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IMPORTANCE OF CAPILLARY GLYCEMIA IN DIABETIC PATIENTS WITH ACUTE PATHOLOGY

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ABSTRACT

Objectives: This study aimed to verify the importance of the control of the values of capillary blood glucose in diabetic patients hospitalized for acute pathology, in an Observation Service (OS) of adults of a Portuguese Urgent Care unit. **Methods**: Primary, exploitative, descriptive, and retrospective study carried out with 109 patients, between January 1 and September 30, 2014. Data were collected for a week following the guidelines of a data collection protocol. The data were then inserted in a grid in Excel, which allowed their statistical analysis. **Results**: The highest values of capillary blood glucose and presence of hypoglycemia were correlated with an increased need of hospitalization and mortality of patients. **Conclusions**: We concluded that the control of the values of capillary blood glucose in diabetic patients, hospitalized for acute pathology, is of utmost importance to ensure the best outcome.

Keywords: Diabetes mellitus; blood glucose; evaluation of results of patient care; hospital emergency service.

INTRODUCTION

Increase of the average life expectancy and adoption of Western lifestyles increasingly sedentary and based on unhealthy diets has led to an increase in the incidence and prevalence of people with diabetes around the world. From 1980 to 2008 the number of diabetics has more than doubled, going from 153 to 347 million people affected[1]. Currently, according to latest data from 2013, it is estimated that the global prevalence is around 382 million individuals, which corresponds to 8.3% of the population. Only in 2013, diabetes will cause 5.1 million deaths, and in 2030 the estimate is that it will be the 7th cause of death around the world, when the estimated prevalence will be of 472 million people[2,3].

Since the 1970s, in Portugal, a National Program for the Prevention and Control of Diabetes is in force, which has been adapted and reworked over the years[4]. Still, our country has the highest prevalence rates in Europe, with 12.9% of the population affected in 2012 (7.3% diagnosed + 5.6% not diagnosed), a value that reaches 27% in people aged between 60 and 79 years.

Recent studies carried out in Portugal warn that from all in-hospital deaths, 23.5% (11,367 patients) occurred in patients with a diagnosis of diabetes and that the fatality rate associated with this pathology has been on the rise in this context, in recent years (20.8% in 2009 and 23.5% in 2012)[3]. Likewise, the number of years potentially lost caused by diabetes presents an unfavorable evolution, being 72 years in 2001 and 82.9 years in 2009, per 100,000 inhabitants[5].

The average duration of hospitalizations associated with decompensations caused by diabetes and its complications is currently around 10 days, while for the remaining causes of hospitalization, this period is around 7.6 days[3].

Given the seriousness of the reality described, studies on diabetes and its complications in hospitalized patients have arisen all around the world. The latest scientific evidence point to the possibility of establishing a relationship between the level of hyperglycemia of patients and their outcome, demonstrating that, in the context of acute pathology, patients that exhibit higher values of blood glucose are those who demonstrate a most unfavorable clinic evolution. To ensure the best outcome, it is essential that nurses and physicians ensure adequate monitoring of the average values of capillary blood glucose, preventing sharp oscillation and occurrence of hypoglycemia[6].

In view of the provisions of the documents from the Quality Standards for Nursing Care[7], which assign responsibilities to the nurses in the prevention of complications and in the pursuit of excellence in the practice of the profession, and since blood glucose monitoring is a nursing intervention, provided for in the International Classification for Nursing Practice (ICNP) catalog[8], it seemed appropriate to carry out a study aiming at verifying the importance of the control of the values of capillary blood glucose in diabetic patients hospitalized for acute pathology in an observation service (OS) of adults in a Portuguese urgent care unit (UC). Thus, we intend to understand what is the glycemic pattern of diabetic patients hospitalized in the aforementioned context and what is its relationship with the clinical evolution of patients.

METHOD

A primary, exploratory, descriptive, and retrospective study was carried out, based on the query of diabetic patients hospitalized in a OS of Portuguese UC, from January 1 to September 30, 2014, in which capillary blood glucose was monitored. In this period, 444 hospitalizations were registered in the SO, in which patients underwent capillary blood glucose monitoring, and an average of 6 assessments per patient during their hospital stay were recorded. In order to better characterize the glycemic pattern of these patients, we decided to include only those patients who had a number of assessments higher than the average (≥ 7). This selection resulted in 149 episodes of hospitalization, but by consulting the electronic processes, we realized that even though all of them met these criteria, only 109 of the patients had diabetes previously identified as personal antecedent in the medical record, thus conditioning the sample to these elements.

