OXYGENOTHERAPY RELATED TO PERIPHERAL OXYGEN SATURATION IN PATIENTS IN THE ANESTHETIC RECOVERY ROOM

Oxigenoterapia relacionada com a saturação periférica de oxigênio em pacientes na sala de recuperação anestésica

Oxigenoterapia relacionada con la saturación periférica de oxígeno en pacientes en la sala de recuperación anestésica

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ABSTRACT: Objective: Objective: To analyze the peripheral oxygen saturation in the use of oxygen therapy in the patient's first hour in a postanesthetic care unit. **Method:** Prospective, quantitative, and comparative study in a federal hospital located in Belo Horizonte, Minas Gerais. The sample consisted of 60 adults divided into two groups, with or without oxygen therapy, and one of the inclusion criteria was peripheral oxygen saturation, greater than or equal to 95% upon admittance to the postanesthetic care unit. **Results:** After 60 minutes, 5 patients without oxygen therapy (16.7%) and 2 patients with oxygen therapy (6.7%) showed mild hypoxemia. There was a marginally significant difference between the two groups for normal oxygen saturation (p=0.0563) and mild hypoxemia (p=0.0578). **Conclusion:** It is important to implement protocols for the admittance of patients to the postanesthetic care unit, including oxygen therapy, in order to maintain peripheral oxygen saturation, aiming to minimize the complications of hypoxemia.

Keywords: Perioperative nursing. Recovery room. Oxygen inhalation therapy.

RESUMO: Objetivo: Analisar a saturação periférica de oxigênio na utilização da oxigenoterapia na primeira hora de pacientes em sala de recuperação pós-anestésica. **Método:** Estudo comparativo, prospectivo e quantitativo, em um hospital federal localizado em Belo Horizonte, Minas Gerais. A amostra foi constituída por 60 adultos, distribuídos em dois grupos, sem ou com oxigenoterapia, e teve como um dos critérios de inclusão a saturação periférica de oxigênio maior ou igual a 95% na entrada da sala de recuperação pós-anestésica. **Resultados:** Completados 60 minutos, 5 pacientes sem oxigenoterapia (16,7%) e 2 pacientes com oxigenoterapia (6,7%) apresentavam hipoxemia leve. Houve diferença marginalmente significativa entre os dois grupos para a saturação periférica de oxigênio normal (p=0,0563) e hipoxemia leve (p=0,0578). **Conclusão:** É importante a implantação de protocolos de recepção de pacientes na sala de recuperação pós-anestésica, incluindo a oxigenoterapia, com o objetivo de manter a saturação periférica de oxigênio, minimizando as complicações da hipoxemia.

Palavras-chave: Enfermagem perioperatória. Sala de recuperação. Oxigenoterapia (vide documento suplementar).

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RESUMEN: Objetivo: Analizar la saturación periférica de oxígeno en la utilización de la oxigenoterapia en la primera hora de pacientes en sala de recuperación pos-anestésica. **Método:** Estudio comparativo, prospectivo y cuantitativo, en un hospital federal localizado en Belo Horizonte, Minas Gerais. La muestra fue constituida por 60 adultos, distribuidos en dos grupos, sin o con oxigenoterapia, y tuvo como uno dos criterios de inclusión la saturación periférica de oxígeno mayor o igual al 95% en la entrada de la sala de recuperación pos-anestésica. **Resultados:** Completados 60 minutos, 5 pacientes sin oxigenoterapia (16,7%) y 2 pacientes con oxigenoterapia (6,7%) presentaban hipoxemia leve. Hubo diferencia marginalmente significativa entre los dos grupos para la saturación periférica de oxígeno normal (p=0,0563) e hipoxemia leve (p=0,0578). **Conclusión:** Es importante la implantación de protocolos de recepción de pacientes en la sala de recuperación pos-anestésica, incluyendo la oxigenoterapia, con el objetivo de mantener la saturación periférica de oxígeno, minimizando las complicaciones de la hipoxemia.
Palabras clave: Enfermería perioperatoria. Sala de recuperación. Terapia por inhalación de oxígeno.

