

Original article:

Management of diabetes mellitus in non-critically ill hospitalized patients: a proposal for Latin America

Manejo de diabetes mellitus en pacientes no críticos hospitalizados, una propuesta a Latinoamérica

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Summary

Patients with diabetes are hospitalized 1.8 times more often than those without diabetes, and are predisposed to a higher frequency of complications. In the hospital ward, a patient with a history of diabetes mellitus should be hospitalized; a glycated hemoglobin (GHB) test should be ordered, and the previously used total insulin dose (TID) should be reduced by 10% to 20%, among other procedures. Hospital-acquired hyperglycemia is defined as a blood glucose level greater than 140 mg/dL, and it must be differentiated from patients with a previous diagnosis of diabetes. Insulin therapy should be initiated in patients with sustained hyperglycemia, greater than 200 mg/dL for more than 24 hours; a basal insulin regimen should be established with a baseline calculation of 0.2 to 0.3 units/kg/day, and titrated to optimal blood glucose levels. The most important process in the management of patients with diabetes mellitus is hospital discharge; It is in this environment that avoidable shortcomings are observed daily: lack of training in administering final doses, failure to administer adequate amounts of insulin prior to appointments or follow-up scheduling, and lack of home instructions on self-care. This creates a vicious cycle leading to readmission. In this article, we propose the need to establish a hospital discharge checklist as a solution to this constant error, confirming compliance with the fundamental pillars of discharge planning in non-critically hospitalized patients with diabetes mellitus in order to maintain control.

Keywords: Hospital-acquired blood glucose levels. Insulin administration. Optimal control. Hospital discharge checklist.

Resumen

Los pacientes con diabetes son hospitalizados 1,8 veces más que pacientes que no padecen esta enfermedad, y se predisponen a mayor frecuencia de complicaciones. En la sala de hospitalización un paciente con antecedente de diabetes mellitus; se debe solicitar una hemoglobina glicosilada y disminuir entre el 10 al 20 % de la dosis total de insulina (DTI) previamente utilizada, entre otros procesos. Conocemos con el término de hiperglucemia hospitalaria a una glucosa en sangre superior a 140 mg/dl y debemos diferenciarla en quien posee diabetes previamente como diagnóstico. La terapia con insulina se debe iniciar en pacientes con hiperglucemia sostenida, superior a 200 mg/dl por más de 24 horas; estableciendo un régimen de insulina basal con un cálculo básico de 0,2 a 0,3 unidades/kg/día e ir titulando a niveles óptimos de glicemia. El proceso más importante del manejo de pacientes con diabetes mellitus es el alta médica hospitalaria; en este ambiente es donde se observa en el día a día falencias evitables: no entrenamiento en aplicación de dosis finales, no cantidad adecuada de insulina previa cita o agendamiento de seguimiento, no indicaciones domiciliarias sobre autocuidado, por tal motivo, se convierte en un círculo vicioso para un reingreso; en este artículo proponemos, que es necesario establecer una lista de verificación de alta hospitalaria como solución a este constante error; que confirme el cumplimiento de los pilares fundamentales de la planificación del alta en pacientes hospitalizados no críticos con diabetes mellitus con el fin de mantener su control.

Palabras claves: *Glicemia hospitalaria. Insulinización. Control óptimo. Check list alta hospitalaria.*

Introduction

Diabetes mellitus is a disease that affects 415 million people worldwide, and it is estimated that the number will rise to 642 million by 2040. Patients with diabetes are hospitalized 1.8 times more often than those without the disease, due to the increased frequency of complications, opportunistic infections, and comorbidities that hyperglycemia and diabetes itself predispose to.

It is important that healthcare personnel be fully trained in managing hyperglycemia in hospitalized patients with diabetes or newly

diagnosed hyperglycemia during their hospital stay. The presence of marked hyperglycemia is associated with complications and repercussions such as prolonged hospital stay, immune system depletion, impaired wound healing, electrolyte abnormalities, nosocomial infections, and increased mortality.