The form for data collection aimed at the following variables: age, gender, specialty for which patients were admitted to the OS (medicine, surgery, orthopedics or another), duration of the hospital stay (in days), all the assessed values of capillary blood glucose (in mg/dl), the occurrence of hypoglycemia (capillary blood glucose<80 mg/dl), the type of prescribed diet (fasting, diet adapted for diabetes, or diet not adapted for diabetes), the primary diagnosis (according to the International Classification of Diseases – ICD 9), type of serum prescribed (physiological saline, glucose solution, or without serum intake), presence or absence of prescribe corticosteroids in repeated doses, values of the vital signs (VS) (systolic arterial pressure, heart rate, and temperature), and the destination of the patient at the time of transfer (home, infirmary, special care unit, or morgue).

The data collected were entered in a grid in Excel, thus allowing their statistical analysis. The data collection period lasted one week and was guided by a data collection form, which provided for the various conditions for each of the variables collected, to make the process uniform and with the smallest possible bias.

The values of capillary blood glucose were inserted into the above-mentioned database according to the time they were assessed (1 a.m., 7 a.m., 1 p.m., 7 p.m.) – these moments corresponded to the standard time of assessment of vital signs and capillary blood glucose at the OS where the study took place. It should be noted that these assessments always occurred before meals, in patients with prescribed diets.

Despite hypoglycemia being defined in Portugal as any value less than 70 mg/dl, by standard 002/2011 of the General Direction of Health (DGS)[9], we considered as hypoglycemia all values below 80 mg/dl, since this was the value set for the software (Alert) used in the

OS at the time of the study. For this reason, this was the value assumed by the nurses as the reference value for the decision-making in this regard.

Values of blood glucose of 126 mg/dl in fasting (night fasting) and 200 mg/dl in the other assessments were used as references for the crossing and analysis of data, since they are values used as criteria in the diagnosis of diabetes in Portugal[9].

To obtain a score of seriousness of the clinic situation of each patient, in order to test its correlation with the average values of capillary blood glucose, we followed the principles underlying the scale Modified Early Warning Score (MEWS), which assigns a numerical value to each of the VS, which increases according to its deviation regarding the normal range of values for each VS. The sum of these numerical values will be the final score. Since the electronic processes do not have access to all VS used by MEWS, this score cannot be purely calculated or called MEWS, as only the cited reasoning was applied to the available VS.

Finally, it is important to stress that this investigation complied with the ethics procedures contained in the Declaration of Helsinki, of the World Health Organization and the European Community, regarding investigation involving human beings. Institutional authorization was obtained by the Director and the Chief Nurse of the Service.

RESULTS AND DISCUSSION

Of the 109 episodes of hospitalization in the studied OS, 46.8% correspond to male diabetic patients and 53.2% to female patients, averagely aged 74 years (the younger patient was aged 29 and the older patient was 91 years old). Regarding the specialty for which these patients were admitted, 72.5% were hospitalized by medicine, 19.3% by surgery, 0.9% by orthopedics, and 7.3% by other specialties.

All patients from the sample had their capillary blood glucose monitored more than 6 assessments during hospitalization, and an average stay of 2.8 days in the OS. At the time of their transfer/discharge, 28.4% of patients went home, 54.1% to an infirmary, 11% to special care units at the hospital, and 5.5% to the morgue.

Various data were crossed to understand in depth the glycemic pattern of the patients. In the four standard daily assessment of capillary blood glucose moments in the OS, patients showed higher average values at 1 p.m. and 1 a.m., and the lowest average value was registered at 7 a.m. (night fasting). The average of all assessments was 206.5 mg/dl (Figure 1).

