation, and synthesis[8].

Dieresis instruments are the group of instruments, such as a scalpel blade, which are used to make a skin incision or opening, thereby opening a gateway to the tissues and organs to be handled. Instruments such as scissors, drill bits, and rongeurs used in specific surgeries also come under this group.

The instruments used in hemostasis, which are intended to interrupt the vascular bleeding subsequent to incisions, are straight or curved hemostats of varying sizes that may or may not be composed of teeth and grooves.

The gripping instruments are used to fasten the tissue, guts, organs, and other parts such as the surgical field. Separating instruments or retractors are designed to separate organs, tissue, and viscera. The synthesis instruments, for the moment of accommodation of organs and tissues to promote healing, are used to approximate the edges of an organ or tissue through needles and wires mounted in needle holders of various types, sizes, and shapes[9,10].

Finally, some examples of special instruments used specifically for some surgical specialties are the Abadie tweezers, used in the digestive tract surgery, or the Sluder-Ballenger tonsillectome for tonsil surgery[10].

The surgical instruments used in the hospital environment are seen as material resources and are extremely important within a for-profit institution or otherwise, representing 75% of the capital of the health care institutions (HCI). Therefore, the way they are managed reflects directly in the hospital costs. The amount of material resources, specifically surgical instruments, should be accounted for in order to provide the care services properly without unforeseen events; but, if there is an excessive amount of unused instruments, this can result in high costs and depreciation, deterioration, and waste[11].

In the costs assessment, it is extremely important to note that the final product — in this case, the sterile

hospital supplies — refers to the action of three interrelated factors, namely: materials used, workmanship, and technology employed. These factors, if well-managed, produce no losses but guide expectations for costs reduction while maintaining quality care. However, to achieve that, there must be an administration of quality, which is attentive to these factors.

To get to this cost reduction associated with sterilization, the accounting of expenditures from inputs, time, and workmanship used to carry out the cleaning of each instrument up to the storage of the material in the SMC was conducted, and the technology used to complete the process was also evaluated, which included the maintenance of the sterilizing machine and the electric power used in the process[12].

For a well-performed surgery with a successful outcome, the instruments must not be in excess or missing in the boxes and the table. It is necessary that the essential or proven useful tools for performing surgery are present during the act[8]. If this basic rule is not met, losses in workmanship, inputs, and technology will occur, with the unnecessary processing of instruments that will not be used but should go through these services[12].

Therefore, managing costs within a SC, and consequently a SMC, is an activity of the nurse, who must take, with astuteness and knowledge, strategic actions calculated to bring a balance between revenue, expenses, and costs in the HCI, ensuring its survival. The hospital should be managed as a business[13].

It is understood, in daily practice, that there is no use of some surgical instruments in the SC. That is, many surgical instruments that make up the box are not used again and go through the sterilization process, causing unnecessary expenses to the SMC.

Thus, this study aimed to quantify the number of instruments used and unused during surgery, detail by surgical time the instruments that are no longer used, and estimate the cost of the sterilization process of these instruments in this institution.

METHOD

This is a quantitative, descriptive, field, and observational study, conducted from data collection through observation and recording of the use or not of surgical instruments present on the surgical boxes.

The sample consisted of the surgeries observed during a week of data collection in the morning. Data were obtained from systematic observation of the surgical boxes used in each surgery and recorded in the data collection instrument.

The instrument had the following data: class of common instruments in surgical boxes, divided into dieresis, hemostasis, gripping, separation, and synthesis, the exact number of surgical instruments in each box, the number of instruments used in surgery, and the number of instruments that remained in the box and/or were not used during the surgical procedure.

Data collection was performed by two researchers, initially requesting an authorization of the surgical team in the room to observe the whole surgical procedure for the counting of the instruments used. The team leader of each surgery, guided by the researchers, signed an informed consent, in which they were informed about the purpose and procedures of the research.

For the selection of the surgeries, the researchers randomly raffled surgeries that would be observed each day for the application of the data collection instrument, making use of the surgical map. Researchers, along with the scrub nurses, counted the instruments as soon as the surgical box was opened for disposition on the table in the operating room and again at the end of each surgery.

For each operation included in the study, the surgeon in charge and the scrub nurse signed the consent form authorizing the collection of data within the operating room during surgery.

In this SC, mostly abdominal surgery is performed, and the surgical boxes are intended to coloproctology, gynecological surgery, obstetrical and gastroenterology specialties, and general surgery. We selected some surgeries within these specialties, such as hemorrhoidectomy, appendectomy, hernia repair, colpoperineoplasty, total or partial hysterectomy, and cesarean section — being these the most frequent types, including small and medium surgeries.

As this survey was conducted in a hospital being accredited by the National Health Organization (ONS), existing data on the institution's costs with sterilization of surgical materials and workmanship were used.

This study was conducted at the SC of a private hospital with 30 beds, in a city in the inner State of São Paulo. These HCI offer small and medium surgeries, running 24 hours a day with a total of 17 employees in the SC and

10 in the SMC, where an average of 191 monthly surgeries being performed.

The structure of the SMC includes an equipped materials processing room with two saturated steam under pressure autoclaves, one marble counter with an envelope sealer, papers and protocols with standards and routines, place for storage of materials used for making instrument packages, and a computer and printer to generate labels with batch, autoclave number, cycle, date, method used, and the name of the responsible employee. All these were to ensure the quality of the sterilization and of the care delivered.

The SMC has an ample storage room for sterile equipment, keeping them organized and packaged in a legally standardized form, with temperature and relative humidity within acceptable parameters.

The dirty area (purge room) is separated from the clean area (preparation and sterilization room) by a bathroom containing a shower and a dressing room. In the prewash area (dirty area), there is also one washbasin with taps, a counter for handling the material, an ultrasonic washer, and a compressed air system for drying materials.

This study was approved by the Research Ethics Committee of the School of Medical Sciences at Universidade Estadual de Campinas, via Plataforma Brasil under protocol No. 341.882.

RESULTS

A total of 17 surgical procedures were observed: 8 cesarean sections, 5 laparotomies, and 4 hysterectomies, and this sequence is presented in Figure 1. The highest incidence of surgery was in cesarean delivery, followed by laparotomy and total hysterectomy. Altogether, 934 instruments were analyzed, counting the used and unused ones in all the surgical instrument classes.

Figure 1 represents all the operations evaluated. The total number of instruments and those used in procedures are described.

The overall mean nonusage of instruments of all surgical specialties was 52%, because, of the 934 instruments evaluated, 485 were not used.

Table 1 presents the cost of the saturated steam under pressure autoclave processing of 275 instruments, that is, a sterilization cycle. It involves the costs of water, electricity, depreciation, maintenance, labor (time/staff/

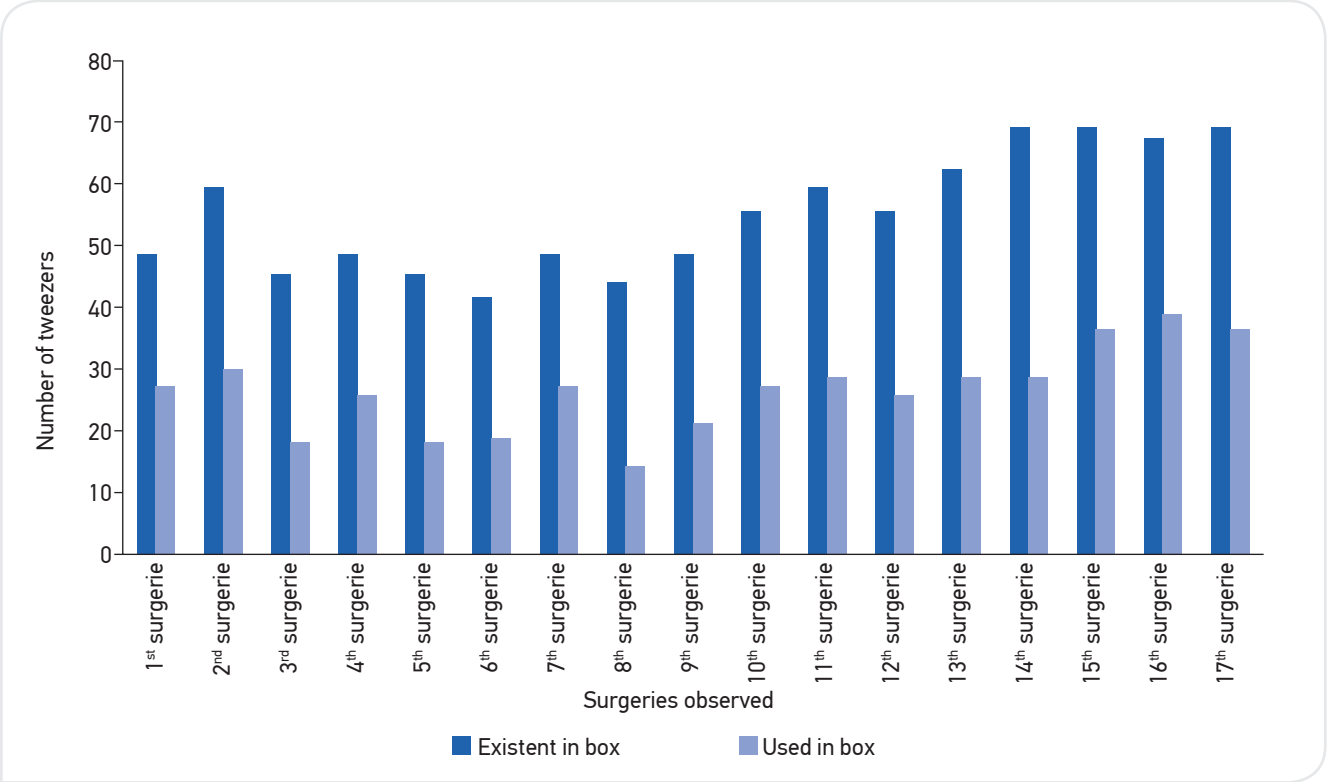

Figure 1. Total existent and used instruments in all surgeries observed. São João da Boa Vista, 2013.

one whole processing cycle), biological testing, Bowie Dick test, water for Bowie Dick test, and electricity to perform the Bowie Dick test. These data were provided by the HCI.

The saturated vapor under pressure autoclave sterilization generally sterilizes a number greater than 275 instruments if they are placed separately. In this case, the calculation was performed with the autoclave sterilizing 5 surgical instruments boxes with an average of 55 instruments in each box.

Considering the data in Table 1, the cost of sterilization of one instrument was calculated. Starting from the value of BRL 42.00 related to the cost of a complete autoclave cycle, divided by the number of boxes, the partial amount obtained was of BRL 8.40 per box sterilized. This amount was divided by the average of instruments that make up the boxes, and the actual cost obtained for sterilization per instrument was of BRL 0.15.

The nursing technician receives a salary of BRL 1,212.86 in this institution to fulfill a workload of 36 hours per week. This value was multiplied by 4 weeks, resulting in 144 hours per month. To find out what a nursing technician makes in an hour, the value of BRL 1,212.86 was divided by 144 hours, and the result reached was BRL 8.42.

With the observation in the SMC, it was identified that an employee takes, on average, 55 minutes to wash, dry, and inspect the operation of tweezers and identify and pack the instruments in the box; so, if the employee takes 55 minutes to process one box with 55 tweezers, that employee spends 1.02 minutes to process one pair of tweezers, costing the HCI the amount of BRL 0.14 per processed pair of tweezers, since a nursing technician is paid, as seen, BRL 8.42 per hour.

Thus, the overall value of sterilization of one instrument is BRL 0.14 + BRL 0.15 = BRL 0.29. This cost of BRL 0.29 per processed pair of tweezers can present variation if we add the detergents involved in washing, the electricity used by the ultrasonic washer, the costs with personal protective equipment (PPE) for employees, costs with the supervising nurse, among others. However, this study was limited to the evaluation of only two parameters (sterilization costs and the costs with workmanship of nursing technicians). Therefore, the total value of five processed boxes is of BRL 79.75 (0.29 x 55 x 5 = 79.75).

Table 2 shows the calculation of estimated costs with workmanship and autoclave cycle with instruments that were not used in 17 surgeries.

By analyzing Table 2, it can be observed that the cost wasted on the sterilization of 485 instruments was BRL 140.65, which is the value of almost 2 sterilization cycles, amounting to BRL 79.75. On the other hand, it can be noted that, in the cesarean section surgery, there were 201 unused sterile instruments, generating an actual waste of BRL 58.29; when we divide it by the number of surgeries performed, which, in this case, was 8, we obtain an average waste of BRL 7.28 per surgical box.

In the abdominal surgery, there were a total of 150 unused sterile instruments, generating a total waste of BRL 43.50. Dividing that figure by the total of performed procedures, which, in this case, was 5, we have an average waste per box of BRL 8.70.

In the hysterectomy surgeries, there were 134 unused sterile instruments, generating a waste of BRL 38.86. It is known that there were four surgeries of this specialty, which brings the average waste per box to BRL 9.71, consisting in the highest waste rate.

As previously stated, the SC studied performs an average of 191 monthly surgeries of different specialties. If there were only cesarean section, laparotomy, and hysterectomy procedures during the month, the average waste with the sterilization of instruments that were not used during surgery but which make up the surgical box would be of BRL 1,584.17.

Table 1. Costs with the saturated steam under pressure autoclave processing cycle. São João da Boa Vista, 2013.

Description	Quantity	Cost
Water	55 liters	BRL 0.58*
Electricity	22 KWH	BRL 7.26*
Depreciation		BRL 1.30*
Maintenance		BRL 5.00*
Employee	15 min.	BRL 3.11*
Biological test	2 x	BRL 22.09*
Bowie Dick test	2 x	BRL 1.06*
Water for the Bowie Dick test	11 liters	BRL 0.12*
Electricity for the Bowie Dick test	4.4 KWH	BRL 1.45*
Total		BRL 41.97

*data provided by the Health Care Institution.
Source: UNIMED, São João da Boa Vista, 2013.
Note: USD 1 = BRL 2,15 (annual average of 2013).

Table 2. Calculation of costs with sterilization of instruments that were not used in 17 surgeries during data collection. São João da Boa Vista, 2013.

Instrument class	Surgeries	Total of unused instruments	Workmanship costs (BRL)	Sterilization costs (BRL)	Total costs (BRL)
Diaresis	Cesarean section	29	0.14	0.15	8.41
	Laparotomy	16	0.14	0.15	4.64
	Hysterectomy	8	0.14	0.15	2.32
Hemostasis	Cesarean section	79	0.14	0.15	22.91
	Laparotomy	52	0.14	0.15	15.08
	Hysterectomy	79	0.14	0.15	22.91
Gripping	Cesarean section	78	0.14	0.15	22.62
	Laparotomy	69	0.14	0.15	20.01
	Hysterectomy	43	0.14	0.15	12.47
Separation	Cesarean section	0	0.14	0.15	0
	Laparotomy	5	0.14	0.15	1.45
	Hysterectomy	2	0.14	0.15	0.58
Synthesis	Cesarean section	15	0.14	0.15	4.35
	Laparotomy	8	0.14	0.15	2.32
	Hysterectomy	2	0.14	0.15	0.58
Total		485	0.14	0.15	140.65

DISCUSSION

The overall average waste of instruments in all surgical specialties was 52%. A total of 934 instruments were evaluated, and of those, 485 were not used, thereby generating a cost of BRL 0.29 to process each pair of tweezers in this HCI.

In Table 2, the data for dieresis show a waste of existing instruments in all the surgeries. Partial results, in waste percentage, were cesarean section with 55%, abdominal surgeries with 53%, and hysterectomy with 29%. With these data, the average of the waste of dieresis tweezers was calculated, which was 47%.

The interpretation of such waste is easy to understand, because surgery evolved along with surgical supplies, surgical techniques, and electrosurgical equipment, with the electrocautery being the most used of them[14], which has contributed to the disuse of much of the dieresis instruments, confirmed by the results found in this study.

Moreover, the electrocautery has other advantages to justify its use in surgery. Reducing the risk of contamination of the surgical field, the incision, and the reduction of blood loss in surgery are some of them[13].

Observing the hemostasis instruments, the highest overall average of nonuse obtained was 60% of existing instruments in the surgical boxes. This result has come up with the sum of the partial averages of cesarean section surgeries contributing to the nonuse with 59%, abdominal surgery with 64%, and hysterectomy surgery with 60%.

These percentages mentioned are closely linked to the results of dieresis instruments waste (47%), because the electrocautery performs the dieresis and, therefore, the hemostasis of sectioned membranes[13].

The method of hemostasis by clamping the vessels is bloody, and if the correct technique is not used, thrombosis can be caused owing to an injury to the vascular endothelium[8]. With this reasoning, it can be understood that the abandonment of this technique and the use of electrocautery makes the procedure easier, safer, and more convenient, justifying the nonuse of various hemostatic tweezers used in clamping of small and medium vessels.

When analyzing the gripping instruments, we came across a surprising result: we found a lot of nonuse in all the surgeries observed — in cesarean section surgery, 54%; in abdominal surgery, 48%; and in hysterectomy surgery

(45%), generating a total of 50% of waste of the existing instruments on the analyzed boxes.

These instruments occupy much of the surgical instrument table, being vulnerable to falling off and consequently to accidental contamination. It is noteworthy that the largest Flash tweezers sterilization rate (a method that skips phases of conventional saturated vapor under pressure sterilization), to make the sterilization process faster, is used only in emergency situations, when a large number of instruments on the table is contaminated or if it occurs accidentally[14].

Regarding the separation instruments, they were in less quantity, because these are used at specific times during the procedure. In addition, they are large, occupying most of the physical space in surgical boxes. So, if there is the need to use more instruments than those in the boxes, the surgeon requests for these instruments individually to the SMC. The average waste of these instruments in surgical boxes is low because each box includes not more than two of them.

The same applies to the synthesis tweezers, which are in small quantities and most often are all used. These two instrumental classes (separation and synthesis) are not manipulated during the surgery, presenting a less risk of being contaminated and having to be replaced. Moreover, the needles used in synthesis are specially adapted to facilitate the surgeon's mobility[8].

These wastes are closely linked to the improper management of these processes in the HCI, and this study shows the presence of unnecessary costs that cause predictable losses to the institution, which can be corrected. The results obtained also include the idea that the nurse does not seem to manage the processes in both the SC and the SMC. The nurse must develop strategies that consider the implementation of cost management systems aimed at reducing costs without loss in the quality of services and assistance[12].

In a SMC, the management of all the work processes is extremely complex, owing to the strict quality controls placed on the production control involving the terms of validity of the processes, the conservation and distribution of materials, among other factors that permeate the management of the materials processed in that unit, which is essential to knowing the logistics of work and the parameters employed in this sector, preparing proposals and plans aimed at improving its viability, and seeking innovation and improvement of the best practices in this sector[15].