Furthermore, it is important to know that patients with diabetes mellitus are twice as likely to be readmitted to the hospital and 30% more likely to return to the hospital in less than a year. For this reason, it is important to optimize glucose levels from admission to discharge and establish regimens that improve glycemic control in the hospital. This includes providing the necessary support to maintain this control throughout the transition after discharge, including insulin, syringes, diabetes education, glycemic targets, self-management education, and monitoring, among others.

The intervention of hospital health personnel is key, before hospital discharge, giving the appropriate amount and dose of medication depending on the hyperglycemic picture presented, in-hospital controls and finally something that is increasingly less common, which is included as DIABETIC EDUCATION: which involves the necessary nutritional training, lifestyle changes, correct method of administering the medication (insulinization techniques, adequate dosage, pharmacological adherence), as well as the importance of regular monitoring of glucose levels.

In practical terms, in hospitals and in Latin America, it is important to recognize that there are many limitations in knowledge, diabetes education, and, of course, in the transition from hospital discharge to outpatient follow-up. This is why we wrote this article, as we believe it is essential to have a source of definitions and protocols for diabetes management in non-critical patients with hospital-acquired hyperglycemia. This can serve as a basic guide for daily decision-making, from hospitals with high levels of complexity to centers where the lack of an endocrinologist can limit action and proper control of hyperglycemia.

Terms and definitions

- **Diabetes mellitus:** A chronic disease that results in an abnormal elevation of blood glucose that

increases the risk of hospital complications.

- **Glucose:** Simple carbohydrate also known as blood sugar, which is obtained through food and functions as the body's main source of energy.
- **Hospital-acquired hyperglycemia:** Elevated blood glucose levels. Hyperglycemia in hospitalized patients is defined as glucose levels greater than 140 mg/dL in patients with known diabetes or patients who were unaware of their diagnosis.
- **Hypoglycemia:** Low blood glucose levels, most often caused by comorbidities or overuse of medication. Hypoglycemia in hospitalized patients is defined as glucose levels below 70 mg/dL.
- **Insulin:** Hormone produced by the beta cells of the pancreas, whose main function is to allow glucose to enter the body's cells, thus helping to regulate blood glucose levels.

Methodology

A systematic review study was carried out based on the search for articles from 2020 to 2025 on the detection and management of diabetes in non-critical hospitalized patients, in indexed journals, clinical practice guidelines, corroborating that it is a little-discussed topic and together with a systematic review within a public hospital, we confirmed the problem of poor management of patients with diabetes within hospital wards and at the time of discharge, thus establishing an action plan and recommendations based on scientific evidence, together with attaching a pre-discharge checklist as a proposal.

Objetives

1. Establish protocols for the management of non-critical patients with diabetes mellitus admitted to the different general hospitalization areas.
2. Provide appropriate treatment to patients with diabetes mellitus during their stay in the hospital wards.
3. Maintain the levels It is optimal for glycemia in the hospital environment and avoid hypoglycemia as a risk factor in controlling the previous objective.
4. Highlight the importance of educating the patient at the time of discharge regarding diabetes education: nutrition, lifestyle changes,

blood glucose monitoring, medication dosage, and medication administration techniques (insulinization techniques).

Materials and methods

Initial assessment

Upon arrival at the hospital ward of a patient with a history of diabetes mellitus, we must review the treatment established prior to admission. If oral medication is used, we should change and/or add it individually (based on HbA1c and patient characteristics) to a basal insulin regimen that allows for stricter metabolic control (but without hypoglycemia). Glycosylated hemoglobin provides a 3-month average of the patient's glycemic status prior to admission; this is key for establishing different types of treatment regimens. It is important to keep in mind that calorie intake is lower in the hospital setting, so we should reduce the total insulin dose (TID) previously used by 10% to 20%.

We know as hyperglycemia in hospital wards a blood glucose level greater than 140 mg/dl, which can be differentiated from in-hospital stress hyperglycemia by measuring glycosylated hemoglobin (HbA1c) values. Thus, an HbA1c $\geq 6.5\%$ refers to pre-existing diabetes mellitus, which in many cases the patient was unaware of; meanwhile, an HbA1c $< 6.5\%$ refers to stress hyperglycemia.

