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GLYCEMIC AND PRESSURE CHANGES IN CRITICALLY ILL PATIENTS

ALTERAÇÕES GLICÊMICAS E PRESSÓRICAS EM PACIENTES CRÍTICOS

CAMBIOS GLUCÉMICOS Y PRESÓRICOS EN PACIENTES CRÍTICOS

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ABSTRACT

***Objective*:** to describe the repercussions of glycemic and pressure variations in hypertensive and diabetic patients. ***Method*:** quantitative, descriptive, and exploratory study with 14 patients admitted to the intensive care unit (ICU). A structured questionnaire was used to collect data. A result with $p < 0.05$ was considered significant. ***Results*:** 78.5% of the patients were hypertensive and 43% were diabetic. The hospitalization period was 66±84 days and the mechanical ventilation period was 70±95 days. The Acute Physiology and Chronic Health Disease Classification System II (APACHE II) with 26±4 signaled the patients' severity. Capillary glycemia, length of hospital stay, and mechanical ventilation time were significantly associated with the worst outcome/death ($p \leq 0.05$). ***Conclusion*:** one of the repercussions of glycemic and pressure changes was associated with risk for kidney injury. Besides, the lack of a safe and effective glycemic control has led patients to the worst outcome/death. Nurse participation is highlighted not only to control glycemic oscillations, but also to provide safe care and help decision making, in order to increase patient survival and ensure effective and good-quality care. ***Descriptors*:** Blood Glucose; Hypertension; Nursing; Intensive Care Units; Health Evaluation; Mortality.

RESUMO

Objetivo: descrever as repercussões das variações glicêmicas e pressóricas de pacientes hipertensos e diabéticos. ***Método***: estudo quantitativo, descritivo e exploratório, com 14 pacientes internados na unidade de terapia intensiva (UTI). Utilizou-se questionário estruturado para coleta de dados. Considerou-se significativo resultado com $p < 0,05$. ***Resultados*:** 78,5% dos pacientes se caracterizavam como hipertensos e 43% diabéticos. O período de internação compreendeu 66±84 dias e o período de ventilação mecânica foi de 70±95 dias. O Acute Physiology and Chronic Health Disease Classification System II (APACHE II) de 26±4 sinalizou a gravidade dos pacientes. Glicemia capilar, tempo de internação e de ventilação mecânica se associaram significativamente ao pior desfecho/óbito ($p \leq 0,05$). ***Conclusão*:** uma das repercussões das alterações glicêmicas e pressóricas se associou ao risco de lesão renal. Além disso, a inexistência de um controle seguro e eficaz da glicemia conduziu os pacientes ao pior desfecho/óbito. Destaca-se a participação do enfermeiro não apenas para controlar as oscilações glicêmicas, mas também proporcionar um cuidado seguro e auxiliar a tomada de decisão, a fim de aumentar a sobrevida do paciente e garantir uma assistência eficaz e de qualidade. ***Descritores*:** Glicemia; Hipertensão; Enfermagem; Unidade de Terapia Intensiva; Avaliação em Saúde; Mortalidade.

RESUMEN

***Objetivo*:** describir las repercusiones de las variaciones glucémicas y presóricas de pacientes hipertensos y diabéticos. ***Método*:** estudio cuantitativo, descriptivo y exploratorio con 14 pacientes que ingresaron en la unidad de cuidados intensivos (UCI). Se utilizó un cuestionario estructurado recogida de datos. Un resultado con $p < 0,05$ se consideró significativo. ***Resultados*:** 78,5% de los pacientes se caracterizaban como hipertensos y 43% como diabéticos. El período de hospitalización fue de 66±84 días y el período de ventilación mecánica fue de 70±95 días. El Acute Physiology and Chronic Health Disease Classification System II (APACHE II) de 26±4 señaló la gravedad de los pacientes. Glucemia capilar, tiempo de hospitalización y de ventilación mecánica se asociaron significativamente con el peor resultado/la muerte ($p \leq 0,05$). ***Conclusión*:** una de las repercusiones de los cambios glucémicos y presóricos se asoció con el riesgo de lesión renal. Además, la inexistencia de un control glucémico seguro y eficaz ha llevado a los pacientes al peor resultado/la muerte. La participación del enfermero se destaca no solo para controlar las oscilaciones glucémicas, sino también para proporcionar un cuidado seguro y ayudar a la toma de decisiones, a fin de aumentar la supervivencia del paciente y garantizar una atención eficaz y de buena calidad. ***Descriptores*:** Glucemia; Hipertensión; Enfermería; Unidades de Cuidados Intensivos; Evaluación en Salud; Mortalidad.

