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# Treatment of Diabetes Mellitus: Invasive Infections in Diabetes Mellitus and Clinical Practice Management

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**Abstract**

Diabetes mellitus is associated with a marked increase of cardiovascular events. The treatment strategy of diabetes has to be based on the knowledge of its pathophysiology. Thus, insulin is essential for treatment of type 1 diabetic patients because there is a defect in insulin secretion. However, treatment of type 2 diabetic patients is more complex because a defect in both insulin secretion and insulin action exists. Therefore, the treatment selection will depend on the stage of the disease and the individual characteristics of the patient. This article examines the general goals of the treatment and reviews the management of type 2 diabetes.

**Keywords:** Diabetes mellitus; Altered immune response; Invasive infection; Treatment strategy

## Introduction

Diabetes mellitus (DM), a non-communicable metabolic condition, has been linked to a broad spectrum of opportunistic bacterial and fungal infections. Inadequate insulin secretion or action causes an increase in blood glucose which, in turn, causes a series of metabolic and physiological abnormalities in the organs. According to 2019 report, 1.5 million deaths were primarily associated with diabetes, and 48% of those deaths happened before the age of 70. The International Diabetes Federation (IDF) estimates that nearly 10% of adults aged 20–79 had DM in 2021. Significant evidence supports the correlation between diabetes mellitus and an increased risk of infection. Many infections are more prevalent in diabetic individuals; some occur almost exclusively in this population. Other infections are more severe and are linked with an increased risk of complications in diabetic people. Since the immune systems of diabetic patients are changed in many ways, patients with diabetes are more prone to microbiological infections, such as pulmonary TB, urinary tract infections, pneumonia, and soft tissue and skin infections. Patients who have diabetes with uncontrolled hyperglycaemia have weakened immune systems and are referred to as immune dysfunctional or sometimes immunocompromised [1]. Therefore, it is hypothesized that hyperglycaemia is the primary cause of impaired immunity in DM patients. Multiple mechanistic pathways are engaged in the impaired immune systems of diabetic individuals. However, each infectious agent causes a distinct type of illness. After extensive review research this article attempts to provide a critical overview of the current understanding of the processes behind the increased sensitivity of diabetes to infectious illnesses, as well to describe the principal infectious diseases associated with this metabolic condition and its management.

## Altered Immune response in diabetes

The human body has incredible defences against millions of bacteria, viruses, fungi, poisons, and parasites. The immune system normally protects against infections, but numerous disorders and deficiencies may impair it. Bacteria may infiltrate through open wounds and cause infections. Natural barriers, including intact skin and mucosal surfaces and the reactive oxygen species, cytokines, and chemokines within their mechanistic organization, help our defence system to fight against pathogens [2]. Due to the immune system's inability to combat microorganisms, infections are a significant concern for people with diabetes. Numerous research have investigated diabetes-related pathways that decrease pathogen resistance. These processes include the inhibition of cytokine production, abnormalities in phagocytosis, immune cell malfunction, and an inability to destroy microbials.

## General principles of treatment

Diet and exercise are fundamental in the treatment of diabetes. Dietary recommendations must be customized for each individual to achieve the general objectives of treatment. It should be remembered that obesity is common in type 2 diabetics so one of the main objectives should be weight reduction. The calorie content of the diet should be adjusted in each individual in accordance with the body mass index and regular physical activity. As far as the nutrient proportions of the diet, it is recommended that proteins should constitute 10%-20% of calorie intake and fats less than 30%, with less than 10% saturated fats. With regard to carbohydrates, emphasis should be placed on total intake rather than on their origin, although rapidly absorbed carbohydrates should be avoided [3].

Physical exercise, aside from constituting a mainstay of the treatment of diabetic patients, helps to prevent the development of diabetes in adult life. In patients with type 2 diabetes, moderate regular exercise is very beneficial, since it reduces glycemia by increasing sensitivity to insulin, improves the lipid profile, lowers blood pressure, contributes to weight loss [4], and improves cardiovascular state In addition, it gives the patient a sense of well being and better quality of life. The main disadvantage of exercise in diabetic patients is hypoglycemia, which can occur several hours later and should condition adjustments in the therapeutic regimen. In addition, in patients with type 1 diabetes and poor metabolic control, especially after anaerobic exercise, hyperglycemic decompensation or even ketosis can take place.