Therefore, the nurse who works in the SMC has a key role in the administration and management of material resources and is responsible for their reception, preparation, conditioning, sterilization, and distribution to hospitals that carry out direct customer service, with a commitment that influences the health–disease process, made possible by the quality and safety of the items that provide and subsidize patient care. Therefore, nurses should conduct research in this sector for the implementation of new guidelines that minimize the waste of resources[16,17].

In search of improvements for the work processes in a SMC, and being directly involved in the management of these processes and improvements, nurses have been using education and training resources, as well as the preparation of procedure manuals, which assist the team's organization, facilitating the activities involved in the processing of instruments. This strategy is of fundamental importance in the cost management of material processing, as the processes of organization and assembly of surgical boxes will have to be extensively revised in order to reduce the costs[18,19].

The nurse of a SMC needs to develop strategies to minimize the costs of nonuse of instruments in surgical boxes. Such strategies aim to review the work processes in the SMC for a better cost management, labor optimization, and organizational dynamics.

CONCLUSION

This study concluded that there is a waste and nonuse of surgical instruments, and it is noteworthy that not all the existing instruments in the boxes are used. The overall average waste of the instruments for all surgery types was 52%. A total of 934 instruments were evaluated, and of those, 485 were not used, allowing the calculation of a cost of BRL 0.29 to process each instrument.

It was concluded that, with the profile of surgeries performed in this SC during 1 month, the average expenditure with the sterilization of instruments that are not used in surgeries but that make up the box surgical is of BRL 1,584.17.

Therefore, the results point to the importance of the nurses involved in the management of work processes in the SMC and SC in controlling costs; the integration of the work processes between these units, allowing new plans and the revision of surgical techniques; the real needs for the processing of these instruments; and the composition of each surgical box already established in the SMC by the surgical teams.

FINAL CONSIDERATIONS

We observed, in this study, the dimension of costs with instruments that were not used during surgery. However, it is noteworthy that more studies are needed to better quantify these expenses, considering that this study was conducted in a small hospital in the state of São Paulo.

It was found that counting these instruments was extremely laborious. However, in the intraoperative nursing care, the control of the instruments used and returned to the surgical box at the end of surgery is critical to ensuring patient safety and the control of materials used during the procedure in the operating room.

Our results indicate an urgent need for the revision of surgical instruments placed in each box for the performance of procedures. This change will reflect in an extensive discussion with the surgical team, professional nurses, scrub nurses and all professionals involved in the intraoperative care of the patient, hospital managers, and administrators.

This study also points out that the SMC and SC nursing should have a new perspective on perioperative nursing care, both contributing and completing the work processes in the operating room and the SMC, for best practices aimed not only at reducing costs but also at ensuring patient safety and further qualifying the perioperative nursing care in the future.

The study limitation observed was the lack of references on SMC, on its work processes, and on the cost management in similar studies in the nursing field, making it difficult to discuss the data in relation to costs.

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SCIENTIFIC PRODUCTION IN PERIOPERATIVE NURSING FROM 2003 TO 2013

Produção científica da enfermagem de centro cirúrgico de 2003 a 2013

La producción científica de enfermería del centro quirúrgico del 2003 hasta el 2013

Jacqueline Aparecida Rios Campos[1], Andréia Cristina Barbosa Costa[2], Carina Aparecida Marosti Dessotte[3], Renata Cristina de Campos Pereira Silveira[3]

ABSTRACT: Objective: To identify the production on operating room nursing in Portuguese. **Method:** Integrative literature review of primary studies indexed in the Lilacs database, in Portuguese, using the descriptor "operating room nursing", published from 2003 to 2013, using a questionnaire available in the literature, critical evaluation of primary studies included, analysis and descriptive summary of the review results. **Results:** The sample consisted of 47 articles, organized according to their focus, divided into the following categories: patient care and safety (n=14), education (n=10), management and administration (n=10), worker health (n=5), fields of work for nurses (n=4), communication and ethics (n=3) and assistance to family members (n=1). **Conclusions:** The main issues studied were the care and safety of adult patients, the nurse's role in management and assistance, teaching of the surgical discipline in undergraduate courses and factors that affect the health of Surgical Center teams.

Keywords: Nursing Care. Operating Room Nursing. Nursing Specialties.

RESUMO: Objetivo: Identificar a produção da enfermagem de Centro Cirúrgico em português. **Método:** Revisão integrativa da literatura dos estudos primários indexados na base de dados Lilacs, no idioma português, utilizando o descritor "enfermagem em Centro Cirúrgico", publicados entre 2003 a 2013, utilizando um instrumento disponível na literatura, avaliação crítica dos estudos primários incluídos, análise e síntese descritiva dos resultados da revisão. **Resultados:** A amostra foi constituída de 47 artigos, divididos nas categorias: assistência e segurança ao paciente (n=14), educação (n=10), gestão e administração (n=10), saúde do trabalhador (n=5), campos de atuação para o enfermeiro (n=4), comunicação e ética (n=3) e assistência aos familiares (n=1). **Conclusão:** As principais temáticas estudadas foram a assistência e segurança do paciente adulto, o papel de gerência e assistência do enfermeiro, o ensino da disciplina cirúrgica na graduação e os fatores que afetam a saúde da equipe de Centro Cirúrgico.

Palavras-chave: Cuidados de Enfermagem. Enfermagem de Centro Cirúrgico. Especialidades de Enfermagem.

RESUMEN: Objectivo: Identificar la producción de enfermería de quirófano en portugués. **Método:** Revisión integradora de la literatura de los estudios primarios indexadas en la base de datos Lilacs, en portugués, utilizando "enfermería de quirófano", publicado desde 2003 hasta 2013, el uso de una herramienta disponible en la literatura, la evaluación crítica de los estudios primarios incluidos, análisis y resumen descriptivo de los resultados de la revisión. **Resultados:** la muestra estuvo conformada por 47 artículos, organizados de acuerdo a su enfoque, divididos en categorías: Asistencia y seguridad a los pacientes (n=14), educación (n=10), la gestión y administración (n=10), la salud de los trabajadores (n=5), campos de juego para los enfermeros (n=4), la comunicación y la ética (n=3) y asistencia a los miembros de la familia (n=1). **Conclusiones:** Los principales temas estudiados fueron el cuidado y la seguridad de los pacientes adultos, el papel de la gestión y atención de enfermería, disciplina quirúrgica de la docencia en la licenciatura y los factores que afectan la salud del equipo del Centro Quirúrgico.

Palabras clave: Atención de Enfermería. Enfermería de Quirófano. Especialidades de Enfermería.

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INTRODUCTION

The knowledge production activities on nursing have emerged with the beginning of modern nursing, gaining greater emphasis in the 1950s due to the increased formation of researchers, with the implementation of the first Master's and Doctoral courses in the field[1].

This scientific knowledge is necessary to consolidate evidence-based care, allowing full autonomy of the profession. Thus, studies of the many nursing specialty areas are growing, keeping up with the technologies in health.

Among the several research foci of Brazilian Nursing, the theme highlighted was operating room nursing, which comprises one of the most critical periods of patient care. The research on this topic began in the 1930s, reinforcing the national events and conferences[2].

With the advancements in knowledge on operating room and facing the need to monitor this scientific development to respond with competence in their professional practice, an increased participation of nurses in field events, conducting courses (update, specialization, Master's, and Doctorate), and using these activities as instruments to encourage research became necessary. Thus, the professional nurses in the operating room have been transforming their practice and being recognized by the internal and external communities (nursing staff, doctors, and care receivers) as a leadership, imposing themselves through knowledge, ethical attitude, and commitment to quality care, and they should keep a watchful on eye the scientific and technological innovations of the modern world[2].

The performance of the operating room nurse includes specific activities that demand great responsibility to ensure the success of surgical procedures, involving management and assistance. Thus, according to the Brazilian Society of Operating Room Nurses, Anesthetic Recovery and Material and Sterilization Center (SOBECC), the team working in the operating room must deal with several aspects, from technical competence, interpersonal relationships, and material resources to the interaction with the patient and the family. Thus, the nursing staff must give patients psychological support on arrival, promote comfort within a safe environment, and ensure the sterilization for all invasive procedures, ensuring quality care[3]. Therefore, it is necessary that nurses are trained and updated to perform in the operating room.

This study sought to identify the scientific production in operating room nursing in Portuguese indexed in the Latin American and Caribbean Literature on Social and Health Sciences (LILACS) electronic database to know the panorama of publications on the subject, to provide the incorporation of scientific evidence to improve patient care.

METHOD

This is an integrative literature review. Generally, in this type of revision, primary or sample studies are heterogeneous, for the review's guiding question is broad and enables the inclusion of primary articles with different study designs[4].

According to the method used, an explicit approach to the search strategy in the electronic database, to the evaluation of the quality of primary studies included, and to the descriptive summary of these is required. Therefore, this study chose to follow the following steps[5]: preparation of the review's guiding question ("What are the scientific evidence published in Portuguese related to Operating Room nursing indexed in the LILACS database?"), search of primary studies indexed in the database chosen, extraction of data from the studies included using an instrument available in the literature[6], critical assessment of the studies included, and descriptive analysis and summary of the review results.

Search of primary studies in the literature

For the search, the controlled descriptor "operating room nursing" was used. We identified 213 citations that have been printed and the title and abstract were read, which was followed by the identification of eligible studies. The electronic database was searched on June 31, 2013.

Inclusion criteria

Primary studies indexed in LILACS database, published in Portuguese, from January 1, 2003 to June 31, 2013, were included. The aim of the review was to identify the knowledge available in Portuguese, considering it is a limitation for nurses to access and use research results in clinical practice in foreign languages[4].

Exclusion criteria

Master's and doctoral dissertations, as well as secondary studies, were excluded because the researcher cannot complete the assessment stage of the individual characteristics of the primary study from a review synthesis[4].

RESULTS

We identified 213 references using the controlled descriptor "operating room nursing." Of this total, 166 studies were excluded; of which, 126 were published before December 31, 2002, 16 were published in a foreign language, 11 were dissertations and doctoral theses, 7 were secondary studies, and 6 did not address the research's question. Thus, the final sample included 47 primary studies[7-53], and the content was analyzed in accordance with Chart 1.

The theme categories were prepared by reading the articles. After reading and identification of the issue addressed in the study, they were grouped by similarities in seven thematic categories shown in Table 1, namely education, occupational health, patient care and safety, management and administration, assistance to family, fields of work for nurses, and communication and ethics.

The category with the most articles published was patient care and safety, with 14 articles (30%)[7-20]. In the education category, 10 articles were identified (21%)[21-30]. In the management and administration category, 10 articles were classified (21%)[31-40]. The category of fields of work for nurses comprised five articles (11%)[41-45]. For the category fields of action for nurses, four articles (8.5%) were identified[46-49]. In the communication and ethics theme, three articles (6.4%) were classified[50-52]. Finally, in the assistance to family category, a single article was classified[53].

Chart 1. Summary of studies included in the integrative review, according to author(s), thematic category, objective, methodological details, key findings, and recommendations, Ribeirão Preto, SP, 2013.

Author(s)	Thematic category	Objective	Methodological details	Key finding	Recommendations
Madeira et al., 2012[7]	Patient care and safety	To evaluate hospital infection (HI) prevention actions performed by the surgical team of the Surgical Center of a public teaching hospital in Teresina, Piauí.	Descriptive exploratory study. n=105 health professionals.	Most used prevention actions: use of the private uniform, the hat, the surgical gown, and surgical field. Infection in the perioperative setting11%.	Seek actions that significantly control infections. Provide the team with qualification opportunities in HI.
Silveira and Faro, 2010[8]	Patient care and safety	To discuss aspects that raise reflections on the role of the OR nurse in the rehabilitation process.	Experience report by a health professional.	Aspects related to accident prevention and minimization of aggravations to the disability.	Participation of the nursing staff in the rehabilitation process.
Reches et al., 2010[9]	Patient care and safety	To observe and record the care of nurses with customer privacy in the OR during the transoperative period; to check the frequency of the exposure of the client's body, as well as the type, the need, and the patient's reactions to such exposure.	Quantitative/ descriptive study composed of 50 observations of anesthetic/ surgical procedures in the Surgical Center of Hospital Israelita Albert Einstein.	In 88% procedures, the nursing staff kept customer privacy, and in 12%, exposed as little as possible. Exhibition in 100% procedures relates to the preparation, monitoring, positioning, and anesthetic-surgical procedure. Patients feel respected in their modesty and privacy.	To evaluate the content taught and the quality of training of professionals, aiming at a humanistic education, not just technical.

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Chart 1. Continuation.

Author(s)	Thematic category	Objective	Methodological details	Key finding	Recommendations
Peniche and Araújo, 2009[10]	Patient care and safety	To identify the activities performed by the nursing team, mentioned by the OR nurses in the transoperative period, with the potential to trigger failure in the nursing care.	Exploratory, descriptive study with a quantitative approach, consisting of 50 nurses.	Activities with potential to trigger failures: 60% annotations by the nursing team; 20% position of the surgical patient; 8% aseptic technique; 8% submission of parts to pathology; 2% surgical planning; and 2% patient identification.	To consider and practice the legal ethical aspect of the documentation of patient care.
Silva and Meirelles, 2009[11]	Patient care and safety	To describe the systematization of OR nursing care to children.	Descriptive study composed of nurses.	The systematization uses the strategy of permanence of family members in the Surgical Center with the child, as well as the use of toys.	Providing cozy recreational activities and psychological support to children clientele and their families.
Barreto and Barros, 2009[12]	Patient care and safety	To investigate the knowledge and opinions of members of the nursing team about the humanization of care, to identify care and non-care aspects in the assistance provided by the nursing staff during surgery.	Descriptive, qualitative and quantitative study composed of 20 nurses.	100% professionals recognize the need for humanized assistance, but some aspect of the care is insufficient. The aspect of leaving the patient alone in the OR was identified in 80% professionals.	The provision of humanized care should include actions aimed at the patient and the integration and involvement of the entire nursing team with others (professionals or clients).
Grittem, Méier and Peres, 2009[13]	Patient care and safety	To develop a participatory process to structure the perioperative nursing care in the Surgical Center unit of a hospital in Curitiba.	Qualitative study consisting of seven nurses.	The participatory process is related to organizational structure and conditions for nursing care.	To reflect on the perioperative nursing care and enhance the actions taken by nurses.
Kunzle et al., 2006[14]	Patient care and safety	To detect concepts that translate myths and truths regarding NI among members of the OR nursing staff in small-, medium-, and large-sized hospitals.	Descriptive analytical study composed of 51 nursing professionals.	72% respondents indicated that perioperative nursing knowledge levels are satisfactory in general.	To invest in continuing education programs aiming at a significant improvement of results on infection control, patient care, and optimization of hospital resources and new scientific research.
Aquino and Caregnato, 2005[15]	Patient care and safety	To understand the perception of nurses working in the Surgical Center of the humanization of perioperative care.	Exploratory-descriptive qualitative study consisting of 10 nurses.	Nurses correctly define what humanization is, but they do not always practice it due to the workload, the staff, and the bureaucratic services, but have awareness of the importance of this initiative for the care of the patient.	To encourage reflection from Surgical Center professionals on the humanization of perioperative care, seeking to improve the quality of care.
Lima, Melo and Rocha, 2005[16]	Patient care and safety	To identify, in the care to adolescents, the Surgical Center, their expectations, fears, and anxieties.	Descriptive study composed of 45 adolescent patients.	60% adolescents did not like the experience of undergoing surgery, due to the waiting, clothing, and not feeling that their feelings were valued.	To provide a warm care and atmosphere to the patient.

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Chart 1. Continuation.

Author(s)	Thematic category	Objective	Methodological details	Key finding	Recommendations
Oliveira, 2005[17]	Patient care and safety	To evaluate the humanization developed by nurses in managing Surgical Center technologies.	Cross-sectional exploratory and descriptive study, with quantitative approach, consisting of 33 nurses.	53% nurses associate humanization and technology as a combination that results in improved quality of the care given to patients.	To update the area's practices, as well as having incentives of institutions and greater opportunities for the management of new technologies.
Gonçalves and Silva, 2005[18]	Patient care and safety	To report experiences and reflections arising from activities implemented by occupational psychology with a group of OR nurses.	Descriptive exploratory study with Surgical Center professionals.	Occupational psychology enabled, in the context of surgical nursing, reflection on the particular ways of doing, feeling, suffering, and subjectifying, as well as to describe and discuss the work organization and relations between workers and technologies.	To achieve balance between manual work and the help of technology.
Bokor and Carvalho, 2004[19]	Patient care and safety	To identify the highest physical risks in ORs, based on construction and service installation standards of the Ministry of Health.	Field study, consisting of photographs of a Surgical Center of a medium-sized hospital in the city of São Paulo.	The main physical risks: windows open during surgical procedures, presence of extension cords in the ORs, inadequate identification of electrical installations, stretched wires in the ORs, open cabinets, and exposed pipes.	Standardization according to the Ministry of Health: the windows should abolished, wall sockets in adequate numbers, identification according to the voltage, and no exposed pipes. Open cabinets and stretched wires should be avoided.
Leite and Bianchi, 2003[20]	Patient care and safety	To evaluate the nursing care given to elderly in the Surgical Center.	Field study with a quantitative approach, consisting of 12 nurses.	91.67% nurses did not provide a differentiated care for the elderly in the Surgical Center.	Nurses should deepen their knowledge of the natural aging process in the biopsychosocial aspects, so that they can be able to evaluate and deploy an appropriate care plan.
Turrini et al., 2012[21]	Education	To provide a summary of the evolution of the contents of the surgical discipline in the School of Nursing of Universidade de São Paulo (EEUSP) and a reflection on the National Curriculum Guidelines (DCN) of the undergraduate course in nursing.	Reflective descriptive study composed of files from the Department of Graduation Services and reports of Surgical Center teachers from EEUSP.	1940s to 1960s: OR nursing. 1960s: performance in the Material and Sterilization Center (MSC) and OR. 1970 to 1990: MSC, OR, and Systematization of the Perioperative Nursing Care. 2000s: MSC, OR, and inclusion in the Supervised Curricular Training DNC values and recognizes the importance of this content for graduation.	Need for appropriating content for a better patient care at different times of their health-disease process.

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Chart 1. Continuation.

