Comparative analysis of vital signs in acutely hospitalized patients according to the pain intensity

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ABSTRACT

Objectives: A relevant aspect in hospitalized patient is pain intensity measurement. The objectives were firstly the identification of associated variables to pain and secondly if there was any association between the intensity of pain and the modification of the vital signs.

Materials and methods: The present research was a cross-sectional study was carried out in diferent areas of acute hospitalization in the University Hospital La Paz. Main variable was intensity of pain measured with numeric verbal scale, and secondary variables were vital signs, body temperature, systolic blood pressure, diastolic blood pressure, mean arterial pressure, heart rate, capillary blood glucose and oxygen saturation from the data obtained in the hospital monitoring instruments. The Student’s T test was used for comparison between groups. The effect size was measured by the Cohen d and the association size by the Pearson r.

Results: A total of 180 patients were included. No statistically significant differences were found for any of the vital signs according to pain intensity levels (p > 0.05) divide in two groups. No statistically significant differences were found between pain intensity and the moment to collect measurements (morning/afternoon/evening) (p > 0.05). No statistically significant associations were found between pain intensity and vital signs except a statistically significant weak and negative association was observed between the diastolic blood pressure and the intensity of pain. No statistically significant differences were found between pain intensity and the moment to collect measurements (morning/afternoon/evening) (p > 0.05). No statistically significant associations were found between pain intensity and vital signs except a statistically significant weak and negative association was observed between the diastolic blood pressure and the intensity of pain.

RESUMEN

Objetivos: El dolor es un aspecto de amplia repercusión en la calidad de vida de los pacientes y se ha propuesto incluirlo entre las constantes o signos vitales para que sea siempre recogido en la evaluación del paciente hospitalizado. El objetivo principal del presente estudio fue evaluar las constantes vitales en función de la intensidad de dolor en pacientes agudos hospitalizados, y el objetivo secundario fue observar si existen posibles asociaciones entre la intensidad del dolor y las constantes vitales.

Material y métodos: El presente estudio fue un estudio transversal realizado en diferentes áreas de hospitalización aguda en el Hospital Universitario La Paz. La variable principal fue la intensidad de dolor y las variables secundarias fueron las constantes vitales: temperatura corporal, tensión arterial sistólica, tensión arterial diastólica, tensión arterial media, frecuencia cardíaca, glucemia capilar y saturación de oxígeno. Se utilizó la prueba t de Student para comparación entre grupos. El tamaño del efecto se midió mediante la d de Cohen y el tamaño de asociación mediante la r de Pearson.

Resultados: Se incluyeron un total de 180 pacientes. No se encontraron diferencias estadísticamente significativas para ninguna de las constantes vitales en función a los niveles de intensidad de dolor (p > 0.05) divididos en 2 grupos. Tampoco se hallaron diferencias estadísticamente significativas entre las constantes vitales en función de la intensidad de dolor en el turno de mañana, tarde y noche (p > 0.05). No se hallaron asociaciones estadísticamente significativas entre la intensidad de dolor y las constantes vitales, excepto...
INTRODUCTION

Currently, pain is considered a major public health problem (1). The prevalence of chronic pain in Spain is estimated to be at 17% according to the scientific literature, presenting a great impact at an economic, social and personal level (2). Pain is the main reason for consultation in hospital emergency services and, in addition, inpatients have high rates of pain (3,4). The prevalence of pain in inpatients affects directly the hospitalization process, delaying recovery and, therefore, increasing the use of hospital resources (5).

The presence of pain in inpatients is widely related to the pathological process of the patient, finding high rates of pain in acute patients, both by healing processes and in postsurgical patients (6). Therefore, monitoring and control of pain in acutely hospitalized patients is presented as a relevant measure, being pain considered as the fifth vital sign (7). The most commonly used tools to assess pain intensity are self-reported subjective scales. Scales commonly used in pain measurement, such as the visual analog scale or the verbal numerical scale, offer a mainly subjective assessment of pain and require the patient's collaboration and ability to communicate. Therefore, currently, other measures are sought to allow a measurement that offers larger objectivity and reliability of pain intensity. One of these measures are the vital signs or physiological variables, which have been suggested as indicators of the increased activity of the sympathetic-excitatory nervous system in the presence of pain (8).

