

General anesthesia is predictive for occurrence of postoperative pain

Anestesia geral é preditiva para a ocorrência de dor pós-operatória

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ABSTRACT

BACKGROUND AND OBJECTIVES: Pain is one of the most frequent complications in the post-anesthetic care unit. Knowing the risk variables is one strategy for its prevention. The objective of the present study was to identify the predictive variables for pain in the post-anesthetic care unit, regardless of its intensity.

METHODS: This was an observational and cross-sectional study with primary data with 98 adults submitted to elective surgery. The pain was assessed using a numerical scale. The patients were divided into two groups: the presence or absence of pain. Also, pre, intra, and postoperative information were gathered. Descriptive, comparative analysis between groups and logistic regression were conducted.

RESULTS: Pain in the post-anesthetic care unit was mentioned by 34.7% of the sample, classified as severe by the majority (61.8%). A significant statistical relationship was found between the presence of pain, regardless of intensity, and two preoperative variables, nine intraoperative variables, and four postoperative variables, namely: female sex; general surgery specialty; supine position; general anesthesia; greater use of intravenous opioids and lower use of intrathecal morphine in the intraoperative period; time in surgery greater than 120 minutes; and oxygen de-

saturation in the postoperative period. The regression analysis revealed that general anesthesia increased the probability of pain in the post-anesthetic care unit by 9.5 times.

CONCLUSION: General anesthesia was identified as predictive of pain in the post-anesthetic care unit, indicating the profile of patients at higher risk.

Keywords: Anesthesia, Elective surgical procedures, Perioperative nursing, Postoperative period, Care unit.

RESUMO

JUSTIFICATIVA E OBJETIVOS: A dor é uma das complicações mais frequentes em sala de recuperação pós-anestésica e uma estratégia para sua prevenção é o conhecimento de variáveis de risco. O objetivo deste estudo foi identificar variáveis preditivas de dor em sala de recuperação pós-anestésica, independentemente de sua intensidade.

MÉTODOS: Estudo observacional e transversal com dados primários, com 98 pacientes adultos submetidos a cirurgia eletiva. A dor foi avaliada utilizando a escala numérica. Os pacientes foram divididos em dois grupos pela sua presença ou ausência de dor. Além disso, foram coletadas informações pré, intra e pós-operatórias. Realizou-se análise descritiva comparativa entre grupos e regressão logística.

RESULTADOS: A queixa de dor na sala de recuperação pós-anestésica foi feita por 34,7%, sendo classificada como intensa para a maioria (61,8%). Houve relação estatística significativa para sua presença, independente da intensidade, com duas variáveis pré-operatórias, nove variáveis intraoperatórias e quatro variáveis pós-operatórias, a saber: sexo feminino; especialidade cirúrgica geral; decúbito dorsal; anestesia geral; maior consumo de opioides por via endovenosa e menor uso de morfina subaracnóideia no intraoperatório; tempo de cirurgia superior a 120 minutos e dessaturação de oxigênio no pós-operatório. A análise de regressão revelou que anestesia geral aumenta em 9,5 vezes as chances de ocorrência de dor em sala de recuperação pós-anestésica.

CONCLUSÃO: A anestesia geral foi identificada como preditiva para a ocorrência de dor em sala de recuperação pós-anestésica, evidenciando o perfil de pacientes com maior risco.

Descritores: Anestesia, Enfermagem perioperatória, Período pós-operatório, Procedimentos cirúrgicos eletivos, Sala de recuperação.

INTRODUCTION

Complaint of pain is reported by 80% of patients in postoperative period (PP), being more intense in the first hours after the surgical procedure^{1,2}. The incidence of pain in post-anesthetic

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care unit (PACU) varies from 25.9 to 45.2%³⁻⁵. This complication leads to physiological changes, increased morbidity and mortality in the PP and prolongation of stay in PACU, influencing the flow of the surgical center^{1,3,4-6}. Furthermore, the worse quality of postoperative recovery impacts on patient safety and satisfaction⁷. The presence of uncontrolled pain in PP is also considered predictive for its chronification, being one of the main conditions of changes in activities of daily life after surgical procedures, leading to functional impairment, lower quality of life, prolonged use of opioids and higher costs with health care^{1,8-10}.

