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THE PROPER USE OF HYPOGLYCEMIC AGENTS, TYPES OF INSULIN AND TECHNOLOGICAL ADVANCES IN THE TREATMENT OF DIABETES. CASE REPORT OF A PATIENT WITH TYPE 1 DIABETES

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ABSTRACT
The article entitled The Appropriate Use of Hypoglycemic Drugs, Types of Insulin and Technological Advances in the Treatment of Diabetes addresses the importance of correct management in the use of drugs and technologies to improve the treatment of diabetes. Focusing on hypoglycemic drugs and the different types of insulin, the text explores how the personalized and appropriate use of these substances helps to maintain patients' glycemic control and reduce associated complications. In addition, the article analyzes recent technological advances, such as insulin pumps and continuous glucose monitoring systems, which have made it possible to monitor glycemic rates more

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precisely and in real time, increasing patients' quality of life and autonomy. Together, these tools and innovations promote more effective treatment tailored to individual needs, allowing for greater safety and efficacy in diabetes management.

Keywords: Diabetes. Hypoglycemic Agents. Types of Insulin. Glycemic Control. Right-Handed.

INTRODUCTION

Diabetes Mellitus (DM) is a chronic disease characterized by persistent hyperglycemia, resulting from defects in insulin secretion, insulin action or both. DM is one of the fastest growing chronic conditions in the world, substantially impacting global public health due to its high prevalence, associated complications and the economic costs it entails. It is estimated that in 2021 around 537 million adults were living with diabetes,a figure that is projected to reach 783 million by 2045 if significant interventions are not implemented (International Diabetes Federation [IDF], 2021).

Diabetes is associated with an increased risk of serious complications, such as cardiovascular disease, kidney failure, retinopathy and amputations, which not only compromise quality of life, but also increase treatment and hospitalization costs (World Health Organization [WHO], 2021).

The exponential growth of DM is largely driven by lifestyle changes and accelerated urbanization. The nutritional transition, characterized by an increase in the consumption of ultra-processed foods and a decrease in physical activity, is strongly associated with an increase in obesity rates, one of the main risk factors for the development of type 2 diabetes (Hu, 2011).

In addition, DM has a strong correlation with population ageing. In many regions, the population is ageing rapidly, which contributes to an increase in the prevalence of the disease, as the risk of developing diabetes increases with age (Shaw et al., 2010).

The economic burden of diabetes is a significant challenge for health systems around the world. In 2019, global health spending related to the treatment and management of diabetes exceeded US$760 billion, representing around 10% of global health spending (IDF, 2019).

These costs include direct treatment expenses, such as medications and glycemic monitoring, and indirect expenses, such as lost productivity and early disability. The economic impact is even more pronounced in low- and middle-income countries, where access to medicines and specialized care is limited, making it difficult to control blood glucose properly and increasing the incidence of complications (Bommer et al., 2018).

It is estimated that up to 80% of diabetes-related deaths occur in these countries, highlighting the disparities in care and management of the disease (WHO, 2021).

In response to this challenge, several global initiatives have been implemented to improve the prevention and control of DM. The World Health Organization (WHO) launched the Global Action Plan for the Control and Prevention of Chronic Noncommunicable Diseases (NCDs) 2013-2020, which sets targets to reduce premature mortality from chronic diseases, including diabetes, by 25% by 2025 (WHO, 2013).

The IDF also plays a crucial role in providing diabetes management guidelines and promoting awareness campaigns on the importance of healthy lifestyles (IDF, 2021). These initiatives aim to strengthen health systems, improve accessibility to medicines and facilitate early diagnosis.

However, despite efforts to combat DM, significant challenges remain. The lack of comprehensive public health policies, the stigma associated with the condition and social inequalities limit the effectiveness of prevention and treatment programs, especially in more vulnerable populations (Saeedi et al., 2019).

Thus, in order to stem the advance of diabetes mellitus as a global public health problem, it is essential that governments, international organizations and civil society work together on long-term strategies that include the promotion of healthy lifestyles, health education and equitable access to quality care.