INTRODUCTION

The postanesthetic care unit (PACU) is a site suitable for the recovery of patients after a surgical procedure, as well as for planned and implemented nursing care to prevent and treat complications resulting from the anesthetic-surgical procedure. In this sense, it is assumed that parameters of evaluation and control of this assistance should be established, and one of the possible evaluation tools is the Aldrete Kroulik Index (AKI)[1,2].

The parameters evaluated by the AKI are muscle activity, breathing, circulation, consciousness, and peripheral oxygen saturation (SpO_2). The AKI is used according to the variation of values from zero to two for each parameter, where zero indicates conditions of greater severity; value one corresponds to an intermediate level; and two represents reestablished functions[2,3].

The application of the AKI in the PACU is indicated upon the patient's arrival, considering minute zero as the patient's arrival in the PACU; afterwards, every 15 minutes in the first hour, every 30 minutes in the second hour, and every hour from the third hour[3].

The period of anesthetic recovery (AR) is the moment when the patient is most vulnerable and unstable, due to anesthetic drugs and the surgical procedure itself. Therefore, the stay in the PACU requires constant evaluation and assistance[3].

Peripheral oxygen saturation (SpO_2) is an important aspect to be analyzed in the PACU, because it suffers significant decreases due to anesthetic-surgical procedures. SpO_2 is one of the components of the AKI that jointly analyzes muscle activity, breathing, circulation, and consciousness – important parameters used for evaluation and evolution of the patient during AR [2].

Out of the respiratory complications, hypoxemia is one of the most frequent in PACU. Every patient needs continuous surveillance due to the development of varied degrees of hypoxemia when SpO_2 is lower than 90%. In order to diagnose hypoxemia, it is necessary to constantly monitor the respiratory level of the patient, mainly through the pulse oximeter[4].

Hypoxemia is defined as the reduction of arterial oxygen content, and is diagnosed by low blood pressure (below 60 mmHg), or by a decrease in SpO_2 (below 95% or a decrease greater than 5% of the initial value). Hypoxemia is considered intense when SpO_2 is below 85%[5].

The treatment of hypoxemia with oxygen through face mask or nasopharyngeal catheter is effective for the maintenance of adequate levels of alveolar oxygen pressure in most cases. This measure does not treat hypoxemia but alleviates symptoms while not being diagnosed and treated[4,5].

The prevention of hypoxemia is desirable and can be minimized with oxygen therapy in the immediate postoperative period, which may improve outcome by reducing the risk of surgical wound infection and the incidence of nausea and vomiting[5].

Not all institutions routinely transport patients from the operating room (OR) to the PACU with the use of oxygen therapy. In addition, in the PACU, SpO_2 is used routinely with 83.4% of patients, and oxygen therapy, with 57.2% of patients[5].

Regarding the patient's physical condition, the classification proposed by the American Society of Anesthesiologists (ASA) in 1963 is widely used throughout the world, being categorized into classes[3]:

1. healthy patient;
2. patient with mild systemic disease;
3. patient with severe systemic disease;
4. patient with impacting systemic disease, with risk of death;
5. patient dying, with little probability of survival;
6. patient with brain death;
7. patient requiring emergency surgery.

The hypoxemia that manifests in PACU, especially in patients with a physical ASA rating of one, is most often related to anesthesia. Usually the patient presents respiratory

depression due to the residual action of opioids and neuromuscular blockers, due to loss of vaso-constricting reflexes, increased oxygen consumption and muscle tremors[6].

In the present study, the importance of anesthesia-related hypoxemia control in the prevention and control of complications during the AR period was considered.

Considering that the patient in the AR period is vulnerable to several complications, with hypoxemia being one of the most frequent, this study poses the following question: do the SpO_2 values improve with the use of oxygen therapy upon the patient's admittance to the PACU?

OBJECTIVE

To analyze the values of SpO_2, with and without the use of oxygen therapy, in the first hour of patient's stay in the PACU.

METHOD

This is a quantitative, comparative, field study with a methodological, prospective approach.