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INTRODUCTION

Diabetes mellitus (DM) and systemic arterial hypertension (SAH) stand out as prevalent chronic conditions that are difficult to control and major public health issues in all countries, especially in developing countries.[1] In spite of the advances in science and therapeutics, as well as in the systems of promotion and prevention, chronic noncommunicable diseases are progressing. In this perspective, one of the factors related to such a progression is associated not only to the age pyramid inversion, but also to often seeking medical care on a late basis, i.e. when the disease is in advanced stages or in the case of complications, too.

Diabetes mellitus type II (DM2), as a chronic multifactorial disease, represents one of the major health issues in the world. Brazil is estimated to have more than 13 million DM2 patients, and this number is expected to increase up to 2035.[1]

DM is known to be characterized by a chronic increase in blood glucose levels, however, hyperglycemia conditions are common in severely ill, non-diabetic, patients. This change is often associated with the physiological response due to trauma/stress, as well as increased metabolic demands, and the most of the cases are followed up by means of increased production and insulin secretion.[2]

Glycemic variability is a condition often experienced in the intensive care unit (ICU), since the stress response is complex and dynamic, making safe and effective glycemic control difficult. Difficulty in obtaining effective glycemic control is considered an independent variable related to increased mortality.[3-4] This fact has motivated one of the strands in this study.

Increased glycemic levels in critically ill patients is a consequence of increased liver gluconeogenesis due to the action of counterregulatory hormones, as well as increased glycemic supply, release of pro-inflammatory mediators, besides the use of enteral and parenteral diets, dialytic solutions, glucocorticoids, and vasoactive substances.[5] The release of pro-inflammatory factors, such as interleukin 6 and alpha tumor necrosis factor, as a stress response, triggers the loss of sensitivity of peripheral insulin-dependent tissues to insulin, which determines resistance to this hormone, resulting in hyperglycemia.[2]

In turn, hypoglycemia is related to increased risk of death and prolonged period of ICU stay. Even in the mild condition, in critically ill patients, it is associated with a worse prognosis, although glycemic control protocols culminate in hypoglycaemia, which is considered a frequent side effect.[6-8]

On the other hand, in the critical patient care setting, there is significant evidence that glycemic control contributes to reduced morbidity and mortality.[3] According to the current recommendations of the American Diabetes Association (ADA), glycemic values for critical patients should include the interval from 110 mg/dL (6.1 mmol/L) to 180 mg/dL (10 mmol/L).[9]

In the scenario of non-communicable chronic diseases, SAH stands out as a sustained elevation in blood pressure > 140/90 mmHg and it affects around 36 million Brazilians, determining metabolic disorders and changes in target organs.[10]

Developing countries, despite accumulating greater absolute numbers of people with hypertension, suffer greater impact from the increasing burden of chronic diseases.[11-2]

Uncontrolled hypertension culminates in huge public health costs.[13] In the United States of America (USA) nearly 1 in 5 young men and 1 in 6 young women have high blood pressure, which increases the risk of heart failure, stroke, acute myocardial infarction, and chronic kidney disease.[10,14]

In ICUs, it is not uncommon to find patients with glycemic, blood pressure, and metabolic alterations[2], whether they are due to DM and SAH or not.[15] The number of critical patients admitted to these units has increased and, in parallel with this, there is a need to determine the clinical profile to establish rather individualized behaviors, inclusion and adequacy of protocols and, consequently, better distribution of resources aiming at good-quality care.[15-6]

OBJECTIVE

- Describe the repercussions of glycemic and pressure variations in hypertensive and diabetic patients.

METHOD

This is a quantitative, descriptive, and exploratory study conducted at the general ICU of a large public hospital, located in the Brazilian Federal District and belonging to the Brazilian National Health System (SUS).

Fourteen patients aged over 18 years with a period of hospital stay longer than 24 hours were chosen by convenience sampling. Those lacking a record of at least 1 glycemic or blood pressure alteration event were excluded. For data collection, a structured questionnaire has been adopted, consisting of

around 44 items, namely: data on patient identification (demographic and clinical characteristics), hemodynamic, laboratory, and vital sign control records. Information was obtained through each patient's electronic medical record, within the period from February to July 2017.

The outcome considered were: discharge to return home or go to another sector; permanence at the ICU, for those who remained hospitalized until the end of data collection; and death, for patients who died during the data collection period.