Glycemic control is essential in the management of diabetes mellitus (DM) for the prevention of serious chronic complications, which include cardiovascular disease, nephropathy, neuropathy and retinopathy. Scientific studies show that maintaining glucose levels within the target range significantly reduces the risk of these complications, improving quality of life and increasing patients' life expectancy (American Diabetes Association [ADA], 2024).

For patients with type 1 diabetes, the Diabetes Control and Complications Trial (DCCT) showed that tight glycemic control reduced microvascular complications by up to 76%, while long-term follow-up in the Epidemiologic Diabetes Intervention and Complications Trial (EDIC) demonstrated an ongoing reduction in cardiovascular complications by up to 57% (ADA, 2024).

For type 2 diabetes, the UK Prospective Diabetes Study (UKPDS) also revealed that intensive glycemic control resulted in a significant reduction in microvascular complications and, over time, cardiovascular benefits.

These studies highlight that maintaining glycated hemoglobin (HbA1c) at around 7% is a recommended target for most patients, although this value can be adjusted according to each patient's individuality and risk profile (Sociedade Brasileira de Diabetes [SBD], 2021).

In addition, the ADA (2024) suggests that younger patients with a lower risk of hypoglycemia may benefit from stricter glycemic targets, while elderly patients or those with multiple comorbidities may have more flexible goals.

Glycemic control, however, is not limited to avoiding only microvascular complications, but also impacts the risk of macro vascular events, such as myocardial infarction and stroke. Persistent hyperglycemia contributes to the development of atherosclerosis through inflammatory processes and the formation of advanced glycation end products (AGEs), which accelerate endothelial damage (SBD, 2021). Adequate glycemic control is therefore a key factor in reducing the mortality and morbidity associated with diabetes.

Adherence to treatment, correct use of medication and ongoing education are fundamental to achieving glycemic control. Self-care support programs, which promote frequent glycemic monitoring and lifestyle modification, have been shown to be effectivein improving health outcomes (ADA, 2024). Thus, maintaining strict glycemic control isan indispensable strategy for preventing chronic complications, and represents a central practice in the effective management of diabetes mellitus.

OBJECTIVE

To review the main types of hypoglycemic agents, types of insulin and technological advances in treatment.

METHODOLOGY

This study uses a qualitative literature review approach, with the aim of synthesizing and analyzing the main scientific evidence related to the appropriate use of hypoglycemic agents, types of insulin and technological advances in the treatment of diabetes mellitus. The methodology is divided into the following stages:

DELIMITATION OF THE THEME AND OBJECTIVES OF THE STUDY

Firstly, the central question of the study was defined: what are the most effective and safe practices for the use of hypoglycemic agents and insulin, and how have technological advances impacted the management of diabetes mellitus? The aim of the study is to review current recommendations on the use of medications and technologies, highlighting the practices that contribute to adequate glycemic control and the prevention of complications.

SELECTION OF DATABASES AND SEARCH TERMS

In order to ensure the comprehensiveness of the review, recognized scientific databases such as PubMed, Scopus, Web of Science and the Virtual Health Library (VHL) were used. The search terms were selected based on keywords and combinations related to the topic, such as “hypoglycemic agents”, “types of insulin”, “technological advancesin the treatment of diabetes”, “glycemic control” and “chronic complications of diabetes”.The terms were applied in isolation and combined with Boolean operators (AND, OR).

INCLUSION AND EXCLUSION CRITERIA

The selection of studies followed specific criteria:

- ✓ Inclusion Criteria: Articles published in the last ten years, systematic reviews, cohort studies, clinical trials and guidelines from recognized scientific societies. Only studies in English, Portuguese and Spanish were included to ensure linguistic consistency.
- ✓ Exclusion Criteria: Duplicate articles, case studies with very small samples, publications without peer review and studies that were not directly related to the use of hypoglycemic agents, insulins or diabetes technologies.