The study site was the PACU of a large general public hospital located in Belo Horizonte, Minas Gerais. The PACU has 7 beds and keeps room temperature between 22 and 24°C and relative air humidity between 45 and 60%, according to the recommendations of the Ministry of Health.

The research project was approved by the Research Ethics Committee of Universidade Federal de Minas Gerais (CEP/UFMG), registered under protocol no. 274.655 and Certificate of Presentation for Ethical Appraisal (CAAE) no. 14887213.4.0000.5149, pursuant to Resolution no. 466/2012 of the National Health Council.

Because the subjects were AR patients, they were located in the unit of origin through the daily surgery scale, and the Informed Consent Term was offered in the patient unit by the researchers before the administration of the pre-anesthetic medication, when indicated.

Inclusion criteria were having signed the ICF; being an adult between the ages of 18 and 64 years; having undergone elective surgical procedure; having received general anesthesia, with at least one hour of anesthesia; and having had an ASA rating of I or II and $SpO_2 \geq 95\%$ upon admittance to the PACU.

Patients with previous respiratory disorders, smokers, age and weight extremes, ASA classification III to VI, urgency and emergency surgeries, local anesthesia and $SpO_2 < 95\%$ upon admittance to the PACU.

The sample consisted of 60 subjects, divided into two groups: 30 subjects for the group without oxygen therapy (GSO) and 30 subjects for the group with oxygen therapy (GCO).

The sample size was defined according to the number of predictive variables initially proposed, using five subjects for each group, in relation to each of the variables[7].

Upon arrival, the GSO subjects did not receive oxygen therapy and GCO subjects received nasal catheter oxygen therapy. Whether or not oxygen therapy was administered upon admittance to the PACU was indicated by the health team at the study site. Therefore, the researchers did not participate in the choice of subjects to the groups to which they belonged, whether GSO or GCO.

Both GSO and GCO subjects were transported from the OR to PACU without oxygen therapy, according to the field study procedure.

For data collection, a structured instrument (Appendix 1) was elaborated containing data on sociodemographic and clinical aspects of the patient, such as sex, age, comorbidities, and ASA classification, and data on the surgical anesthetic procedure, which were the specialty of the surgery and the duration of anesthesia.

The data on the PACU were the patient's time of arrival and the group to which they belong, whether GSO or GCO (for the latter, also the time of administration of oxygen therapy). Data were collected during the first hour of stay in the PACU. The first analysis of the SpO_2 was carried out immediately, upon the patient's entry into the PACU, followed by four other collections: after 15, 30, 45 and 60 minutes, as recommended by the AIK[3].

SpO_2 was analyzed as normal (≥95%), mild (91–94%), moderate (90–86%), and intense (<85%) hypoxemia[5].

The software used in the data analysis was R, version 2.13.1. To verify the homogeneity between the GSO and the GCO, the Mann–Whitney test was used for the comparison of the quantitative variables and for presenting the absolute and relative values with a significance level of 5%.

RESULTS

The results were organized according to sociodemographic and clinical data, anesthetic-surgical procedure and SpO_2 analysis in the first hour of stay in PACU.

Sociodemographic and clinical data

Table 1 shows that, in relation to sex, there was a similarity between the groups, which consisted mostly of women, with 23 (76.7%) and 20 (66.7%), compared to 7 (23.3%) and 10 (33.3%) men in the GSO and GCO, respectively.

The mean age of patients in the GSO was 46.3 years, with a range of 18–64 years. In GCO, the mean was 48.6 years, with an amplitude of 20–64 years.

The comorbidities more frequently identified were systemic arterial hypertension (SAH) and diabetes mellitus (DM). The highest frequency was SAH, in 30% of GCO patients.

In the ASA assessment, there was a predominance of ASA II in 18 patients (60.0%) in GCO, followed by ASA I in 17 patients (56.7%) in GSO.

Anesthetic-surgical procedure data

In this study, all patients underwent general anesthesia, which was one of the inclusion criteria in the sample. Regarding the time of anesthesia, it can be observed in Table 2 that there was similarity between the groups, lasting more than 180 minutes, 20 (66.6%) in the GSO and 22 (73.4%) in the GCO.