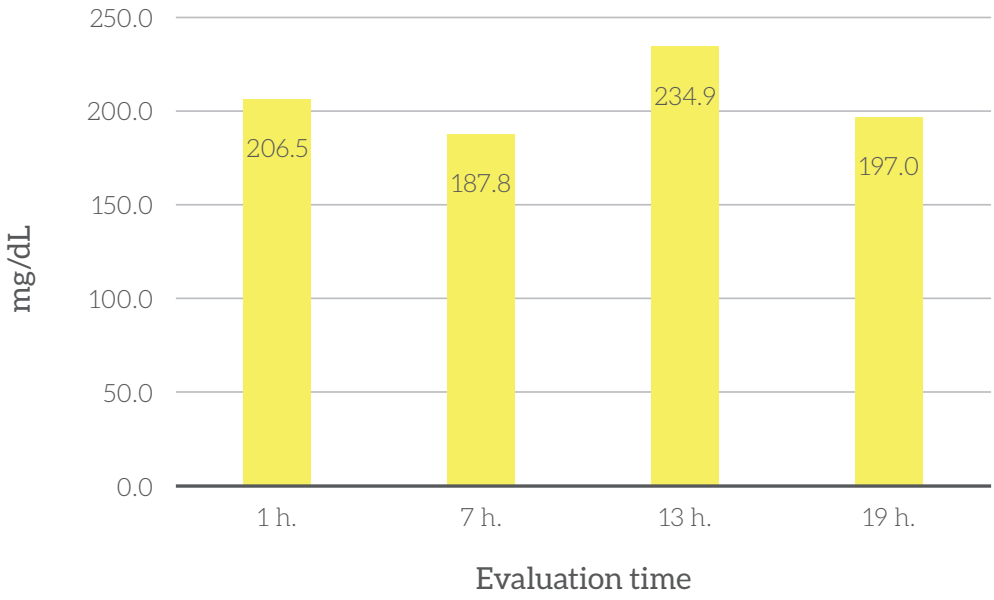

Figure 1 - Relação da glicemia capilar média com hora de avaliação.

Values of capillary blood glucose decreased from 1 p.m. to 7 p.m., which means that the treatment (insulin and/or oral antidiabetics) had some degree of effectiveness in this interval, despite the average values continuing to be higher than desired. However, from 7 a.m. to 1 p.m. and from 7 p.m. to 1 a.m., the average values of blood glucose rose considerably. We verified an average variation of 28.3 mg/dl among the four daily standard assessments of blood glucose moments. For many authors, more than the absolute values of capillary blood glucose, the oscillation among them is the factor that exerts greater influence on the patients' prognosis, which ends up being worse as the verified oscillation increases[6,10]. Among patients who suffered hemorrhagic cerebrovascular accident (CVA), those who showed an average variation of capillary blood glucose from 38.7 to 62 mg/dl, had worse outcomes than those in which the average registered variation ranged from 28 to 31.7 mg/dl[11].

About 47.7% of the patients of the sample presented a daily average blood glucose > 200 mg/dl and 86.2% presented average blood glucose ≥ 126 mg/dl at 7 a.m. We found that orthopedics was the specialty that presented the patients with greater decompensation of the average values of blood glucose (with 283.7 mg/dl) and that medicine was the specialty that managed to get better control of their patients (with an average daily rate of 202.5 mg/dl). In view of ICD-9, it was possible to observe that the diabetic patients admitted for circulatory pathologies, most prevalent group of the study (50.5%), were the ones who reported lower average values (191.3 mg/dl).

The glycemic pattern of the patients of the sample considerably exceeds the values advocated by the DGS, regardless of the time they were assessed and the specialty in which patients were admitted to the OS. It is scientifically proven that hyperglycemia is an adverse marker to patients' outcome and is, at the same time, an alterable factor that must be optimized[12]. A patient with acute pathology admitted to the surgical area must present glucose around, at most, 110 mg/dl; for a patient admitted to the medicine are, the value is of 140 mg/dl. In our study, patients of the surgical/orthopedics areas were precisely the ones who showed the highest average values of capillary blood glucose, contrary to the recommendations of these authors. As with the findings of another author, which proved that the fractures of femural neck caused stress hyperglycemia, we can assume that, by the data collected, this phenomenon also occurred in this study, as patients from the surgical specialties were the who presented higher average values[13].

Regarding the hospitalization time in the OS, we observed that as it increased, the values of capillary blood glucose tended to decrease (289.7 mg/dl for patients with a day of hospitalization and 202.2 mg/dl for patients hospitalized for over 5 days). It is important, however, to note that even though we verified a trend of decrease of the values, it was not a linear variation, with occurrence of a daily average variation of 39.1 mg/dl. In addition, the lower average values recorded over the several days of hospitalization continue to be higher than the values recommended by the DGS[9].

Analyzing hypoglycemia in the 109 studied patients, we found that it occurred only in 13 patients (11.9% of the sample) with average capillary blood glucose of 184.3 mg/dl. Of these patients, 15.4% were fasting, representing 18.2% of the total patients who were fasting; 38.5% had a diet adapted to diabetes, 8.5% of the total of patients with this diet; and 46.1% did not have an adapted diet, which means 15.4% of patients with this diet presented hypoglycemia.

Relating to the type of prescribed serum, we found that the episodes of hypoglycemia occurred in 16.7% of patients with glucose solution intake, in 13.6% of those who had PS in progress, and 7.3% of those who did not have any serum prescribed to them.