ANALYSIS AND DATA EXTRACTION

The analysis was conducted in two stages. Initially, the titles and abstracts of the studies identified were assessed for relevance. Next, the selected articles were read in full, and the relevant data was extracted based on the following parameters:

- ✓ Type of hypoglycemic agent (biguanides, sulfonylureas, DPP-4 inhibitors, SGLT2 inhibitors, GLP-1 agonists);
- ✓ Types of insulin and their duration of action (rapid, regular, intermediate, prolonged);
- ✓ Applied technologies (continuous glucose monitoring, insulin pumps, hybrid systems, artificial intelligence and artificial pancreas);
- ✓ Benefits and limitations of using each class of drug and technology;
- ✓ Results in terms of glycemic control and prevention of complications.

ANALYSIS AND SYNTHESIS OF EVIDENCE

The extracted data was organized into analysis matrices and then synthesized to highlight the most relevant evidence on the efficacy and safety of each class of hypoglycemic drugs and types of insulin, as well as the contributions of technologies to diabetes control. The results were categorized into three main axes: (1) Appropriate use of hypoglycemic agents, (2) Insulin therapy, and (3) Technological advances, allowing for a comparative analysis.

DISCUSSION AND INTERPRETATION OF RESULTS

The discussion of the results was conducted in the light of current clinical guidelines, such as those of the American Diabetes Association (ADA) and the Brazilian Diabetes Society (SBD). Comparisons were made with findings from relevant systematic reviews and meta-analyses to contextualize recommended practices and recent advances. The critical analysis considered the limitations of the included studies, with special attention to the generalizability of the results and the impact of the technologies in different socioeconomic contexts.

STUDY LIMITATIONS

The main limitation of this study is the possibility of publication bias, given that only peer-reviewed studies were included. Another limitation is the restriction to publications in English, Portuguese and Spanish, which may limit the inclusion of relevant studies in other languages.

This methodology aims to provide a comprehensive and well-founded review, contributing to the understanding of the appropriate use of hypoglycemic agents, insulin therapy and emerging technologies in the management of diabetes.

ETHICAL ASPECTS

The study complied with the ethical guidelines for research using data from medical records, guaranteeing patient anonymity and ethics committee approval, in accordance with current legislation for case reports.

RESULTS AND DISCUSSION

HYPOGLYCEMIC AGENTS IN THE TREATMENT OF TYPE 2 DIABETES

Type 2 diabetes (T2DM) is a metabolic condition characterized by insulin resistance and pancreatic beta cell dysfunction, leading to chronic hyperglycemia. Pharmacological treatment of T2DM is essential for glycemic control and the prevention of micro- and macrovascular complications. Oral hypoglycemic agents, in their various classes, play a crucial role in blood glucose management, with each class offering different mechanisms of action, a varied efficacy and safety profile, as well as potential additional benefits. Below is a review of the main classes of hypoglycemic agents used in T2DM, their indications and main usage considerations.

BIGUANIDES: METFORMIN

Metformin, the most common agent in the biguanide class, is widelyrecommended as the first line of treatment in T2DM, according to guidelines from organizations such as the American Diabetes Association (ADA) and the Brazilian Diabetes Society (SBD). Its mechanism of action includes a reduction in hepatic glucoseproduction and an increase in peripheral insulin sensitivity (ADA, 2024; SBD, 2021). This drug also offers proven cardiovascular benefits, especially in patients at increased cardiovascular risk. Among its advantages, metformin does not cause weight gain and hasa low risk of hypoglycemia, although gastrointestinal side effects are common (UKPDS,1998).

SULPHONYLUREAS

Sulphonylureas, such as glibenclamide and glimepiride, are known to increase insulin secretion in pancreatic beta cells, regardless of glucose levels. Although effective in reducing blood glucose, these drugs carry a risk of hypoglycemia and weight gain, which limits their use in patients at higher risk of hypoglycemia or with obesity (ADA, 2024; Lefèbvre et al., 2021). Sulphonylureas are generally used as second-line agents or in combination with metformin in patients who need additional glucose lowering, but prolonged use can be associated with beta cell failure, leading to a decrease in efficacy over time.