Glucose monitoring in hospitalized patients

The first step upon admission to the hospital ward of a patient with hyperglycemia is to perform an HbA1c check if it has not been performed in the last three months.

Once the type of hyperglycemia in hospitalized patients has been identified, capillary glucose monitoring should be performed every 6 to 12 hours, or before breakfast and dinner (postprandial monitoring after lunch will be considered in patients with a high incidence of postprandial hyperglycemia). In patients who remain NPO (nothing by mouth), capillary glucose monitoring should be performed every 4 to 6 hours, since their monitoring will not be with a basal insulin regimen, but with the use of rapid/ultrarapid insulin.

Continuous glucose monitors (CGMs) have become widely used since the COVID-19 pandemic. However, they are not currently recommended in non-critical areas because they are prone to

inaccuracies due to the use of medications and substances. Therefore, despite their use, capillary and blood glucose monitoring would be necessary, and their availability in hospitals is limited. We are at the forefront of a transition process, where even in countries like the USA and Spain, their use has not yet been formalized in a protocol.

Glycemic goals in hospitalized patients

Glycemic targets in hospitalized patients depend on their associated comorbidity; however, in most cases, according to the American Diabetes Association (ADA), we can establish a range between 100 mg/dL and 180 mg/dL in non-critical patients, including surgical patients. Lower levels predispose us to a higher risk of future hypoglycemic episodes, so we must adjust the medication dose. There are special populations, such as older adults, in whom glucose values up to 200 mg/dL may be acceptable without the need for correction. This will be assessed individually according to their comorbidity status. In critically ill patients, the suggested range is 140–180 mg/dL, being more adjusted for specific and individualized reasons.

En pacientes embarazadas los objetivos glucémicos no son diferentes dentro o fuera del hospital, se estima un valor de glucosa entre 70 mg/dl a 90 mg/dl en ayunas, después de 1 hora postprandial 110 mg/dl a 140 mg/dl y después de 2 horas postprandial entre 100 mg/dl a 150 mg/dl.

Insulin therapy

La terapia con insulina se debe iniciar en pacientes con hiperglucemia sostenida, superior a 200 mg/dl por más de 24 horas. Debemos iniciar un régimen de insulina basal haciendo el cálculo con la fórmula entre 0,2 a 0,3 unidades/kg/día teniendo en cuenta pacientes con comorbilidades y personas de edad avanzada. La mayoría de los pacientes en nuestro hospital usan la insulina NPH humana como primera opción, teniendo en cuenta que, en términos de efectividad, razón principal de esta propuesta de control, la insulina humana NPH y las insulinas análogas de primera generación o segunda generación, no tienen mayores diferencias en el control glicémico. El uso de NPH tiene prioridad en términos de costo efectividad; de la misma manera recordando que para dosis mayores a 20 unidades por día, esta dosis se divide en 70 % en la mañana y 30 % dosis de uso nocturno, si el paciente mantiene una dieta adecuada por vía oral.

In specific cases where there is: chronic kidney disease 3b (glomerular filtration rate (GFR) <50 ml/min), type 1 diabetes mellitus (T1DM), liver failure, and confirmed high risk of hypoglycemia, the use of a first-generation basal analogue that we have in our basic framework will be considered after prior consultation, ideally with the endocrinology specialty. In specific scenarios and under the direction and monitoring of endocrinology, the implementation of insulinization regimens with the use of ultra-rapid postprandial or rescue insulin (basal plus or basal bolus) will be considered for individualized management.

It is important to note that the use of oral antidiabetics is not generally recommended in hospitalized patients. Adherence to an insulin therapy regimen should be prioritized if necessary, with exceptions that must be evaluated by the Endocrinologist. We recognize the ADA's proposal to maintain them in cases of established kidney or liver failure. However, we consider it prudent to carefully review this scenario, especially the absolute discontinuation of sulfonylureas, if the patient will not be eating or will be on NPO (nothing by mouth).