It's necessary to reduce the prevalence of postoperative pain (POP), especially in countries where sub-treatment of pain is present, with absence of institutional care protocols and records^{11,12}. One strategy is to identify patients at risk, since studies show the existence of factors related to POP in adults^{2,13-15}. There are few studies that address pain in PACU. Most classify pain as intense, associated or not to intervention with analgesic therapy^{6,16-19}, without considering a set of pre-, intra-, and postoperative variables that may influence the presence of this complication in PACU, either by frequency analysis or predictive variables identified by regression²⁰.

Thus, the identification of predictors for pain in PACU, regardless of intensity, can help in the assistance provided by the multidisciplinary team, not only during the stay of patients in this unit, but in all perioperative planning.

The objective of this study was to identify the predictive variables of pain in PACU, regardless of intensity, considering pre, intra, and immediate postoperative characteristics.

METHODS

An observational, cross-sectional, prospective, and exploratory survey was conducted in a PACU of a secondary level care hospital of the *Sistema Único de Saúde* (SUS) of the *Distrito Federal*. The sample was nonprobabilistic, consisting of 98 patients selected on a convenience basis, as it was operationally simpler to include a more accessible group of the interest population. The probabilistic sample would not be feasible due to the availability of patients according to exclusion criteria and visiting hours.

Inclusion criteria were patients of both genders, aged 18 years or older, submitted to elective surgery with general and/or regional anesthesia and who remained in the PACU in the immediate PP. Those whose pain could not be assessed, who refused to participate in the study, who died in the intraoperative period or who were referred to a hospital unit other than the PACU were excluded. To assess pain in PACU, the numerical scale was used, in which zero is equivalent to the absence of pain and 10 to the maximum intensity of pain already experienced by the patient, being classified as mild pain - score from 1 to 2; moderate pain - 3 to 7; intense pain - 8 to 10²¹.

Moreover, socio-demographic, preoperative, intraoperative and postoperative information were collected for the identification of predictor variables of pain in PACU. Interviews were made in preoperative visits to obtain preoperative and socio-demographic information, collection of intraoperative information and the history of the patient's health in electronic record and careful

clinical evaluation in PACU for the identification of complications. The assessment of the patient vital signs and physical examination in the immediate PP was performed with the following standardized and recommended instruments: the Ramsey sedation scale and the Aldrete-Kroulik Index (IAK)^{5,22,23}.

The project was approved by the *Comitê de Ética em Pesquisa com Seres Humanos* (CAAE 62615916.4.0000.0030) in the year 2017, and patients were included in the study after agreement and signature of the Free and Informed Consent Term (FICT).

Statistical analysis

The data were analyzed in IBM SPSS Statistics 22.0 and R version 3.6.1 programs^{24,25}. The categorized variables were expressed in frequencies and percentages, while the continuous ones with median and 1st and 3rd quartiles. The variables normality was evaluated with graphical analysis and Shapiro-Wilk test, from which non-parametric tests were performed. For the comparison between the groups, the Chi-square, Fisher's Exact and Likelihood Ratio tests were used for categorized variables, and the Mann-Whitney U test for continuous variables. Odds ratios for the presence of pain in PACU, with corresponding p-values and 95% confidence intervals were obtained by logistic regression analysis. The stepwise procedure was used for the selection of variables in the logistic model. Values of $p \leq 0.05$ were considered statistically significant.

RESULTS

All 98 patients were divided into two groups: group P⁺ with 34 patients who presented pain in PACU and group P⁻ with 64, who did not present pain in PACU. Intense pain was reported by 61.8% (n=21) of the patients, moderate pain by 29.4% (n=10) and mild pain by 8.8% (n=3).

A comparison of the preoperative and intraoperative characteristics (Table 1) demonstrated in the P⁺ group: higher prevalence of females, lower hospitalization rate due to external causes, higher prevalence of general surgical specialty, dorsal decubitus position and use of general anesthesia, lower use of subarachnoid morphine and benzodiazepines, greater use of muscle relaxants adjuvant to anesthesia, less use of corticosteroids and greater use of opioids, morphine and tramadol throughout the surgical procedure, greater median time of surgery, greater use of opioids adjuvant to anesthesia ($p=0.03$), with only fentanyl being used.

