THE IMPACT OF SARS-COV-2 INFECTION ON METABOLIC AND ENDOCRINE CHANGES IN PATIENTS WITH DIABETES MELLITUS

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Abstract

This article explores the impact of COVID-19 (SARS-CoV-2) infection on metabolic and endocrine changes in patients with diabetes mellitus. Diabetic individuals are at significantly higher risk of severe disease, characterized by hyperglycemia, insulin resistance, inflammatory cytokine elevation, and hormonal imbalance. The article discusses viral damage to pancreatic β-cells, endocrine consequences of cytokine storm, and the bidirectional relationship between COVID-19 and diabetes.

Keywords: COVID-19, SARS-CoV-2, diabetes mellitus, metabolic changes, endocrine system, insulin resistance

ВЛИЯНИЕ ИНФЕКЦИИ SARS-COV-2 НА МЕТАБОЛИЧЕСКИЕ И ЭНДОКРИННЫЕ ИЗМЕНЕНИЯ У ПАЦИЕНТОВ С САХАРНЫМ ДИАБЕТОМ

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Аннотация

В статье рассматривается влияние инфекции COVID-19 (SARS-CoV-2) на метаболические и эндокринные изменения у пациентов с сахарным диабетом. У больных с диабетом заболевание протекает тяжелее, сопровождается гипергликемией, повышенной инсулинорезистентностью, воспалением и гормональным дисбалансом. Проанализированы механизмы поражения β-клеток поджелудочной железы вирусом, эндокринные последствия цитокинового шторма и взаимосвязь между COVID-19 и диабетом.

Ключевые слова: COVID-19, SARS-CoV-2, сахарный диабет, метаболические нарушения, эндокринная система, инсулинорезистентность

1. Introduction

The coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), emerged in late 2019 and has since evolved into a global pandemic affecting multiple organ systems. Although primarily a respiratory illness, COVID-19 also exerts profound effects on metabolic and endocrine functions. Clinical evidence shows that patients with diabetes mellitus (DM) experience more severe forms of COVID-19, with higher rates of hospitalization, complications, and mortality.

Diabetes mellitus is a chronic metabolic disorder characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both. It is known to compromise immune responses and increase systemic inflammation, which predisposes patients to more severe viral infections. In the context of COVID-19, these factors are further exacerbated by the virus's effects on the endocrine system.

SARS-CoV-2 uses the angiotensin-converting enzyme 2 (ACE2) receptor to enter human cells. This receptor is expressed not only in the lungs but also in the pancreas, thyroid, adrenal glands, and gonads, suggesting that the endocrine system may be a direct target of viral invasion. Viral entry into pancreatic β-cells can impair insulin secretion, potentially triggering new-onset diabetes or worsening glycemic control in pre-existing diabetes.

Additionally, systemic inflammation and cytokine release — often referred to as a "cytokine storm" — amplify insulin resistance and disrupt metabolic balance. Treatment regimens involving glucocorticoids, frequently used in severe COVID-19 cases, further exacerbate hyperglycemia.

The interaction between diabetes and COVID-19 thus forms a vicious cycle: hyperglycemia impairs immune defense, facilitating viral replication and worsening inflammation, which in turn deteriorates glucose homeostasis. Understanding this bidirectional relationship is essential for optimizing management strategies for diabetic patients during and after COVID-19 infection.

Beyond glycemic abnormalities, COVID-19 has been linked to disturbances in other endocrine axes. Studies have demonstrated transient thyroid dysfunction, adrenal insufficiency, and gonadal hormonal imbalance during and after infection. These findings highlight that COVID-19 should not be viewed solely as a respiratory disease but rather as a **multisystemic endocrine disorder** in certain contexts.

Understanding the **metabolic-endocrine interface of COVID-19** is crucial for developing appropriate treatment strategies, as unregulated glycemia contributes to increased disease severity, prolonged recovery, and higher mortality. Furthermore, the recognition of post-COVID metabolic complications underscores the need for long-term endocrinological monitoring.

2. Methods

This review was conducted through a comprehensive literature search using PubMed, Scopus, and Google Scholar databases for the years 2020–2025. Search terms included *"COVID-19," "SARS-CoV-2," "diabetes mellitus," "metabolic changes," "endocrine dysfunction,"* and *"insulin resistance."*
Over 100 publications were initially screened. Thirty of the most relevant studies were analyzed in detail, and fifteen high-quality, peer-reviewed articles were selected for citation in this paper based on clinical significance and methodological rigor.

3. Results

- **Increased Insulin Resistance:** COVID-19 was found to increase insulin resistance in diabetic patients by 25–50%, leading to poorer glycemic control.
- **β-Cell Damage:** Pancreatic β-cells expressing ACE2 receptors showed susceptibility to direct viral injury, reducing insulin secretion.
- **New-Onset Diabetes:** Several studies reported cases of new-onset diabetes in previously non-diabetic patients following SARS-CoV-2 infection.
- **Inflammatory Markers:** Elevated cytokines such as IL-6 and TNF-α were associated with disrupted insulin signaling pathways.
- **Hyperglycemia and Ketoacidosis:** The incidence of severe hyperglycemia and diabetic ketoacidosis increased among COVID-19 patients with diabetes.
- **Higher Mortality:** Diabetic patients demonstrated a 2–3 times higher risk of severe outcomes and mortality from COVID-19 compared to non-diabetic individuals.

4. Discussion

The evidence demonstrates a complex bidirectional relationship between COVID-19 and diabetes. Diabetes increases susceptibility to infection, while SARS-CoV-2 further aggravates metabolic dysfunction. Hyperglycemia enhances viral replication and immune dysregulation, contributing to cytokine storm and endothelial injury.

The use of corticosteroids in COVID-19 therapy, although lifesaving, complicates glucose management. Therefore, continuous glucose monitoring, insulin therapy adjustment, and anti-inflammatory interventions are critical in managing diabetic patients with COVID-19.

Furthermore, post-COVID-19 follow-up studies indicate persistent metabolic disturbances even after viral clearance. Endocrine evaluations—particularly of thyroid, adrenal, and pancreatic function—should be included in post-COVID care for diabetic patients.

5. Conclusion

SARS-CoV-2 infection profoundly impacts metabolic and endocrine systems in patients with diabetes mellitus. The virus not only worsens glycemic control but also triggers endocrine dysfunctions that contribute to disease severity and mortality. Optimal management requires integrated care, including strict glycemic monitoring, tailored insulin therapy, and endocrinological follow-up after recovery.

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