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RESEARCH

Influence of socio-demographic, clinical and surgical variables on the Aldrete-Kroulik Scoring System

Influência de variáveis sociodemográficas, clínicas e cirúrgicas no Índice de Aldrete Kroulik

Influencia de variables sociodemográficas, clínicas y quirúrgicas en el Índice de Aldrete y Kroulik

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ABSTRACT

Objective: To identify the influence of the variables sex, age, type of anesthesia, occurrence of intraoperative complications, pain and surgical complexity on the Aldrete-Kroulik Scoring System in patients in the immediate postoperative period, in the post-anesthesia care unit. **Method:** Non-experimental, longitudinal study, with a quantitative approach, conducted with 241 surgical patients. Descriptive analysis, Student's t-test, Pearson and Spearman Correlation Indexes and multiple linear regression were used to analyze the data. **Results:** Correlations between the Aldrete-Kroulik Scoring System and pain ($r=-0.13$; $p=0.05$) and surgical complexity ($r=-0.12$; $p=0.05$) were statistically significant. The type of anesthesia and pain ($p<0.01$) influenced the decrease of the Aldrete-Kroulik System's scores. **Conclusion:** Considering the vulnerability of patients in the immediate postoperative period, it is essential for the nurse to know the factors that can influence the Aldrete-Kroulik Scoring System to provide a safe and optimal post-anesthesia recovery.
Descriptors: Perioperative Nursing; Postoperative Pain; Care Unit; Elective Surgical Procedures; Postoperative Complications.

RESUMO

Objetivo: Identificar a influência das variáveis sexo, idade, tipo de anestesia, ocorrência de complicações intraoperatórias, dor e porte cirúrgico sobre o Índice de Aldrete e Kroulik em pacientes no pós-operatório imediato, na sala de recuperação pós-anestésica. **Método:** Estudo não experimental, longitudinal, de abordagem quantitativa, realizado com 241 pacientes cirúrgicos. Análise descritiva, teste *t de Student*, Correlações de *Pearson* e *Spearman* e regressão linear múltipla foram utilizados para analisar os dados. **Resultados:** Correlações entre o Índice de Aldrete e Kroulik e dor ($r=-0,13$; $p=0,05$) e porte cirúrgico ($r=-0,12$; $p=0,05$) foram estatisticamente significativas. O tipo de anestesia e a dor ($p<0,01$) influenciaram a diminuição dos escores do Índice de Aldrete e Kroulik. **Conclusão:** Em virtude da vulnerabilidade dos pacientes no pós-operatório imediato, é fundamental que o enfermeiro conheça os fatores que podem influenciar o Índice de Aldrete e Kroulik para propiciar uma recuperação pós-anestésica segura e de qualidade.
Descritores: Enfermagem Perioperatória; Dor Pós-Operatória; Sala de Recuperação; Procedimentos Cirúrgicos Eletivos; Complicações Pós-Operatórias.

RESUMEN

Objetivo: Identificar la influencia de las variables género, edad, tipo de anestesia, ocurrencia de complicaciones intraoperatorias, dolor y porte quirúrgico sobre el Índice de Aldrete y Kroulik en pacientes en el posoperatorio inmediato, en la sala de recuperación posanestésica. **Método:** Estudio no experimental, longitudinal, de abordaje cuantitativo realizado con 241 pacientes quirúrgicos. Análisis descriptivo, prueba t de Student, Correlaciones de Pearson y Spearman y regresión lineal múltiple fueron utilizadas para analizar los datos. **Resultados:** Las correlaciones entre el Índice de Aldrete y Kroulik y el dolor ($r=-0,13$, $p=0,05$) y el porte quirúrgico ($r=-0,12$; $p=0,05$) fueron estadísticamente significativas. El tipo de anestesia y el dolor ($p<0,01$) influenciaron la disminución de los escores del Índice de Aldrete y Kroulik. **Conclusión:** Considerando la vulnerabilidad de los pacientes en el

postoperatorio inmediato, es fundamental que el enfermero conozca los factores que pueden influir en el Índice de Aldrete y Kroulik para propiciar una recuperación posanestésica segura y de calidad.
Descriptores: Enfermería Perioperatoria; Dolor Posoperatorio; Sala de Recuperación; Procedimientos Quirúrgicos Electivos; Complicaciones Posoperatorias.