The analysis of postoperative characteristics (Table 2) revealed the following differences for patients in the P⁺ group at the time of admission in PACU: higher prevalence of score 2 in the evaluation of muscle activity; lower prevalence of score 2 in the evaluation of the level of consciousness, and lower prevalence of the level of sedation equal to 2. As observed for the intraoperative, these data pointed to a relationship between the presence of pain in PACU and general surgeries and anesthesia. Analysis of the variables at the time of discharge from PACU did not point to differences between the P⁺ and P⁻ groups. This was expected, considering that stability and anesthetic recovery criteria are met for discharge, independently of the surgical specialty, anesthetic type or complication presented.

Table 1. Median [interquartile intervals] or percentages (absolute frequencies) and p-values of the preoperative and intraoperative demographic and clinical characteristics of patients with and without pain in the post-anesthetic care unit

Variables	Pain		p-value*
	Yes (n=34 e %)	No (n=64 e %)	
Gender			
Female	70.6 (24)	45.3 (29)	0.017 [†]
External causes	17.6 (6)	42.2 (27)	0.014 [†]
Preoperative analgesia	17.6 (6)	10.9 (7)	0.364 [‡]
Surgical specialty			
Orthopedic	26.5 (9)	51.6 (33)	
General	52.9 (18)	29.7 (19)	0.039 [†]
Gynecological	20.6 (7)	18.8 (12)	
Cardiovascular risk			
Low	14.7 (5)	23.4 (15)	0.307 [†]
Intermediate	85.3 (29)	76.6 (49)	
Surgical position			
Dorsal decubitus	91.2 (31)	71.9 (46)	0.043 [§]
Lithotomy	8.8 (3)	17.2 (11)	
Prone decubitus	-	1.6 (1)	
Sideways	-	9.4 (6)	
Anesthesia			
Subarachnoid	35.3 (12)	82.8 (53)	
Block	8.8 (3)	6.3 (4)	<0.001 [§]
General	44.1 (15)	10.9 (7)	
Combined	11.8 (4)	-	
Subarachnoid morphine	41.2 (14)	70.3 (45)	0.005 [†]
Adjuvant to anesthesia			
Opioids	87.9 (29)	75.0 (48)	0.137 [†]
Benzodiazepines	45.5 (15)	74.2 (46)	0.005 [†]
Muscle relaxers	42.4 (14)	11.3 (7)	<0.001 [†]
Intraoperative control of pain			
Corticosteroids	38.2 (13)	59.4 (38)	0.046 [†]
Opioids	35.3 (12)	12.5 (8)	0.008 [†]
Intraoperative complication			
Time of surgery	120 [90-169]	90 [65-135]	0.020

Significance level (p<0.05); [†]Chi-square test; [‡]Fisher's Exact test; [§]Likelihood Ratio Test; ^{||}Mann Whitney U test.

The median time of stay in the PACU for the P⁺ Group was 132 minutes with an interquartile interval of 95 to 170 minutes and in the P⁻ group 129.5 and an interval of 98 to 178 minutes, with no significant difference between the groups (p=0.934). Oxygen desaturation was more prevalent in patients who reported postoperative pain (52.9 versus 29.7%, p=0.02).

Logistic regression analysis (Table 3) showed that general anesthesia increases 9.5 times the chances of the individuals presenting pain in PACU in relation to subarachnoid anesthesia, while

Table 2. Median [interquartile intervals] or percentages (absolute frequencies) and p-values of the postoperative clinical characteristics of patients with and without pain in the post-anesthetic care unit