Author(s)	Thematic category	Objective	Methodological details	Key finding	Recommendations
Borghetti and Caregnato, 2011[22]	Education	Meeting the expectations and experiences of nursing students about the Surgical Center discipline.	Exploratory, descriptive research with qualitative and quantitative approach, consisting of 101 nursing students.	Students who have not had the discipline expected to learn, challenge their fears, knowing the Surgical Center, and the role of the nurse. Students who have already had the discipline understand the responsibility of nurses in the area and recognize its structure and operation as critical and complex.	To reinforce the need to revisit the insertion of the Surgical Center discipline as indispensable in the curriculum in undergraduate courses in nursing.
Ribeiro, Bonfim and Silveira, 2011[23]	Education	To report the experience in Continuing Education applied to the OR nursing staff of a major institution, specializing in oncology.	Experience report composed of 27 nursing professionals.	Due to the specificity of this area, Continuing Education is applied by the team itself.	Well-developed training, with the aim of providing quality patient care/safety.
Oki and Carvalho, 2009[24]	Education	To identify the positive and negative feelings raised by students in the fourth year of the undergraduate course in the Surgical Center nursing discipline. To survey the pros and cons experienced by these students during the training in the Surgical Center nursing discipline, as well as to know their opinion on that experience.	Descriptive study with quantitative analysis, with 46 undergraduate students in nursing.	Positive feelings of curiosity and interest predominated in relation to negative feelings of anxiety. The pros include interaction with the staff, opportunity to learn, and adapt routines, and cons relate to the lack of experience, agility, skill, and dexterity. 91.2% students considered the experience great.	To demystify the negative concept about the experience related to OR nursing.
Bronzatti, Ponteli and Ferretti, 2008[25]	Education	To report the experience of a group of OR nurses in the supervision of the extracurricular paid internship program with nursing students.	Experience report with nurses.	Nurses working in supervising the extracurricular paid internship program with undergraduate students in nursing believe the program will enable nursing students to, in the future, coordinate the OR nursing team, endowed with autonomy, responsibility, and competence, thus ensuring a qualified and humanized assistance to the entire community.	To provide opportunities and infrastructure that contribute to the process of practical learning.
Silva and Leitão, 2008[26]	Education	To describe the situation experienced by students in the internship program.	Descriptive analytical study with 31 students.	The Surgical Center is a naturally stressful context, with the power play of the surgeon as the leader of the team, difficulty of the students to get along with the staff, and their lack of maturity.	There are initial problems, but students finish the internship with satisfaction.

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Chart 1. Continuation.

Author(s)	Thematic category	Objective	Methodological details	Key finding	Recommendations
Paoli, Caregnato and Millão, 2007[27]	Education	To know the opinion of nurses about the need for a Surgical Center discipline in the undergraduate nursing course to support the theoretical and practical knowledge in patient care.	Exploratory and descriptive study with a quantitative approach consisting of 50 nurses.	The existence of the Surgical Center subject in the curriculum of undergraduate nursing courses is required for a general professional training.	To (re)think about the Surgical Center discipline in the curriculum of undergraduate nursing courses.
Matheus and Carvalho, 2005[28]	Education	To gauge feelings, expectations, and pros and cons of the third-year nursing students in their first experience with surgical instrumentation.	Descriptive study with 30 undergraduate nursing students.	Feelings vary before and after instrumentation, going through anxiety, nervousness, tiredness, worry, incapacity, tranquility, security and relief, meeting the expectation of 80% students. Students easily settled into the team and had difficulties with nervousness.	To enable new opportunities for students to experience surgical instrumentation.
Coutinho and Friedlander, 2004[29]	Education	To evaluate the teaching-learning process of psychomotor skills of the OR nursing discipline.	Descriptive study composed of 77 undergraduate students in nursing.	Students who presented better psychomotor performance the OR were not necessarily the same who had the same performance in the laboratory.	Nursing laboratories assist in the psychomotor performance of students.
Carvalho and Coutinho, 2003[30]	Education	To evaluate the theoretical knowledge acquired by students in undergraduate courses in nursing during surgical instrumentation activities.	Descriptive study composed of 33 undergraduate students in nursing.	90.91% students had high average grades in theory after training with surgical instruments in the laboratory.	To conduct training in the laboratory after theory, which facilitates the understanding of the content, knowing that this is a continuous process, to be improved frequently.
Macedo et al., 2013[31]	Management and administration	To identify the occurrence of cancelation of surgeries at the Surgical Center of a university hospital knowing: surgical specialties involved, those responsible for surgical cancellations, the causes of surgical cancelations, the age range of patients, the period between cancelation and the performance of the new procedure surgical.	Quantitative, retrospective study comprising 1,449 surgeries canceled.	Frequent reasons for cancelation: the user was not hospitalized (18.5%), change in the surgeon's conduct (17.3%), elective time exceeded (16.5%), and patients with unfavorable clinical conditions (11.2%). Surgeries canceled: 80.9% were elective, 17.7% were urgent, and 1.3% were emergencies.	Encourage greater involvement of the professionals. Make the surgical schedule electronic. Active search for missing patients.
Gomes and Melanda, 2012[32]	Management and administration	To describe the experience of the development of a systematic model for describing nursing routines in the Surgical Center of a rehabilitation hospital.	Descriptive analytic study with experience report.	A systematic model for describing nursing routines in the Surgical Center provides, through scientific evidence, the establishment of practices that can contribute to the continuous improvement of nursing care in the pursuit of total quality of services provided in the Surgical Center.	Standardization or systematization of information on routines and procedures in educational charts provides a more enjoyable and fast reading of such information, and contributes to the quality of nursing care.

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Chart 1. Continuation.

Author(s)	Thematic category	Objective	Methodological details	Key finding	Recommendations
Machado and Caregnato, 2012[33]	Management and administration	To know the performance of the nursing staff working at the Surgical Centre in harvesting multiple organs for transplantation.	Exploratory, descriptive, qualitative study consisting of four OR nurses.	Teams trained and committed to act in the harvesting process of multiple organs for transplantation, and all use systematization of nursing care to run the process.	The performance of nurses in the surgery for multiple organ removal for transplant is essential, considering the teams trained to act in this process.
Medrado and Moraes, 2011[34]	Management and administration	To describe the importance and difficulties of nursing audits and to identify adverse events of this process in the Surgical Center.	Experience report of a nurse auditor.	It is important for the quality of care and satisfaction of the institution and health insurers.	Continuing education in assistance and audit.
Gaspareli and Garanhani, 2010[35]	Management and administration	To identify the meaning that OR circulators attribute to the nursing report done during surgery.	Descriptive study with qualitative analysis, with six OR circulators.	Different meanings are attributed covering communication skills, professional valuation, and legal documentation of the acts performed.	To value the content of nursing reports.
Souza et al., 2010[36]	Management and administration	To identify the number of elective surgeries canceled in a time frame of 9 months, considering and analyzing determinants on the emotional, physical, and social implications for clients, family, and the institution.	Documental, retrospective and quantitative study composed of 973 canceled surgeries.	Surgical cancelation rate was 27.4%. This situation causes increase or reinforcement of fear about the surgical procedure, doubts, and fears of the family and customers about the actual clinical and surgical conditions, and the withdrawal of customers.	Cancelations can and should be controlled and restricted. It is recommended, in the first instance, to raise awareness in all those involved in such a situation, seeking to decrease suspension rates and, subsequently, to joint efforts to implement measures to restrict this event as much as possible.
Garanhani et al., 2009[37]	Management and administration	To report the experience of resident nurses in the use of administrative tools in the diagnosis and prioritization of a strategic planning phases.	Experimental study with nursing home residents.	The knowledge and use of administrative tools available for strategic planning is considered relevant.	Understanding the management training helps in the development of a strategic planning.
Nepote, Monteiro and Hardy, 2009[38]	Management and administration	To analyze the dynamics of ORs using operational indexes that measure the optimization, resistance, overload, and utilization of SC.	Prospective study comprising the analysis of 1,908 surgeries.	It is necessary to adapt the action plans to customer profiles and to exercise management based on facts and predefined processes, emphasizing effective performance practices and encouraging proactive actions and continuous learning.	Development of an operational score to evaluate the services provided by the Surgical Center and critical review of the main processes and routines involved in the surgical production.

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Chart 1. Continuation.

Author(s)	Thematic category	Objective	Methodological details	Key finding	Recommendations
Stumm, Maçalai and Kirchner, 2006[39]	Management and administration	To identify difficulties faced by nurses who work in a Surgical Center of a hospital in the central region of the state of Rio Grande do Sul.	Qualitative, descriptive, and exploratory study consisting of four nurses.	Difficulties related to the demand of bureaucratic and administrative activities, maintenance of good interpersonal relationships between medical staff and nursing staff, and deficiency of personnel and material.	The need for the systematization of nursing care is not fulfilled, and it is necessary to rethink the structure, materials, and equipment, allowing the teams working in the Surgical Center to develop their activities in a more peaceful, productive, and effective way.
Ribeiro and Graziano, 2003[40]	Management and administration	To identify and describe the criteria adopted by the nurses in the selection of surgical sutures for the development of their provision. To survey the modalities of provision of surgical sutures adopted in the Surgical Center.	Exploratory, descriptive, field, cross-sectional study, with a quantitative approach, consisting of health institutions and nurses.	Suture selection criteria: surgeon's request, standardization by specialty and knowledge. Suture supply: in the OR , 40% sutures are chosen at the time of surgery, whereas 32% are kits by specialty. At the hospital, 46% are purchased from the supplier and 32% through public competition. The stock is replenished according to a established quota in 58% hospitals.	To encourage reflection on the issue and to provide an incentive for the seeking of solutions to problems identified in the activities that permeate the task of providing the surgical sutures, one of several functions of the Surgical Center nurses.
Semeniuk, Durman and Matos, 2012[41]	Occupational health	To investigate the feelings of the nursing team professionals working in the Surgical Center of a teaching hospital in western Paraná concerning the death of patients.	Field, descriptive study with qualitative analysis composed of 15 nursing professionals.	Nurses become more sensitive when the patient who died is a child or when the death is due to tragic causes. There is evidence to suggest veiled suffering.	Questions for reflection in relation to the theme: what expected sentiment is considered healthy? What is normal in the face of death? Is there an ideal reaction?
Ferreira, Possari and Moderno, 2006[42]	Occupational health	To identify factors that generate job satisfaction and dissatisfaction to Surgical Center nurses of a large public hospital in the city of São Paulo.	Quantitative study composed of 17 nurses.	The satisfaction factors are related to professional recognition, self-realization, and appreciation from colleagues and family for the work they do, and dissatisfaction is related to physical and psychological stress, benefits, function status, and personal development.	To create opportunities for intellectual improvement, systematization of care, valuation of workers and their activities, multidisciplinary interaction, allocation of responsibilities, and chances of participation in decision-making processes.
Schwarz and Baldin, 2005[43]	Occupational health	To know the impact of the work in the OR on the health of nurses; To identify risk situations that the professional is exposed to; To propose self-care measures.	Field, qualitative and descriptive study composed of 15 members of a nursing team.	Impact is related to psychological tiredness and physical exhaustion; Risk situations are related to chemical, physical, biological, and ergonomic hazards; Health promotion and education measures are tools for self-care.	To promote the health of professionals; Need for professional and political articulation of the nursing staff, as well as training and updating of knowledge.

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Chart 1. Continuation.

Author(s)	Thematic category	Objective	Methodological details	Key finding	Recommendations
Carvalho et al., 2004[44]	Occupational health	To determine the stress level of the nursing staff working in closed sectors (Surgical Center).	Descriptive study with 31 nursing professionals.	9.7% presented high levels of stress.	To encourage and enable situations to relieve stress, such as institutional spaces that provide interaction between team members so that they can verbalize feelings of anxiety, dissatisfaction, and conflict, experienced in the workplace.
Meirelles and Zeitoune, 2003[45]	Occupational health	To define the profile of nursing professionals at an Oncology Surgical Center in the personal and professional aspects; To identify the degree of job satisfaction and stress, and stressors pointed out by them.	Descriptive study with a quantitative approach consisting of 70 members of a nursing team.	Most of the sample participants were women, in the age group of 31–40 years, and most had only secondary education, having another job also in a Surgical Center; Does not do it for the salary, but also because they feel deep emotional satisfaction related to the work and the results that come from their efforts; stressors are related to the conditions of the work environment.	To promote reflections on the worker's quality of life related to work environment conditions, to implement health-care programs aiming at workers' health, rational organization, and valuing of the work and the multidisciplinary interaction.
Gomes et al., 2013[46]	Fields of work for nurses	To report the experience of Surgical Center nurses in a rehabilitation hospital that act as instrument nurses; To describe the use of the method of the 5S to Total Quality used by nurses as an educational mechanism to systematize the surgical instrumentation activity; To conduct a critical analysis of the nursing practice in surgical instrumentation, considering the legislation.	Experience report and descriptive analysis composed of nurses.	With multidisciplinary interaction, they develop knowledge that contributes to the improvement of patient care and for a more safe performance of surgeries. The five "S" method to Total Quality involves: Sense of use, Sense of sort, Sense of cleaning, Sense of health, and Sense of self-discipline; Surgical instrumentation is a component of the nursing and medicine actions for the recovery of health of human beings, as permitted by law.	To encourage nurses to dedicate to surgical instrumentation and its involved aspects.
Dienstmann and Caregnato, 2013[47]	Fields of work for nurses	This study aims to ponder on the role of the perfusionist in cardiac surgery, revealing a field of work for nurses.	Experience report with a qualitative approach on the trajectory of a perfusionist.	It is believed that the nurse is a professional who has all the conditions and the expertise in the curriculum to carry out the perfusionist function.	It is necessary to look for and conquer new fields of work where nurses can show their ability and competence, occupying spaces that were so far nonexclusive.
Bianchi and Leite, 2006[48]	Fields of work for nurses	Some considerations on the OR nurse and their future prospects.	Reflective study.	Professional training prospects and satisfaction provided to the client and their family, to the team, and to the nurses themselves.	Individual and institutional investment for professional training.

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Chart 1. Continuation.

Author(s)	Thematic category	Objective	Methodological details	Key finding	Recommendations
Caldona, Hayashida and Mendes, 2006[49]	Fields of work for nurses	To present a reflection and some considerations about the inclusion of nurses in the legal aspects of the operation of the Bank of Bones.	Reflective study.	The nurse participates effectively in the actions of the Bank of Bones, as well as the Organ Procurement Organizations and Transplant Centers. Thus, there is a need to regulate their inclusion.	To develop and invest in research on the subject and to comply with current legal requirements for this work.
Braga et al., 2009[50]	Communication and ethics	To identify favorable and/or unfavorable situations that interfere in interpersonal relationships in the Surgical Center; To provide discussion spaces for the development of the interpersonal competence of the nursing team.	Exploratory, cross-sectional and qualitative study consisting of 10 professionals of the nursing team (focus group).	Favorable situations: dialogue and feeling valued. Unfavorable situations: lack of dialogue, of team spirit, of care with material savings and maintenance of equipment, and lack of knowledge of Surgical Center rules and procedures.	To encourage and value the proposals made by the groups in the team as part of the qualified development of nursing care.
Silva and Freitas, 2007[51]	Communication and ethics	To know and understand, based on the daily experiences of nurses working in the OR , the meanings they attach to their actions on the ethical occurrences with the nursing staff.	Qualitative study consisting of OR nurses.	To provide risk-free care to the patient and to avoid new occurrences, offering nursing care with responsibility, as recommended by the Code of Ethics for Nurses.	To raise interest in this issue, encouraging reflection of prospective students, nurses and professionals on the issue of nursing care and health with an ethical approach.
Duarte and Lautert, 2006[52]	Communication and ethics	To unveil current conflicts and dilemmas for nurses working in the OR from the point of view of communicative action.	Descriptive study composed of 12 nurses.	Conflicts occur more frequently among nurses and surgeons due to lack of infrastructure to meet the demand, disrespect, and errors of the team. The dilemmas are related to the lack of infrastructure of institutions for health care and to sharing the difficult choices of doctors. They do not provide conditions for dialogue.	The development of the communicative competence is combined with technical expertise, enabling individuals to better understand each other.
Salimena, Andrade and Melo, 2011[53]	Assistance to family members	To understand the feelings and perceptions of the family in the waiting room, in the case of surgical processes.	Qualitative study consisting of 17 family members of patients.	With comprehensive analysis, the highlights were anxiety, feeling of chest compression and suffering, as well as the lack of information on and clarification of the moment being experienced.	It up to the nurse and the other members of the health-care team to care for the family in a humane and empathetic way, paying attention to their needs, providing comfort during their stay, in addition to answering their questions, perceived by expressions of fear and anxiety.

Table 1. Distribution of the studies included in the review according to thematic categories, Ribeirão Preto, SP, 2013.

Thematic categories	n	%
Patient care and safety	14	30
Education	10	21
Management and administration	10	21
Occupational health	5	11
Fields of work for nurses	4	8.5
Communication and ethics	3	6.4
Assistance to family members	1	2.1
Total	47	100

DISCUSSION

Considering the patient care and safety category, which has the largest number of similar studies, its prominence is due to addressing questions about the care practice of the nursing staff, for the safety of the patient, concurrent with the concern of the "Safe Surgery Saves Lives" program, which aims to improve the safety of surgical care in the world by defining a core set of safety standards that can be applied in all countries and settings[54].

Thus, nursing care is defined as a set of therapeutic actions based on technical and scientific knowledge that considers the social, economic, cultural, political, and religious aspects, being organized in a thought-out and planned manner, designed to achieve the desired results in terms of patient safety and care, with family participation[55].

On analyzing the patient care and safety category, it was possible to characterize its specificities. In particular, one article on children[11], one article on adolescents[16], and one article on elderly[20] point to the importance of personalized care for each phase, providing a play area for children, privacy and acceptance for adolescents, and, for the elderly, a service that involves not only the physical care but also with the aging process to develop and implement an appropriate and individualized care plan.

Also in this category, technology was discussed in two articles[17,18], namely the advancement and use of new technologies in the operating room providing patient assistance and security. Technology is indispensable to guarantee care with quality, but one cannot forget that this care is provided to human beings, and they need attention, love, and understanding. Thus, the nurse should always motivate their team toward humanization.

It was also possible to identify the physical risks that include health professionals and patients, indicating that the operating room nurse must ensure the safety and well-being of patients and surgical, anesthesia, and nursing teams because the physical risks can be prevented, reduced, or controlled when the procedures and regulations are adopted, being supervised by nurses[19].

Of the 14 articles[7-20], 6[11,16-20] addressed the specifics patient care, and the other 8 articles[7-10,12-15] encompassed concepts of humanization, exposition, and control of nosocomial infection in adult patients, aiming at a skilled nursing care and ensuring care and safety.

One study in the education category discusses the extension and specialization in operating room nursing for professionals in the area[23], and nine studies address the surgical discipline at graduation[21-22,24-30], which reinforces the need for innovation in teaching techniques and the importance of the aid of technology in laboratories to improve the quality of nursing education in the operating room.

