Short communication

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# Nanomedicine As A Cancer Treatment

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## Abstract

Traditional cancer treatments have inherent limitations, prompting the development and implementation of diverse nanotechnologies for more effective and safer cancer therapy, referred to as cancer nanomedicine. Although there has been significant technological progress in this field, the main roadblocks to nanomedicine becoming a new paradigm in cancer therapy are the complexities and heterogeneity of tumour biology, a lack of understanding of nano–bio interactions, and the chemistry, manufacturing, and control challenges that are required for clinical translation and commercialization. The progress is highlighted in this report. The increased interest in using nanotechnology to treat cancer is due to its unique advantages in drug administration, detection and imaging, synthetic vaccine generation, and small medical devices, as well as the therapeutic properties of particular nanomaterials. Several therapeutic nanoparticle (NP) platforms, such as liposomes, albumin NPs, and polymeric micelles, have been approved for cancer treatment, and many more nanotechnology-enabled therapeutic modalities, such as chemotherapy, hyperthermia, radiation therapy, gene or RNA interference (RNAi) therapy, and immunotherapy, are currently being studied in clinical trials. This insufficiency is caused by an autoimmune reaction in afflicted people, which results in the death of -cells by T-cells, resulting in hypoinsulinemia and hyperglycemia5. Unlike type 1 diabetes, type 2 diabetes is sometimes referred to be a "lifestyle disease".

**Keywords:** Nanomaterials; treatments; nanomedicine; hypoinsulinemia.

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## Introduction

We have progressively understood the difficulties and opportunities that lay ahead as we have made significant progress in the field of cancer nanomedicine. To begin with, the complexity and variety of tumours indicate that rigorous patient selection is essential to determine which patients are most likely to benefit from a given nanotherapy. This is similar to the tailored medicines that have been authorised or are in the works for particular biomarker-defined patient groups. The majority of therapeutic NPs for solid tumour therapy are given systemically, where they concentrate in the tumour due to the increased permeability and retention (EPR) effect, which is hypothesised to be caused by leaky tumour vasculature and inadequate lymphatic outflow. Maintaining blood glucose levels within acceptable normoglycaemic limits (70–140 mg per dl or 4–8 mM; termed as euglycaemia) is the objective of type 1 and type 2 diabetes therapy. NP parameters (such as size, geometry, surface features, elasticity, stiffness, porosity, composition, and targeted ligand) can then affect these biological processes, dictating the EPR effect and therapeutic effects. Nonetheless, it's worth noting that animal data accounts for the majority of our present knowledge of NP behaviour in vivo. This insufficiency is caused by an autoimmune reaction in afflicted people, which results in the death of -cells by T-cells, resulting in hypoinsulinemia and hyperglycemia5. Unlike type 1 diabetes, type 2 diabetes is sometimes referred to be a "lifestyle disease". Glycemic management is an important driver of long-term results for diabetic patients. For a more prominent EPR and therapeutic effect, NP delivery is used. We also look at the principles behind the creation of nanotechnologies that target the TME, which plays such a crucial role in tumour growth and metastasis, and give our thoughts on the obstacles facing cancer nanomedicines in clinical trials.

## Nanomedicine platforms in the arsenal

Liposomes (for example, liposomal doxorubicin (LD); Doxil and Myocet) were the first therapeutic NPs to earn FDA clearance for cancer therapy, and they, along with other lipid-based NPs, continue to make up a significant fraction of clinical-stage nanotherapeutics. Despite the fact that encapsulating pharmaceuticals in liposomes has been proven to increase PK and biodistribution, no commercially available liposomal therapeutic treatments have yet to show an overall survival (OS) improvement when compared to the parent medication. In patients with high-risk acute myeloid leukaemia, the phase III findings of liposomal cytarabine–daunorubicin (Vyxeos; also known as CPX-351) compared to the standard of care regimen of cytarabine and daunorubicin revealed an improved OS of 9.56 months against 5.95 months. Cancer immunotherapy works by bolstering a patient's immune system's ability to combat the illness. Clinically, however, potential immunotherapy techniques have been hampered by unpredictability in response and severe side effects. These constraints might be mitigated by a drug delivery system (DDS) that successfully targets tumours while reducing drug exposure to normal tissue. Cancer is still a prominent illness with significant healthcare and socioeconomic consequences across the world. Unfortunately, chemotherapy-based therapies frequently fail to successfully control cancer development or prevent recurrence. The development of tailored treatments has significantly improved results in recent decades. Nanotechnology has been extensively researched as a DDS for targeting tumours with various oncologic medications in this regard. Several of these have led to better treatment and outcomes. Nanoparticle medication delivery technology can potentially be used in immunotherapy, according to research. The present state of nanotechnology will be examined in this overview. Because protein medicines have been authorised for most cancer immunotherapies in recent years, this paper will focus on micellar nanocomplex (MNC) technology.

## Discussion

When NP formulation involves numerous processes or sophisticated technologies, large-scale and repeatable synthesis will be more challenging. Indeed, scaling-up considerations are a crucial part of early NP design and engineering since the transfer from laboratory to clinic is almost usually accompanied by the optimization of formulation parameters, or even a change in formulation methodologies. Although the PRINT method allows for repeatable NP production, scalability to kilos has yet to be shown. A coaxial turbulent jet mixer method has recently been developed for mass production of polymeric NPs (potential of 3 kg/day per channel), which offers the features of homogeneity, repeatability, and tunability generally only available in microscale mixing techniques such as microfluidics. Despite the fact that NP manufacture is still a staple today.

## Conclusion

Nanotherapeutics will be safer and more effective if we have a better knowledge of nano–bio interactions, systemic transport of NPs to tumour cells, and targeting of NPs to the TME or premetastatic niche. Clinical development will be aided by addressing the issues of controlled, repeatable, and scalable NP synthesis, as well as NP screening and assessment. Although existing pharmaceuticals have been utilised as payloads in most authorised nanomedicines, we expect the next generation of nanomedicines to progressively contain new molecular entities (for example, kinase inhibitors24) and novel therapeutic agent classes (for example, siRNA, mRNA and gene editing). We're quickly gaining a better knowledge of the obstacles and opportunities that cancer nanomedicine presents.