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Mini Review

Hospital hyperglycemia protocol for non-critical patients in a tertiary-level university hospital

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Introduction

Diabetes Mellitus (DM) is a frequent comorbidity in hospitalized patients, with prevalence ranging from 15% - 35%. However, in almost half of the cases, this antecedent is omitted in the medical records or even unknown by the patient. Furthermore, about 10% of hospitalized individuals may have hyperglycemia of stress, a condition characterized by transient and reversible elevation of blood glucose, in the presence of acute circumstances, such as trauma, surgery, medications, shock, or infections [1].

During the pandemic COVID-19, it was observed that people with diabetes are more vulnerable to the development of complications related to the disease, and the association of glucocorticoid therapy, in a hospital setting, can worsen hyperglycemia in such patients or precipitate hyperglycemia in normoglycemic patients [2].

In addition, hospital hyperglycemia (HH) in people with and without diabetes is associated with increased complications, higher mortality and higher healthcare costs.

There is evidence that patients who remain with blood glucose between 140 and 180 mg/dL in a hospital environment have better outcomes. In some selected cases, such as the perioperative period of elective surgeries, the goal may be even more restricted, between 100 and 140 mg/dL. However, it is common to receive patients who are not yet on optimal treatment, which contributes to the lack of glycemic control during hospitalization [3]. In view of this, protocols become fundamental tools to optimize the treatment of DM and, thus, reduce morbidity and the consequent costs to health services.

However, what is observed is that the treatment is not optimized yet, which contributes to a lack of glycemic control during hospitalization. Therefore, protocols become fundamental tools for optimizing the treatment of HH and thus, reducing morbidity and mortality and the consequent costs to health services.

In view of the increase in patients with HH in recent months, due to the COVID-19 pandemic and the risk of complications that these patients are exposed to, we chose to carry out a protocol, which aims to help the management of glycemic control by the assistant teams [4].

Hyperglycemia in hospitalized people can have serious consequences on clinical outcomes, so every hospitalized patient should have their serum glucose measured. It is a simple, inexpensive test that can help in recovery from an acute illness or surgical procedure.

Particular attention should be directed to the patient who will be exposed to situations that predispose to the development of hyperglycemia. Hyperglycemic therapies such as corticosteroids, octreotide, Enteral Nutrition (EN), Parenteral Nutrition (PN) and peritoneal dialysis may pose a risk of elevated blood glucose [5].

Glucocorticoids, in turn, can precipitate hyperglycemia in hospitalized patients without a diagnosis of diabetes, this situation is associated with the risk of higher mortality compared to chronic hyperglycemia [1].

In the hospital, both hyperglycemia and hypoglycemia are associated with adverse outcomes, including death [1].

Hypoglycemia is defined as blood glucose less than 70 mg/dL and is also associated with increased morbidity due to cardiovascular events such as arrhythmias, ischemia and death sudden [1].

Advances in diabetes technology are revolutionizing day-to-day diabetes care and work is ongoing to implement these technologies (ie, continuous glucose monitoring and automated insulin delivery) for inpatient care [6].

Objective

To standardize the management of glycemic control in hospitalized patients with hyperglycemia in a university hospital in the interior of the state of São Paulo - Brazil.

Target audience

Physicians who are interested in monitoring patients with HH.

Hyperglycemia diagnosis and monitoring

During the hospitalization, people who will be exposed to hyperglycemic therapies should have their glycemic control assessed at the bedside for should have bedside glycemic control for at least 24 - 48 hours after starting therapies at least 24 - 48 hours after starting therapies [7].

A random serum glucose value greater than 180 mg/dL or fasting glucose greater than 140 mg/dL is already considered hyperglycemia and, therefore, requires more rigorous control with capillary glucose test (CGT) capillary blood glucose or blood glucose testing (HGT)or blood glucose testing (BGT) (HGT) at specific times for diagnostic confirmation.

According to some studies, the assessment of CGT, before meals and at bedtime, in patients on an oral diet, or every 4 - 6 h, in patients fasting or on a continuous enteral diet, is sufficient for diagnosis and follow-up. In addition, it is convenient to assess serum creatinine and recent glycated hemoglobin, from at least 3 months before admission [8].