In patients with previously diagnosed diabetes mellitus and on a prescribed insulin regimen, we should reduce the total insulin dose (TID) by 10% to 20%, since carbohydrate consumption is limited in a hospital setting and could cause hypoglycemia. However, if we find an HbA1c <8%, we can reduce the total dose of previously used basal insulin by up to 25%. We also remember the proposed management with DPP4 inhibitors (DPP4Is) and low doses of basal insulin and/or prandial rescue insulin as a proposed course of action. Remember that DPP4Is are not included as the molecule of choice in our national basic medication schedule.

Intermediate-acting insulin (NPH) should be administered ensuring the patient has breakfast and/or dinner, to avoid the hypoglycemia that is very common in hospital settings. Before carbohydrate intake, rapid-/ultra-rapid-acting insulin should be administered before or after meals to avoid hypoglycemia. First-generation basal analogue insulins do not require adjustment and are administered once daily if converting from NPH to insulin glargine in a 1:1 ratio, taking into account the possibility of a 10% decrease in DTI,

according to updated guidelines individualized in the hospital setting.

The use of rapid-acting insulin alone is not recommended except in mild hyperglycemia (blood glucose levels <200 mg/dl) or stress, i.e., in a scale correction regimen, since it could have a reactive rather than proactive approach. In patients with sustained hyperglycemia, it is important to prioritize a basal regimen, and it has been shown to be widely believed that glycemic variability is better controlled with a basal regimen, avoiding generating a deleterious effect on the risk of comorbidities in patients who already have some, and their possibility of reactive hypoglycemia with compensatory hyperglycemia will be more common in a regimen conceived as "insulin correction scales" than as a single maintenance regimen.

It is important to mention that the optimal blood glucose targets in the hospital environment of a non-critical patient should be taken into account, which are 100-180 mg / dl with an average of 140 mg / dl, generated from the evidence published in the NICE SUGAR study, where it was confirmed that a blood glucose lower than this produced unnecessary deleterious in-hospital risks in non-critical patients, likewise it is important to always remember that HOSPITAL HYPOGLYCEMIA (emphasis on greater risk in vulnerable populations such as the fragile population, older adults, chronic kidney failure, NPO patients, liver failure, patients undergoing multiple investigational procedures that require fasting, among others) is even more likely to occur and requires taking the aforementioned criteria into account more. Hypoglycemia should be avoided, and if it occurs, it should be reported with consultation to a specialty, for investigation and correction, even worse if it is repetitive; In the hospital it is defined as a blood glucose level <70 mg/dl, worse if it is a blood glucose level <54 mg/dl, which leads to neuroglucopenic symptoms, which is considered level 2 hypoglycemia, and investigate the cause of this clinical situation and treat it quickly if it occurs.

Reasons for endocrinology consultation

It is important to remember that in the presence of a specialty service with training in insulinization, a specialized opinion must be requested to command or coordinate the insulin therapy process. For this purpose, the specific reasons for generating

a consultation with this service are established and listed:

- Diabetes mellitus admitted due to glycemic decompensation requiring the use of basal insulin and/or reporting a glycosylated hemoglobin greater than 8.0%.
- Blood glucose \geq 200 mg/dl (sustained hospital-acquired hyperglycemia)
- Patient who requires admission to a critical area (ICU - NICU - Emergency) with decompensated diabetes.
- Patient admitted with hyperglycemic onset: diabetic ketoacidosis and/or non-ketotic hyperosmolar hyperglycemia.
- Pre-surgical patients with blood glucose levels greater than or equal to 200 mg/dl should be consulted for compensation as a prerequisite before surgery.
- Patients with type 1 diabetes.
- Persistent and/or recurrent hypoglycemia (with or without diabetes)

Discharge planning

The crucial stage in the management of patients with diabetes mellitus is hospital discharge. In recent years, maintaining glucose levels within normal parameters has become a real challenge for patients once they return to their daily lives outside the hospital. When a patient is discharged, they often resume consuming carbohydrates, poor nutrition due to multiple occupations, or lack of exercise prior to hospital discharge. They fail to obtain their medication or administer it at inappropriate times, i.e., they clearly lack adherence to insulin therapy. Likewise, unintentional errors by medical staff occasionally hinder a safe and successful discharge. Examples include poor communication, staffing shortages, prescribing medication unavailable in the hospital or difficult for the patient to access, and failing to ensure timely follow-up care due to limited appointment space.