According to the management and administration category, the nurse takes the managerial role of the operating room and becomes responsible for planning and organizing activities, control and evaluation of material, and human resources and leadership. That is, they manage and administer the operating room with their team[31-40].

The five articles[41-45] in the occupational health category refer to aspects that affect the health of the professionals who make up the nursing staff in the operating room. Among them, some ailments were highlighted, such as musculoskeletal injuries, depression, varicose veins, and gastritis, which are health situations that can be related to unfavorable working conditions, whether in the ergonomic aspect, with overload of psychic, physical, and emotional tension, or in the environmental aspect, with the neglect of safety requirements in dangerous situations.

These studies point to the need for training and updating the knowledge of these professionals, considering the technical and scientific complexity of their workplace and the fragility of nursing workers faced with this increasingly complex environment, both in the technical aspect and in interpersonal relationships, in the constant contact with pain, human suffering, and death[43].

The articles in the fields of work for nurses category represent 8.5% of the total, that is, four articles[46-49] that discuss some specifics in relation to nurses' work in the operating room.

One article[49] discusses the importance of involving the operating room nurse professional in a Bank of Bones, both in the organization and in relation to the collection, processing, and distribution process of bone tissue. Another article[47] addresses the issue of the perfusionist nurse, characterizing them as professionals with all the conditions and experience necessary to perform the function, and can also assist in the pre-, intra-, and postoperative, allowing a holistic view of the entire process and benefiting the patient's care. The article[46] that investigates the performance of nurses in surgical instrumentation reinforces that this provides high patient safety and greater confidence of the team, as it has knowledge that contributes to and facilitates work in the surgical field.

The article[48] that discusses the future prospects of the operating room nurse reports that the educational preparation is critical to the nurse's performance and valuation, performing their health-care, management, and educational functions, encompassing the role of nurse in the immediate pre-, intra-, or transoperative or immediate postoperative, regarding the patient, the family, and the health-care team.

In the communication and ethics theme, two articles[51-52] discuss the importance of proper communication and ethics in the work team, seeking to provide assistance without risks to patients, continuous improvement of the service and responsibility in nursing care. One article[50] approaches the interpersonal relationship prioritizing communication, stressing that teamwork is based on dialogue, which is influenced by the individuals, group, and environment, considering communication as a qualified nursing care process.

Assistance to families was addressed in a single article[53], which emphasizes that nursing care should not revolve around the patient only, but also around the family that experiences the situation with the patient, revealing the family's need to feel supported, assisted, and heard on their particularities, through a relationship of trust and solidarity. Thus, nursing must be present to clarify any doubts about the anesthetic-surgical procedure and perform in a safe and humane way.

The anxiety, the suffering, and the lack of information surround the family. Therefore, nurses and other members of the health-care team should establish greater interaction, promoting an integrated health care and establishing a bond of trust, cooperation, and acceptance regarding the diagnosis and procedures that the patient is undergoing[53].

CONCLUSION

Studies address issues such as the care and safety of adult patients, the role of nurses in management and assistance, the teaching of a surgical discipline in undergraduate nursing courses, and the factors that affect the health of the operating room team. This review identifies a few articles related to assistance to children, adolescents, and the elderly, as well as a scarcity of studies addressing family care during the anesthetic-surgical procedure.

It is believed that future research focused on these specific issues could provide support for the planning of nursing care in the operating room, considering specific elements of these groups to optimize their safety. It is worth highlighting the importance of studies focused on dealing with the relatives of the patients during the anesthetic-surgical procedure because this moment is experienced by both, the operating room is often completely unknown to them.

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TOXIC ANTERIOR SEGMENT SYNDROME AFTER CATARACT SURGERY: THE IMPLICATIONS FOR NURSING

Síndrome tóxica do segmento anterior após cirurgias de catarata: implicações para a enfermagem

Síndrome tóxico del segmento anterior después de cirugía de catarata: las implicaciones para la enfermería

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ABSTRACT: **Objective**: To describe the characteristics of the toxic anterior segment syndrome (TASS) and its implications for nursing actions. **Method**: It is a literature review through research in the MEDLINE (Medical Literature Analysis and Retrieval System Online) and LILACS (Latin American and Caribbean Center on Health Sciences Information) databases. **Results**: TASS is an acute ocular inflammatory reaction after ophthalmic surgeries, mainly cataract surgery. The clinical signs in the first 12 hours after the surgery include corneal edema, presence of cells in the anterior chamber, increased intraocular pressure, and irregular pupil. The main causes are related to noninfectious substances introduced into the patient's eye by products used during surgery or due to failures in cleaning and sterilization of surgical instruments. **Conclusion**: The implications for nursing consist of preventive measures, staff training, orienting the patients, and active epidemiological surveillance aimed at the early identification of warning signs of TASS.

Keywords: Cataract extraction. Perioperative nursing. Epidemiological surveillance. Sterilization. Endophthalmitis.

RESUMO: **Objetivo:** Descrever as características da síndrome tóxica do segmento anterior (TASS) e as implicações para as ações de enfermagem. **Método:** Trata-se de uma revisão da literatura por meio de pesquisa nas bases de dados *Medical Literature Analysis and Retrievel System Online* (MEDLINE) e Literatura Latino-Americana em Ciências da Saúde (LILACS). **Resultados:** A TASS é uma reação inflamatória ocular aguda após cirurgias oftálmicas, principalmente a cirurgia de catarata, cuja apresentação clínica nas primeiras 12 horas após o procedimento inclui sinais como edema da córnea, presença de células na câmara anterior (CA), pressão intraocular aumentada e pupila irregular. As principais causas estão relacionadas com substâncias não infecciosas introduzidas no olho do paciente a partir de produtos usados durante a cirurgia ou devido a falhas no processamento dos instrumentais. **Conclusão:** As implicações para a enfermagem consistem nas medidas de prevenção, treinamento de pessoal, orientação aos pacientes e vigilância epidemiológica ativa visando à identificação precoce de sinais indicativos da TASS.

Palavras-chave: Extração de catarata. Enfermagem perioperatória. Vigilância epidemiológica. Esterilização. Endoftalmite.

RESUMEN: **Objetivo**: Describir las características del síndrome tóxico del segmento anterior (TASS) y las implicaciones para las acciones de enfermería. **Método**: Se trata de una revisión de la literatura mediante búsquedas en las bases de datos MEDLINE y LILACS. **Resultados**: El TASS es una inflamación ocular aguda que se produce después de la cirugía oftálmica, especialmente la cirugía de cataratas, cuya presentación clínica en las primeras 12 horas incluye signos tales como edema corneal, la presencia de células en la cámara anterior, aumento de la presión intraocular y la pupila irregular. Las principales causas están relacionadas con sustancias no infecciosas introducidas en el ojo del paciente durante la cirugía o debido a fallas en el lavado y esterilización de instrumentos quirúrgicos. **Conclusión**: Implicaciones para la enfermería consisten en medidas de prevención, capacitación del personal, la orientación a los pacientes y la vigilancia epidemiológica activa encaminada a la identificación temprana de signos de advertencia de TASS.

Palabras clave: Extracción de catarata. Enfermería perioperatoria. Vigilancia epidemiológica. Esterilización. Endoftalmitis.

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INTRODUCTION

The toxic anterior segment syndrome (TASS) is an acute inflammatory reaction caused by noninfectious substances that enter the anterior chamber (AC) of the eye, damaging the intraocular structures, particularly the corneal endothelium and the trabecular meshwork[1-3].

Monson et al.[4] reported for the first time in 1992 three cases of intraocular inflammation after a cataract extraction surgery, with a pattern in the signs that appeared, as generalized corneal edema, corneal endothelium damage, reduced visual acuity, and dilated pupil. Because of the characteristics of all the observed signs, this type of inflammatory reaction started to be called toxic anterior segment syndrome[5].

Several eye surgeries can be affected by this type of adverse event, such as posterior vitrectomy[6,7], corneal transplant[8], and combined surgeries of posterior vitrectomy and cataract extraction[9]. However, the latter is the one that most commonly presents this type of postoperative complication.

Despite the frequency that researches about this topic have been published in the world, only one study has been released in Brazil reporting the occurrence of TASS[10]. This gap can be attributed to the difficulty in the diagnosis of these cases by ophthalmologists and nurses working in the ophthalmology area or in the area of prevention and control of health-care-associated infections (HAIs).

The nursing staff must actively participate in the process of identifying adverse events after cataract surgeries and intervene preventively in the actions under its responsibility. Thus, this study aimed to present the phenomenon of TASS, its epidemiology, and its implications for nursing actions.

METHOD

This is a review of scientific literature about the epidemiological aspects, clinical characteristics, and factors associated with TASS. A search in the databases MEDLINE (Medical Literature Analysis and Retrieval System Online) and LILACS (Latin-American and Caribbean Center on Health Sciences Information) was performed. The data were collected from January to July 2014, with no limitation regarding the study's publication period, using the following keywords in Portuguese, English, and Spanish, respectively: *síndrome tóxica do segmento anterior, inflamação do segmento anterior*; toxic anterior segment syndrome, anterior segment inflammation; and *síndrome tóxico del segmento anterior* and *inflamación del segmento anterior*, and adopting the Boolean operator "OR".

We selected studies focused on factors associated with TASS, including its epidemiological aspects and clinical characteristics, to identify factors on which the nursing staff can act. Editorials and commentaries were excluded.

The variables investigated in the review included the following components: incidence, clinical signs and symptoms, evolution, treatment, factors associated to TASS, and prevention measures.

RESULTS

Incidence and clinical characterization

Most of the selected articles are case reports in which it was not possible to identify the incidence, but five of them reported 0.98% incidence of TASS, on average, ranging from 0.07 to 2.13% (Table 1).

As for its clinical characterization, great variation is observed between the reported cases. The most common signs are corneal edema, deposition of cells, fibrin in the AC, flare[14,16,17] (Tyndall effect, in which small particles that are impossible to be seen with the naked eye are viewed through a beam of light), and mydriasis[1,2,4,14]. Other less common signs are irregular and/or nonreactive pupil[1,2,4], high intraocular pressure (IOP)[3,4,15,18], and hypopyon[16,18-20].

The time frame to detect these signals is 12–36 hours, and, in most cases, they are detected in the first 12 hours with at least four of the manifestations described earlier[1-3,14].

The affected patients do not show a characteristic symptomatology. In some cases, they may have low visual acuity (LVA)[1,4,19,21] and, rarely, pain[2,18].

As for the morphological characteristics, the affected corneas are characterized by the low density of the endothelial cells, the high coefficient of variation of cell areas, and the low average percentage of hexagonal cells[17].

Evolution and treatment

The evolution of cases with TASS has usually a favorable prognosis[15,18,19,22], however, most severe cases, more than half, on average, evolve to the need for corneal transplant surgery[1-3,20,23,24]. Another complication of the syndrome is the elevation of IOP, which may demand

Table 1. Incidence of toxic anterior segment syndrome according to different authors and countries. São Paulo, 2014.

Country	Year of publication	Surgeries performed	Number of cases	Incidence (%)
South Korea[1]	2008	801	15	1.87
USA[11]	2006	2,713	2	0.07
India[12]	2011	26,408	60	0.23
Turkey[13]	2010	1,742	14	0.80
Pakistan[14]	2013	18,140	15	0.80
Turkey[15]	2012	893	19	2.13

USA: United States of America.

antiglaucomatous surgery when it is impossible to control it by drug therapy[1-3].

The treatment is usually pharmacological based on the concomitant use of steroid eye drops, antibiotics, and 5% NaCl[1,15,25,26]. In some cases, additional surgical procedures are needed, such as washing the AC, replacing intraocular lens (IOL), and anterior or posterior vitrectomy[3,18,19].

Factors associated with the toxic anterior segment syndrome

In 2006, eight cases of TASS were reported in the United States of America (USA). Despite adjustments in the cleaning procedures and sterilization of surgical instruments, among other measures, other patients had the TASS clinical status. After additional measures have been adopted, other cases were not reported. Several hypotheses have been raised, but the causes have not been identified[27].

Members of the industry and the American Society of Cataract and Refractive Surgery (ASCRS) developed a task force. The first actions were posting an online questionnaire on the practices of eye care services and notification of cases of TASS. This questionnaire was answered by centers in several countries, including the USA, Italy, Spain, Romania, Mexico, Argentina, and Brazil.

The result of the analysis of these questionnaires was supplemented by data obtained through interviews and direct observation in visits to ophthalmology centers in the USA. Of the 68 questionnaires included in the study, 909 cases were identified in 50,114 performed surgeries and 367 cases were reported during the visits to the American centers after 143,919 surgeries from 2005 and 2009. The noncompliance most observed in these visits were the inadequate rinsing of the phacoemulsification probe and the irrigation and aspiration devices and the reuse of single-use devices, such as cannulas and "Sleeves" infusion gloves[28].

Continuing this work, a retrospective analysis of the same database referring to the 2009–2012 period was performed. In this period, the participating centers reported to have performed approximately 69,000 surgeries with the detection of 1,454 cases of TASS, with the washing and sterilization process and the reuse of single-use devices being the most common nonconformities observed[29].

Rose[30] reported six cases in which it was not possible to determine the etiology. However, with the implementation of precleaning of phacoemulsification probe and irrigation and aspiration (I/A) handpieces immediately after the surgery, no new cases were reported over 2 years, which suggests a causal link between the cleaning failure and the occurrence of TASS in cataract surgeries.

Other works could point out some products as the possible causes of TAAS (Table 2).

Cleaning and sterilization process

The misuse of *ortho*-phthalaldehyde solution was the cause indicated in the report of a case in which this solution was used to soak the instruments before being subjected to sterilization by Ethylene Oxide (EtO)[26].

Another report suggested the glutaraldehyde solution as the cause of an outbreak of six cases, five of which have evolved to the need for corneal transplant. This solution was used in the processing of instruments as an autoclave pretreatment without rinsing[2]. Similar to this report, the use of a surgical instrument sterilized in glutaraldehyde solution was pointed out as the likely cause of TASS in a child after cataract surgery[22].

Table 2. Products mentioned as causes of toxic anterior segment syndrome in the literature, according to country, year of the study, and number of cases. São Paulo, 2014.

Place	Year of the study	Number of cases	Mentioned products
South Korea[1]	2008	15	Ethylene oxide gas
Turkey[2]	2006	6	Glutaraldehyde
USA[3]	2006	8	Remnants of ointment
USA[11]	2006	8	Sulfate
India[12]	2011	60	BSS with altered pH
Pakistan[14]	2013	15	Lactated Ringer with high pH
Turkey[15]	2012	19	Ethylene oxide gas
USA[18]	2000	10	IOL
Israel[19]	2010	2	Viscoelastic solution
USA[20]	2010	2	Trypan blue
Netherlands[21]	2011	3	Viscoelastic solution
China[22]	2010	1	Glutaraldehyde
USA[25]	2006	1	IOL
South Korea[26]	2010	1	*Ortho*-phthalaldehyde
USA[31]	2008	112	Endotoxins in BSS
USA[32]	2004	16	Enzymatic detergent

USA: United States of America; BSS: balanced salt solution; IOL: intraocular lens.

Clouser[32] described the investigation of three cases that arose several hypotheses, including the fact that the enzymatic solution was not changed at the appropriate frequency, but only when it was visibly dirty. Another hypothesis was the possibility of evaporation of the water from the enzymatic detergent bath in the tanks of the ultrasonic washer and consequent increase in its concentration. However, an experimental study that simulated an inadequate rinsing of the instruments does not support this hypothesis, concluding that even a high amount of detergent remnants could not be the main cause of TASS[33], as shown in the study of Parikh et al.[34].

Ari et al.[15] described the clinical course of 19 cases, and the analysis of the data from the surgeries led the authors to suspect that the EtO sterilization of the kits for anterior vitrectomy was the cause.

Another study that examined 15 case records also indicated EtO sterilization as the most likely cause. After using steam sterilization, instead of EtO for processing instruments, no more cases were reported in the next 2 years[1]. However, this hypothesis did not prove to be reliable according to a study that evaluated the intraocular reaction caused by EtO in rats and found that it is not associated with TASS[35].

Hellinger et al.[11] investigated the causes of an outbreak of eight cases focusing on the quality of the water used in the cleaning and sterilization process. These authors concluded that, although the outbreak was possibly multifactorial in its etiology, sulfate was one of the impurities found in the water of the autoclave's reservoir, which may be pointed out as the main factor associated with those cases.

In an experimental study in partnership with the Food and Drug Administration (FDA), in which the ability of metals to produce intraocular inflammation was evaluated, the results confirmed this hypothesis[35], but this study used much higher concentrations than those found in the study by Hellinger et al.[11].

Supplies and medicines used during surgeries

Kutty et al.[31] presented the results of an investigation in which tests were conducted to detect and quantify toxins and microbial contaminants in the solutions used in the hospital, which were the following: lubricants, anesthetics,

balanced salt solution (BSS), polyvinylpyrrolidone–iodine (PVP-I), and anti-inflammatories, among others. Of the products tested, the BSS had high level of endotoxins of, on average, 0.908 endotoxin units per milliliter (EU/mL), therefore greater than the recommended limit, which is 0.5 EU/mL[36]. The products of the tested brand were taken out of the market, which resulted in the discontinuation of outbreaks. Until then, there were 112 cases.

Buchen et al.[36] conducted an experiment in an animal model to assess the maximum level of endotoxins in the solutions for intraocular use capable of inducing ocular inflammation after eye surgeries. The study showed that an endotoxin concentration in the range of 0.25–0.75 EU/mL may have the capacity to promote deposition of cells on the IOL surface, flare, and deposition of cells in the AC but no corneal edema.

Reinforcing these findings, another experimental study investigated the minimal concentration of endotoxins capable of causing TASS in the eyes of rats and found that a concentration of 0.23 EU/mL can cause an inflammatory reaction in the anterior segment of the eye[37].

Considering these findings, the FDA changed the recommendations for maximum levels of endotoxin in products used in cataract surgery, from 0.5 to 0.2 EU/ml[38].

Sengupta et al.[12] reported 60 cases of TASS. In 31 of them, the etiology remained unknown, but there were two clusters of cases in which the causes were identified as the pH of 6.0 (cluster of 12 cases) of BSS and a specific batch of Ophthalmic Viscosurgical Device (OVD) (cluster of 17 cases).

Other reports also suggested the OVD as a likely cause of TASS in patients undergoing implantation of a type of IOL that does not require the removal of the crystalline lens[19,21]. Although an investigation that supports this hypothesis has not been performed. It was reinforced by the fact that the OVD was longer in contact with the AC tissues of the eye, particularly the iris and corneal endothelium.