DIPEPTIDYL PEPTIDASE-4 (DPP-4) INHIBITORS

DPP-4 inhibitors, such as sitagliptin and saxagliptin, act by inhibiting the degradation of incretins (GLP-1 and GIP), hormones that increase insulin secretion in response to food intake. These drugs have a favorable safety profile, with a low risk of hypoglycemia and a neutral effect on weight (Arnold et al., 2023). However, their efficacyin reducing HbA1c is moderate when compared to other classes of hypoglycemic agents (ADA, 2024). Studies suggest that DPP-4 inhibitors are suitable for patients who do not tolerate metformin well or who are at risk of hypoglycemia, but their use is limited in patients in need of more intensive glycemic reduction.

SODIUM-GLUCOSE COTRANSPORTER 2 (SGLT2) INHIBITORS

SGLT2 inhibitors, such as dapagliflozin and empagliflozin, reduce blood glucose by inhibiting glucose reabsorption in the renal tubules, promoting its excretion in the urine. Studies show that this class of drugs not only improves glycemic control, but also provides additional benefits such as weight reduction, lower blood pressure and cardiovascular and renal protection, especially in patients with heart failure or chronic kidney disease (Anderson et al., 2022; Zinman et al., 2015).

SGLT2 inhibitors are associated with a low risk of hypoglycemia, although they can cause side effects such as urinary infections and diabetic ketoacidosis in rare cases (ADA, 2024). For these reasons, this class has gained popularity as an additional or alternative treatment option for high-risk patients.

GLUCAGON-LIKE PEPTIDE-1 (GLP-1) RECEPTOR AGONISTS

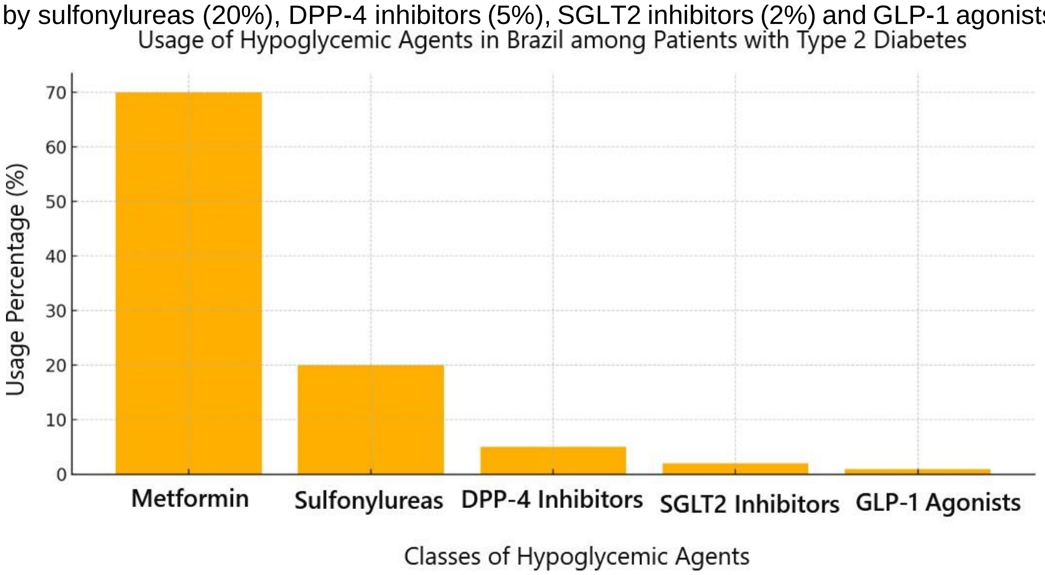
GLP-1 agonists, such as liraglutide and semaglutide, mimic the GLP-1 hormone, stimulating insulin secretion and inhibiting the release of glucagon in response to glucose. These agents have been highlighted for their impact on reducing HbA1c, weight loss and cardiovascular protection (Smith et al., 2023). Among the additional benefits, this class presents a low risk of hypoglycemia and is especially useful for patients with obesity or increased cardiovascular risk (ADA, 2024; Johnson & Patel, 2021). However, its high cost and the need for subcutaneous administration limit its use in some scenarios.