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INTRODUCTION

Post-anesthesia recovery comprises the period between leaving the patient in the operating room and the moment he/she is recovered from the anesthesia and returns to his/her normal physiological state, after elimination of the anesthetic and hemodynamic stabilization of his/her vital signs[1].

The recovery period is considered critical because the patient may exhibit changes in level of consciousness, vital signs, instability of motor activity and decreased protective reflexes[2]. Until these functions are normalized, the patient must remain in the Post-Anesthesia Care Unit (PACU) under observation with respiratory and hemodynamic support and constant care by the nursing staff, which ensures the prevention of possible postoperative complications related to surgery and resulted from the administration of anesthetic drugs[3-5].

In an attempt to systematize the criteria for the patient's discharge from the care unit, a scale elaborated by Aldrete and Kroulik was developed in 1970[6], which was then revised in 1995[7], being considered both simple and easy to apply. This scale is used in the evaluation and evolution of patients in the post-anesthesia period, through the analysis of muscle activity, respiration, systemic circulation, conscience and oxygen saturation. The score ranges from zero to two points for each parameter, with zero indicating more serious conditions, one corresponding to an intermediate level and two representing the restored functions[2,8].

It is worth noting that, according to the Aldrete-Kroulik Scoring System (AKSS), most patients in the PACU achieve the highest score in the evaluation of clinical parameters after 2 hours of stay in the unit[8]; however, the need for additional investigation of the factors influencing the parameters evaluated by the AKSS, such as surgical complexity, type of anesthesia, temperature, occurrence of nausea and vomiting, pain and analgesia, should not be ruled out[2], because the occurrence of complications in the PACU can be associated with these factors.

Considering the need of additional investigation for the prevention of complications in the post-anesthesia period, the importance of the subject and the scarcity of studies in the literature on factors that influence the AKSS, the following question is made: do sex, age, type of anesthesia, the occurrence of intraoperative complications, pain and surgical complexity influence the scores of the Aldrete-Kroulik Scoring System in surgical patients?

OBJECTIVE

To identify the influence of the variables sex, age, type of anesthesia, occurrence of intraoperative complications, pain and surgical complexity on the Aldrete-Kroulik Scoring System in patients in the immediate postoperative period, in the post-anesthesia care unit.

METHOD

Ethical aspects

To meet the ethical criteria, the recommendations of Resolution 466 from 12 December 2012 of the National Health Council for research involving human beings were followed[9]. The participants' anonymity was maintained and they were asked to sign the informed consent form. The research project was approved by the Research Ethics Committee of Universidade Federal do Triângulo Mineiro.

Study design, location, and period

This is a non-experimental, longitudinal study with a quantitative approach, carried out in the operating room and PACU of a public university hospital for medium and high complexity cases, located in Minas Gerais, Brazil. It has 302 beds and is responsible for serving 27 municipalities. It should be noted that the Surgical Center unit has 13 operating rooms and a Post-Anesthesia Care Unit with 13 beds. The data were collected in May and June 2016.

Population, inclusion and exclusion criteria

The study population was composed of adult patients who underwent elective surgical interventions in this institution. The inclusion criteria were: being over 18 years of age, in the immediate postoperative period at the post-anesthesia care unit, and being able to verbalize the pain felt. Patients submitted to cardiac and neurological surgical procedures were excluded, since these patients are referred directly to the Intensive Care Unit.

The calculation of sample size considered a $R^2 = 0.10$ determination coefficient, in a multiple linear regression model, with four predictors, having significance level or type I error $\alpha = 0.01$ and type II error $\beta = 0.1$, resulting, therefore, in a 90% *a priori* statistical power. By introducing the values described above in the Power Analysis and Sample Size (PASS) application, a minimum sample size of 218 patients was obtained. The main outcome variable was the Aldrete-Kroulik Scoring System.