Unlike these studies, Mathys et al.[39] observed in approximately 20 patients remnants of OVD between the posterior capsule and the IOL, and that, in a period of 2 months, when these remnants were removed for analysis, there was no inflammatory reaction.

An experimental study analyzed the cytotoxitity of the cannulas used for OVD injection. After filling the lumens with OVD, cannulas were pre-cleaned in an ultrasonic washer with enzymatic detergent, rinsed with pressurized water pistols and sterilized. The samples were submitted to the cytoxoticity test, which showed no cytotoxic effect. In a group of samples that were not rinsed, alterations in the cells morphology were observed. Although not considered toxic, such alterations may suggest an inducer or precursor of the phenomenon of TASS.[40]

Intraocular dyes and antibiotics used during surgery and ointments used in bandage at the end are also mentioned as potential causes of TASS. Buzard et al.[20] reported two cases related to the use of trypan blue dye of a generic brand, which, after laboratory analysis, proved to be almost three times more toxic than the trademark used as control.

Werner et al.[3] reported the clinical characteristics of TASS that had in common remnants of oily substance found on the surface of the explanted IOLs, from ophthalmic ointment used under the bandage after surgery. The ophthalmic ointment was identified as the etiology of the cases that evolved mostly for the replacement of the IOL, and, in four of the eight cases, there was a need for corneal transplant.

Although the ointment has been strongly associated as the cause, other studies have shown an inert reaction of that product. Chen et al.[41] reported the case of a patient who had ointment remains deposited on the surface of the IOL for over a year without causing inflammatory reaction, similar to other two other studies that reported the ointment remains on the AC of the eye as not being enough to cause inflammatory reaction[42,43].

Other factors

Jehan et al.[18] reported 10 cases and investigated through questionnaires sent to the surgeons involved. The authors claimed that IOL was the probable cause because all cases used the same type and the same brand, besides the fact that such IOL has been taken out of the market by the own manufacturer after other reports of adverse events. Also regarding the type of IOL, Moshirfar et al.[25], despite having considered other possible causes, suggested the possibility that a specific model of IOL was the cause.

Kim et al.[44] did a report of a case in which a patient evolved to a characteristic clinical condition of TASS after cataract surgery in both eyes. The collection and analysis of materials to assess the IgE and IgG levels present in the vitreous found a higher value than expected. The authors postulated that the probable cause is a hypersensitivity of unknown etiology.

Nursing actions to prevent toxic anterior segment syndrome

Nursing can play an important role in preventing TASS, as long as the professionals are aware of the main factors involved in its causality.

The cleaning and sterilization process has often been mentioned as a factor associated with the occurrence of TASS[1,2,11,15,22,26,32]. In Brazil, as in many other countries, the nursing team is responsible for processing instruments. Therefore, ensuring the completion of the correct procedures, the nurses can contribute significantly to reduce the chances of occurrence of TASS. On the basis of the recommendations found in the literature, we can summarize the main preventive measures regarding the handling of surgical instruments, namely:

- to keep the employees of the Surgical Center and of the Material and Sterilization Center aware of possible adverse events and how to prevent them[45,46];
- to acquire sufficient quantity of instruments to allow sufficient time for cleaning and sterilization[45,46];
- to not reuse single-use products[46,47];
- to wash the instruments immediately after use to prevent OVD from drying in the lumens. If the immediate washing is not possible, a pre-rinsing still in the operation room is recommended[45,46];
- to wash ophthalmic instruments separately from other instruments[48];
- to promote abundant rinsing of instruments and of the I/A handpieces[45,47,48] with purified water[49], preferably using high-pressure rinse gun;
- to dry the instruments with filtered compressed medical air[45,49]; and
- to never sterilize the instruments with chemical solutions, such as glutaraldehyde, *ortho*-phthalaldehyde, and peracetic acid[46].

Other forms of nursing activities are the standardization and the training for dilution of drugs that are administered into the eye during surgery to prevent the administration of toxic doses[50] or medications with preservatives[47,51]. In addition, it is essential to maintain detailed records on the use of materials, solutions, and medicines[45] capable of causing TASS, such as BSS[12,31], OVD[19,21], Lactated Ringer[14], trypan blue[20], and IOL[18,25] so that further investigation in case of outbreaks could be possible.

Although a mild and transitory inflammatory process characterized by the eye's AC reaction is common after cataract surgery[52,53], it is necessary to be aware of it because it is a warning sign of TASS[51]. In this sense, an active surveillance system that intends to monitor this sign in cataract postoperative period could have it as an indicator for early detection of this type of adverse event. The active search for new cases and continuous surveillance can be added to this measure, as attitudes that will allow us to know the endemic levels and favor the early detection of outbreaks[52].

For the success of this active search, the involvement of all medical staff is necessary. They should be oriented and encouraged to report any suspected cases to the nurse responsible for the prevention and control of HAIs[54].

Among the general recommendations found in the literature regarding adverse event surveillance, the following stand out:

- monitoring of postoperative inflammatory reactions[51];
- investigating all episodes of outbreaks, for the enlightenment of the etiology[51];
- orienting patients to return immediately to the clinic in case of LVA or pain[51];
- establishing the registration of drugs and solutions used in the surgeries to enable tracing[46,51]; and
- developing effective communication regarding the changes in the purchase of solutions and medicines to ensure that new products will be properly used[51].

FINAL CONSIDERATIONS

The TASS is a worrisome event because of its severity and multi-causal nature. In addition to issues related to the failure to diagnose it and underreporting, the limitation of the investigation methods makes it difficult to determine its causes.

The main recommendations for preventing new cases consist of staff training, implementation of best practices for medical device processing, and adoption of a system of records on the use of materials, solutions, and medicines used in eye surgery, in addition to the establishment of an active surveillance system aiming at early identification and management of cases of TASS.

Next to the important role of the ophthalmologist, it was identified in the literature the role of nursing in the measures for preventing the phenomenon, from the processing of materials and the provision of inputs to the epidemiological surveillance and the orientation to the patient.

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CRITICALLY ILL PATIENTS IN THE POSTANESTHESIA CARE UNIT: INTEGRATIVE REVIEW*

Pacientes críticos na Unidade de Recuperação Pós-anestésica: revisão integrativa

Pacientes críticamente enfermos en la Unidad de Cuidados Post-anestesia: una revisión integradora

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ABSTRACT: Objective: To identify articles related to nursing care of critically ill patients during the immediate postoperative period in the postanesthesia care unit. **Method:** Integrative literature review included the following steps: develop guiding question; establish inclusion and exclusion criteria; define the information to be extracted from the study; assess the studies included in the research; interpret the results; and present the review. The following databases and/or portals were used: BVS, PubMed, Scopus, COCHRANE, Web of Science, and CINAHL. **Results:** Seven articles were found. The nursing care evidenced in this study was composed of performing invasive and noninvasive hemodynamic monitoring, pulmonary physical examination, urinary output control, fluid, electrolytes and acid-base balance, laboratory tests of samples and their interpretation, and recommendations for interventions during respiratory distress. **Conclusion:** It became clear that there is a need for a critical eye associated with the nurses' clinical knowledge to provide patients with intensive care during their stay in the postanesthesia care unit.

Keywords: Postanesthesia nursing. Perioperative nursing. Intensive care.

RESUMO: Objetivo: Identificar artigos relacionados à assistência de enfermagem para pacientes críticos no pós-operatório imediato na recuperação pós-anestésica. **Método:** Revisão integrativa, que contempla as seguintes etapas: elaboração da questão norteadora; estabelecimento dos critérios de inclusão e exclusão; definição das informações a serem extraídas do estudo; avaliação dos estudos incluídos; interpretação dos resultados e apresentação da revisão. Foram utilizadas as bases de dados e/ou portais: BVS, PubMed, Scopus, COCHRANE, Web of Science e CINAHL. **Resultados:** Foram encontrados sete artigos. A assistência de enfermagem evidenciada por este estudo compreendeu na realização da monitorização hemodinâmica invasiva e não invasiva, no exame físico pulmonar, no controle do débito urinário, no balanço hidroeletrolítico e acidobásico, nas coletas de exames laboratoriais e sua interpretação e nas recomendações para intervenções em crises respiratórias. **Conclusão:** Evidenciou-se a necessidade de um olhar crítico associado ao conhecimento clínico do enfermeiro a fim de prestar cuidados intensivos durante a permanência do paciente na recuperação anestésica.

Palavras-chave: Enfermagem em sala de recuperação. Enfermagem perioperatória. Cuidados intensivos.

RESUMEN: Objetivo: Identificar los artículos relacionados con los cuidados de enfermería a los pacientes críticos en la recuperación posanestésica inmediata. **Método:** Revisión integradora que incluye las siguientes etapas: la preparación de la cuestión guiadora; lo establecimiento de los criterios de inclusión y exclusión; la definición de informaciones que se extraen del estudio; la evaluación de los estudios incluidos; la interpretación de los resultados y la presentación de la revisión. Se utilizaron las siguientes bases de datos y/o portales: BVS, PubMed, Scopus, COCHRANE, Web of Science y CINAHL. **Resultados:** Se encontraron siete artículos. Los cuidados de enfermería evidenciados por eso estudio comprendieron la realización del monitoreo hemodinámico invasivo y no invasivo, el examen físico pulmonar, el control del débito urinario, el equilibrio de líquidos y del ácido básico, las pruebas del laboratorio de muestras y su interpretación y las recomendaciones para intervenciones en las crisis respiratorias. **Conclusión:** Se evidenció la necesidad de una mirada crítica asociada con el conocimiento clínico de enfermeros para el cuidado intensivo durante la estancia del paciente en la recuperación anestésica.

Palabras clave: Enfermería posanestésica. Enfermería perioperatoria. Cuidados intensivos.

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INTRODUCTION

The postanesthesia care unit (PACU) is the unit responsible for the immediate postoperative care, which is composed of the period the patient leaves the operating room (OR) until he regains consciousness, he eliminates the anesthetics from his body, and his vital signs stabilizes (S1). For this reason, it is a sector whose purpose is to critically assess the postoperative patients, focusing on the prediction and prevention of the complications resulting from anesthesia or a surgical procedure (S2).

Some guidelines should be followed when planning the PACU to guarantee that its set purpose can be accomplished. One of these guidelines is related to the installation of the PACU: it should be situated within the Surgical Center (SC), or in its vicinity, to facilitate the transfer of the anesthetized patient, allow prompt access to healthcare professionals, and, in case a complication occurs, facilitate the referral of the patient back to the OR[3].

According to the recommendations made by the Brazilian Association of Surgical Center, PACU and Supply and Sterilization Nurses (SOBECC), the number of beds in the PACU should be in accordance with the number of ORs plus one bed[4]. Every patient should be referred to the PACU after surgery, with a few exceptions, according to Resolution 1.363/1993 from the Brazilian Federal Council of Medicine.

Regarding the role of the nursing team, the care provided by them has changed over time; more and more, the focus is on providing specialized, individualized, and humanized care to the surgical patients[2]. For this, the nurse refers the Standardization of Perioperative Nursing Care (SPNC), which allows the planning of individualized care and identifies the nursing diagnostics[6].

The nurse, when caring for a patient in the immediate postanesthesia period, should have a specific and specialized knowledge concerning the standard of care to be provided, the anesthetics and their effects, and the pharmacodynamics of anesthesia and analgesia, in addition to knowing about the physiology, pathophysiology, surgical procedures, and the management of potential complications[7].

It is well known that, for any type of patient in the PACU, the nurse should be watchful of the possible complications resulting from the surgical stress, which can cause various changes in the organic homeostasis, such as hypothermia, blood pressure changes, irregular heartbeat, respiratory discomfort, alterations in fluid, electrolytes and acid–base balance, and bleeding, among others[8].

What differentiates a PACU nurse from the nurse who provides care for critically ill patients? The ability to handle and use technology with a careful eye for clinical interventions and hemodynamic effects, which is a profile commonly seen in intensive environments. In 2000, the American Society of PeriAnesthesia Nurses (ASPAN) approved recommendations, which included the need for an adequate personnel to maintain a safe and competent nursing care for the critically and noncritically ill patients[9]. In the ASPAN standards, the nurses who work in the PACU should gain intensive care skills[10].

Another problem is the high demand of surgical patients and the few beds available for the critical care, because of overcrowding, which results in an increase of admission of patients who require intensive care in the PACU. The use of this unit for the admission of critically ill patients, with the need for specialized care or with the risks of hemodynamic instability, has become a routine, seeing that there is a physical space and the appropriate supplies to guarantee support for this type of patient[11,12]. Admitting a patient from the intensive care unit (ICU) to the PACU raises the question regarding how to guarantee the care for the critically ill patient with a clinical eye, aimed not only at his recovery from the effects of anesthesia but also at his comprehensive care so as to provide him with safe clinical care.

From this concern and from the author's professional experience as a resident nurse at an innovative institution, which introduced the acute care nurse to the critically ill and immediate postoperative care alongside the surgical nurse at the PACU, the need was raised to search the national and international literature for an evidence regarding nursing care for critically ill patients in the PACU.

OBJECTIVE

To identify, in the literature, articles related to nursing care for critically ill and immediate postoperative patients in the PACU, in studies published in the national and international scope.

METHODS

The integrative review is a research method that has a broader scope, as it allows the synchronic inclusion of experimental

and nonexperimental studies, theoretical, and empirical questions. Because of this, it allows for a better understanding of a health problem or phenomenon[13].

The guiding question for this study was as follows: What evidence is there for the nursing care of critically ill patients in the PACU?

The inclusion criteria for the articles during the research and construction of the integrative review were as follows: articles published in the national and international scientific literature, available in Portuguese, English, or Spanish, accessible in the selected databases, without a year of publication limit, and which portrayed nursing care for critically ill patients in the PACU. The exclusion criteria included studies not available in their entirety, thesis, dissertations, and materials yet to be published, and qualitative studies and discussion, which did not direct nursing care and did not portray the presence of critically ill patients in the PACU.

The following portals and/or databases were used to select the articles: *Biblioteca Virtual em Saúde* (BVS); Elsevier SciVerse Scopus; National Library of Medicine (PubMed); Web of Science; Cumulative Index to Nursing and Allied Health Literature (CINAHL); and The Cochrane Library.

The study was done via an online access, following the preestablished inclusion and exclusion criteria from July 2014. For the research, the following descriptors from Health Sciences Descriptors (DeCS) and Medical Subject Headings Section (MeSH) were used, and the research methodology adopted was the acronym PICO[14], where P stands for patient; I, intervention; C, comparison group, and O, outcome. For this study, the strategy was configured as: P, patients in the PACU, I, postoperative and postanesthesia nursing care, C, does not apply, and O, critical and intensive nursing care.

The research strategy was adapted according to the portal and/or database, that is, the use or omission of quotation marks, parentheses or descriptors, having as guidelines the study question, and the preestablished inclusion criteria of the integrative review.

In the PubMed portals, Web of Science, and the databases, Scopus and COCHRANE the research strategy utilized was as follows: *((recovery room)* OR *(postanesthesia care unit)* OR *PACU))* AND *((postanesthesia nursing)* OR *(postoperative care nursing))* AND *((critical care nursing)* OR *(intensive care nursing))*.

In the BVS portal, two search strategies were used, because, after the first one, it was noted that articles in Portuguese did not come up. Therefore, to amplify the search and reduce the bias, the strategy with the descriptors in Portuguese was inserted. The first search was composed of: *(tw:(recovery room))* OR *(tw:(post anesthesia care unit))* OR *(tw:(PACU))* AND *(tw:(post anesthesia nursing))* OR *(tw:(postoperative care nursing))* AND *(tw:(critical care nursing))* OR *(tw:(intensive care nursing))*. While the second search contained: *(tw:(sala de recuperação))* OR *(tw:(período de recuperação da anestesia))* AND *(tw:(enfermagem pós-anestésica))* OR *(tw:(cuidados de enfermagem))* AND *(tw:(terapia intensiva))* OR *(tw:(enfermagem em cuidado crítico))* AND *(instance: "regional")*.

In the CINHAL database, the strategy was applied in the following ways: *MH recovery room* OR *MH postanesthesia care unit* OR *MH PACU* AND *MH post anesthesia nursing* OR *MH postoperative care* AND *MH critical care nursing* OR *MH intensive care nursing*.

At the end of the searches, 1,111 articles were found. After reading the titles and abstracts, 60 articles were selected, according to the preestablished inclusion and exclusion criteria. However, 16 of them were not available to read in their entirety, which resulted in a total of 44 articles.

Among the articles read in their entirety, 37 of them were excluded for not meeting the inclusion criteria; of these, five studies were qualitative, three were case studies, one a clinical discussion, two were final papers, two were published in annals, and 24 did not present the nursing assistance and/or did not report the presence of critically ill patients in the PACU, which resulted in seven articles included into the review (Figure 1).

The articles found in the search were first entered into an Excel table and analyzed, separately, by two evaluators based on their title and abstract. The ones that were analyzed differently were discussed to verify the possibility of their inclusion. Later, after the selection of the texts, they were read in their entirety, and those that did not meet the preestablished criteria were excluded.

For the included articles, data were collected by completing an adapted instrument[15], which is composed of the following: identification of the article, methodological characteristics of the study (type, objective or problem, location and period of the study, intervention or care, assessment method, and instrument of measurement), results, and conclusions.

The articles were classified according to their level of evidence. To assess the quality of these texts, it is necessary to understand the methodological approach in which the study is inserted[16]. To assess the scientific evidence, the level of scientific evidence by the type of study was used according to the Oxford Centers for Evidence-based Medicine (CEBM)[17].

To synthesize the articles, a synoptic table was used with the following focus: study, year, and country of publication, objective, type of study, results, and conclusion.

RESULTS

Although the research was done without a restriction for the year of publication, 57.14% of the studies were published after 2000, followed by 28.7% in the 1970s, and 14.28% in the 1990s. From the seven studies selected, all were theoretical, being a review of literature, without a scientific or updating method. According to the classification of levels of evidence in the CEBM[17], all studies presented a level 5 of evidence, a score for low scientific evidence.

Although a few studies referred to critically ill patients, those that were found were close to the observed clinical practice. Descriptions were found regarding nursing care for patients admitted for abdominal aortic aneurysm repair and kidney transplantation; patients with adult respiratory distress syndrome and sleep apnea; and patients with respiratory distress, ineffective breathing pattern, and the need for invasive airway management.

Regarding the place of publication, six studies originated from the United States and one from the United Kingdom. As for the journal, four were published in the *Journal of PeriAnesthesia Nursing*, and one in each of the following: *Journal of Perioperative Practice*, *International Anesthesiology Clinics*, and *American Journal of Nursing*.

Chart 1 presents a panoramic synthesis of the studies included in this review according to country/year, type of study, results, and conclusion.