It is necessary to establish a checklist, which is part of this proposal (Annex 1. Includes a list of discharge compliance for non-critical patients with type 2 diabetes) that confirms compliance with the fundamental pillars of discharge planning, including: assessments of comorbidities such as diabetic heart

disease and ophthalmopathy (cardiology and ophthalmology assessment), confirmation that the patient has received adequate and complete medication with the respective dosage indication and correct forms of application; education in frequent self-monitoring of glucose with clear glycemic targets, guarantee of continuous follow-up by an endocrinology outpatient clinic, in case of insulinization), since with a glycated hemoglobin $\geq 8.5\%$ it is very likely that the patient will go home with basal insulin. We must ensure that they are well trained and must correctly understand insulin doses and administration techniques until further follow-up with the endocrinology attending physician, as well as an in-hospital consultation with nutrition (substitution of simple sugars, healthy plate management, knowledge of the glycemic index, individualization, taste and characteristics of their diet, among others). Only in this way will we ensure efficient control and avoid preventable admissions in patients who require global and transdisciplinary changes in their glycemic control.

Discussion

The management of non-critical patients with diabetes mellitus in hospital wards is a rarely discussed topic worldwide, despite being a recurring problem that causes a large number of complications during short-, medium-, and long-term management. It is important for physicians from different specialties to understand the steps to follow when managing a patient with diabetes mellitus in hospital wards, to have the basic tools and manage unified criteria, and to establish the correct management upon hospital discharge, with the necessary multidisciplinary assessments, adequate patient education, and appropriate medication doses for proper glycemic control once the hospitalization period is over.

Conclusions

Proposals

This is the first proposal in Ecuador for the organized and systematized management of in-hospital hyperglycemia in non-critical patients by an in-hospital team. It establishes guidelines that can be applied from a general hospital to a specialty hospital. It provides a checklist for staff, as well as patients, to ensure that the most basic procedures have been followed upon discharge and to address

common errors encountered in our daily hospital work. We also acknowledge that this proposal may be subject to individual circumstances and should be applied within the framework of each hospital setting. We must join forces to manage in-hospital hyperglycemia in non-critical patients uniformly and with education at different levels, including the medical team, residents, interns, nurses, and, of course, the patient, who requires education on the proper management and administration of their medications before being discharged. We believe that future reviews should address this issue as a priority in medical forums, where, regardless of specialty, hospital-acquired hyperglycemia should be managed in a unified manner from admission to discharge.

Peer review

The manuscript was peer-reviewed and approved in due time by the INSPILIP journal Editorial Team.

Availability of data and materials

The data supporting this manuscript are available upon request from the corresponding author.

Conflicts of interest of each author

None of the authors have any conflicts of interest.

Authors' contribution

The different phases of the research were carried out by the authors, who contributed equally throughout the process.

Anexes

ANNEX 1

PROCESO REVISADO	REALIZADO	NO REALIZADO
AGENDAMIENTO DE CONTROL POR CONSULTA EXTERNA		
MEDICACIÓN COMPLETA HASTA PROXIMO CONTROL		
INDICACION DE DOSIFICACIÓN Y TITULACIÓN DE LA MISMA		
INDICACIONES DE TECNICAS DE INSULINIZACIÓN		
JERINGUILLAS ENTREGADAS HASTA PROXIMO CONTROL		
VALORACIÓN CARDIOLÓGICA INTRAHOSPITALARIA REALIZADA		
VALORACION OFTALMOLÓGICA REALIZADA Y/O PROGRAMADA		
EDUCACIÓN NUTRICIONAL		
EDUCACIÓN SOBRE MONITORIZACIÓN DE GLUCOSA DOMICILIARIA		
DESCARTE DE NEUROPATÍA DIABÉTICA (EDUCACIÓN PODOLÓGICA)		
FIRMA DE MEDICO REVISOR		
FIRMA DEL PACIENTE EN PLAN DE ALTA		

LIST OF COMPLIANCE WITH DISCHARGE OF NON-CRITICAL PATIENTS WITH TYPE 2 DIABETES

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