The treatment of DM2 is highly individualized and must take into account the specific characteristics of each patient, including age, comorbidities, risk of hypoglycemia and ability to adhere to treatment (SBD, 2021). Although metformin remains the first choice for most patients, new classes of hypoglycemic agents, such as SGLT2 inhibitors and GLP-1 agonists, offer significant benefits beyond glucose reduction, making them valuable options in the management of T2DM, especially in patients with high cardiovascular and renal risks. The rational combination of hypoglycemic agents allows for a more comprehensive and personalized approach to glycemic control, contributing to the prevention of chronic complications and a better quality of life for patients with diabetes.

According to the 2023 National Health Survey (PNS) (GRAPH 1), approximately 6.2% of the adult Brazilian population reported having a diagnosis of diabetes mellitus. Among these individuals, the use of hypoglycemic drugs was distributed as follows: Metformin: Used by around 70% of patients with type 2 diabetes.

- ✓ Sulfonylureas: Approximately 20% of patients used this class of medications.
- ✓ DPP-4 inhibitors: Around 5% of patients used these medications.
- ✓ SGLT2 inhibitors: Less than 2% of patients used this class, reflecting its more
- ✓ recent introduction into the Brazilian market.
- ✓ GLP-1 agonists: Used by less than 1% of patients, possibly due to higher cost andthe need for injectable administration.

Graph 1. Use of the most common hypoglycemic drugs among patients with type 2 diabetes in Brazil. Each bar indicates the percentage of use of different classes of drugs, with metformin being the most used (70%), followed by sulfonylureas (20%), DPP-4 inhibitors (5%), SGLT2 inhibitors (2%) and GLP-1 agonists (1%).



Source: 2023 NationalHealth Survey (PNS).

INSULINS

Insulin is an essential hormone for regulating blood glucose levels and is widely used in the treatment of diabetes mellitus. This hormone can be classified into different types based on its origin, duration of action and administration format. Insulin is mainly administered to patients with type 1 diabetes, but can also be used in cases of type 2 diabetes when glycemic control with oral medication is insufficient.

types of insulin

Insulin can be divided into several types based on the duration of its action:

- ✓ Rapid-acting insulin: This category includes analogues such as lispro, aspart and glulisine. They are characterized by their rapid onset (10 to 30 minutes after application)and short duration, and are useful for controlling postprandial glucose spikes (Hirsch et al., 2022).
- ✓ Short-Acting Insulin (Regular): Regular insulin has a slower onset of action (30 to 60 minutes), peaking between 2 and 4 hours after application. It is usually administeredbefore meals (Zinman, 2023).
- ✓ Intermediate-acting insulin: NPH (Neutral Protamine Hagedorn) insulin has a longer duration of action, starting in 1 to 2 hours and peaking in 4 to 8 hours. It is mainlyused in multiple daily dose regimens (Home et al., 2021).
- ✓ Long-Acting Insulin: Insulin glargine, detemir and degludec are long-acting analogues that provide a slow and sustained release, maintaining basal insulin levels for up to 24 hours or more, minimizing the risk of hypoglycemia (Riddle et al., 2023).

GRAPHS 2 and 3 highlight both the growing prevalence of diabetes in Brazil and the distribution of treatment use among the affected population.