DISCUSSION

The presence of critically ill patients in the PACU, previously referred to the ICU, can be related to the fact that this unit contains befitting technology and has minimally invasive procedures, which are capable of providing these patients with care. This would explain a larger number of publications, which report this care in the PACU in the 2000s (21st century).

The PACU was developed to provide care for patients who needed continuous monitoring until full anesthesia recovery. Meanwhile, the ICUs were developed to provide care for more critically ill patients, offering nurses who are experienced in

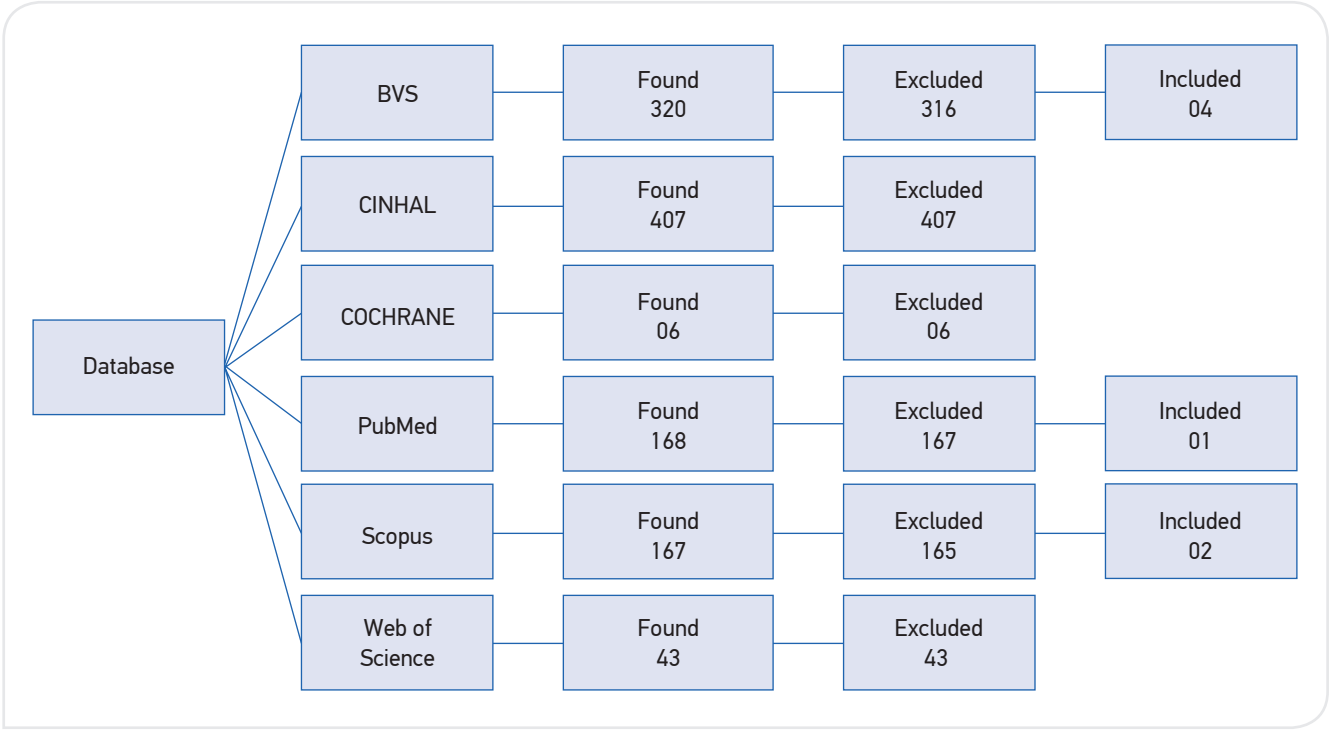

Figure 1. Diagram of the selection of the articles found in the databases that meet the inclusion criteria.

Chart 1. Panoramic synthesis of the studies included in the integrative review. São Paulo, 2014.

Study, year, and country	Objective	Results	Conclusion
S1[18], 2002, United States	Understand the abdominal aortic aneurysm (AAA) and patient management in the first few postoperative hours, for the implementation of nursing care.	On admission, assess skin integrity; laboratory results (renal function and red cells); neurovascular assessment (pallor, pulse, paraesthesia, pain, and paralysis in distal limb) every hour; hemodynamic monitoring (arterial pressure, central venous pressure, temperature, and, in some cases, pulmonary artery and cardiac output); urinary output monitoring; pulse oximetry (focusing on the reading of hemoglobin oxygenation) and pain (management and patient education). Every two hours, perform a physical abdominal examination (auscultation of bowel sounds, distention, nausea, vomit, and fever).	The postoperative patient with AAA needs intensive care; for this reason, quality assistance for the critically ill patient in the PACU can guarantee his adequate recovery, making it unnecessary for him to be referred to the intensive care unit.
S2[19] ,2012, United Kingdom	Understand the essentials for caring for intubated patients and noninvasive mechanical ventilation patients in the PACU.	Observe breathing pattern (pulmonary auscultation, peripheral perfusion, and pulse oximetry); hemodynamic monitoring (arterial pressure control, cardiac output and vascular resistance, and pulse oximetry with a focus on the oxyhemoglobin, arrhythmias); control body temperature; assess blood gas results (control of acid–base balance), and observe neurological pattern.	Knowing the respiratory physiology is essential in understanding how various factors affect the homeostasis and the respiratory pattern to provide an adequate care for any patient in the PACU.
S3[20], 1996, United States	Discuss respiratory distress syndrome in adults and the care provided in the PACU.	Assess breathing pattern (emphasis on the physical pulmonary examination); control pulse oximetry (focus on the oxyhemoglobin) and the hemodynamic standard (arterial pressure control and cardiac output).	The nurse should know the physiology and the signs/symptoms to assess and for fast intervention.
S4[21], 2003, United States	Identify the normal and abnormal findings of the renal transplant recipient and the care provided in the PACU.	Assess urinary output; maintain hydration; control the laboratory examinations (biochemistry); assess the hemodynamic standard (arterial pressure and venous central pressure); and manage pain.	When caring for a patient who is a renal transplant recipient, the nurse should be aware of the complications and provide an immediate care.
S5[22], 1971, United States	Discuss the factors that are necessary for the adequate respiratory assistance in the PACU.	Observe the breathing pattern and hemodynamic standard (arterial pressure control and cardiac frequency) and skin color; stimulate movement in the hospital bed; call patient's name to evaluate responsiveness; in cases where there is obstruction of airways, manage airways (open airway; aspiration; use of Guedel tube; and hyperextension of the head).	Adequate nursing care reduces pulmonary complications during this critical period for patients in the PACU.
S6[23], 1975, United States	Recognize respiratory distress and provide the appropriate intervention.	Observe breathing pattern (coughing, respiratory rate, and pulmonary auscultation); hemodynamic standard (arterial pressure and cardiac rate); in case of airway obstruction, hyperextend the head by elevating it, turn patient's head sideways, use an oropharyngeal airway, clear secretions, provide adequate ventilation; assess blood gas, and relate it to the patient's physiology.	Recognize signs and symptoms for airway obstruction and intervene as soon as possible, with the intention of reducing risks.
S7[24], 2006, United States	Identify the perianesthetic implications associated with the patient who has obstructive sleep apnea syndrome (OSA).	On admission, assess the level of consciousness, the breathing pattern, and hemodynamic standard; control pulse oximetry and pain (ice and transcutaneous electrical stimulation); keep the patient in a lateral position, except when contraindicated; and administer supplementary oxygen.	One must be aware of the risk factors, complications, and the care provided for these patients.

technology and with the proper knowledge concerning the treatment of this type of patient. However, in the last few years, hospitals have reduced the time of admission for procedures and the style of patient care has changed. Currently, a patient admitted for a carotid endarterectomy or a femoropopliteal bypass, for example, is referred to the PACU and is released to the inpatient unit, instead of going to the ICU. This generates a higher demand of intensive care from the PACU[8].

Some investigations found in this study reported this type of experience. Studies S1[18], S3[19], S4[20], and S7[21] reported nursing care in the PACU for patients admitted for abdominal aortic aneurysm, kidney transplantation, acute adult respiratory distress syndrome, and sleep apnea, whereas studies S2[22], S5[23], and S6[24] reported alterations in breathing patterns and other critical situations, which could increase the gravity of the situation of the patient. Despite the little methodological rigor of these studies, they can indicate some general guidelines for the practice of the nursing professional in this new reality.

In the findings from this integrative review, monitoring cardiac output was described in studies S1[18] and S4[20] as an aiding method for the nurse to assist and determine fluid replacement, as an adequate intravascular volume is maintained through appropriate blood flow, tissue perfusion, and blood pressure. Study S2[22] reports blood pressure as an aiding method in diagnosing hypovolemia and hypotension, which may be measured using invasive and noninvasive forms. However, it is essential that the nurses assess the mean arterial pressure so as not to cause any problems in the fluid dynamics. Noninvasive monitoring measurements can facilitate the evaluation of the depth of the anesthesia and adapt pain management. In the anesthetized patient, the objective of the hemodynamic monitoring is to guarantee adequate tissue perfusion and the demand for oxygen, to prevent instability, and to provide the necessary therapy[25].

Study S1[18], which involves the postoperative patient for abdominal aortic aneurysm, suggests the use of dopamine to support blood pressure and systolic cardiac output inferior to 90 mm Hg, until the diagnosis and adequate interventions are established for the cause of decrease in blood pressure. This type of action is recommended in another study, which mentions an intervention through the use of hemodynamic variables to determine if the cardiac output is adequate and, if not, establish an intervention for improvement by administrating fluids and/or vasoactive and inotropic drugs[25]. This peculiar eye and the knowledge regarding this type of monitoring are characteristics of intensive care nurses, as is the handling of vasoactive drugs, which require a deeper understanding of their interactions, doses, and infusions.

The assessment of measurements from blood pressure was mentioned in all studies. However, the electrocardiogram for arrhythmia was only described in studies S2[22], S5[23], and S6[24]. In S1[18], S2[22], and S3[19], the necessity was raised regarding the measurement of cardiac output, pulmonary artery pressure, and the vascular resistance of some patients, respectively.

Hemodynamic monitoring of the central venous pressure (CVP) was reported in S1[18] and S4[20]. In S1[18], CVP is a part of the hemodynamic monitoring and should be used judiciously. In S4[20], the relationship between the CVP and the fluid management is discussed as being of extreme importance, which should be related to the urinary output for an adequate volume replacement. This same recommendation was observed in a study conducted with kidney transplant patients. It was suggested that the CVP be maintained between 10 and 15 cm of H_2O and the volume replacement with normal saline at 0.9% of 70 to 90 mL/kg. However, the hydration measurements should be associated with the clinical care through simple actions, such as measuring blood pressure, CVP, and the assessment of the appearance of edemas[26]. It is a fact that the isolated value of CVP cannot be considered as an intervention, but it should be associated with other factors, including a clinical evaluation of the patient to be cared for[27].

Regarding the care for critically ill patients, another point found in the results of this study refers to bladder control. In the study S1[18], the nurse was aware of an output inferior to 30 mL/h during two sequential hours, a fact that can be related to the presence of embolization, thrombus, edemas, obstruction of renal artery, kidney damage, and volume depletion, or it can characterize acute renal failure. In these cases, an immediate intervention is necessary along with informing the responsible surgeon about it.

The S4[20] indicated that it would be ideal to verify with the surgeon what the desired urinary production is in the PACU, because kidney patients can have anuria, oliguria, and/or polyuria. As is presented in the study S1[18], production inferior to 30 mL/h can be related to some sort of complication, for example, possible acute tubular necrosis, renal obstruction, or urinary obstruction. In the cases of interruption of urinary output, the nurse should insert a Foley catheter and/or do a bladder irrigation. When there is a need to change the catheter, it should be done by the surgeon. Production over 500 mL/h, common in transplants with live donors, requires a rigorous monitoring to guarantee maintenance of the electrolytes.

A Brazilian study regarding the relationship between anesthesia and transplant revealed the importance of early diuresis in kidney transplants as a prognostic factor and found the presence of early diuresis in live donors. In the case of cadaveric donors, diuresis was less frequent owing to variable periods of ischemia and the need for electrolyte solutions and low temperatures to maintain the organ until it is transplanted. It is evident that nurses must know the type of donor to program the proper nursing care, seeing that it can be altered depending on the origin of the donated organ.

Another type of intervention found in critically ill patients is the need to manage electrolytes, as discussed in studies S1[18] and S4[20]. In both the studies, the importance of the control of renal function is mentioned, and it is recommended that samples for laboratory tests are collected when patients are admitted into and, if possible, when they are released from the PACU. In Brazilian institutions, only a doctor can request the collection of laboratory test samples, which does not invalidate the unit nurse from suggesting that the anesthesiologist or the surgeon make the request.

In S1[18], apart from the tests to examine the renal function, hematological (hemoglobin, hematocrit, and platelets) and coagulation tests are added, which show tissue perfusion and signs of bleeding and monitor anticoagulants, common in the postoperative care for abdominal aortic aneurysm. In S4[20], other important electrolytes (ionized calcium, glucose, and sodium bicarbonate) are suggested for the control of postoperative care of major surgeries. Collecting laboratory test samples to manage the care provided was reported in other studies (S2[22] and S6[24]). In these, the collection of arterial blood gas to control the acid–base balance was discussed. The results of these examinations can aid in maintaining the adequate relationship between perfusion and ventilation and should be compared with the medical history of the patient.

In anesthetized patients, the functional residual capacity is reduced by 20%, which leads to the increase in hypoxemia risk[22]. The clinical diagnosis of hypoxemia is done by the presence of cyanosis. Nursing care regarding breathing patterns is presented in S2[22], S3[19], S5[23], S6[24], and S7[21], which recommend that the nurse frequently assesses the respiratory depth, notice the ease of breathing, perform auscultation, and observe oxygen saturation at admission and release of a patient during recovery.

Pulse oximetry is the basic resource used to monitor an anesthetized patient as peripheral capillary oxygen saturation (SpO_2) is correlated to the arterial oxygen saturation (SaO_2). Thus, it aids in the early detection of hypoxemia[28]. Observing pulse oximetry was presented in the studies S1[18], S2[22], S3[19], and S7[21] as a measurement to evaluate the breathing pattern. However, in studies S1[18], S2[22], and S3[19], the discussion is raised regarding the misapprehension of these data being common, because the values of oxygen saturation below 85% cannot be interpreted precisely. For this reason, the calculation of capillary oxygen is recommended. The fact is that pulse oximetry does not differentiate reduced hemoglobin from its other form, making it possible to overestimate the SaO_2[29].

One study regarding the limits of agreement between the SpO_2 and SaO_2 values in anesthetized and critically ill patients, in mechanical ventilation, to establish minimum values for SpO_2 associated with arterial saturation of capillary oxygen superior to 90%, revealed that values for SpO_2 equal to or higher than 99% were not associated with the occurrence of any SaO_2 inferior to 90%. Consequently, the use of capillary oxygen measurements, recommended in the studies from this integrative review, become more trustworthy in the assessment of breathing patterns in critically ill patients[29].

During the postanesthesia, the tongue is the most common cause of airway obstruction, an observation found in S2[22], S3[19], S5[23], S6[24], and S7[21]. However, only in the studies S5[23] and S6[24], recommendations were found for assisting a patient with reduction of air passage, with warnings regarding the hyperextension of the head, oropharyngeal airway, clearing of secretion, and ventilation with positive pressure through the bag valve mask.

Investigation S7[21] portrays patients with sleep apnea and recommends the continuous positive airway pressure (CPAP) system as soon as it is possible, preferably when patients are admitted into the PACU. Once this patient has been operated on, hypoxemia and hypercapnia are the main concerns during postoperative care, with the first two hours requiring more attention, maintaining the head elevated to minimize the obstruction of air passage through superior airways[30]. As in the clinical practice, in S7[21], the nurse should request that the patient have his own equipment. In case the institution where he is at does not use this practice, its benefits for the patient should be discussed, as he is familiarized with the facial mask and how it functions and is comfortable with it, and this guarantees better results with positive pressure ventilation. This practice is observed in a Venezuelan study, which affirms the benefit of the use of a CPAP system as a way of keeping superior airways continuously open and reinforces the importance of requesting that the patient bring his own equipment to the hospital[30].

Another practice seen in the findings of this review is directed at the control of body temperature. When it is low, it is related to the metabolic rate of the organism, and it was mentioned in two studies: S1[18] and S2[22]. In S1[18], it is recommended that the patient is kept normotensive, to prevent vasoconstriction and to reduce the possibility of infection and cardiovascular events. In S2[22], it is stated that hypothermia can interfere with the global consumption of oxygen and increase the demand on the respiratory system. Heat loss is common in patients subjected to general anesthesia, once the anesthetics alter the thermoregulation center of the hypothalamus, inhibit tremors, and produce peripheral vasodilatation. During the recovery from anesthesia, the inhibition disappears, and the tremors start when the temperature is lower than the thermal regulation threshold[31]. Among the implications that can occur as a result of hypothermia are: cardiovascular implications such as myocardial ischemia, arterial hypertension, tachycardia, and deep venous thrombosis; changes in coagulation such as platelet activation and coagulopathy; immunological changes such as the increase of surgical site infection; and hydroelectrolytic and endocrine metabolic changes[32].

In a Brazilian study[31], with the objective of assessing factors associated with the development of intraoperative hypothermia, it was evidenced that the longer the duration of a surgery, the lower the body temperature of the patient. This can occur in critically ill patients who are admitted into the PACU and who, characteristically, need major surgical procedures and, consequently, longer durations.

In regard to this necessity of maintaining normothermia in the perioperative care, a systematic review concluded that there is a moderate evidence when suggesting that carbon-fiber warming blankets are as efficient as forced-air heating system to avoid hypothermia and that circulating-water garment is the most efficient method to maintain normothermia[33].

The complexity of a critically ill patient and the amount of responsibility of a nursing professional at the PACU where he is admitted can be noted. This justifies the need for an acute care nurse to provide the adequate clinical care, owing to their specific knowledge regarding mechanical ventilation, hemodynamic monitoring, and administration and handling of vasoactive and/or inotropic drugs.

CONCLUSION

This integrative review presented contributions from the international literature to the nursing care of critically ill patients who should be recovering in the ICU but who have been referred to the PACU. It was evidenced that there is a need for a nurse with a critical eye in addition to the clinical knowledge to provide an intensive care during the patient's stay at the PACU. The presence of an acute care nurse in the PACU can enhance the quality of nursing care and reduce the possibilities of complications for critically ill patients.

The development of studies regarding this type of patients is considered paramount, as is the use of the results of these studies for the evidence-based practice in the SC area.