Variables	Admission			Discharge		
	Yes (n=34)	No (n=64)	p-value [†]	Yes (n=34)	No (n=64)	p-value [†]
IAK Score	8 [8-9]	8 [8-9]	0.447 [†]	9 [9-10]	9 [9-10]	0.754 [†]
Muscle activity						
2	44.1 (15)	10.9 (7)	<0.001 [‡]	97.1 (33)	90.6 (58)	0.416 [§]
1	55.9 (19)	89.1 (57)		2.9 (1)	9.4 (6)	
Breathing						
2	97.1 (33)	96.9 (62)	1.000 [§]	100.0 (34)	98.4 (63)	1.000 [§]
1	2.9 (1)	3.1 (2)		-	1.6 (1)	
Circulation						
2	55.9 (19)	40.6 (26)	0.179	41.2 (14)	40.6 (26)	0.651
1	44.1 (15)	56.3 (36)		58.8 (20)	57.8 (37)	
0	-	3.1 (2)		-	1.6 (1)	
Consciousness						
2	58.8 (20)	82.8 (53)	0.010 [‡]	100.0 (34)	100.0 (64)	¶
1	41.2 (14)	17.2 (11)		-	-	
Oxygen saturation						
2	67.6 (23)	82.8 (53)	0.087 [‡]	94.1 (32)	84.4 (54)	0.208 [§]
1	32.4 (11)	17.2 (11)		5.9 (2)	15.6 (10)	
Sedation level = 2	55.9 (19)	82.8 (53)	0.004 [‡]	97.1 (33)	100 (64)	0.347 [§]

IAK = Aldrete-Kroulik Index. [†]Significance level (p<0.05); [‡]Mann Whitney's U test; [§]Chi-square test; ^{||}Fisher's Exact test; [¶]Likelihood Ratio Test. ¶ It was not possible to perform statistical analysis because all patients had a level of consciousness equal to 2.

Table 3. Logistic regression analysis for pain predictors in post-anesthetic care unit

Variables	Estimate	Standard error	CR [CI 95%] [†]	p-value [†]
Intercept [‡]	-1.5	0.3	0.2 [0.1-0.4]	<0.001
Plexus blockade	1.2	0.8	3.3 [0.6-17.0]	0.148
General anesthesia	2.2	0.5	9.5 [3.3-30.0]	<0.001

CR = Chance Ratios; CI = Confidence Interval. [†]Chance ratios were adjusted to dependent variables; [‡]significance level (p<0.05). [‡]The subarachnoid anesthesia group was the reference (Intercept).

plexus blockade had no significant association. The group that received subarachnoid anesthesia was used as the reference group because it was the most frequent and was considered a protective factor for this sample. It was not possible to analyze the rela-

tionship of the combined anesthesia with POP due to the low number of patients in whom this anesthetic technique was used. Other variables such as gender, age, use of analgesics in the preoperative, surgical specialty, time of surgery and opioids used in the intraoperative were not presented as predictive factors for the presence of pain in PACU.

DISCUSSION

In the present study, a significant association between gender and pain was identified in the bivariate analysis, but it was not considered by regression as a predictive factor, which may have occurred due to the higher prevalence of women in the general surgical specialty and consequently in the use of general anesthesia and, thus, it's an explanatory and not independent variable. There is evidence that women present higher chances of intense pain and need for analgesic intervention in PACU^{17,19,26}. Such differences are associated with hormonal factors, women's lower skin thickness, neurobiological variations, psychological and social variations²⁶⁻²⁸. Higher rates of anxiety and depression are reported by women and correlated with pain intensity²⁸. Moreover, the use of preoperative benzodiazepines is higher in patients with intense pain, which reflects the impact of preoperative anxiety¹⁶.

Characteristics involved with the causes of hospitalization are also related to the intensity of POP². In the present study, it was possible to observe that the hospitalization for external causes was more prevalent in the group with no pain. It is important to note that this variable was directly related to the orthopedic surgical specialty in 100% of cases, and that there was no direct association in the literature between external causes and pain in PACU – probably due to regional anesthesia, which provides greater comfort in relation to pain in the first postoperative hours – therefore, this variable was not part of the regression analysis. The relationship of pain with the surgical specialty may vary. Higher pain intensity in PACU is reported in patients undergoing general and gynecological surgery, but also after orthopedic surgery^{17,19,20,29}. For the present sample, the general surgical specialty presented a significant relationship with occurrence of pain in PACU. Differences were also found for surgical positioning in dorsal decubitus. This relationship may have occurred as a consequence of the surgical specialty and general anesthesia, since the three variables are directly related. Differences in samples and study designs, in the adopted assistance protocols, in the types of surgeries performed by the specialties may explain such data. Hence the importance of each Institution to know the data referring to the population attended in addition to the data in the literature, subsidizing the establishment of assistance protocols that meet local specificities.