Data on hemodynamics, positive end-expiratory pressure (PEEP), and mechanical ventilation time were extracted from the patient's daily clinical control information stored in the electronic medical record. The highest and lowest alterations in capillary blood glucose and systemic blood pressure within the first 24 hours were registered, as well as those referring to the 15th day of ICU stay (last data collection day). The reference values for blood pressure (> 140/90 mmHg) and capillary glycemia (≥ 180 mg/dL).[1,10]

During follow-up, serum creatinine values were registered for posterior stratification of the renal function impairment degree in patients, according to the Kidney Disease Improving Global Outcome (KDIGO) classification.[17]

This study has been approved by the Research Ethics Committee of the University of Brasília (UnB) and the Health Science Teaching and Research Foundation (FEPECS) under the Brazilian Certificate of Submission for Ethical Assessment (CAAE) No. 57037516.3.0000.0030, complying with Resolution CNS No. 466/2012.

During data collection, the variables were registered in the worksheet on the software *Microsoft Excel*. Subsequently, after exporting data to the software *Statistical Package for the Social Sciences* (SPSS), version 23.0, the analysis of variables was performed. Data are expressed as absolute frequency (n), relative frequency (%), mean, median, minimum and maximum, and standard deviation. For inferential analysis, the Mann-Whitney test has been adopted. The *p* value < 0.05 was considered significant.

RESULTS

Out of the total of 14 patients, a homogeneous distribution was identified between men and women, i.e. 50% of women and 50% of men, with a mean age of 59±17 years. Mean arterial pressure regressed within the first 24 hours, initially represented by the value 100±22 mmHg, and later by 95±29 mmHg. The patients' oximetry showed no variation, remaining within the normal range. Mean capillary glycemia within the first 24 hours ranged from 161.3±68.3 mg/dL to 185.3 mg/dL ±120.3.

Among laboratory variables, only the serum glucose level was outside the normality curve, with a mean value 214±217 mg/dL. The other laboratory variables, such as serum sodium and potassium, remained within the normal range.

The ICU stay period was 66±84 days and the mechanical ventilation (MV) period lasted for about 70±95 days. The Acute Physiology and Chronic Health Disease Classification System II (APACHE II) corresponded to 26±4 for the patients, signaling patient severity. While half of the patients were discharged from the ICU, death was registered in 1/3 of the sample. Even so, a lower percentage (14.3%) remained hospitalized. The reason for hospitalization in almost 30% of the patients was characterized by the presence of pneumonia and sepsis. The PEEP remained virtually unchanged over the days observed, varying between 9 and 10 cmH_2O.

During the hospitalization period, acute kidney injury (AKI) stood out among the medical diagnoses, reaching 21.4% of the cases, followed by DM2, pancreatitis, and ischemic stroke, representing 14.3% of the cases, respectively. As each patient had more than 1 medical diagnosis, there were also cases of arrhythmia, diabetic ketoacidosis, diabetes mellitus type I (DM1), pleural effusion, dysphagia, atrial fibrillation, chronic liver disease, acute myocardial infarction, abdominal surgical wound infection, congestive heart failure, sepsis, Mallorys-Weiss syndrome, and diabetic ulcer, which accounted for 7.1%, each.

SAH stood out among comorbidities (78.5%). On the other hand, 43% reported a history of DM and 28.5% had SAH and DM combined. In a smaller percentage, there were 14.3% of patients with chronic obstructive pulmonary disease (COPD) and ischemic stroke. However, there were other comorbidities, such as chronic hepatopathy, stroke, gout, obesity, heart disease, dialytic chronic kidney disease, osteoarthrosis, nephropathy, and alcoholism, with 7.1%, each.

Antibiotics stood out as the only pharmacological class administered in all 14 patients. Less than half of the patients (42.6%) were given antihypertensive drugs, followed by hypoglycemic agents and anticoagulants in 28.5% of the cases, and anticonvulsant in 21.4% of the patients. In

addition, analgesic, loop diuretic, antiemetic, benzodiazepine, and vasopressor drugs were given to each 14.3% of the patients.

The serum creatinine dose on the first day of hospital stay was high and it reached the value 3.6±2.5 mg/dL; on the second day, a reduction (3.2±2.1 mg/dL) was identified; and on the third day day of hospital stay, this reduction was more marked (2.3±1.5 mg/dL). Based on these values, the patients were assessed for the renal impairment stage, according to the KDIGO classification. Most of the patients (55.5%) were identified at risk for kidney injury, almost half (44.4%) with renal failure, and almost 1/4 (22.2%) with kidney injury itself.

The length of hospital stay, the mechanical ventilation time, and capillary glycemia (1-day follow-up) were significantly associated (*p* value < 0.05), with the worst outcome for patients (death) (Table 1).