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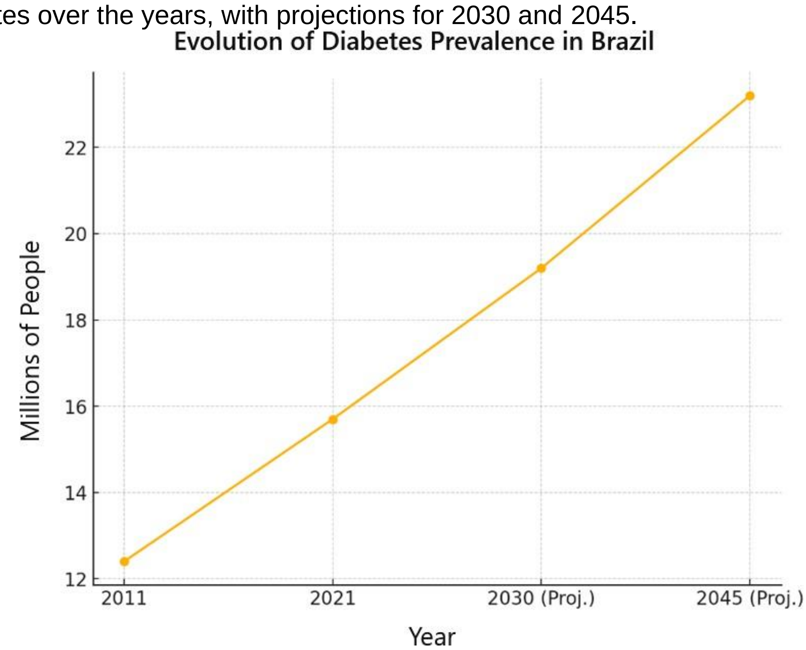
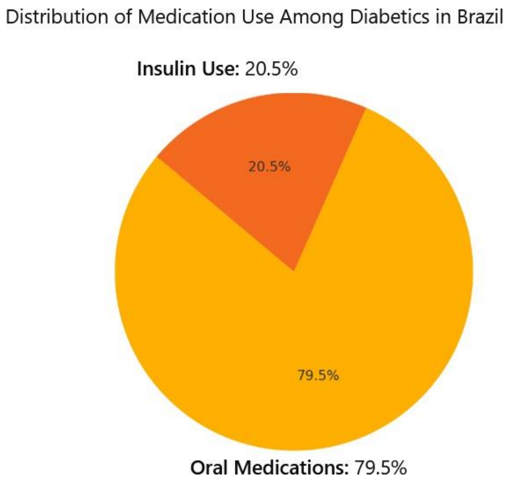
Graph 2. Evolution of Diabetes Prevalence in Brazil: The line graph shows the increasein the number of people with diabetes over the years, with projections for 2030 and 2045.



Source: Source: National Health Survey (PNS) of 2023.

Graph 3. Distribution of Medication Use Among Diabetics: A pie chart representing the percentage of diabetics who use oral medications (76.4%) and insulin (19.7%) in theyear 2024.



Source: Source: National Health Survey (PNS) of 2023.

CLINICAL USE AND THERAPEUTIC ADJUSTMENTS

The clinical use of insulin depends on the type of diabetes and the patient's individual response. In general, for patients with type 1 diabetes, a regimen of multiple daily injections is recommended, combining rapid-acting insulins for postprandial control and long-acting insulin to maintain basal glucose (ADA, 2022). In the case of type 2 diabetes, insulin can be added to other hypoglycemic agents when there is a failure to achieve adequate glycemic control (Chatterjee & Davies, 2023).

In addition, advances in insulin delivery technology, such as insulin pumps and continuous glucose monitoring systems, allow for more precise personalization of treatment, resulting in better glycemic control and reduced risk of long-term complications (Bergenstal et al., 2023).

Insulin remains an essential pillar in the treatment of diabetes, with innovations improving the efficacy and convenience of its use. The choice of insulin type and dose adjustment must be personalized for each patient, taking into account factors such as lifestyle, diet and level of physical activity.

TECHNOLOGICAL ADVANCES IN DIABETES TREATMENT: CHALLENGES AND PROSPECTS FOR THEFUTURE

Diabetes mellitus, a chronic metabolic disease characterized by persistent hyperglycemia, presents ongoing challenges for patients and healthcare professionals. The development of new technologies has significantly transformed the management of the disease, promoting better glycemic control and a higher quality of life. This summary addresses the main technological advances and discusses the challenges and prospects forthe future of diabetes treatment, based on recent literature.

CONTINUOUS GLUCOSE MONITORING AND AUTOMATED DEVICES

Continuous glucose monitoring (CGM) is a central innovation that has revolutionized real-time blood glucose monitoring. Devices such as Dexcom and FreeStyle Libre have enabled patients to monitor their glucose without the need for frequent punctures. Studies show that MCG reduces episodes of hypoglycemia and contributes to more stable glycemic control (Battelino et al., 2019).

In addition to the MCG, integration with insulin pumps has enabled the creation of closed-loop systems, known as artificial pancreas. These devices automatically adjust insulin based on real-time glucose readings, simulating pancreatic function. Clinical trials have shown that systems such as the Medtronic 670G reduce glycemic variability and improve HbA1c levels compared to conventional treatment (Bergenstal et al., 2016).