As for the surgical specialty, there was a diversity for the two groups; for the GSO, the most frequent was breast surgery, with 7 patients (23.3%), and for the GCO, it was the digestive tract and associated organs, in 11 patients (36.7%).

Analysis of SpO_2 in the first hour of stay in the PACU

Table 3 shows the variation in SpO_2 of the patients during the first 60 minutes, period of stay in the PACU. SpO_2 was checked every 15 minutes and classified into normal, mild, moderate, and intense hypoxemia, according to previously defined criteria.

In this study, the inclusion criterion was normal SpO_2 (≥95%) upon the patient's admittance to the PACU; therefore, at minute zero, all patients, of both GSO and GCO, presented a normal SpO_2.

In the first 15 minutes of stay in the PACU, 4 patients (13.4%) from the GSO presented a decrease in SpO_2, and 3

Table 1. Distribution of the patients of the groups without oxygen therapy and with oxygen therapy, according to sociodemographic and clinical data. Belo Horizonte, MG, Brazil, 2014.

Variables	GSO		GCO	
	n	%	n	%
Sex				
Male	7	23.3	10	33.3
Female	23	76.7	20	66.7
Age				
18|– 28	7	23.3	3	10.0
29 – 38	5	16.6	4	13.3
39 – 48	7	23.3	5	16.6
49 – 58	9	30.0	11	36.7
59 |–65	2	6.7	7	23.3
Comorbidities				
Hypertension	3	10.0	9	30.0
DM	0	0.0	1	3.3
Hypertension + DM	3	10.0	3	10.0
ASA				
I	17	56.7	12	40.0
II	13	43.3	18	60.0

GSO: group without oxygen therapy; GCO: group with oxygen therapy; DM: diabetes *mellitus*; ASA: classification proposed by the American Society of Anesthesiologists.

Table 2. Distribution of patients in the groups without oxygen therapy and with oxygen therapy, according to the duration of anesthesia and surgical specialty. Belo Horizonte, MG, Brazil, 2014.

Variables	GSO		GCO	
	n	%	n	%
Duration of anesthesia (minutes)				
60 to 120	5	16.7	4	13.3
121 to 180	5	16.7	4	13.3
Over 180	20	66.6	22	73.4
Surgical specialty				
Digestive system and accessory organs	5	16.7	11	36.7
Bucomaxillofacial	5	16.7	2	6.7
Head and neck	2	6.7	1	3.3
Cardiovascular	0	0.0	2	6.7
Breast surgery	7	23.3	1	3.3
Neurosurgery	0	0.0	1	3.3
Orthopedics and traumatology	2	6.7	4	13.3
Otolaryngology	3	10.0	4	13.3
Plastic	3	10.0	4	13.3
Urology	3	10.0	0	0.0

GSO: group without oxygen therapy; GCO: group with oxygen therapy.

(10.0%) shifted from the normal classification to mild hypoxemia, and 1 (3.3%), for moderate hypoxemia.

It was identified that the GCO remained with a normal SpO2 within the first 15 minutes in the PACU.

Within 30 minutes of stay in the PACU 1 patient (3.3%) from the GSO presented moderate hypoxemia.

Mild hypoxemia, within 45 minutes, was more frequent in the GSO – 6 patients (20.0%) – than in the GCO – 4 patients (13.3%).

No patient had severe hypoxemia in the course of 60 minutes of PACU stay. However, it was observed that, in this period, 5 patients (16.7%) from the GSO and 2 patients (6.7%) from the GCO had mild hypoxemia.

Table 4 shows the behavior of the groups over the course of 60 minutes in relation to the SpO_2 values.

Normal SpO_2 (p=0.0563) and mild hypoxemia (p=0.0578) values were observed to have a marginally significant difference between GSO and GCO, analyzed during the 60 minutes of patient stay in the PACU.

It is also observed that there was no statistical significance for moderate hypoxemia between groups, because only one subject was present in each group, and p=1.00. No subject presented severe hypoxemia, that is, $SpO_2 \leq 85\%$.