Study protocol

An instrument was prepared containing the sociodemographic and clinical variables, related to the anesthetic-surgical procedure and to analgesia in the postoperative period. The variables included were: age; sex; color; comorbidities; surgical specialty; type of anesthesia; time of duration of the anesthetic-surgical procedure; surgical complexity; classification of the American Society of Anesthesiologist (ASA); complications in the operating room;

analgesia in the operating room; pain-killers prescribed; AKSS; presence, location and intensity of pain and physiological changes.

The information was obtained through interviews and the evaluation of patients and their medical charts. The instrument was subjected to face and content validity tests by three nurse practitioners specialized in perioperative nursing, who suggested no changes.

Data collection was performed by two researchers, one being a Master's and the other a Doctorate student in Health Care, who received specific training for conducting the study, *in loco*, for a week.

Initially, a pre-test was conducted to estimate the time of collection, the applicability of the instrument, as well as the need for adjustments. The resulting data were not used in the final analysis. To reach the necessary sample size, the data were collected through non-probability and sequential sampling, after the training of the researchers and realization of the pre-test, during the stay of the patients in the post-anesthesia care unit, in the morning and evening, from Monday to Friday, when the elective surgeries are performed.

In the months of May and June, a total of 1013 surgeries were conducted at the institution. However, there was a loss of 18 surgeries due to the impossibility of monitoring the patients who were admitted in the PACU at night, and exclusion of 754 due to them being pediatric, neurological, cardiac and emergency surgeries, which resulted in the final sample of 241 surgeries.

The patients were evaluated in five moments, defined for this study as follows: at admission (T1), after 30 minutes of stay in the recovery room (T2), after 60 minutes of stay (T3), after 120 minutes of stay (T4), and at the time of discharge (T5) for those who remained for longer than 120 minutes. Of the 241 patients evaluated, there were three losses in T3, 30 in T4 and 120 in T5, which means the patient was evaluated in the moments prior to his/her exit from the PACU. These time intervals were adopted according to the recommendations for evaluation of the AKSS[6,9].

The classification of surgical complexity was carried out according to the surgery's duration, namely: minor – up to 120 minutes; intermediate – between 120 and 210 minutes; major – more than 210 minutes. This criterion is adopted by the institution used as research field.

The ASA classification was obtained through the patients' anesthesia record, which was determined in accordance with the assessment of physical condition and based on their self-report in relation to age, smoking and presence of comorbidities[10].

The characterization of preemptive analgesia was obtained by identifying the analgesic treatment and drugs used, this information having been found in the patient's perioperative anesthesia record and post-operative medical prescription record. The drugs were classified in: simple analgesics, nonsteroidal anti-inflammatory drugs (NSAIDS) and opioid analgesics[11]. In relation to analgesic treatment, the following classification was used: without analgesia, analgesia with a fixed schedule (analgesia with pre-established schedules, according to medical prescription), analgesia if necessary (analgesia when requested by the patient due to allergy complaints) and continuous analgesia (continuous analgesic infusion with an infusion pump).

The location of the pain was obtained through the patient's indication or verbal report. Its intensity varied according to the numerical visual pain scale, having been categorized into no pain, mild pain, moderate pain and severe pain[12].

To identify the physiological changes (changes in heart rate, respiratory rate, blood pressure, temperature, low blood oxygen and occurrence of nausea and vomiting) a physical examination of the patient was conducted to verify their presence or absence. To verify the vital signs, the institution's multiparameter monitors, available in the care unit, and a digital thermometer that belonged to the researcher were used.

The following parameters were considered in the identification of changes: tachycardia (more than 100 beats per minute), bradycardia (less than 60 beats per minute), tachypnea (more than 20 respiratory incursions per minute), bradypnea (less than 12 respiratory incursions per minute), hyperthermia (axillary temperature greater than or equal to 37.8°C), hypothermia (axillary temperature lower than 35.5°C), increased blood pressure (20% above the preanesthetic level), decreased blood pressure (20% below the preanesthetic level) and low blood oxygen (less than 92%)[13-14].