Pharmacological management of HH

Medical societies recommend discontinuation of oral antidiabetics and consider insulin therapy the gold standard for the pharmacological management of inpatients, directing subcutaneous insulin therapy for stable patients and intravenous insulin in an intensive care setting.

Insulin regimens: In an attempt to mimic the physiology of a person without diabetes, the basal-bolus insulin regimen is associated with a lower risk of in-hospital complications and includes the administration of basal insulin which may be a long-acting insulin analog (glargine or degludec). Or intermediate-acting insulin (NPH insulin) given one or more times throughout the day in combination with fast-acting insulin (regular insulin, fast-acting insulin analogs) given before meals in orally fed patients. Occasionally, corrective doses of rapid-acting insulin may be necessary when blood glucose is far above the established targets.

For patients who have never used insulin or those treated with low doses, it is recommended to start with a total daily dose of insulin between 0.3 and 0.5 IU/kg/day. Of this dose, half will be used as basal insulin (divided into one or more times a day) and the other half for rapid-acting insulin, divided three times a day before the meals (Table 1).

The prescription of insulin at lower doses is reserved for patients with a greater risk of hypoglycemia (elderly, people with (está ok people plural) renal insufficiency, insufficient food consumption, or fluctuating level of consciousness). For people who previously used insulin at higher doses (greater than 0.6 IU/kg/day), it is recommended to reduce the total daily dose by 20% during the hospitalization period, to prevent episodes of hypoglycemia (Table 2).

It is important to understand that these insulin doses are initial. These settings will be made from glucose monitoring. For example, insulin requirements may decrease rapidly after discontinuation of corticosteroid therapy and the insulin doses should be adjusted accordingly.

Treatment goals: As per guidelines from the American Diabetes Association (ADA) and the American Association of Clinical Endocrinologists (AACE), we recommend a glucose concentration of 140 mg/dL - 180 mg/dL for the most non-critically ill patients with hyperglycemia [1].

On the other hand, in palliative patients, with severe comorbidities, or in inpatient settings where frequent glucose monitoring is not feasible, glucose targets of up to 200 mg/dL may be acceptable. Therefore, we suggest that glycemic targets be individualized according to the clinical status.

Insulin therapy and hypoglycemia

As happens with hyperglycemia, hypoglycemia in a

Table 1: Example of insulin dose calculation and the division of doses throughout the day.

Individuals weighing 60 kg have a prescription of 0.4 IU/kg/day, Calculated dose is 24 IU (0.4 x 60 = 24).
· Half of this dose (12 IU) is used for basal insulin therapy:
· If once a day 12 IU
· If 2 twice a day 1/2 in the morning and 1/2 in the evening 6 IU early and 6 IU in the evening
· If 3 times a day 4 IU - 4IU - 4 IU (early, before lunch and at 10 p.m)
· Half (12 IU) for bolus application, before meals: 3 times a day: 4 IU - 4 IU - 4 IU (regular insulin, prescribe 30 minutes before meals)
Note: NPH insulin lasts up to 16 hours, so one dose a day may not be enough to the control.

Table 2: Example of insulin dose calculation from the dose used previously.

Daily insulin use before admission:
NPH insulin (28 IU early and 20 IU at night) 48 IU/day Daily
Regular insulin (4 IU before meals) 12 IU/day dose total
20% Reduction (12 IU) new daily dose of 48 IU insulin of 60 IU

hospitalized patient is also associated with poor hospital outcomes and increased costs related to health care. To avoid hypoglycemia, we suggest maintaining a diet and/or intravenous glucose supply (IV) according to daily needs. For the maintenance of values of CGT below 100 mg/dL, it is recommended to reassess antidiabetic therapy [9-15].

