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Chapter 8: Nanomaterial for Cancer Therapeutics

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Abstract

Recent developments in nanotechnology offer researchers opportunities to significantly transform cancer therapeutics. This technology has enabled the manipulation of the biological and physicochemical properties of nanomaterials to facilitate more efficient drug targeting and delivery. Clinical investigations suggest that therapeutic nanoparticles can enhance efficacy and reduced side effects compared with conventional cancer therapeutic drugs. The mechanisms of cancer drug resistance include over expression of drug efflux transporters, defective apoptotic pathways, and hypoxic environment. Nanoparticles targeting these mechanisms can lead to an improvement in the reversal of multidrug resistance. promising progress in cancer nanotechnology, researchers continue to develop novel and efficacious nanoparticles for drug delivery. The use of therapeutic nanoparticles as unique drug delivery systems will be a significant addition to current cancer therapeutics. nanotechnology has been increasingly used in medicine, including applications for diagnosis, treatment, and tumor targeting in a safer and more effective manner.

Key words: Nanoparticels, Cancer therapy, Drug delivery, drug resistance, Anti-tumor multidrug resistance (MDR).

8.1 Introduction

Cancer is a group of diseases that can affect almost any part of the body. It is caused by uncontrolled cell growth and division, leading to the formation of a mass of abnormal cells, known as a tumor. Cancer can be classified into several types, including carcinoma, sarcoma, lymphoma, and leukemia. Understanding the pathology of cancer is crucial for

4. Cooper GM, Adams KW. The cell : a molecular approach. New York, NY: Oxford University Press; 2023.
5. Bahrami B, Hojjat-Farsangi M, Mohammadi H, Anvari E, Ghalamfarsa G, Yousefi M, et al. Nanoparticles and targeted drug delivery in cancer therapy. Immunology Letters [Internet]. 2017 Oct 1 [cited 2020 Mar 26];190:64–83
6. Das KP, J C. Nanoparticles and convergence of artificial intelligence for targeted drug delivery for cancer therapy: Current progress and challenges. Frontiers in Medical Technology. 2023 Jan 6;4.
7. Al-Thani AN, Asma Ghafoor Jan, Abbas M, Mithra Geetha, Kishor Kumar Sadasivuni. Nanoparticles in cancer theragnostic and drug delivery: A comprehensive review. Life Sciences. 2024 Jul 1;352:122899–9.
8. Yazdani N, Moran CS, Salomon C, Chaminda Jayampath Seneviratne, Sašo Ivanovski, et al. Unveiling clinical applications of bacterial extracellular vesicles as natural nanomaterials in disease diagnosis and therapeutics. Acta biomaterialia. 2024 Apr 1;
9. Dang Y, Guan J. Nanoparticle-based drug delivery systems for cancer therapy. Smart Materials in Medicine. 2020;1:10–9.
10. Ranil Vikraman Kumarasamy, Natarajan PM, Vidhya Rekha Umapathy, Roy JR, Mironescu M, Chella Perumal Palanisamy. Clinical applications and therapeutic potentials of advanced nanoparticles: a comprehensive review on completed human clinical trials. Frontiers in Nanotechnology. 2024 Oct 21;6.
11. Hong L, Wen L, Li Y, Yin S. Nanoparticle-based drug delivery systems targeting cancer cell surfaces. RSC Advances. 2023 Jan 1;13(31):21365–82.
12. Al-Thani AN, Asma Ghafoor Jan, Abbas M, Mithra Geetha, Kishor Kumar Sadasivuni. Nanoparticles in cancer theragnostic and drug delivery: A comprehensive review. Life Sciences. 2024 Jul 1;352:122899–9.
13. Gavas S, Quazi S, Karpiński TM. Nanoparticles for Cancer Therapy: Current Progress and Challenges. Nanoscale Research Letters. 2021 Dec;16(1).
14. Rashidi N, Davidson M, Apostolopoulos V, Kulmira Nurgali. Nanoparticles in cancer diagnosis and treatment: Progress, challenges, and opportunities. Journal of drug delivery science and technology. 2024 May 1;95:105599–9.
15. Babu A, Templeton AK, Munshi A, Ramesh R. Nanoparticle-Based Drug Delivery for Therapy of Lung Cancer: Progress and Challenges. Journal of Nanomaterials. 2013;2013:1–11.
16. Bai X, Smith ZL, Wang Y, Butterworth S, Tirella A. Sustained Drug Release from Smart Nanoparticles in Cancer Therapy: A Comprehensive Review. 2022 Sep 28;13(10):1623–3.

17. Bertrand N, Wu J, Xu X, Kamaly N, Farokhzad OC. Cancer nanotechnology: The impact of passive and active targeting in the era of modern cancer biology. Advanced Drug Delivery Reviews. 2014 Feb;66:2–25.
18. Liao J, Wei X, Ran B, Peng J, Qu Y, Qian Z. Polymer hybrid magnetic nanocapsules encapsulating IR820 and PTX for external magnetic field-guided tumor targeting and multifunctional theranostics. Nanoscale. 2017;9(7):2479–91.
19. Kandasamy G, Maity D. Recent advances in superparamagnetic iron oxide nanoparticles (SPIONs) for in vitro and in vivo cancer nanotheranostics. International Journal of Pharmaceutics. 2015 Dec;496(2):191–218.