# Restoring Immune and Metabolic Balance with BCG Therapy in Type 1 Diabetes

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## Introduction

Type 1 diabetes (T1D) is a chronic autoimmune disorder characterized by the selective destruction of insulin-producing pancreatic β-cells, leading to insulin deficiency, hyperglycemia, and metabolic imbalances. Traditional therapeutic approaches for T1D primarily focus on insulin replacement, yet emerging strategies seek to address the underlying immune dysregulation responsible for β-cell destruction [1-3]. One such approach that has garnered increasing attention is the use of Bacillus Calmette-Guérin (BCG) therapy, originally developed as a vaccine against tuberculosis. BCG therapy's immunomodulatory effects have shown promise in halting or even reversing the progression of T1D [4, 5].

The intricate relationship between immunity and metabolism in T1D underscores the need for comprehensive therapeutic approaches that address both aspects of the disease. BCG therapy offers a novel perspective, as its effects extend beyond immune modulation to potentially impact metabolic pathways and restore balance within the complex interplay of immune responses and metabolic processes [6- 8].

### BCG therapy's immunomodulatory effects

**1. Regulatory T cells (Tregs):** BCG therapy has been shown to enhance the expansion and functionality of regulatory T cells (Tregs), promoting immune tolerance and dampening autoimmune responses directed against insulin-producing β-cells [9].

**2. Cytokine profile modulation:** BCG treatment exerts anti-inflammatory effects by shifting the cytokine milieu towards a more balanced profile, reducing pro-inflammatory mediators that contribute to β-cell destruction.

**3. Antigen-presenting cells (APCs):** BCG impacts antigen-presenting cells, promoting a tolerogenic phenotype that helps prevent immune recognition of β-cell antigens.

### BCG and metabolic balance

**1. B-cell function preservation:** BCG's immunomodulatory effects have the potential to preserve β-cell function by mitigating autoimmune destruction and reducing β-cell stress.

**2. Metabolic pathways:** BCG therapy has been associated with metabolic changes that impact glucose homeostasis, potentially improving insulin sensitivity and utilization.

### Potential mechanisms linking immunity and metabolism

**1. Immunometabolism:** BCG therapy's effects on immune cells could influence their metabolic activity, creating a feedback loop that affects both immune regulation and metabolic homeostasis.

**2. Gut microbiota:** BCG's impact on gut microbiota composition might influence immune responses and metabolic outcomes, suggesting a broader network of interactions.

### Clinical implications and future directions

The potential of BCG therapy as an adjunctive or alternative approach to T1D management is promising. Its immunomodulatory effects and influence on metabolic pathways open avenues for combination therapies that address both autoimmune and metabolic components of T1D. As research advances, further studies are warranted to elucidate BCG therapy's precise mechanisms, optimize dosing regimens, and identify patient subgroups that could benefit the most [10- 12].

## Conclusion

BCG therapy's potential to restore balanced immunity and metabolic harmony in the context of T1D offers a compelling avenue for therapeutic intervention. By unraveling its immunomodulatory effects, metabolic implications, and potential mechanisms linking immunity and metabolism, we gain valuable insights into BCG therapy's multifaceted role in reshaping the landscape of T1D management. This review underscores the importance of exploring innovative strategies that address both immune dysregulation and metabolic disruption in the pursuit of comprehensive T1D treatment approaches.

## Acknowledgement

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## Conflict of Interest

None

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