Regarding the average value of capillary blood glucose, we found that it was higher in patients with diet adapted to diabetes (211.6 mg/dl), while the lowest was 198.7 mg/dl in patients without an adapted diet. Fasting patients registered an intermediate value.

Regarding the prescribed serum therapy, patients with physiological saline intake (PS) were the ones who registered a higher average capillary blood glucose, in comparison with patients with glucose solution intake and with those who did not undergo any intake.

Relating diet with serum therapy, we noticed that the highest average values of capillary blood glucose were recorded in patients to whom PS was prescribed and who had a diet adapted to diabetes or who were fasting. The lower average values corresponded to patients under glucose solution and who had an adapted diet, and also those who did not have any infusion and who did not have an adapted diet. In general, given this analyzed relationship, it is possible to prove that the average values of capillary blood glucose were higher in patients who were fasting, than in those who had a prescribed diet.

Regarding corticosteroids, the average capillary blood glucose was always higher in patients whose prescription contemplated a management of these medicines repeatedly, regardless of the prescribed diet or considering the average value of all assessment or just the value of the 7 a.m. assessment (Table 1).

Table 1 – Average values of capillary blood glucose in function of diet and its relationship with the prescribed serum therapy/ corticosteroid therapy (mg/dL)

Therapeutics	Diet		
	Fasting	Adapted	Non-adapted
Average Serum therapy	207,3	207,1	203,5
Physiological Saline	210,5	234,6	202,2
Glucose solution	204,1	188,2	234,5
Without Serum	N/D	198,4	173,9
Corticosteroid therapy			
Yes	313,5	219,2	213,9
No	196,4	209,4	196,0

The results obtained regarding the diet, the type of serum, and the relationship between these two variables were not consistent with the theoretically expected results. Patients with fasting diet were those that showed a higher rate of hypoglycemia, on the one hand, and they also presented a higher average value of capillary blood glucose. On the other hand, patients with diets adapted to diabetes were the ones who presented a lower rate of hypoglycemia and were also those who showed higher average values of capillary blood glucose, even when the parenteral intake was made with PS. We would also like to highlight the curiosity that, patients who had their parenteral intake with glucose solution were the ones who presented higher hypoglycemia rates, while patients without parenteral intake presented the lowest rate. Therefore, two hypotheses can be made to explain the described phenomenon. On the one hand, there is the hypothesis that the diet adapted to diabetic patients had an excess of carbohydrates, requiring further adjustment. On the other, the nurses at the OS showed a defensive conduct concerning the therapeutic plan directed to blood sugar control, motivated by the fear of secondary inducement of hypoglycemia. This fear was documented mainly in the range between the 1 a.m. and 7 a.m. assessments (night shift). In this period, in patients without infusion of serum (without any carbohydrates intake), the decrease of capillary blood glucose was 3 times lower than in patients with infusion of glucose solution, which means that, for the previous, the values decreased mainly at the expense of the night fasting and not due to the therapeutic. For the average values of blood glucose to be around 126 mg/dl at 7 a.m., patients with glucose solution intake should have decreased their values 4.2 times more than the verified decrease. Regarding patients without serum intake, the decrease should be 8.6 times higher considering the observed reduction, which shows the hypoglycemia preventive conduct present in the night shift. This fear, evidenced by the nurses of the OS, originates on a valid reason, as it is documented that 78% of hypoglycemia occur in the night shift[14] and that it may be associated with seizures, arrhythmias, or even cardiorespiratory arrest situations[15].

Concerning the administration of corticosteroids, the obtained results met the conclusions of a study carried out on palliative patients, which states that hyperglycemia is induced by the administration of these medicines and that the level of hyperglycemia depends on the administered amount[16].

We found that, as the destination of the patients' transfer began to be known, showing greater clinic seriousness, the averages values of capillary blood glucose were increased, assuming a linear trend from discharge to the home until the transfer to one of the special care units of the hospital, culminating in the cases of death occurring in the OS (Figure 2).