The hypothesis of the present study states that acute pain could modify some of the vital signs and these signs could be used for the measurement of pain. Therefore, the main objective of the present study was to evaluate the vital signs according to the intensity of pain in acute inpatients. The secondary objective was to analyze the relationship between pain intensity and vital signs in patients with mild or moderate-severe intensity of pain.

MATERIAL AND METHODS

Study design

The present research was an observational cross-sectional study following the design of the STROBE statement for observational studies (10). The study protocol was previously approved by the Clinical Research Ethics Committee of La Paz University Hospital (PI: 2283); an encoding that prevented the violation of the participants' right to anonymity.

Participants

All the information of the participants was obtained at different acute admission areas of La Paz University Hospital of the Community of Madrid. The inclusion criteria were the following: a) acutely hospitalized patients whose stay was equal to or more than 48 hours and, b) adults (> 18 years old). The measurement and recording of all the variables studied was performed at the same time. The exclusion criteria were the following: a) patients admitted to chronic units, b) minor patients (under 18 years of age) and c) patients with a medical diagnosis of chronic degenerative musculoskeletal pathology.

Procedures

The data collection was performed at La Paz University Hospital of the Community of Madrid between February and March 2017. A simple random sampling was performed among patients admitted to acute care units between 2012 and 2015 (last 3 years available...
at the time of the study), who met the inclusion criteria of the study.

Main variable: pain intensity

The assessment of pain intensity was performed from the data obtained by the healthcare staff using the verbal numerical scale (VNS) [11,12] on a scale from 0 to 10, being 0 “painless” and 10 “the worst pain imaginable”. The patient was asked what would be the score that would assign to his/her level of pain at that moment.

The median of the results obtained for the pain intensity variable (m = 4) was calculated to classify the sample according to the levels of pain perceived by acutely admitted patients, considering mild pain when the VNS score was below 4 points, and moderate-severe pain when the score was greater than or equal to 4 points. We analyzed the data of 180 patients, which were divided into two groups, a group with mild pain (n = 87) and a group with moderate-severe pain (n = 93). In addition, the sample was divided between the morning, afternoon and evening shifts in order to verify the existence or not of differences in pain intensity at different time slots.

Secondary variables

Body temperature (T) was measured in the axillary region and in degree Celsius [13] according to the existing protocols.

Blood pressure was measured and divided into three variables [systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial pressure (MAP)], and a standardized formula was used to calculate blood pressure: (2 x DBP + SBP)/3. The millimeters of mercury were used as a unit of measure (mmHg) for all of them [14].

The heart rate (HR) was measured in beats per minute [15]. Capillary glucose (CG) in milligrams per deciliter (mg/dl) [16] and capillary oxygen saturation (SpO2) data were collected as percentages [17], according to previously published protocols.

The assessment of these vital signs was performed using the hospital monitoring equipment, the Dinamap Carescape V100 multiparameter monitor and the Welch Allyn Propaq C5 monitor; recorded according to manufacturer’s protocols and obtaining the average of several measurements.

Sample size calculation

A bivariate normal correlation model corresponding to the GPower software of the University of Düsseldorf was used (version 3.1.9.2) for the calculation of the sample size. Assuming an α error of 0.05, a power of 95% and a possible association size of r = 0.25 (obtained from a previous pilot analysis on 30 records between the pain intensity variables and the DBP), a total of 170 records would be needed to detect statistically significant differences.

Statistical analysis

The statistical package for social sciences (SPSS 22, SPSS Inc., Chicago, IL, U.S.A.) was the software used for the statistical analysis. The level of significance for all tests was established at p < 0.05. In the data analysis, descriptive statistics were used to show the data of the continuous variables that are presented as mean ± standard deviation (SD), 95% confidence interval (CI) and relative frequency (percentage) in the case of categorical variables. Because each group consisted of more than 30 participants, it was decided not to perform the normality tests and to use parametric tests according to the central limit theorem [18]. Even so, it was found that the variables followed a normal distribution using a Kolmogorov-Smirnov test. The Student’s t test for independent samples was applied as a statistical test to compare the continuous variables between both groups. The effect size (Cohen’s d) was calculated for the variables studied. According to the Cohen’s method, the effect was considered small (0.20 to 0.49), medium (0.50 to 0.79) or large (> 0.8) [19].