The Aldrete-Kroulik Scoring System, main dependent or outcome variable of this study, was obtained in accordance with the classification of the patient's physical condition, through the observation of muscle activity, respiration, systemic circulation, conscience and oxygen saturation[7].

Analysis of the results and statistics

For the sample's characterization, central tendency measures (mean and median) and variability measures (standard deviation and range) were used, along with absolute and relative frequency distribution for categorical variables. The bivariate analysis of the influence of predictive variables (sex, age, type of anesthesia, occurrence of intraoperative complications, pain and surgery complexity) on the scores of the Aldrete-Kroulik Scoring System was carried out using Student's t-test, as well as the Pearson (r) and Spearman (rs) correlation coefficients. Finally, the simultaneous analysis of the influence of predictive variables on the AKSS scores used the multiple linear regression model. The criteria for inclusion of predictive variables in the multiple linear regression considered the conceptual and clinical relevance of each variable. The results were considered significant at a significance level $\alpha = 0.05$ (5%) for bivariate analysis and $\alpha = 0.01$ (1%) for multiple linear regression.

RESULTS

A total of 241 patients were included in this study, of which the majority (140; 58.1%) were male, self-reported themselves as white (195; 80.9%), had no associated comorbidities (146; 60.5%) and were classified as ASA II (144; 59.8%) (Table 1). The average age was 48.50 years old (s = 17.494), with the minimum age being 18 and the maximum 91 years old.

With regard to the variables related to the anesthetic-surgical procedure, it was demonstrated that Orthopedics was the most frequent surgical specialty (22.4%); spinal anesthesia was used in more than half of the surgical procedures (50.6%); most surgeries were classified as minor (178; 73.9%) and only 12 (5%) patients had complications in the intraoperative period, hypotension being the most frequent (4; 2.0%.)

Table 1 – Distribution of the sample according to sociodemographic and clinical variables (N = 241), Uberaba, Minas Gerais, Brazil, 2016

Variables	n	Percentage (%)
Sex		
Female	101	41.9
Male	140	58.1
Color		
White	195	80.9
Non-white	46	19.1
Comorbidities		
Yes	100	39.5
No	146	60.5
ASA Classification*		
I	71	29.5
II	144	59.8
III	25	10.4
IV	1	0.4

*Note: * American Society of Anesthesiologist*

As for the duration of the anesthetic-surgical procedure, the average was 131.74 minutes (standard deviation = 82.97; median = 120; minimum = 20; maximum = 450.) In relation to the time of surgery, the average duration was 89.88 minutes (standard deviation = 68.84; median = 75; minimum = 5; maximum = 380.) Moreover, the average time of stay of patients in the PACU was 152.57 minutes (standard deviation = 75.17; median = 120; minimum = 30; maximum = 450.)

In relation to analgesia in the operating room, 232 (96.3%) of the patients received it, the association between simple analgesics and nonsteroidal anti-inflammatory drugs being the most frequent (94; 40,4%.) Regarding postoperative analgesia, 15 (6.2%) patients left the PACU without prescription of analgesics. Among the 226 patients who had the prescription, the association between simple analgesics, NSAIDS and opioid analgesics was the most frequent (89; 36.9%.) The most common analgesic treatment was the one with fixed schedules associated with analgesia if required (95; 39.5%).

Regarding the occurrence of physiological changes in the immediate postoperative period, in all time analyzed (T1 to T5) the occurrence of hypothermia prevailed (T1: 73.9%; T2: 65.6%; T3: 49.4%; T4: 28.6% e T5: 10.0%.)

Table 2 shows that there was presence of pain at all times evaluated in this study during the patients' stay in the PACU. In the patients who had pain, surgical incision and abdomen were the most frequent locations.

The average score of pain in the five times evaluated showed low intensity: 1.32; 1.37; 1.39; 1.19 and 1.19 at times T1, T2, T3, T4 and T5, respectively.

With regard to the postoperative clinical variables, the average score of the Aldrete-Kroulik Scoring System, in the five moments analyzed during the patients' stay in the PACU, indicated a positive trend: 8.89; 8.98; 9.23; 9.75 and 9.97 at times T1, T2, T3, T4 and T5, respectively.

