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One-step Detection of Vancomycin in Whole Blood Using the Lateral Flow Immunoassay

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Abstract

The emergence of antibiotic-resistant bacteria poses a significant challenge to public health worldwide. Vancomycin, a potent antibiotic, is often used as a last resort for treating infections caused by such bacteria. However, the monitoring of vancomycin levels in patients' blood is crucial to ensure its therapeutic efficacy and prevent toxicity. In this article, we delve into the development and application of a one-step lateral flow immunoassay for the rapid and efficient detection of vancomycin in whole blood samples. We discuss the principles behind the assay, its advantages over traditional methods, and its potential implications for clinical practice.

Keywords: Antibiotic • Health • Blood

Introduction

Antibiotic resistance is a pressing global health issue that threatens the effectiveness of many commonly used antibiotics. Vancomycin, a glycopeptide antibiotic, has been a cornerstone in the treatment of infections caused by methicillin-resistant Staphylococcus aureus and other resistant bacteria. However, the overuse and misuse of vancomycin have led to the emergence of vancomycin-resistant strains, necessitating careful monitoring of vancomycin levels in patients' blood to ensure therapeutic efficacy and avoid adverse effects [1].

Literature Review

Traditional methods for quantifying vancomycin levels in blood, such as high-performance liquid chromatography and enzyme-linked immunosorbent assay are time-consuming, labour-intensive, and require specialized equipment and trained personnel. Consequently, there is a growing need for rapid and cost-effective point-of-care diagnostic tools for vancomycin detection. Lateral flow immunoassays have emerged as promising candidates for point-of-care testing due to their simplicity, rapidity, and low cost. LFAs, also known as immunochromatographic assays, are paper-based devices that employ the principles of capillary action and specific antibody-antigen interactions to detect the presence of a target analyte in a sample. In recent years, researchers have developed one-step LFAs for the detection of various analytes, including drugs, hormones, and infectious agents [2]. The one-step lateral flow immunoassay for vancomycin detection relies on the specific binding between vancomycin molecules and antibodies immobilized on a nitrocellulose membrane.

Discussion

This pad contains colloidal gold nanoparticles conjugated with anti-vancomycin antibodies. A porous membrane where the whole blood sample is applied. This membrane contains immobilized capture antibodies that specifically bind to vancomycin. A cellulose pad that absorbs excess liquid and facilitates the flow of the sample along the nitrocellulose membrane. When a whole blood sample containing vancomycin is applied to the sample pad, the sample migrates along the membrane by capillary action. As the sample flows through the membrane, vancomycin molecules in the sample bind to the gold nanoparticle-conjugated antibodies in the conjugate pad, forming a vancomycin-antibody-gold nanoparticle complex. As the complex migrates along the membrane, it encounters the immobilized capture antibodies specific to vancomycin. The vancomycin-antibody-gold nanoparticle complex binds to these capture antibodies, resulting in the formation of a visible test line. The intensity of the test line correlates with the concentration of vancomycin in the sample. In addition to the test line, a control line containing immobilized anti-IgG antibodies serves as a procedural control, indicating that the assay has functioned correctly [3,4].

The one-step lateral flow immunoassay provides results within minutes, enabling timely clinical decision-making. The assay requires minimal sample preparation and no specialized equipment, making it suitable for use in resource-limited settings and point-of-care environments. The assay exhibits high sensitivity, allowing for the detection of vancomycin at clinically relevant concentrations HealthCare providers can use the assay to monitor vancomycin levels in patients receiving vancomycin therapy, ensuring optimal dosing and minimizing the risk of toxicity. The assay can be deployed in outpatient clinics, emergency departments, and other point-of-care settings to facilitate rapid vancomycin detection and decision-making [5,6].

Conclusion

The one-step lateral flow immunoassay represents a promising tool for the rapid and efficient detection of vancomycin in whole blood samples. Compared to traditional methods such as HPLC and ELISA, the lateral flow immunoassay is more cost-effective, making it accessible to a wider range of healthcare providers and patients. Its simplicity, rapidity, and cost-effectiveness make it well-suited for point-of-care testing and therapeutic drug monitoring applications. Further research and development efforts are warranted to optimize the assay's performance and broaden its clinical utility in the management of vancomycin therapy and antibiotic resistance.

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Conflict of Interest

None.

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