DISCUSSION

The results showed that there was a marginally significant difference between GSO and GCO regarding normal SpO_2

Table 3. Distribution of patients in the groups without oxygen therapy and with oxygen therapy, according to the classification of peripheral oxygen saturation, within 60 minutes of stay in the postanesthetic care unit. Belo Horizonte, MG, Brazil, 2014.

SpO_2 (%)	0		15		30		45		60	
	n	%	n	%	n	%	n	%	n	%
Normal (≥95)										
GSO	30	100.0	26	86.7	28	93.3	24	80.0	25	83.3
GCO	30	100.0	30	100.0	28	93.3	26	86.7	28	93.3
Mild hypoxemia (94–91)										
GSO	0	0.0	3	10.0	2	6.7	6	20.0	5	16.7
GCO	0	0.0	0	0.0	1	3.3	4	13.3	2	6.7
Moderate hypoxemia (90–86)										
GSO	0	0.0	1	3.3	0	0.0	0	0.0	0	0.0
GCO	0	0.0	0	0.0	1	3.3	0	0.0	0	0.0
Intense hypoxemia (≤85)										
GSO	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
GCO	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0

GSO: group without oxygen therapy; GCO: group with oxygen therapy; SpO_2: peripheral oxygen saturation.

Table 4. Distribution of patients in the groups without oxygen therapy and with oxygen therapy, according to the association of the occurrence of hypoxemia, within 60 minutes of stay in the postanesthetic care unit. Belo Horizonte, MG, Brazil, 2014.

SpO_2 (%)	Groups	Mean	SE	Median	Minimum	Maximum	p value
Normal	GSO	98.1	0.19	97.6	96	100	0.0563
	GCO	98.3	0.38	97.9	96	100	
Mild hypoxemia	GSO	97.2	0.51	96.5	91	97	0.0578
	GCO	97.3	1.05	96.9	91	97	
Moderate hypoxemia	GSO	97.1	0.11	95.5	86	96	1.00
	GCO	97.3	0.25	95.6	86	96	

GSO: group without oxygen therapy; GCO: group with oxygen therapy; SpO_2: peripheral oxygen saturation; PACU: postanesthetic care unit; SE: standard error.

and mild hypoxemia within 60 minutes of patient stay in the PACU.

Factors related to a decrease in arterial oxygen content include all those that modify the amount of hemoglobin, the fraction of inspired oxygen, and the fractional saturation of oxyhemoglobin[5].

The origin of the changes that trigger hypoxemia during the immediate postoperative period is multifactorial and encompasses the synergy between the patient's illness, the effects of anesthesia, and the changes caused by the surgical procedure performed[5,8].

The main components involved in the development of hypoxemia are related to the patient's age, preoperative pulmonary function, residual action of the anesthetics used, the surgical area involved in the procedure, duration of anesthesia, and the type of postoperative analgesia employed[5,6,8-10]. Please refer to the supplementary document.

The hypoxemia that manifests in patients in the PACU, especially patients with an ASA I classification, is mostly related to anesthesia. The patient may present respiratory depression due to the residual action of opioids and neuromuscular blockers, loss of vaso-constricting reflexes, increased oxygen consumption and muscle tremors, which may, among other things, cause drowsiness and increase recovery time and delay discharge from the PACU[8-10].

In this study, ASA I and II classifications were more frequent in GSO and GCO, consecutively, demonstrating the need for supplemental oxygen in all cases.

A literature review of research conducted on the subject from 1998 to 2008 demonstrated that hypothermia is the most frequent complication in the PACU, followed by nausea, pain, vomiting, sweating, and hypoxemia, among other signs, symptoms, and complications[9].

Studies report hypoxia and bronchospasm as adverse effects of respiratory origin in patients during the period of AR, as well as those of cardiovascular origin such as dysrhythmias, hypertension, and hypotension[2,9].

A meta-analysis confirmed the need for pulse oximetry to detect hypoxemia in the immediate postoperative period and its consequences. In addition to being non-invasive and cost-effective, its use contributes to an increase in the early identification of cardiac events due to hypoxemic episodes, with a reduction in the incidence of myocardial ischemia and bradycardia. It also identifies the possible need for oxygen therapy after discharge from the PACU and thus decreases the rate of complications and postoperative mortality[5].

