

An Overview on Metformin and Mechanism of Action

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DESCRIPTION

Metformin, a widely prescribed prescription, has received substantial attention in the medical community due to its several benefits in the treatment of Type 2 Diabetic Mellitus (T2DM) and other conditions. Metformin, which was originally obtained from the French Lilac plant, has become an essential tool in the treatment of diabetes and is still being studied for its potential use in a variety of other illnesses. This page gets into the mechanism of action, therapeutic applications, adverse effects, and new research on metformin.

Mechanism of action and therapeutic uses

Metformin's therapeutic benefits are principally achieved through the activation of AMP-activated protein kinase, a major regulator of cellular energy metabolism. Metformin reduces blood glucose levels by decreasing hepatic gluconeogenesis and improving insulin sensitivity in peripheral tissues, while without increasing insulin production from pancreatic β cells. Metformin has also been proven to increase mitochondrial function, alter lipid metabolism, and have anti-inflammatory actions, which contribute to its overall metabolic advantages.

Type 2 Diabetes Mellitus (T2DM): Metformin is considered the first-line pharmacological therapy for T2DM due to its efficacy, safety profile, and cardiovascular benefits. It helps to lower fasting and postprandial blood glucose levels, reduce Hemoglobin A1c (HbA1c), and decrease the risk of diabetes-related complications.

Gestational Diabetes Mellitus (GDM): Metformin may be prescribed to manage hyperglycemia in pregnant women with GDM, offering an alternative to insulin therapy while minimizing the risk of maternal and neonatal complications.

Polycystic Ovary Syndrome (PCOS): Metformin is frequently used off-label to improve insulin sensitivity and regulate menstrual cycles in women with PCOS, thereby addressing associated symptoms such as irregular periods, hirsutism, and infertility.

Weight management: While not primarily indicated for weight

loss, metformin may modestly reduce body weight in individuals with T2DM or obesity by promoting satiety, decreasing appetite, and enhancing fat utilization.

Potential anti-cancer effects: Emerging evidence suggests that metformin may possess anti-cancer properties, with studies demonstrating potential benefits in reducing the incidence and mortality of certain malignancies, including colorectal, breast, and prostate cancers.

Side effects of metformin

Metformin is generally well-tolerated, however, like any medication, it may cause adverse effects, most commonly gastrointestinal symptoms such as nausea, diarrhoea, and abdominal discomfort. These side effects are usually transient and can be mitigated by starting with a low dose and gradually titrating upward, taking the medication with meals, or switching to extended-release formulations. Rare but serious side effects include lactic acidosis, particularly in individuals with renal impairment or other predisposing factors, and vitamin B12 deficiency, necessitating periodic monitoring and supplementation. Emerging research, beyond its established uses ongoing research is investigating the potential therapeutic applications of metformin in diverse medical conditions, including:

Cardiovascular disease: Metformin's cardiovascular benefits extend beyond glycemic control, with studies suggesting a reduction in cardiovascular events and mortality in patients with T2DM and possibly in those without diabetes.

Neurodegenerative disorders: Preclinical studies and observational data indicate that metformin may have neuroprotective effects and could potentially mitigate the risk of neurodegenerative diseases such as Alzheimer's and Parkinson's disease.

Aging and longevity: Metformin has attracted attention for its potential to extend lifespan and delay age-related decline by targeting fundamental metabolic pathways implicated in aging processes, prompting ongoing clinical trials to explore its effects on longevity in humans.

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COVID-19: Preliminary studies suggest that metformin may confer protective effects against severe outcomes in patients with COVID-19 by modulating immune responses and reducing inflammation, although further research is needed to confirm these findings.

CONCLUSION

Metformin stands as a proof to the remarkable intersection of basic science, clinical medicine, and translational research. Its

well-established role in managing T2DM has paved the way for exploration into its broader therapeutic potential across various medical domains. As ongoing research continues to clarify the complexities of metformin's mechanisms and effects, it holds ability as not only an important therapy for diabetes but also a versatile agent with far-reaching implications for human health and longevity.