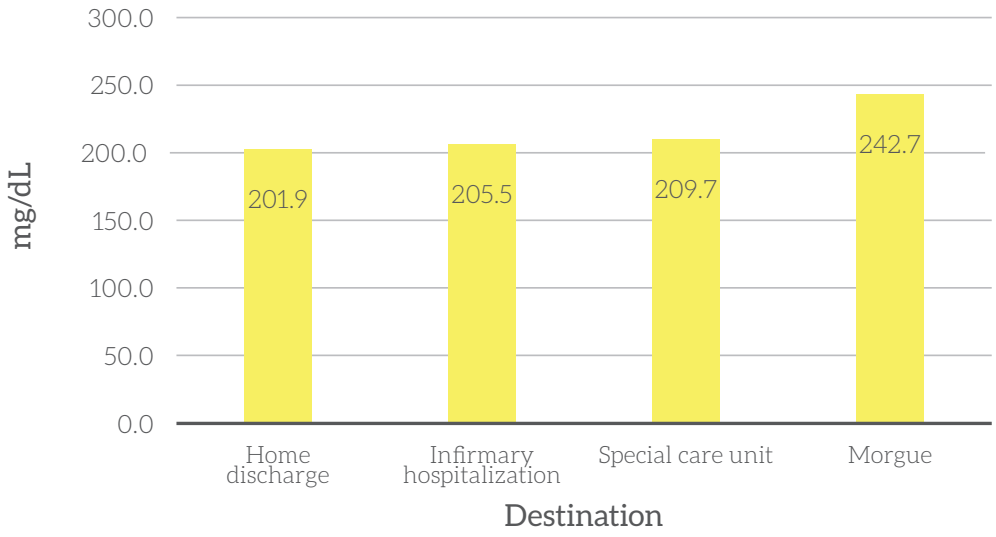

Figure 2 - Relationship of average capillary blood glucose with the patients' destination at the time of their transfer.

Similarly to studies carried out in patients with acute coronary syndrome (ACS) and in patients who had a CVA, this study also found a correlation between the outcome of patients and the average value of capillary blood glucose (11,17,18). It was possible to establish the same almost perfect relationship between the patients' discharge and the high isolated value of capillary blood glucose at 7 a.m., as was possible to find in other authors[19]. Concerning the critical patient in general, the available scientific evidence also support the presence of hyperglycemia as an important risk factor for in-hospital morbidity and mortality. A mortality rate of 1.7% is described for patients with normal values of blood glucose, and of 3% for patients with hyperglycemia[6,12].

Considering the degree of hyperglycemia, we also found that the presence of hypoglycemia is correlated with the destination after discharge, since in patients who were discharged to go home, the rate was 9.7%, while for those who were admitted to an infirmary was 11.9%, and for those who were transferred to a special care unit or died, the rate increased to 16.7%. These findings are in line with the conclusions of other authors, who argue that the occurrence of hypoglycemia is correlated with a worse outcome of patients[10,20].

Regarding the calculated seriousness score, it registered higher average values in patients who were hospitalized and those who died, when compared with those who went home. Regarding their relationship with the average value of capillary blood glucose, we found that patients with: score 0 had average capillary blood glucose of 206.1 mg/dl; score 1, 202.1 mg/dl; score 3, 224.4 mg/dl; and score 4, 248.4 mg/dl. This is another evidence that increased clinic seriousness is correlated with the increase in the average values of capillary blood glucose.

CONCLUSION

A considerable number of the diabetic patients from the sample presented a glycemic pattern with high average values, both generally in all assessment and at 7 a.m., demonstrating that, in the context of hospitalization for acute pathology in this adult OS, diabetes was not controlled. In addition, these high values and the presence of hypoglycemia were correlated with a worse outcome of the patients studied, similarly to scientific evidence available in other studies. Therefore, we can conclude that the control of the values of capillary blood glucose in these patients is of extreme importance and that the implementation of more effective strategies to ensure it is urgent. In the light of the results achieved, we suggest a revision of the therapeutic plan and of the diet of patients, as well as a sensitization on the part of nurses to the unhealthy effects of hyperglycemia, in order to optimize the fulfillment of the therapeutic plan[13,17].

Given the predictions of high under-diagnosis rate of diabetes in Portugal and the presence of stress hyperglycemia in non-diabetic patients in the context of acute pathology (equally prejudicial regarding outcome), we recommend the adoption of a strategy that allows the early detection of patients with elevated levels of capillary blood glucose at the time of their admission to the OS, so that they can benefit timely from an appropriate specific treatment.

We hope that the results and conclusions of this study can influence the clinical practice of professionals who provide care for diabetic patients admitted to adult OS, namely the practice of nurses, since it is expected that these professional incorporate the results of this investigation to their decision making process in clinical practice – an essential process to ensure the continuous improvement of the quality of their professional exercise[10].

We suggest that this study is replicated after the implementation of the above mentioned corrective measures, to properly ascertain their degree of effectiveness.

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