ARTIFICIAL INTELLIGENCE AND PREDICTIVE ALGORITHMS

Artificial intelligence (AI) has contributed to the development of predictive algorithms that help personalize treatment. These algorithms analyze glycemic, physical activity and diet data to identify patterns and predict glycemic fluctuations. The use of AI, for example in the Control-IQ app, makes it possible to automatically adjust the insulin dose, which has proven effective in preventing episodes of hypoglycemia and hyperglycemia (Heinemann et al., 2018).

AI is also being explored to help doctors optimize insulin regimens, taking into account factors such as glycemic history and response to different doses. These machine learning-based models aid clinical decision-making, improving diabetes management, especially for patients with type 1 diabetes.

NEW MEDICINES: GLP-1 AND SGLT2 INHIBITORS

In addition to insulin control technologies, the development of new classes of drugs, such as GLP-1 agonists and SGLT2 inhibitors, offers additional benefits. These therapies not only help with glycemic control, but also reduce cardiovascular risk and improve kidney function, critical factors for patients with type 2 diabetes (Zinman et al., 2015).

GLP-1 agonists, such as liraglutide and semaglutide, act to increase insulin secretion and reduce appetite, contributing to weight loss. SGLT2 inhibitors, such as empagliflozin, have shown renal and cardiovascular benefits, reducing serious adverse events such as heart failure (Wiviott et al., 2019).

CHALLENGES FOR THE IMPLEMENTATION OF NEW TECHNOLOGIES

Although these advances have shown efficacy, several challenges remain. The high cost of devices and drugs still limits access, especially in low-income regions. The lack of adequate health infrastructure and trained professionals to operate these technologies is also an obstacle.

Another important aspect is data privacy and security. With the use of connected devices and AI-based systems, there is an increase in the volume of sensitive patient data, raising concerns about privacy and cybersecurity. In addition, the efficiency.

FUTURE PERSPECTIVES: BIONIC PANCREAS AND GENE THERAPIES

Future research in the field of diabetes treatment is focused on approaches that can offera more lasting and definitive solution. Among these, the development of bionic pancreas, implantable devices that combine glucose sensors with insulin and glucagon infusion to automatically regulate blood glucose levels, stands out (Weinzimer et al., 2018).

INITIAL CLINICAL TRIALS HAVE SHOWN PROMISING RESULTS, BUT THESE DEVICES STILL FACE TECHNICAL AND COST CHALLENGES

Another emerging field is gene therapy. Studies are exploring the use of techniques such as CRISPR to modify pancreatic cells, restoring the ability to produce insulin in patients with type 1 diabetes. However, safety and ethical issues need to be resolved before these technologies are available to the general population.

Technological advances in diabetes treatment are providing more effective glycemic control and a significant improvement in the quality of life of patients. However, high costs, privacy challenges and the need for specialized training to use these technologies remain significant barriers. In the future, it is expected that gene therapies and the development of bionic pancreases may offer more comprehensive and personalized alternatives, contributing to more effective management of diabetes and, possibly, a cure for the disease.

CASE REPORT OF A PATIENT WITH DM1.CASE REPORT

This is the case report of patient T. P. M. A, 37 years old, diagnosed with Type 1 Diabetes Mellitus (DM1) 30 years ago. When she was 7 years old, she presented the classic symptoms of DM1, that is, polyphagia, polydipsia, polyuria and involuntary weight loss.

He started therapy with NPH insulin and over the years, with therapeutic advances, he used glargine (24-hour insulin) and more recently degludec (30-hour insulin) associated with ultra- rapid bolus insulin.

Even with regular capillary blood glucose levels, reaching an incredible eight pricks per day, he reported difficulty in controlling his blood glucose.

Since 2019, he has been using a blood glucose sensor, also known as a continuous glucose monitoring (CGM) system, which is a device that allows the measurement of glucose in the interstitial fluid without the need for frequent finger pricks. This device has become increasingly popular among people with diabetes, as it offers a practical and less invasive way to monitor glucose levels throughout the day, avoiding the dreaded chronic complications.