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Aside from disturbing glucose metabolism, physical exercise can entail other risks. Therefore, the patient´s exercise program must be planned individually taking into consideration physical capacity and potential risks [5].

The diabetological education that the patient receives from qualified healthcare personnel is essential in achieving therapeutic objectives. For example, self-testing of capillary blood glucose informs the patient about the time of day when glycemic control is worse and helps to identify undetected hypoglycemia. Therefore, self-tests are fundamental for making opportune modifications in therapy. In addition, the patient who knows how to modify treatment based on capillary blood glucose measurements and has received advice on how to handle various situations, such as hypoglycemia or hyperglycemic-ketotic decompensation, will require fewer hospital admissions and have a better quality of life [6].

### Invasive infection susceptibility and management in diabetes

### Invasive Aspergillosis infection

Diabetic patients are more prone to microbial infection, particularly fungal infections. A significant mortality rate is associated with invasive aspergillosis infection, a form of fatal fungal infection. The mortality rate of invasive fungal illnesses is approximately 10 to 15%, with aspergillosis infection accounting for 42 to 64% of deaths in critically sick patients. Invasive aspergillosis is caused by the mould Aspergillus, which causes different infections and allergy disorders depending on human immunity [7]. Aspergillus fungi are ubiquitous in outdoor and indoor environments. Aspergillus spores are inhaled regularly but do not cause any illness. In immune-dysfunctional diabetic individuals, Aspergillus causes lung infections, allergic responses, and organ infections. Aspergillus spores cause moderate to severe lung infections. Aspergillosis becomes dangerous when it spreads to the blood vessels. Invasive pulmonary aspergillosis, which was first described in 1953, spreads rapidly under immunosuppression or chemotherapy. IPA is a type of aspergillosis in immunocompromised people, and it often infects critically sick patients comorbid with chronic obstructive pulmonary disease [8]. Low white blood cell levels, lung cavities, asthma, cystic fibrosis, and long-term use of steroid medication may also induce IPA. Aspergillus causes fever, cough, asthma, shortness of breath, headaches, joint discomfort, and skin lesions. Aspergillosis may cause lung haemorrhage and extend to the heart, kidneys, and brain.

### Treatment possibilities for invasive infection in diabetes with impaired immunity

Most of the treatment strategies and techniques for aspergillosis, zygomycosis, mucormycosis, or herpes zoster do not change between diabetic and non-diabetic patients; however, the therapy does vary depending on the symptoms and tolerance level of the diabetic patient. Even if antifungal medicines and surgical treatment are available, invasive fungal infection in diabetic populations continues to be a disease with a high death rate. This is an unfortunate fact despite the availability of therapeutic options. The presence of ketoacidosis at the time of diagnosis is related to an increased likelihood of death. Imaging at many time points may be helpful in identifying intracranial expansion at an earlier phase. Following the diagnosis of the condition, focus should be on the clinical response and, subsequently, radiological imaging to direct the treatment strategy [9]. If health care professionals have a better understanding of this atypical infectious condition, they may be able to lower fatality rates until more advanced treatment options become available. Here, we explored the many therapeutic options now available to fight against infectious ailments in diabetic patients [10].

## Conclusions

The chance of developing certain invasive infections is well-known in the diabetic condition. When dealing with diabetic patients with facial symptoms, medical professionals should proceed with extreme care. Purulent nasal discharge may indicate an active fungal infection, although diagnosis is sometimes challenging. Ketoacidosis undoubtedly increases the risk of fatal infections, yet most infections occur in poorly balanced diabetics without ketoacidosis. In diabetic patients, diagnostic delay is the leading cause of morbidity and fatality. Unfortunately, there are currently no vaccinations approved for use against infectious diseases, and the number of medications that may be used to treat potentially fatal infections is very restricted. Despite the availability of potentially beneficial therapeutic options, additional treatments have not been pursued in recent years. It is imperative that more research is conducted to achieve a more in-depth understanding of the pathogenic processes and the association between microbial organisms and the microenvironment that can be found in the human body. This understanding, in conjunction with the use of cutting-edge technology, such as CRISPR/Cas9 for the genetic alteration of the intricate genome of the microbes, will undoubtedly lead to the creation of improved antimicrobial drugs, alternative treatment options, and vaccines.

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