

A Study on Isolation, Characterization, and Exploration of Multiantibiotic-Resistant Bacteria in the Wound Site of Diabetic Foot Ulcer Patients

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Abstract

This study collected wound swab samples from 50 diabetic patients, especially in Wagner's grade 2 (28) and grade 3 (22) foot ulcers. The samples were processed and subjected to bacterial isolation and characterization. The obtained diabetic foot ulcer (DFU) bacterial isolates were also subjected to antibiotic susceptibility assay. All the collected samples were culture positive and produced a total of 85 isolates. Monomicrobial and polymicrobial infections were observed from the collected grade 2 and 3 samples, respectively. Gram's staining and morphological analyses of the obtained bacterial colony demonstrated the presence of both Gram-positive and Gram-negative bacilli, Gram-positive cocci, and Gram-negative cocco-bacilli in the wounds of diabetic patients. The bacterial profiling of 85 isolates revealed the presence of Gram-negative bacteria such as *Pseudomonas aeruginosa*, *Escherichia coli*, *Proteus* spp, *Acinetobacter* spp, *Enterobacter* spp, *Klebsiella pneumoniae*, *Citrobacter* spp, *K oxytoca*, and *Stenotrophomonas* spp Gram-positive bacteria such as *Staphylococcus aureus*, *Bacillus subtilis*, *Enterococcus faecalis*, *Corynebacterium* spp, and *Streptococcus dysgalactiae* were also identified. The predominant microbial flora found in the collected samples were *Staphylococcus aureus* (38%) and *P aeruginosa* (23.2%), followed by *B subtilis* (21%) and *Escherichia coli* (18%) and other bacteria. Furthermore, the obtained antibiotic susceptibility assay data of DFU isolates have also confirmed the distribution of multiantibiotic-resistant bacteria in the wound site of diabetic patients. The findings of the present study suggest that there is a need for the discovery of novel drug(s) to alleviate antibiotic-resistant bacterial infections in DFU patients.

Keywords

diabetic foot ulcer, bacteria, isolation, characterization, antibiotic resistant

Introduction

The prevalence of diabetes has been increasing worldwide. Globally, 171 million people are affected by diabetes, and it is estimated to reach 366 million in 2030.¹ According to the statement of the World Health Organization, India has the highest number of people with diabetes, and it is expected to increase by 87 million in 2030.² The prevalence of diabetes-associated complications, including foot infections, have been increasing in India and other countries.^{3–6} Among the total of the diabetic population, about 15 to 20 patients have been experiencing a foot ulcer in their lifetime.⁷ Around 15% to 27% of patients require either minor/major amputations of their lower limbs. This demonstrates that diabetic patients are highly susceptible to get a foot ulcer in their lifetime.

It has been explained that the chronic nonhealing foot ulcer in diabetes is mainly due to several factors such as neuropathy, high plantar pressures, vascular insufficiency (i.e)

reduced blood supply, and neutrophil function. It is also stated that hyperglycemia inhibits the wound healing process by delaying/extending the inflammatory and proliferative phases through the formation of advanced glycation end products (AGEs).⁸ AGEs can eventually accumulate free radicals, which lead to oxidative stress-mediated cytotoxicity and delayed wound healing.⁹ Furthermore, it has been stated that in more than 50% of cases, infection is the major contributing factor. The microbial etiology of diabetic foot infection has been studied extensively in India and other countries.^{10–14} But discrepancies have still existed in the

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