The American Society of peri-Anesthesia Nurses (ASPAN) recommends patient admission to the PACU in three stages. The first stage is called ABC assessment, being Airway, Breathing, and Circulation. In the evaluation of the airways, the recommended interventions are the observation of patency, administration of humidified oxygen, and placement of pulse oximetry, in order to prevent hypoxemia[11].

In the AR period, the postoperative assessment includes the verification of respiratory rate and heart rate, level of consciousness, oxygen saturation, and blood pressure, as well as observation of wound and dressing conditions, permeability of access, and drainage routes and assessment of pain levels[2,3,11,12].

Oxygen monitors for perioperative use need to be in continuous operation to detect early adverse events, and ideally reduce anesthetic-surgical morbidity. Currently, the decrease in SpO_2 measured by the pulse oximeter is the earliest and most important sign of hypoxemia[5,6,8].

The impact of the anesthetic-surgical act on the patient's pulmonary function is responsible for the development of hypoxemia in the immediate postoperative period. In times of cost reduction, as well as the adoption of evidence-based conducts, the use of supplemental oxygen therapy should be rationally oriented. However, the risk of potentially serious complications associated with its non-use cannot be underestimated[5].

Since the PACU is destined to the care of patients in the immediate postoperative period submitted to general and/or loco-regional anesthesia, specialized technical and human resources are needed to support the prevention, detection, and early implementation of specific care[8].

In a study carried out in Porto Alegre, Rio Grande do Sul, regarding the nursing needs of patients in a post-anesthetic recovery unit, the authors highlighted the assistance specificities of these patients, who "present a high degree of dependence and require rigorous clinical observation for skilled management and quick and accurate decision-making skills"[13].

Patient SpO_2 monitoring during the AR period is an important aspect to be considered in planning and implementing patient care in the PACU, since the occurrence of a decrease in oxygen saturation can trigger a number of preventable postoperative complications.

CONCLUSION

The results of this research allowed us to conclude that the use of oxygen therapy upon the patient's admittance to the PACU can prevent hypoxemia.

The data analyzed showed that there was a marginally significant difference in peripheral oxygen saturation for patients of the two groups throughout the PACU stay, for normal SpO_2 ($p=0.0563$), and mild hypoxemia ($p=0.0578$).

This marginally significant difference between the group that did not receive and the group that received oxygen therapy was demonstrated by the difference in oxygen saturation at minute zero, equal in all subjects of both groups, and at 60 minutes, with five GSO subjects presenting mild hypoxemia.

In this sense, measures to control oxygen saturation should be part of the systematization of nursing care. It is necessary to construct and implement assistance protocols for the perioperative period, increasing the patient's stay in the PACU and including oxygen therapy in the intervention processes, aiming to maintain the peripheral oxygen saturation, in order to minimize the consequences of hypoxemia, such as drowsiness and nausea.

It can be concluded that the use of oxygen therapy upon the patient's admittance to the PACU prevents hypoxemia, and this should be associated with measures of patient care in the PACU period.

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Appendix 1. Data Collection Instrument.

Initials: Bed:					
Sex: ( ) M ( ) F			Date:		Registration:
Age:			Surgery performed:		
ASA:	( ) I	( ) II	IA:	TA:	T:
( ) Hypertension	( ) DM	( ) Other	( ) IV total		( ) IV + Inhalation

Anesthetic recovery					
Admittance:		Discharge:		Total:	
Oxygen therapy upon admittance: ( ) Yes ( ) No Mask ( ) Catheter( )					
If yes, removes in: 0 15 30 45 60					
Decrease in SpO_2: ( ) Yes ( ) No					
If yes, after how many minutes of PACU stay: 0 15 30 45 60					
Start:		End:		Total:	
Oxygen therapy during decrease in SpO_2: ( ) Yes ( ) No					
Start:	End:	Total:	Mask ( )		Catheter ( )
	0	15	30	45	60
Activity					
Consciousness					
Breath					
Circulation					
SpO_2					
TOTAL					
BP					
HR					
RR					
Temperature					