The Pearson’s correlation coefficient was used to test the correlations between quantitative variables. A Pearson’s correlation coefficient greater than 0.60 indicates a strong correlation, a coefficient between 0.30 and 0.60 indicates a moderate correlation, and a coefficient less than 0.30 indicates a weak correlation.

RESULTS

Regarding the descriptive data, statistically significant differences were found regarding pain intensity (p < 0.001), but no differences were found regarding age or sex (p > 0.05) (Table I).

No statistically significant differences were found for any of the vital signs according to pain intensity levels (p > 0.05) (Table I). In addition, we analyzed whether there were statistically significant differences in the vital signs according to pain intensity depending on the shift in which the measurements were conducted. No statistically significant differences were found in the vital signs based on the pain intensity in the morning, afternoon and evening shifts (p > 0.05).

Finally, with regard to the analysis of correlations, no statistically significant correlations were found between the variables of age, temperature, SBP, MAP, HR, CG and SpO2 in relation to the intensity of pain perceived by acutely admitted patients (p > 0, 05). However, a weak negative statistically significant association was obtained between the DBP and the pain intensity perceived by the patients (r = -0.219, p = 0.032) (Table III).

DISCUSSION

The main objective of the present study was to evaluate the vital signs according to the pain intensity in acutely hospitalized patients. The results of this study suggest that there are no differences in vital signs based on the intensity of pain in acutely hospitalized adults, regardless of whether they present mild pain or moderate-severe pain.
The results obtained are consistent with those described in most of the scientific literature. Daoust et al. conducted a cohort study, where they did not find differences between vital signs and pain in patients in the emergency department (20). Furthermore, Bruijns et al. conducted an investigation in which they subjected healthy subjects to an acute painful process, finding that the perception of pain by the participants was not related to a variation in vital signs (21). In addition, Ledowski et al. did not find significant correlations between postsurgical pain intensity and hemodynamic and neuroendocrine changes recorded in the resuscitation units, suggesting that the absence of variation in vital signs or autonomic variables should not be interpreted as guaranteeing the absence of significant pain (22).

In contrast, Bendall et al. conducted a study where they found associations between the vital signs, respiratory rate, HR and SBP with respect to pain intensity, although these associations were weak. In addition, they obtained that the increased respiratory rate was a predictor of the presence of severe pain (23). The value of the mean pain intensity obtained in the mentioned study was 8 points in the VNS, while the values of the means obtained in the present study were

<table>
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<th>DESCRIPTIVE DATA OF THE SAMPLE</th>
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<tr>
<td>Variables</td>
<td>Mild pain (n = 87)</td>
</tr>
<tr>
<td>Age (years)</td>
<td>63.58 ± 18.56</td>
</tr>
<tr>
<td>Pain (VNS)</td>
<td>3.00 ± 0.76</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
</tr>
<tr>
<td>Man</td>
<td>42 (48.3)</td>
</tr>
<tr>
<td>Woman</td>
<td>45 (51.7)</td>
</tr>
</tbody>
</table>

*p < 0.05. †p < 0.001. Values expressed as mean ± standard deviation and n (%). VNS: verbal numerical scale (0-10).

<table>
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<th>TABLE II</th>
<th>INTER-SUBGROUP ANALYSIS ACCORDING TO PAIN INTENSITY USING STUDENT’S T TEST</th>
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<tr>
<td>Variables</td>
<td>Mild pain (n = 87)</td>
</tr>
<tr>
<td>T (ºC)</td>
<td>36.11 ± 0.59</td>
</tr>
<tr>
<td>SBP (mmHg)</td>
<td>122.38 ± 20.48</td>
</tr>
<tr>
<td>DBP (mmHg)</td>
<td>70.94 ± 11.33</td>
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<tr>
<td>MAP (mmHg)</td>
<td>88.08 ± 13.27</td>
</tr>
<tr>
<td>HR (bpm)</td>
<td>79.55 ± 15.82</td>
</tr>
<tr>
<td>CG (mg/dl)</td>
<td>123.27 ± 34.45</td>
</tr>
<tr>
<td>Sp02 (%)</td>
<td>94.94 ± 3.28</td>
</tr>
</tbody>
</table>

*p < 0.05. †p < 0.001. CI: confidence interval. T: temperature. SBP: systolic blood pressure. DBP: diastolic blood pressure. MAP: mean arterial pressure. HR: heart rate. CG: capillary glucose. Sp02: capillary oxygen saturation. mmHg: millimeters of mercury. bpm: beats per minute.