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PRACTICE IN THE INTRAOPERATIVE PERIOD OF SURGICAL CORRECTION OF A "SKY OPEN" MYELOMENINGOCELE IN UTERO

Atuação no intraoperatório da correção cirúrgica de mielomeningocele a "céu aberto" intraútero

Práctica intraoperatória de la corrección quirúrgica de mielomeningocele a "cielo abierto" en útero

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ABSTRACT: Objective: To report the experience of a nurse's practice in the intraoperative period of meningomyelocele surgical repair in the open in utero. **Method:** Report of a practice experience in a private hospital in São Paulo. **Results:** Nurses have a fundamental role in anticipating and providing materials and equipment for surgery, in following up the patient to admission in the Operating Room, and in assisting the surgical anesthetic procedures. **Conclusion:** Primary factors for the surgery success include field staff's knowledge and domain about the phases of surgery, and being prepared to care for the pregnant patients, and to recognize the possible complications involving the mother and fetus.

Keywords: Meningomyelocele. Spinal dysraphism. Fetal monitoring. Anesthesia. General surgery.

RESUMO: Objetivo: Relatar a experiência da atuação da enfermeira no intraoperatório de correção de mielomeningoceles a céu aberto intraútero. **Método:** Relato de experiência da prática em um hospital privado de São Paulo. **Resultados**: A enfermeira possui papel fundamental na previsão e na provisão de materiais e equipamentos para a cirurgia, no acompanhamento da paciente na admissão no Centro Cirúrgico e no auxílio durante o ato anestésico-cirúrgico. **Conclusão:** Fatores primordiais para o sucesso da cirurgia são o conhecimento e o domínio da equipe sobre as fases da cirurgia e o atendimento a pacientes gestantes, considerando as possíveis complicações que podem envolver a mãe ou o feto.

Palavras-chave: Meningomielocele. Disrafismo espinal. Monitorização fetal. Anestesia. Cirurgia geral.

RESUMEN: Objetivo: Reportar la experiencia de la práctica de una enfermera para la reparación quirúrgica intraoperatória del mielomeningocele al aire libre en útero. **Método:** Reporto de la experiencia práctica en un hospital particular de São Paulo. **Resultados:** La enfermera tiene el rol esencial de prever y proveer materiales y equipos necesarios para dar seguimiento al paciente al ingreso en el Quirófano y ayudar en los procedimientos anestésicos quirúrgicos. **Conclusión:** Los factores principales para el éxito de cirugía son conocimiento y personal de campo sobre las fases de cirugía, estar preparado para responder a las pacientes, y reconocer posibles complicaciones debido a cirugía que pueden envolver la madre y el feto.

Palabras clave: Meningomielocele. Disrafia espinal. Monitoreo fetal. Anestesia. Cirugía general.

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INTRODUCTION

Meningomyeloceles (MMC) are birth defects of the closure of the neural tube. This congenital malformation affects mainly the lumbosacral region. Studies have shown that hydrocephalus occurs in 80 to 90% of cases[1], involving also the overlying tissues to the spinal cord, the vertebral arch, the dorsal muscles, and skin. It is known as spina bifida and classified as occult and cystic, with two main forms: the meningocele and MMC[2].

The formation of the neural tube occurs in two stages: the first of which happens during the fourth to fifth week of pregnancy, called primary neurulation, which is the formation of the neural tube from the high lumbar region up to the cranial region, and the second occurs around the seventh week of pregnancy and is the formation of the neural tube of the lumbar and sacral region, between 24 and 28 days after conception. The neural plate closes, originating the neural tube. Incomplete premature closure results in spina bifida[3].

The causes that lead to this malformation are still uncertain[4] but are associated with genetic and environmental factors, such as: maternal diabetes, zinc deficiency, alcohol intake during the first trimester of pregnancy, food contaminated by pesticides, anesthetic agents, and anticonvulsant drugs, among others, with the main factor being the lack of folic acid[2]. As a result, MMC generates sequelae that may be significant, such as motor impairment in varying degrees, skeletal deformities, urinary and/or bowel incontinence, and hydrocephalus with consequent Arnold–Chiari II malformation, which is an abnormality characterized by permanent herniation of the bulb and cerebellum[5].

Diagnosis can be identified prenatally, thanks to the development of fetal medicine[6]. Noteworthy are the high-resolution ultrasound (US) examination and biochemical tests [measurement of alpha-fetoprotein in plasma in amniotic fluid (AF) and acetylcholinesterase][3,7].

Thus, the advantage of early diagnosis led to an improvement in fetal medicine, with a new surgical technique for repair of MMC. Open in utero surgical repair has been performed in pregnant women with gestational age (GA) between 21 and 27 weeks. This aims to reduce the consequences resulting from neural tube defects (NTDs)[5,7]. Studies show that the earlier the NTD is repaired, the lower the degree of sequelae[8,9].

The first procedure report with fetal medicine was conducted in 1963 by William Liley, who made a fetal blood transfusion, and in 1981, there was a hydronephrosis correction[9].

The first model with surgical technique for MMC correction with fetal repair was created by Michejda in 1984[5]. The technique for the open in utero MMC repair is currently being performed in Latin America by its precursor, Professor Antonio Fernandes Moron[10]. It is performed only in two hospitals in the city of São Paulo, Brazil, one is private and the other is public.

The in utero MMC surgery is classified as an open procedure, involving laparotomy and hysterectomy. The incision is performed in accordance with the position of the fetus, which may be anterior or posterior. The AF is extracted and stored in a sterile container and heated to be reinfused at the end of the procedure. This procedure involves two medical specialties: fetal medicine and neurosurgery[9]. Studies show that the in utero repair of MMC decreases the occurrence of hydrocephalus and brain injury and enables an improvement in motor function of the lower limbs[5].

There are some criteria for in utero surgical repair, such as careful assessment of each case, GA, care with anesthesia (for this surgical technique involves the mother–child binomial)[7], well-trained and qualified medical and nursing staff, intensive care unit (ICU) backup, and blood bank.

The intraoperative care practices by nurses and all the nursing staffs in MMC repair surgery are of utmost importance, but there is a lack of description of these actions in the publications of this area. Thus, considering the profile of these surgical patients, the mother–child binomial, we believe this study may contribute to the improvement of nursing care in this period.

OBJECTIVE

This study aimed to describe the intraoperative role of nurses in the open in utero surgical repair of MMC in a private hospital in São Paulo, Brazil.

METHOD

This is a descriptive and an analytical experience report study, aimed at seeking scientific information underevidenced by nursing. It gives an account of the practice of a nurse who works during surgery, having the opportunity to experience the open in utero surgical technique of MMC repair in a private hospital in São Paulo. The appreciation of the experience

report method is based on the premise that problems and practices can be improved through the description and analysis of objective and direct observations[11].

The study describes the experience of a nurse who works in the Surgical Center (SC), dealing directly with pregnant patients admitted for the open in utero MMC repair in a private, midsized hospital, located in São Paulo, which has been offering the technique since 2011. In this hospital, there is only one surgical team that performs this procedure, consisting of fetal medicine and neurosurgery specialists. The aim is to demonstrate the improvement and evolution of the nursing staff, in conjunction with fetal medicine, in the admission of these patients, in the care for the mother–child binomial in the operating room (OR), in the nursing practices, in assistance to the anesthesiologist and surgical teams involved, and in the preparation for any complications, aiming to improve the care provided to these patients.

RESULTS

This experience report is based on the experience of the first author as acting nurse in the SC of a midsized private hospital in São Paulo, performing the open in utero surgical repair of MMC. The first experience with this surgical technique occurred in the company of a fetal medicine doctor in 2011. Before scheduling the first surgery with the intrauterine correction technique, a team member (fetal medicine) went to the SC to guide and show the nurses how would the open in utero surgery technique be performed in pregnant patients and to describe the materials needed, surgical time, and the teams involved. Everything was presented in slides based on a surgery that was already performed at another institution by the same team.

The role of the nurse was to predict and provide all the materials and equipments needed for a surgery, to follow-up the patient in the admission to the SC, and to assist during surgical anesthetic procedures, acting in the OR.

The work dynamic includes, initially, requests for materials, namely: obstetric surgical drapes and double-barrier disposable aprons, latex-free gloves, specific instruments (CS and delicate neurosurgery boxes), fibrin glue and spray device, US device, thermal blanket, wedge, heel protectors, and basic materials for surgeries (gauze, bandages, tanks, domes, surgical thread, etc.). It is imperative that the reservation is made for adult ICU and in the blood bank for blood products.

On the recommendation of the surgical team, the patient is admitted on the day before the surgery in order to receive the preoperative visit, both from the anesthesiologist and the nurse, to start preparations for the surgery. Blood typing is performed, laboratory tests are collected, medications are administered according to prescription, and the reservations for the adult ICU and blood products are made. The GA profile of patients undergoing the open in utero surgical treatment of MMC varies between 25 and 26 weeks of gestation.

The arrival of the patient to the SC takes place 30 minutes before the scheduled surgery, and personal information is confirmed (full name and date of birth), and a picture is taken, which is transmitted to the OR through a panel, which enables the display to everyone involved in the surgery. At the end of the proceedings, the documents are printed with the photograph of the patient. Thus, it is possible to increase the efficiency in the safety of the patient (correct patient and medical staff).

The SC of the institution where the procedure is performed has a preanesthetic room, where the team makes the patient's first admission in the Surgical Block). The medical records, test results, and reservations are checked, and signatures in terms of consent (anesthetic and surgical) are confirmed. Venipuncture is performed, and premedication is administered, if prescribed by the doctor. The patient remains in the preanesthesia room until the arrival of all members of the surgical team and the preparation of the OR.

The patient is then transferred to the OR, accompanied by a nursing technician (circulating nurse), with the help of a nurse. The safe surgery checklist begins, which is performed before induction of anesthesia, confirming the patient's full name, the procedures to be performed, the report of allergies, the risks of airway difficulty and bronchoaspiration, and blood loss beyond the expected (up to 500 mL). Maternal monitoring follows, initially with pulse oximetry, cardiac monitoring, and noninvasive blood pressure (NIBP).

An obstetric US examination is performed by the fetal medicine doctor, to observe the fetal positioning, vitality, and fetal heart rate (FHR). A wedge is placed on the patient's right flank region, in order to reduce the burden on large vessels and avoid hypotension, given that the position for surgery is the supine–horizontal position.

The anesthesiologist performs another peripheral venous puncture with a caliber catheter (14 or 16 G), followed by combined anesthesia, which may be general, spinal, or epidural and general. Then, monitoring is completed with the performance of capnography; a heated thermal blanket is used on the patient's upper body (thorax and upper limbs), in order to reduce or prevent postoperative hypothermia.

To contribute to the prevention of surgical site infection, degermation is performed on the abdominal and pelvic regions. The urethral catheter is inserted for water control during the intraoperative and postoperative periods, and the dispersive electrocautery plate is positioned at the nearest site of surgery, usually the thigh area.

Before the surgery starts, the second part of the checklist is performed, with the confirmation of the presence of all the people involved in the surgery, what procedure will be performed, surgical time, availability of tests and materials in the OR, and if the dose of antibiotic prophylaxis was administered. Throughout the preparation period, already intraoperatively, the nurse's role is dynamic, helping the patient, the anesthesiologist, the surgical team, and the circulating nurse.

The surgery itself begins with the skin incision, followed by hysterotomy and extraction of the AF, with the aid of a latex-free vesical probe (type Foley 14). The AF remains stored in 60-mL syringes in buckets, immersed in a 0.9% saline solution (SS), and heated, on the surgical table. The procedure is guided by US examination for fetal monitoring. The fetus is exposed and positioned so that the neurosurgeon can perform the repair of MMC. To this end, the uterus is sutured using fibrin glue with the spray device. The AF is reinfused into the uterus, repositioning the uterus in the abdominal cavity for closure by plans and the completion of the dressing.

At the end of the surgery, the third step of the checklist is performed, with confirmations of the number of used compresses, needles, and surgical instruments and identification of parts or tests that were requested during the intraoperative period. The patient is then extubated by the anesthesiologist and transferred to the previously reserved bed in the adult ICU, where they are monitored (pulse oximetry, NIBP, and cardioscopy) and supplemented with oxygen if necessary. On transfer, the patient is always accompanied by a circulating nurse (nursing technician), by the nurse, and by the anesthesiologist.

It is observed that, along the working trajectory with this particular procedure, there is a need for the nursing staff to be ready for early delivery due to stimulation of the uterus and the profile of GA (24–26 weeks). Therefore, to prepare the OR for the open in utero MMC surgery, neonatal resuscitation materials should be organized, and the neonatologist doctor and a midwife must be forewarned, if necessary, and a reservation must be made with NICU in the case of premature labor.

In the course of acting as nurses, being present at nearly a hundred open MMC repair surgeries, only one premature birth that resulted in fetal death was experienced, but no hospital infection was recorded. In addition, over the years, there has been a constant improvement in the surgical team's ability, with consequent reduction of surgical time. Another key factor for the success of the surgery is the better preparation of the nursing staffs, in order to care for pregnant patients who were admitted to the SC for the open in utero MMC surgery. Through the report, this procedure can be identified as a highly complex surgery.

It is shown that, by means of quality indicators from 2011 to 2013, there is a significant increase in the number of in utero MMC surgeries, compared with the conventional repair of MMC, employed in newborns, in the first 24 hours after delivery.

DISCUSSION

In the recent years, there have been important advances in perinatal medicine. There are many procedures performed during pregnancy, from minimally invasive (amnioscopy, cordocentesis, and aspiration of cysts) to highly complex surgery (tracheal occlusion with inflatable balloon in cases of diaphragmatic hernia and open surgery, such as in utero MMC repair) with the intention of treating or ameliorating the chance of fetal survival[9]. Currently, monitoring the evolution of complex fetal surgery in Brazil is a challenge[12].

Owing to the high complexity of in utero MMC surgery, a preoperative evaluation is carried out[13], thus justifying the admission of the patient on the day before the surgery. Given this, Resolution 1363/1993 of the Brazilian Federal Council of Medicine (CFM), in its Article 1, paragraph 1, states that "prior to any anesthesia, it is necessary to know in advance the clinical conditions of the patient to be submitted to it, and the anesthesiologist shall decide on the desirability or not of the practice of anesthesia, in an indisputable and non-transferrable fashion." Therefore, preoperative evaluation is needed to assess the risks and possible preventable complications[13].

During in utero fetal surgery, maternal monitoring is required, which includes pulse oximetry, NIBP, cardioscopy, capnography, and evaluation of neuromuscular blocking by acceleromyography[7]; fetal monitoring is also required, through US examination, which evaluates fetal vitality, FHR, placental location, fetal position, and uterine contractility[14].

Antibiotic prophylaxis is performed, in order to avoid or decrease the infection rate in the postoperative period[9], although the author did not find any epidemiological studies related to postoperative infection in patients who underwent the in utero MMC surgical technique (and did not witness any cases that evolved with infection), unlike the conventional MMC repair techniques, which demonstrate a high incidence of postoperative infection in other studies[15].

However, anesthesia for in utero fetal surgery involves the mother and fetus. Therefore, the anesthesiologist must know the physiological changes of pregnancy and the effects of anesthetics on the maternal and fetal organisms. Anesthetic agents, given to the mother, can interfere with the fetus, directly through the placental passage or indirectly by interfering in maternal cardiovascular and respiratory systems[9,14]. General anesthesia is the technique that offers greater security for fetal surgery under hysterotomy, allowing control of uterine relaxation, ventilation, oxygenation, and blood pressure. Therefore, it has become the method of choice for in utero repair surgery, in combination with local anesthesia, which can be achieved by epidural puncture and contributes to postoperative analgesia[14].

Prenatal in utero MMC repair involves laparotomy and hysterotomy. The incision in the uterus depends on the position of the fetus, may be anterior or posterior. AF is removed and stored in a sterile container (with antibiotic or not) so that, at the end of surgery, it can be reinfused[9] and supplemented with a warm 0.9% SS, in case part of the AF was lost during the intraoperative period. The fetus is positioned so that the MMC repair can be performed; fetal monitoring is continuous, through US examination. After surgical correction, the closure of the uterus and amniotic membranes begins, using fibrin glue as a seal[7].

A major challenge or obstacle is the risk of preterm labor, resulting from uterine stimulation and contraction, caused by manipulation and incision of the uterus, and may also lead to detachment of the placenta, which reduces placental blood flow and leads to fetal hypoxia[16]. Therefore, the prevention and treatment of preterm labor are continuous and crucial to the success of in utero MMC surgery, with tocolytic drugs being administered pre-, intra-, and postoperatively[7]. It is noteworthy that studies show that GA for in utero surgical repair of MMC have a variability between 20 and 26 weeks of gestation[5,8,9].

The in utero MMC repair technique cannot be compared with others, because there are no studies comparing their benefits[16]. However, studies show that children who underwent in utero fetal MMC surgery showed improvements in motor function of the lower limbs, decreased occurrence of hydrocephalus due to Arnold–Chiari II malformation, in head injuries, and in the use of ventriculoperitoneal shunt[5,7,17].

Fetal surgery is in full development, with new techniques and approaches, and to increase its success rate, further studies and improvement of the professionals involved are needed, so that they are able to recognize the possible complications associated with new surgical techniques[16,18].

In utero fetal MMC surgery is still performed in a few surgical centers, and its success depends on a highly qualified and trained multidisciplinary approach, which stresses the role of the nurse working in the OR and its entire staffs, including the circulating nurse.

Starting from the point that, in utero MMC surgery is highly complex and involves two individuals, health-care professionals, especially the nursing staff, should be able to care for the pregnant patients in the OR, SC, and ICU and to recognize the possible complications related to this procedure, the main interventions, and appropriate conduct. One form of training is to provide knowledge to all individuals involved. Hence, there is an importance of this report, because no studies were found in the national literature, which were conducted by nurses during their performance in the care to the mother–child binomial during the open in utero surgical repair of MMC.

Many ethical issues related to the benefits of the open in utero surgical repair of MMC will still be identified and discussed, but a better future for people with MMC can be demonstrated through studies.

It is worth mentioning that in utero fetal surgery is a recent development in Brazil and performed in a few health institutions. The nursing staff's responsibilities are continuous and face a great challenge in following this complex evolution of fetal medicine. We consider this experience extremely rewarding, being able to contribute, as a nurse, to this advancement in medicine and to improve the quality of life of the children affected by this serious disease. This enhancement extends to the future child's entire family.

CONCLUSION

This experience report allowed to present and discuss the role of a nurse in the intraoperative period of the open in utero surgical repair of MMC in a midsized hospital in São Paulo, Brazil, which has been offering this technique, since 2011. Emphasis is given to the intraoperative care by the multidisciplinary team to the mother–child binomial. It shows the importance of preoperative guidance, the nursing practice from the preparation of the OR, the admittance of the pregnant patient, positioning, anesthesia, the surgery itself, the referral to the ICU, and the need for recognition of possible complications, using, at all stages, the recommendations contained in the safe surgery protocol, aiming at the safety of the mother and fetus.