The bivariate analysis of the Aldrete-Kroulik Scoring System revealed statistically significant correlation for variables pain ($r = -0.13$; $p = 0.05$) and surgical complexity ($rs = -0.12$; $p = 0.05$). The AKSS's comparison for type of anesthesia indicated statistically significant difference ($p < 0.001$) between the means of general anesthesia (8.57) when compared with local anesthesia (9.05.)

Multiple linear regression showed that only the type of anesthesia and pain were statistically significant, indicating that these variables influence the AKSS score (Table 3.)

Table 3 – Association between variables and score of the Aldrete-Kroulik Scoring System in patients undergoing elective surgeries (N = 241), Uberaba, Minas Gerais, Brazil, 2016

Variables	B*	*p*†
Anesthesia	0.22	0.001
Sex	0.06	0.27
Intraoperative complication	0.001	0.99
Pain	- 0.14	0.01
Age	0.09	0.12
Surgical complexity	0.08	0.19

*Note: * Standardized regression coefficient; † Probability*

DISCUSSION

Based on the results, it was observed that there was a predominance of males. Differently from this study, an investigation[15] held with 566 patients undergoing orthopedic, abdominal, vascular and elective surgeries had female predominance (58.3%).

Table 2 – Presence and location of pain in the post-anesthesia care unit in patients undergoing elective surgeries (N = 241), Uberaba, Minas Gerais, Brazil, 2016

Variable	Time 1		Time 2		Time 3		Time 4		Time 5	
	n	%	n	%	n	%	n	%	n	%
Presence of pain										
Yes	57	23.7	59	24.5	61	25.3	52	21.6	33	13.7
No	184	76.3	182	75.5	177	73.4	159	66	88	36.5
Location of pain										
Surgical incision	25	10.4	25	10.4	21	8.7	14	5.8	9	3.7
Anterior thorax	3	1.2	3	1.2	3	1.2	1	0.4	2	0.8
Abdomen	19	7.9	24	10.0	28	11.6	30	12.4	18	7.5
Upper Limbs	3	1.2	3	1.2	3	1.2	2	0.8	0	0
Lower Limbs	4	1.7	4	1.7	4	1.7	3	1.2	3	1.2
Other	3	1.2	1	0.4	3	1.2	2	0.8	1	0.4

In relation to the duration of the anesthetic-surgical procedure and the surgery itself, the average was 131.74 and 89.88 minutes, respectively. A similar result was found in a study conducted in a large hospital in Santos (SP), where the average duration of anesthesia was 144 minutes and 53.6% of surgical procedures lasted for less than 60 minutes[16]. Contrariwise, a study conducted in a federal public hospital located in Belo Horizonte found the average duration of anesthesia to be 211.9 minutes and the average duration of the surgical procedure to be 165.6 minutes[3].

As for the length of stay in the PACU, the average found in this study was 152.57 minutes. However, another study concluded that most of the 24 patients (80%) remained in the PACU for less than 120 minutes[3]. The length of stay in this unit is not well established in the literature; however, the patient is usually ready to be discharged from it when evaluated by the AKKS after two hours of stay[2].

As the objective of the PACU is to recover the physiological balance with stabilization of the vital signs, return of the consciousness level, minimum level of pain and lack of evidence of possible complications, the patient must stay in the unit as long as necessary until all objectives described have been reached[4].

As for analgesia, corroborating the present investigation, a study with the objective to evaluate the intensity of pain in 351 patients in the postoperative period showed that 98.9% of them received analgesia in the operating room[11]. Regarding postoperative analgesia, a study that included 186 patients also obtained similar results[17]. It may be noted that analgesia has been carried out according to WHO's recommendation, which advocate multimodal analgesia, with administration of various types of analgesic drugs[18].

In relation to the occurrence of physiological changes, this study showed that the most common change was hypothermia, which occurred in 73.9% of the patients at the time of admission to the PACU. However, discrepant results were found in another study, showing that the average temperature at the time of admission was 35.9°C[2]. The unintended hypothermia is a consequence of the anesthetic-surgical procedure, since the mechanisms involved in the control of body temperature are compromised by the anesthetic drugs, which cause depression of the thermoregulatory center[2].