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<tr>
<th>TABLE III</th>
<th>ANALYSIS OF PEARSON’S CORRELATIONS</th>
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<tr>
<td>Variables</td>
<td>Mild pain (n = 87)</td>
</tr>
<tr>
<td>Age (years)</td>
<td>0.091</td>
</tr>
<tr>
<td>T (ºC)</td>
<td>-0.080</td>
</tr>
<tr>
<td>SBP (mmHg)</td>
<td>-0.058</td>
</tr>
<tr>
<td>DBP (mmHg)</td>
<td>-0.219*</td>
</tr>
<tr>
<td>MAP (mmHg)</td>
<td>0.125</td>
</tr>
<tr>
<td>HR (bpm)</td>
<td>-0.004</td>
</tr>
<tr>
<td>CG (mg/dl)</td>
<td>0.188</td>
</tr>
<tr>
<td>Sp02 (%)</td>
<td>-0.104</td>
</tr>
</tbody>
</table>

*p < 0.05. †p < 0.001. T: temperature. SBP: systolic blood pressure. DBP: diastolic blood pressure. MAP: mean arterial pressure. HR: heart rate. CG: capillary glucose. Sp02: capillary oxygen saturation. PI (VNS): pain intensity (verbal numerical scale). bpm: beats per minute. me: median.
3 in the group of mild pain, and 5.37 in the group of moderate-severe pain, both less than 8 points. In this regard, the results of a review of the current scientific literature about the procedures for assessing the intensity of pain in adult patients in intensive care units suggests that the variations of vital signs in the presence of severe pain represent a reliable way to estimate its intensity (24). Therefore, based on the results of the present study and those found in current scientific evidence, the authors suggest that the use of vital signs in the presence of mild-moderate pain are not reliable for predicting the intensity of pain; however, there is controversy regarding the presence of severe pain, because studies in favor, but also against this estimate have been found. Therefore, more studies and of higher methodological quality are needed to give solid answers to this question.

Moreover, the measurement of vital signs in newborn infant patients is also an aspect that has been studied in the scientific literature, suggesting that this is a reliable way to estimate pain intensity, unlike that found in the literature regarding adult patient. In fact, the vital signs, in conjunction with the behavioral aspects in this newborn population, are widely used for the evaluation of the intensity of infant pain (25,26). The authors of this study suggest that the differences between the infant population and the adult population regarding the differences between the vital signs and the intensity of pain may be motivated by cognitive-evaluative and affective-emotional aspects present to a greater extent in the adult patient. In this regard, Block et al. found that catastrophic thoughts have a larger relationship with respect to pain than vital signs, thus giving a possible explanation to the differences found in the validity of these constants between the adult patient and the infant patient (27).

LIMITATIONS OF THE STUDY

There are limitations in the present study that should be taken into account for the interpretation of the results.

First, the mean pain intensity in the moderate-severe pain group was 5.37 points in the VNS. It would have been interesting to obtain a sample with higher scores on pain intensity in order tosegment it into moderate pain (between 3 and 6 points) and severe pain (≥ 6 points) because, despite studies analyzing the relationships between vital signs and pain intensity are not available to date in Spain, the main controversy described in the current scientific literature is found in acutely hospitalized adults who present severe pain.

Secondly, all the patients included in the present study presented acute pain and were undergoing analgesic pharmacological treatment according to the intensity of pain presented and the relevant medical assessment. However, records of other types of medication added due to causes other than pain management were not included.

Furthermore, the results of the present study should be taken with caution, since neither the total clinical characteristics of the patients nor the exact treatment for their pain were recorded, and which in turn could be interfering with the evaluation of the vital signs.

Finally, due to the design of the study itself, it was impossible to determine the exact time of the measurements, as well as the age and/or experience of the professionals who obtained the non-monitored variables.

CONCLUSIONS

Based on the results obtained in the present study, there are no differences in the vital signs according to the intensity of pain. Variations in vital signs do not appear to be a reliable estimate of pain intensity in patients with mild or moderate-severe pain. Prospective analyzes are needed to confirm these results.

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CONFLICT OF INTEREST

The authors of the present study have no conflict of interest to declare.

REFERENCES