Oncology, Nuclear Medicine and Transplantology
(eISSN 3105-8760)

Congress Abstract

Fiber Optic Biosensors for Triple-Negative Breast Cancer Cells Detection

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Proceedings of International Scientific and Practical Conference *"ONCO FUTURE KAZAKHSTAN 2026: Precision Oncology Theranostics, Artificial Intelligence,"* **September 24-26, 2026, Astana, Kazakhstan**

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Introduction: Triple-negative breast cancer (TNBC) is an aggressive subtype lacking effective targeted therapies, highlighting the need for sensitive and selective cancer cell detection. Optical fiber biosensors offer high sensitivity, compact size, and label-free operation for cancer cell detection. This study developed a quasi-random extrinsic interferometer-based fiber-optic biosensor for label-free TNBC cell detection using two complementary recognition strategies: gold–anti-CD44 antibody functionalization and polydopamine (PDA)-based molecularly imprinted polymer (MIP) recognition. The performance of these functionalized sensors was evaluated for selective recognition of TNBC cells, demonstrating their potential as a sensitive and label-free detection platform.

Materials and Methods: A quasi-random extrinsic interferometer-based fiber-optic sensor was fabricated and coated with polydimethylsiloxane (PDMS), a biocompatible polymer widely used in biomedical applications. For antibody-based recognition, a gold-coated surface was functionalized with anti-CD44 antibodies to target HCC1806 breast cancer cells, with HEK293 cells used as a control. For synthetic recognition, dopamine was polymerized on the sensor surface to form a polydopamine (PDA)-based molecularly imprinted polymer (MIP) designed to recognize HCC1806 and MDA-MB-231 cells. Optical responses at different cell concentrations were recorded using a fiber-optic interrogator, and sensor performance and cell attachment were evaluated by calibration analysis and scanning electron microscopy.

Results and Conclusions: The developed fiber-optic biosensors show potential for integration into liquid biopsy platforms for label-free detection of circulating tumor cells in biological fluids, providing a rapid and minimally invasive approach for cancer detection and monitoring.

Keywords: Biosensing Techniques; Antibodies; Polymers; Cell Line; Triple Negative Breast Neoplasms