A study conducted with 84 patients, with the goal to determine the frequency of pain in the PACU, found that 61.63% of the patients felt no pain at the time of admission to the unit[19]. Another study conducted at Hospital da Cruz Vermelha in Curitiba (n = 165) had a small number (40; 24.25%) of patients with postoperative pain[20].

A study conducted at the University Hospital of the city of Aachen, in Germany, pointed out that the intensity of pain decreased considerably as the patient remained in the PACU[21], corroborating the data presented in this and another study[22].

Despite the low levels of pain found in this study, recent evidence recommend the use of preventative analgesia, in which the drug is administered prior to the surgical incision[23-24]. It is important to point out that, although the hospital where this study was conducted does not have a protocol for the treatment of pain, one can observe that its management was carried out appropriately.

In relation to the results of the Aldrete-Kroulik Scoring System, it may be noted that at the time of discharge the average score was 9.97 points, a result that is consistent with that of other studies, in which patients were discharged from the PACU after reaching a score greater than or equal to 9[21-22]. Similar results were also found in a study with the objective to analyze the comorbidities of 42 patients in the post-anesthesia recovery period, in which the average of the AKSS scores at the time of admission was 8.4[3], whereas this study's was 8.89.

When patients are admitted to the unit, they are still under the effect of anesthetic and analgesic drugs, which cause drowsiness, respiratory depression and motor depression, with consequent loss of points in the system's scores. However, as these drugs are metabolized and eliminated from the body, they begin to re-establish their level of consciousness and vital signs, gaining points in the system's scores and increasing their possibility of discharge[23].

Despite its broad use, it should be noted that the Aldrete-Kroulik Scoring System does not guarantee a safe evaluation, because it evaluates some parameters in isolation, resulting in discharge from the unit even when the patient does not have stable conditions[2].

As for the influence of pain on the Aldrete-Kroulik Scoring System, this study found a statistically significant relationship, showing that the lower the intensity of pain, the higher the system's scores. Despite pain not being covered by the AKSS, it is expected to result in possible physiological changes that may interfere with the system's scores[17].

In a study that included 152 patients with the objective to evaluate the conditions of patients in the immediate postoperative period at the moment of admission to the inpatient unit of an institution that has no PACU, similar results were found. Of the patients who scored 10 in the AKSS, only 3 (2.0%) reported pain[25].

In relation to anesthesia, the results obtained are in accordance with those expected. Patients who got general anesthesia had lower scores in the AKSS when compared to patients who got local anesthesia, this difference having been statistically significant. Indeed, general anesthesia works as a depressant of the cardiovascular and respiratory systems, negatively influencing the AKSS scores[26].

Limitations of the study

The limitation of this study concerns its limited time and consequent reduction of the sample size in the different moments of evaluation, as it is known that the re-establishment of the clinical conditions implies in discharge from the post-anesthesia care unit. The results indicate the need for future studies to extend the knowledge about the subject.

Contributions to the field of Nursing

Perioperative nursing aims to ensure the safety and quality of the care provided to surgical patients. The authors understand that evidence-based practice includes standardized processes, which promote patient safety. Thus, the knowledge of the variables that can influence the clinical conditions for discharge and, consequently, the length of stay in the post-anesthesia care unit, is essential.

The results of this study indicate that it is fundamental for nurses of the post-anesthesia care unit to have knowledge of the Aldrete-Kroulik Scoring System, in addition to other factors that also influence the patients' recovery, ensuring their safety and the quality of care.

CONCLUSION

This study made it possible to conclude that type of anesthesia and pain negatively affect the score of the Aldrete-Kroulik Scoring System. These findings indicate the need for new studies that include new variables in the evaluation of patients as a criterion for discharge from the post-anesthesia care unit. It is expected that this investigation subsidizes the creation of protocols for the development of safe and optimal clinical practices in the context of post-anesthesia recovery.

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