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IMPLEMENTATION OF A STEAM TERMINAL CLEANING SERVICE IN OPERATING ROOMS

Implantação de um serviço de limpeza terminal a vapor em salas operatórias

Implementación de un servicio de limpieza terminal a vapor en quirófanos

Sandra Terumi Yoshino[1], Ana Cristina Cardoso Hering[1], Rachel de Carvalho[2]

ABSTRACT: Objective: To report the experience of the first implementation of a steam terminal cleaning service in operating rooms at a private hospital in São Paulo, Brazil. **Method:** A descriptive and narrative study of a case report, through a review of the different types of hospital cleaning, with emphasis on steam cleaning of operating rooms. **Results:** The implementation of steam cleaning and disinfecting in operating rooms showed positive results, such as optimization and quality in the work process, occupational safety, reduced time of terminal cleaning and room working, procedure automation, environmental benefits (saving water and chemicals), and security by providing an environment free of important pathogens for the development of infections. **Conclusion:** Steam cleaning is an effective alternative to hospital hygiene combined with technology. The steam system is able to effectively reduce the microbial load on surfaces with higher quality and safety.

Keywords: Housekeeping, Hospital. Operating rooms. Disinfection. Contamination.

RESUMO: Objetivo: Relatar a experiência da implantação pioneira de um serviço de limpeza terminal a vapor nas salas operatórias de um hospital privado de São Paulo. **Método:** Pesquisa descritiva, narrativa, do tipo relato de experiência, mediante a realização de revisão acerca dos diversos tipos de limpeza hospitalar, com ênfase na limpeza de salas operatórias a vapor. **Resultados:** A implantação da limpeza e a desinfecção de salas operatórias a vapor mostrou resultados positivos, tais como otimização e qualidade no processo de trabalho, segurança ocupacional, redução no tempo de limpeza terminal e de giro de sala, automatização do procedimento, benefícios ambientais (economia de água e produtos químicos) e segurança, por oferecer um ambiente livre de patógenos importantes ao desenvolvimento de infecções. **Conclusão:** A limpeza a vapor é uma alternativa eficaz de higienização hospitalar aliada à tecnologia. O sistema a vapor é efetivamente capaz de reduzir a carga microbiana em superfícies, com mais qualidade e segurança.

Palavras-chave: Serviço hospitalar de limpeza. Salas cirúrgicas. Desinfecção. Contaminação.

RESUMEN: Objetivo: Reportar la experiencia de la primera implementación de un servicio de limpieza a vapor terminal en los quirófanos de un hospital privado de São Paulo, Brasil. **Método**: Estudio descriptivo, narrativo, un relato de experiencia mediante la celebración de la revisión de los diferentes tipos de limpieza del hospital, con énfasis en el sistema de limpieza de quirófanos a vapor. **Resultados**: La aplicación de limpieza y desinfección de quirófanos a vapor mostraron resultados positivos, como la optimización y calidad en el proceso de trabajo, seguridad en el trabajo, reducción en el tiempo de limpieza terminal y de habitación, automatización del procedimiento, beneficios ambientales (ahorro de agua y productos químicos) y seguridad al proporcionar un ambiente libre de patógenos importantes para el desarrollo de infecciones. **Conclusión**: El limpiador a vapor es una alternativa eficaz para la higiene hospitalaria combinado con la tecnología. El sistema de vapor es capaz de reducir eficazmente la carga microbiana en las superficies, con mayor calidad y seguridad.

Palabras clave: Servicio de limpieza en hospital. Quirófanos. Desinfección. Contaminación.

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INTRODUCTION

The environment is identified as an important reservoir of microorganisms in health services. Contaminated environmental surfaces can play an important role in the transmission of some pathogens. Many of these can remain in the hospital for weeks or months and may pose a risk to patient safety[1,2]. Therefore, providing effective measures to control infection aiming at the safety of an environment that involves the patients is considered as an important factor in preventing healthcare-associated infections (HAIs)[3]. The measures such as the implementation of good hygiene practices and proper cleaning frequency form a crucial component in the overall strategy for preventing infections[4]. On the other hand, failure in cleaning and disinfecting surfaces may result in the dissemination and transfer of microorganisms in healthcare environments, risking the safety of patients and professionals working in these places[3,4].

For some time, it was believed that an environment had little involvement in the epidemiological chain of HAIs, and ignoring the importance of hospital hygiene just ended up favoring the survival of these microorganisms in the environment. This scenario did not comply with the practices for strict control of antibiotics, combined with contact precautions in place for colonized patients[5]. Thus, the quality of care cannot be restricted to an approach limited to the care provided directly to the patient. Therefore, the nursing staff is responsible for seeking a biologically safer and more comfortable hospital setting[2].

Over the past decade, there has been a dramatic evolution in the recommendations and norms for improving the hospital environment. In 2003, recommendations made by the Centers for Disease Control and Prevention (CDC), in 2010, the Best Practices in Surface Cleaning and Disinfection by the Brazilian Health Surveillance Agency (ANVISA), and scientific studies that discuss the importance of the environment are some examples[1,6].

In this context, the surfaces of operating rooms (ORs) also have great importance regarding the risk factors to the onset of HAIs in surgical patients. The completion of the cleaning and disinfection of surfaces is essential to reduce the incidence of infections, as it reduces the inoculum of the agent on the environment[2,7].

Cleaning is defined as the removal of dirt lying on the surfaces of the OR using mechanical means, such as friction; physical means, such as temperature; or chemicals means, such as sanitizing and disinfectant products. As a result, physical and nutritional media that support the microorganisms are eliminated, as the epidemiological chain is interrupted[1,7].

The Surgical Center (SC), as a critical area of the hospital, requires specific types of cleaning related to the instant of operation of the OR. Thus, the preparatory cleaning is performed before the first operation of the day, to remove the dust particles from the surfaces of surgical lights, furniture, and equipment. The operative cleaning is done during surgery, in the event of contamination of the ground with organic matter, in the presence of residue or drop of material, and to keep the organization and within the OR hygiene. The concurrent cleaning is performed after each surgical procedure so that it can remove dirt and contaminants before the next operation. Finally, terminal cleaning, which takes place daily or weekly, depending on the hospital routine, aims to reduce the amount of dirt and microorganisms from all the surfaces in the OR, both the horizontal and the vertical, to reduce the likelihood of environmental contamination[1,7-9].

In the literature, several methods of terminal cleaning used in hospitals were found. However, in this study, the terminal steam cleaning will be addressed specifically. It is a recent practice and little known in Brazil, although it is already being studied and used in health services in Europe for about six years[4,10]. This terminal cleaning method has attracted some relevance in the hospital environment, as it only uses the water steam for cleaning and disinfection, reducing the use of sanitizing chemicals. Furthermore, the steam cleaning method avoids the use of polluting substances, without disregarding the required hygiene standard and, at the same time, reduces operating costs. Another factor is the decreased risk of developing resistance among pathogens, triggered by an excessive use of disinfectants on surfaces[10-12].

Faced with the related evidence, this study describes the practical experience of steam terminal cleaning implementation in the ORs of a private hospital in São Paulo. Another issue that prompted us to conduct this study was the lack of available articles about steam cleaning. This shows that the issue is still a challenge that needs to be studied for the dissemination of this knowledge and for encouragement for the development of new studies.

OBJECTIVE

To report our experience in implementing a steam terminal cleaning service in the ORs of a private hospital in São Paulo.

METHOD

This is a descriptive and narrative study of a case report, which described the work conducted by the first author in a private hospital in São Paulo. The case report consists of acquiring practice for us to gain a deeper knowledge of the study object, seeking a new path for its understanding[13,14].

The study aimed to describe the experience of implementing a hospital cleaning service in the ORs of a large private hospital located in São Paulo. The institution under study has two SCs, being composed of two distinct areas, in which one has six digital rooms for the performance of minimally invasive surgery and the other six conventional rooms, besides the ophthalmology center. The other SC consists of 14 ORs for the performance of highly complex procedures and robotic surgery encompassing all specialties[15].

Through this case report, we describe how the activity was developed and the studies conducted before the implementation, comparing the conventional terminal cleaning with steam cleaning, in addition to the positive and negative results, and the difficulties encountered in this pioneering OR terminal cleaning method.

RESULTS

Case report: study, description, and implementation of steam cleaning actions in operating rooms

The steam cleaning method emerged in Brazil in 2011, with the purpose of offering a cost-effective, practical, and an effective alternative to hospital cleaning combined with technology.

To minimize the risk of surgical site infection (SSI), a private hospital in São Paulo outlined several improvement actions in the OR, including OR terminal cleaning process. Previously, the procedure was performed with manual techniques and relied heavy on labor; so, the proposal was to optimize resources through the implementation of a steam cleaning equipment. Thus, a hygiene service provider, in partnership with the hospital itself, began a comparative study between the conventional method and steam cleaning using a high-temperature equipment (150°C), without the use of chemicals and saving natural resources, such as water.

The project was conducted by a nurse, and the activity was carried out by one professional from the cleaning staff, who was trained to operate the equipment. In addition, all the areas of the interface were involved: Hospital Infection Control Service, work safety, healthcare staff, clinical engineering, and maintenance.

The electrical structure of the building was evaluated by the maintenance staff to ensure the functioning of the equipment and ensure patient and employee safety. For the control and monitoring of environmental safety, adenosine triphosphate (ATP) tests were performed before and after cleaning.

Some guidelines were taken into consideration for the collection of data and for quantitative and qualitative analyses:

- Standard operating procedure (SOP) and cleaning techniques adopted by the institution: these items were evaluated to compare the method used by the hospital and later describe the items that could be sanitized with steam. The cleaning sequence, the procedures performed (waste collection or disinfection of organic matter), and the items to be cleaned were previously agreed with the nursing and governance staff.
- Measurement of the area under study: measurements were performed (total and individual) of the OR to calculate productivity in square meters.
- Process indicators: hospital indicators were analyzed to verify the productivity, the average cleaning time, and the consumption of raw materials by the conventional method.

The SC routine was not changed because of the study. Therefore, the terminal cleanings were made according to the clearance of each OR and the availability of nursing staff.

The method was applied from December 2011 to January 2012, during the night shift, when the terminal cleaning had already been carried out. Sixty terminal cleanings were monitored, whose data were recorded in its own checklist, and the following items were evaluated: total activity time, number of rooms cleaned per shift, sanitized items, and quantity of water and chemicals used. However, only a portion of this sample was applied to complete the study, that is, 11 terminal cleanings were recorded during four shifts, which are as

follows: one terminal cleaning on the first day, two on the second day, four on the third day, and four in the fourth day. This occurred because of the unavailability of the nursing staff, and that the technical capacity studied could reach an average of six cleanings per day.

Chart 1 specifies all activities performed in the ORs, including the sanitized items. Some items and surfaces not compatible with steam, such as electrical parts, surgical lights, negatoscope, and telephone, were cleaned manually.

At first, we conducted the cleaning of items covered by the cleaning staff (designated in Chart 1). However, throughout the study, we began to add more items that were cleaned by the nursing team (Chart 2). This is because of the greater technical cleaning capacity with steam equipment when compared with the conventional method.

Thus, the results on the mean cleaning time were found to be as follows: first day, 56 minutes; second day, 45 minutes; third day, 50.5 minutes, and the fourth day, 44.5 minutes, which results in an average of 47.81 minutes. These results varied greatly according to the size of the OR (from 30.27 to 51.87 m^2) and procedures performed (waste collection, process of disinfection of organic matter, etc.). However, the result was positive, when compared with the conventional method adopted by the hospital, whose average cleaning time was 115 minutes, i.e., a 58.43% reduction in time to accomplish terminal cleaning in the ORs.

Another important result was the reduction of water consumption and sanitizing chemicals. The hospital consumed, on average, 6,472 mL water and 152 mL concentrated sanitizing product during a terminal cleaning. In contrast, the steam equipment consumed only 1.730 mL of water and 144 mL concentrated product. The reduction in consumption of cleaning products was not as significant as the water, corresponding to 5%, as the use of these products was necessary for disinfecting items that were incompatible with steam and during the disinfection procedure of the organic material. However, the water consumption was extremely low, with a reduction of 73% compared with the conventional method.

One year after the study, the hospital hired the steam terminal cleaning service. The team hired was properly trained on site and the activity was monitored, in the first weeks, by a nurse from continuing education and a technical coordinator of the service provider company. The team was responsible only for terminal cleanings, and an initial target of 17 in the SC and two in the obstetric center, daily, was agreed. Therefore, each OR was sanitized, altogether, three times a week, since the previous frequency was just once a week.

A checklist of terminal cleaning was implemented for checking and recording the activities, and an SOP was also prepared. Subsequently, the process indicators were created and monitored monthly.

Chart 1. Activities performed and items sanitized with steam and manually in operating rooms.

Item	Status
Waste	Collected (manually)
Disinfection	Performed (manually)
Waste baskets	Performed (manually)
Hamper rims	Performed (steam)
Roof	Performed (steam)
Lamps, externally	Performed (steam)
Exhaust screens	Performed (steam)
Walls	Performed (steam)
Air vents	Performed (steam)
Roof	Performed (steam)
Negatoscope	Performed (manually, only rims)
Telephone	Performed (manually)
Fixed benches	Performed (steam)
Monitor	Performed (manually)
Medical gas panel	Performed (manually)
Power outlet plates	Performed (manually)
Surgical lights support	Performed (manually)
Doors	Performed (steam)
Alcohol gel support	Performed (steam)
Packing replacement for hamper	Performed (manually)

Chart 2. Items sanitized by the nursing staff, which were incorporated during steam cleaning.

Item	Status
Auxiliary table	Performed (steam)
Mayo table	Performed (steam)
Surgical table	Performed (steam)
IV pole (without pump)	Performed (steam)
Chairs	Performed (steam)

After a certain time, when the team was more skilled and familiar with the steam equipment, the average cleaning time decreased from 47.8 (results found in the study) for 30 minutes, further optimizing the workforce and increasing the productivity.

DISCUSSION

During the study period, the SC staff showed to be very interested and curious by the novelty of the steam equipment for terminal cleaning, and many were even unaware about this technology, which facilitated the implementation period, for the whole routine standardization process was monitored by them. Thus, there was no resistance from the SC team.

At first, the cleaning staff came across some operational difficulties, which were resolved as they acquired experience in the use of the equipment, for example, handling of the machine and cleaning sequence without the risk of cross contamination.

Another difficulty found was the increase in complaints about the aspect of the OR floor after the use of the steam, which was left with scratch-like marks. This was because the floor was impregnated with dirt. Therefore, scratches happened because of the output of steam that penetrated the impregnated floor. With this, the elaboration of a separate schedule for floor treatment, with the use of industrial washers for cleaning and maintenance, was necessary, as the steam could not completely remove the dirt.

Among the main results, we obtained

- 58.43% reduction in the average length of OR terminal cleaning;
- 12% reduction in room turnover time;
- 73% reduction in water consumption;
- 5% reduction in the consumption of sanitizing chemicals;
- optimization of the workforce of the healthcare team (absorption of some cleaning equipment by the hygiene professional);
- improvements in the environmental hygiene process with reduced ATP count;
- mechanization of the process and reduction of labor;
- reduction in the ergonomic risk of the professional, because of the reduction of physical effort through process automation, minimizing the possibility of removal from the job.

Another challenge found in the study and implementation of this service was the search for a scientific evidence for a theoretical basis, as there is a large shortage of articles that address this matter. No Brazilian studies were found on this subject, and only American and European studies were published[16,17].

In Brazil, in a survey conducted in Goiânia (GO), the authors had the care to characterize the cleaning of the OR and the use of personal protective equipment by professionals, who performed it manually. It was found, through the observation of 40 surgeries, that there was organic matter on the floor in 37.5% of them and that disinfection with 70% alcohol was not performed. In addition, the use of personal protective equipment was ignored by many professionals, which reflects directly on the security of the employee. The authors highlight the need for training of professionals regarding the cleaning process, the use of PPE, hand hygiene, and their responsibility in controlling SSI[18].

This study can be used to reflect about the advantages of steam terminal cleaning of ORs compared with the conventional method.

In other countries, since 2008, studies have been conducted on the use of steam cleaning/disinfecting systems, including considerations that this cleaning system is able to reduce significantly and consistently the presence of pathogens on surfaces[3,4].

A study in the United States[16] showed over 90% of reduction in the microbial load after cleaning with steam, proving that bacterial spores can also be effectively treated with this type of device. However, on surfaces with rounded edges, reduction rates were lower, and the effectiveness was proven in smooth and flat surfaces, as they guarantee the better heat transfer of the equipment. These decreases can also be improved if the steam contact time is extended. Even with the extension of the contact time, the steam treatment also requires less time when compared with the use of chlorine-based disinfectants, for example, with the advantage of not producing harmful byproducts. Furthermore, the steam system does not represent a risk of cross contamination of surfaces, as may occur in other conventional cleaning methods[16].

Another American study shows the speed of steam in reducing concentrations of pathogens in just five seconds. On the other hand, most of the liquid chemicals require five to ten minutes to achieve microbial reductions on surfaces.

Another positive aspect observed is the elimination of the risk of antimicrobial resistance present in the indiscriminate use of disinfectants. This is explained by the absence of residues on the surface when only steam is used[17].

FINAL CONSIDERATIONS

This case report has highlighted the successful implementation of the steam terminal cleaning service in ORs from a private hospital in São Paulo. Faced with the concern for the safety of the surgical patient and the risk of SSI related to the environment, this study showed an effective alternative to hospital hygiene combined with technology.

Despite the lack of scientific evidence, the few studies found show that the steam system is able to effectively reduce the microbial load on surfaces, with higher quality, when compared with the use of disinfectants. According to the results obtained, along with environmental benefits and occupational safety, this suggests that steam cleaning is a viable alternative to the conventional cleaning method, which uses chemicals for cleaning/ disinfecting environmental surfaces.

However, given the shortage of studies on this subject, there is still the need for further studies related to the use of steam in hospital hygiene to be developed.

Thus, this cleaning method was implemented in a pioneering way in the hospital studied, and was shown to be more productive and efficient than conventional terminal cleaning regarding the positive results such as optimization and quality in the work process, reduction of ergonomic risk for the professional, reduction in terminal cleaning time and room turnover, automation of the cleaning procedure, and reduction in the consumption of natural resources. In this way, the environmental sustainability guidelines practiced by the institution were adopted. Above all, the patient safety should be ensured by means of an environment free of important pathogens for the development of HAIs.

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