General anesthesia was considered a predictive variable for pain in PACU. Studies demonstrate its association with greater intensity of pain and opioid consumption in the PACU when compared to regional anesthesia^{4,16,20,30}. The relation between POP and the anesthetic technique is more intense for general anesthesia in the first two hours, period in which patients remain in the PACU, but after six hours it is reversed for regional anesthesia, generally with patients in the hospitalization units^{31,32}, which

is demonstrated in the present study by regional anesthesia as a protective factor. However, after PACU this may not occur. Such differences can occur due to pharmacokinetic differences, especially in relation to the administration routes, but also to pharmacodynamic differences of anesthetics and are related to the results found in the present work. For example, general anesthetics can directly activate nociceptors, sensory neurons responsible for the transmission of information of pain, by means of TRPA1-type ion channels (Transient receptor potential cation channel, subfamily A, member 1)³³, which would explain the higher frequency of pain in PACU for general anesthesia.

There was a higher frequency of subarachnoid morphine and benzodiazepines adjuvant to anesthesia in patients in group P⁻, which is related to regional anesthesia, while for patients in group P⁺ there was a higher frequency of muscle relaxants adjuvant to anesthesia, which facilitates tracheal intubation for general anesthesia. These variables were not used in the regression analysis due to the direct relationship with the anesthetic technique. Equally influenced by the anesthetic technique was the relation between lower scores in the evaluation of muscle activity at admission for patients in group P⁻, which is due to locoregional lower limb blocks. Lower score in the evaluation of the consciousness level and lower prevalence of sedation level equal to 2 at admission for patients in group P⁺, also explained by general anesthesia, since it results in higher sedation in up to 18 hours of PP in relation to regional anesthesia³⁰.

The present study found a higher frequency of intraoperative administration of opioids for patients with pain. This relationship is described in literature and is related to greater consumption of analgesics and pain after high doses of opioids in the operating room (OR)^{16,18} and is more frequent after fentanyl administration³⁴. The mechanism seems to involve short-term tolerance due to the use of high doses administered during surgery^{16,35}. A recent study suggested that intraoperatively administered opioids have less efficiency in the descending mechanisms of pain inhibition at the end of surgery³⁶. Therefore, multimodal therapy is recommended, since it reduces the risk of pain in the PP¹⁴, which can be observed in the present study for the group without pain that presented higher frequency of use of corticosteroids associated with intraoperative morphine via subarachnoid. Moreover, the maintenance of opioid therapy in PACU is mainly recommended, continuing the therapy started in OR, considering the need for adequate pain control during the stay of patients in the unit. Association between pain and oxygen desaturation in the PACU was observed, and this variable may have been influenced by intraoperative administration of opioids, as they were more frequent in the P⁺ group and cause depressant effects on the respiratory system. Moreover, the general surgical specialty may be another variable that contributed to such result, since abdominal cavity procedures cause increased pain-induced reflex in the skeletal muscle tension, which decreases lung compliance, possibly triggering changes in ventilation-perfusion and resulting in oxygen desaturation³⁵. This complication in the PACU was also not considered for regression analysis because it's related to other variables.

According to the present study, the time of surgery had an impact in the POP, which is due to greater awareness by longer

handling time. This parameter has been related to the presence of intense pain and greater need for opioids in PACU^{15,16,18,19}.

The study presents a limitation of preoperative pain not being evaluated in respect to its intensity and chronicity, having been indirectly evaluated by means of pharmacological prescription. Also, anxiety and depression in the preoperative period were not evaluated using scales, while the history of comorbidities and prescription of drugs were used for these conditions.

CONCLUSION

This study analyzed predictive and pain-related variables in PACU considering a set of preoperative, intraoperative and postoperative characteristics and the general anesthesia was the predictive factor found while related factors were: female gender, general surgical specialty, surgical positioning in dorsal decubitus, greater use of intravenous opioids and lower use of subarachnoid morphine in the intraoperative period, surgical time greater than 120 minutes and oxygen desaturation in the postoperative period.

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