Table 1. Relation of demographic and biological and ventilatory variables to the worst outcome (death) patients. Brasília (DF), 2017.

Variables	Outcome (death)	
	Median (25-75)	*P* value
Age (years)	65 (56-72)	0.2
APACHE II	26 (20-29)	0.8
Length of hospital stay (days)	57 (47-65)	0.04
VM time (minutes)	57 (52-65)	0.05
Capillary glycemia (mg/dL – 1st day)	155 (154-185)	0.04
Capillary glycemia (mg/dL - last register)	179 (132-241)	0.2

VM = invasive mechanical ventilation; PEEP = positive end-expiratory pressure; APACHE II = Acute Physiology and Chronic Health Disease Classification System II; Mann-Whitney test.

DISCUSSION

The current context, as well as the age group profile of this study, confirms that the Brazilian population has been characterized by a progressive increase in population aging and, consequently, a higher incidence of chronic degenerative diseases.[18]

The mortality identified in this study was high in 1/3 of the patients and this may be interpreted as one of the consequences of the high APACHE II value. It should be recalled that the score 26 in this classification system indicates an estimated 55% chance of death, a common feature considering the severity of patients admitted to the ICU.[19]

There are more than 13 million individuals with DM in Brazil, corresponding to 6.9% of the country's population, and this figure represents an ever-increasing scale. Likewise, SAH affects more than 32% of the adults and more than 60% of the Brazilian elderly.[1,10] The high incidence of chronic conditions is associated with population aging and poor eating habits, as well as physical inactivity. The figures published in the literature are equivalent to those obtained in our study, where 43% of the patients reported DM and 78% reported SAH.

The combination of SAH and DM can be lethal due to the increased risk of acute myocardial infarction, stroke, and kidney disease. It is noteworthy that smoking increases the risk of DM and SAH. The chances of evolving with acute myocardial infarction or stroke are multiplied if there are other risk factors, besides DM and SAH, as in our study, many patients accumulated several comorbidities, predisposing to an increased mortality rate.

The importance of glycemic control, as well as controlling blood pressure and hemodynamic variables, for better prognosis of critically ill patients, stood out among the results found in this study. The hyperglycemia condition, in spite of representing an expected response associated with stress in critically ill patients, alters the body's functions, causing an increased risk of mortality in these patients. Strict and severe glycemic control is also related to the increased mortality[2], considering that it may predispose to hypoglycemia conditions.

A retrospective study conducted within the period from 2010 to 2014 demonstrated the association between mortality and glycemic lack of control in patients admitted to the ICU.[20] Likewise, in this study, altered glycemic values were directly related to the worst outcome for patients ($p < 0.05$). In addition to altered glycemic values, the length of hospital stay and the mechanical ventilation time were also significantly associated ($p < 0.05$) with hospitalized patients' death.

In this study, comorbidities differed significantly between patients, and the most frequent reason for hospitalization was pneumonia, sepsis, and AKI. Pneumonia stands out as one of the most frequent pathologies in ICU patients, a fact that may be associated

with mechanical ventilation time, as well as prolonged length of hospital stay.[21]

AKI is a common condition in critical patients. In addition, it is recognized as an independent risk factor for increased morbidity and mortality among patients with DM and SAH. A finding also identified in this study, where more than half of the patients had at least risk for kidney injury and 44% of the patients were at the renal failure stage. However, it is known that AKI is multifactorial, asymptomatic, and difficult to predict, something which encourages the preparation of initiatives and deployment of protocols that anticipate the identification of this pathology.[17]

For patients with kidney disease, decreasing blood pressure is the most effective measure to minimize the risk of cardiovascular disease and slow the progression of kidney damage, regardless of the antihypertensive drug used.[17]

In the general context, DM and SAH are often associated and characterized by substantial overlapping of the etiology and mechanisms of each disease.[22] Physical activity plays a major protective role in both pathologies. Thus, knowing the common causes and the mechanisms of these pathologies allows a rather effective, proactive, and targeted approach to prevention and treatment.

The limitations of this study consisted in the fact that it was developed in a single institution and in the reduced turnover of ICU patients, restricting the sample size.

CONCLUSION

The study patients were characterized by elderly individuals who accumulated comorbidities and, consequently, had a higher risk of death. One of the repercussions of glycemic and pressure alterations was associated with the risk of kidney injury. Moreover, the lack of a safe and effective glycemic control has led patients to the worst outcome/death.

Nurse's participation stands out not only to control glycemic oscillations, but also to provide safe care and help decision making, in order to increase patient survival and ensure effective and good-quality care.

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