Hypoglycemia is defined as blood glucose less than 70 mg/dL and is also associated with increased morbidity due to cardiovascular events such as arrhythmias, ischemia and death sudden. This occurs especially when it is a serious event, that is, blood glucose lower than 40 mg/dl. Thus, both situations – hyperglycemia and hypoglycemia – must be avoided. Hypoglycemia is identified with the presence of autonomic and/or neuroglycopenic symptoms.

It is characterized by autonomic and/or neuroglycopenic symptoms (Table 3) and falling blood glucose. In this situation, we recommend performing glucose replacement.

In cases where the patient is conscious and has no contraindications for feeding orally, give 15 g of glucose (which corresponds, for example, to 3 ampoules of 50% of glucose or 1 tablespoon of sugar in a glass of water). In unconscious patients or those with contraindications to oral intake, administer 3 ampoules of 50% glucose intravenous. In both cases, the HGT should be repeated after 15 minutes and, if hypoglycemia persists and you keep the hypoglycemia, repeat the procedure. Ideally, after the hypoglycemic episode has resolved and when the patient can eat, should be offered a snack containing carbohydrates and proteins (milk with wafer) after 30 - 40 minutes.

Hospital discharge considerations

Ideally, at hospital discharge, the same therapeutic regimen as before admission is prescribed, the same therapeutic regimen as hospitalization is prescribed, that is, i.e. reinstitution of pre-admission insulin regimen or oral antidiabetic drugs and/or injectables if pre-admission glycemic control is acceptable and there is no contraindication for its continued use.

In patients with glycated hemoglobin (HbA1c) at admission between 7% and 9%, the addition of a small dose of basal insulin or intensification of the pre-admission regimen may be considered. However, in patients with uncontrolled diabetes, the combination of oral antidiabetic drugs with basal insulin or a basal-bolus insulin regimen, with adjustment to 80% of the inpatient dose, may be effective in most patients. It is recommended that patients and caregivers, at the time of hospital discharge, receive instructions on the therapeutic regimen of the diabetes. In addition, it is important to advice on the need for outpatient medical follow-up to assess short-term glycemic control.

Table 3: Symptoms of hypoglycemia.

Autonomic symptoms	Neuroglycopenic symptoms
Tremor	Paresthesias (tingling or heat)
Anxiety	Irritability
Tachycardia, palpitations	Mental confusion
Sweating and clammy skin	Difficulty thinking, speaking
Dry mouth, hunger	Drowsiness, mental confusion
Pallor	Ataxia
Pupil dilation	Convulsion

Protocol summary

Hospital hyperglycemia protocol in non-critical patients

1. Diagnosis: Fasting blood glucose 140 mg/dL or random 180 mg/dL request: blood glucose, glycated hemoglobin, creatinine. Measure the patient weight (kg)

2. Prescribe a diabetic diet

3. Capillary blood glucose monitoring schedules: 7 a.m-11 a.m-2 p.m- 5 p.m-9 p.m

4. Patient with a previous diagnosis of Diabetes:

   4.1 Suspend oral antidiabetics and observe capillary blood glucose

   4.2. Maintain home insulin regimen and observe capillary blood glucose

5. Patient with capillary blood glucose 180 mg/dL (2 occasions):

   5.1. Start basal-bolus insulin regimen. Total daily dose: 0.2-0.5IU/Kg

   5.2. Diabetic diet, with night snack (be careful not to delay meals)

   5.3 50% NPH ½ before breakfast

   Total Dose ½ at 10.pm

   50% Regular 1/3 before breakfast; 1/3 before lunch; 1/3 before dinner

   5.4 Capillary glycemic target: between 140 and 180 mg/dL

6. If hypoglycemia: Hypoglycemia < 70 mg/dL 3 ampoules glucose 50% (VO or IV).

Repeat capillary blood glucose in 15 minutes.

If hypoglycemia persists, repeat the step above.

7. Insulin adjustments, according to capsillary blood glucose .

Option: If there is hypoglycemia, at least two episodes, reduce the total daily dose by 20%.

If blood glucose > 180 mg/dL, assess 20% increase in total daily dose

Fast m ing patients: Maintain NPH insulin and suspend Regular insulin Maintain EV glucose supply as needed daily.

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