The patient highlighted the advantages and disadvantages of the glucose sensor:

Advantages:

- ✓ Continuous Monitoring: Allows real-time visualization of glucose levels, helping in the
- ✓ early detection of hypoglycemia or hyperglycemia.
- ✓ Less Invasive: Reduces the need for frequent finger pricks, improving adherence to
- ✓ treatment.
- ✓ Personalized Alerts: Many devices offer alarms for glucose levels outside the desired
- ✓ range.

Disadvantages:

- ✓ Cost: Sensors can be expensive and are not always covered by health plans.
- ✓ Calibration: Some models require regular calibration with capillary glucose
- ✓ measurements.
- ✓ Accuracy: Accuracy may vary depending on the type of sensor and the patient's condition.

In association with the glucose sensor, the patient reported that she was influenced by herendocrinologist to study automatic insulin pump therapy, also known as a closed-loop insulin delivery system or artificial pancreas, which represents a significant advance in the management of diabetes mellitus, especially in DM1. This device combines continuous insulin administrationwith continuous glucose monitoring (CGM), allowing for more precise regulation of glucose levels.

How an Automatic Insulin Pump Works: Automatic insulin pumps use advanced algorithms to adjust insulin infusion based on CGM readings. The main components include:

- ✓ Insulin Pump: Device that delivers insulin continuously through a subcutaneous catheter.
- ✓ Continuous Glucose Monitor (CGM): Sensor that measures glucose levels in theinterstitium, sending real-time data to the pump.
- ✓ Control Algorithm: Software that processes CGM information and adjusts the insulininfusion rate automatically.

- ✓ It is worth highlighting the recent technological advances:
- ✓ Data Integration: Systems that connect the pump and the CGM, allowing dynamic
- ✓ adjustments in insulin delivery.
- ✓ Artificial Intelligence: Algorithms that learn from the user's glycemic patterns, improving dosage accuracy.
- ✓ User Interface: Improved usability, with applications that allow patients to monitor and
- ✓ adjust their settings easily.
- ✓ Clinical Evidence: Studies have shown that the use of automatic insulin pumps results in: Improved Glycemic Control: Significant reduction in glycated hemoglobin (HbA1c) without increasing the risk of hypoglycemia; Quality of Life: Patients report greater satisfaction and less stress related to diabetes management; Reduction in Complications: Lower incidence of microvascular and macrovascular complications associated with diabetes.

CONCLUSION

The conclusion of the article reinforces the relevance of an integrated and personalized approach to the treatment of diabetes, considering the particularities of each patient. The appropriate use of hypoglycemic agents and the appropriate selection of insulin types are crucial factors for effective glycemic control, which aims to prevent complications and improve quality of life. Healthcare professionals need to continually evaluate the treatment regimen and adjust doses as necessary, ensuring that the patient achieves the best therapeutic results safely. Technological advances, such as insulin pumps and continuous glucose monitoring systems, have represented a milestone in diabetes management, allowing real-time interventions

and reducing the need for manual measurements.

These innovations facilitate treatment management, providing more accurate data on blood glucose levels, which in turn contributes to better adherence to treatment and a reduction in episodes of hypoglycemia and hyperglycemia. Personalization of treatment is another crucial aspect addressed in the study, since each patient presents a unique response to treatment with insulin and hypoglycemic agents.

Understanding these individual variabilities and adapting therapies based on the specificneeds of each person maximizes the benefits of treatment, in addition to reducing side effects and improving the patient's experience with managing the condition. Furthermore, the article emphasizes the need for education and ongoing guidance so that patients can make correct use ofavailable technologies, such as continuous monitoring, and so that they understand the importanceof following the treatment plan. The formation of multidisciplinary teams is also recommended, as it provides a more comprehensive approach, with support in areas such as nutrition, psychologyand health education, which increases the effectiveness of treatment.

It is concluded that the combination of well-established pharmacological strategies with the intelligent use of new technologies and a patient-centered approach represents the most promising path to diabetes control. By providing more individualized and technologically advanced treatment, it is possible to significantly improve glycemic control, reduce complicationsand promote a healthier and more independent life for patients with diabetes.

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