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Editorial: Biomedical nanotechnology in cancer diagnostics and treatment

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Editorial on the Research Topic
Biomedical nanotechnology in cancer diagnostics and treatment

Our understanding and methodology of conducting medical research and therapeutic procedures have been completely changed by nanotechnology (Deshmukh, 2023). In recent years, the field of biomedical nanotechnology has experienced fast expansion, promising exciting new avenues for the detection and treatment of various diseases, including cancer (Yang and Jiao, 2023). In order to improve patient outcomes, nanotechnology has the potential to increase the accuracy of diagnostic and therapeutic methods in cancer research and therapy. This editorial's goal is to look into developments in biomedical nanotechnology for the prevention and treatment of cancer. One of the most exciting uses of biomedical nanotechnology is cancer diagnostics. Invasive techniques like biopsies are routinely used in conventional cancer screening approaches, which can be painful for patients and have unfavourable outcomes. Nevertheless, nanoparticles offer an extremely sensitive, non-invasive method for cancer diagnosis (Raab et al., 2024). Nanoparticles are extremely sensitive and selective, and they can be engineered to target compounds, such as cancer biomarkers (Ren et al., 2024). Additionally, they can be engineered to have certain optical, magnetic, or electrical properties that make them perfect for use in diagnostic imaging procedures including magnetic resonance imaging (MRI), computed tomography (CT), and positron emission tomography (PET) scans (Vélez et al., 2022). For instance, it has become possible to create gold nanoparticles that can target and bind to cancer cells, making it possible to scan and detect them. Similarly, iron oxide nanoparticles have been used in MRI to detect liver cancer cells. These nanoparticle-based imaging techniques enable earlier and more precise cancer diagnosis due to their excellent sensitivity and specificity. Nanoparticles have huge potential for cancer treatment as well as diagnosis (Larsen et al., 2024). Nanoparticles that particularly target cancer cells can be developed to deliver therapeutic medications directly to the tumour area. This targeted method can improve therapy efficacy while minimising unwanted effects on healthy tissues. One of the most promising nanoparticle-based cancer treatments is nanodrug delivery. Using nanoparticles, this approach delivers chemotherapy drugs directly to the tumour site (Ferrell et al., 2024). This targeted administration can increase therapy effectiveness while decreasing systemic toxicity by enhancing medication uptake by cancer cells. Nanoparticles can also be used to deliver a variety of cancer treatments, including radiation therapy and gene therapy. For instance, using gold nanoparticles to increase the radiation dose delivered to the tumour while preserving healthy tissues can enhance the therapeutic effects of radiation therapy. Similar to this, using nanoparticles to deliver therapeutic genes directly to cancer cells enables targeted gene therapy (Ishibashi et al., 2023). Despite the enormous potential of biomedical nanotechnology for the prevention and treatment of cancer, there are still substantial obstacles to be addressed. One of the most difficult problems is the possible toxicity of nanoparticles. Although most nanoparticles are believed to be harmless, their small size and distinctive characteristics may make them difficult to remove from the body, which could result in accumulation and toxicity. As a result, it is critical to develop nanoparticles that are both safe for therapeutic usage and biocompatible. Another challenge is the regulatory framework for nanoparticle-based therapies. Because the regulatory environment for nanotechnology is still developing, the approval procedure for medicines based on nanoparticles can be challenging and time-consuming. As a result, more research is needed to determine the efficacy and safety of nanoparticle-based medicines, as well as to develop a regulatory framework that would allow for clinical implementation of these therapies. Notwithstanding these challenges, there are numerous opportunities for using biomedical nanotechnology in cancer detection and treatment (Kalita et al., 2022). There is a demand for targeted and personalised therapy, which nanoparticle-based approaches can provide, as a result of the development of personalised medicine and precision oncology. Also, the ongoing development of novel nanoparticles with unique properties and functions offers the potential to produce increasingly effective and targeted cancer medicines (Vassal et al., 2023). Finally, the diagnosis and treatment of cancer have a lot of promise for biomedical nanotechnology. In contrast to focused nanodrug delivery and other nanoparticles, which are invasive, nanoparticles offer non-invasive and extremely sensitive cancer diagnostic procedures.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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