Journal of Rehabilitation and Pain Medicine

Hunis A, 2023- J Rehab Pain Med
Editorial Note

Nanomedicine and Cancer

Adrián Hunis*

Keywords: Nanomedicine; Cancer; Drugs; Leukemia; Tumors; Nanomaterials.

School of medicine, University of Buenos Aires Maimonides University, Argentina

***Corresponding Author:** Adrián P Hunis, School of medicine, University of Buenos Aires Maimonides University, Argentina.

Received Date: 04-18-2023
Accepted Date: 04-22-2023
Published Date: 05-10-2023

What is nanomedicine?

Nanomedicine is a branch of medicine that uses nanotechnology, science and materials engineering on the nanometer scale (1 nanometer is equal to one billionth of a meter), for the diagnosis, treatment and prevention of diseases. Nanotechnology makes it possible to manipulate and control matter at the molecular level and create materials and devices with unique properties on the nanoscale [1-3].

What is cancer?

Cancer is a disease characterized by the abnormal and uncontrolled growth of cells in the body. These cancer cells can invade nearby tissues and spread to other parts of the body through the lymphatic system or the bloodstream. Cancer can affect any part of the body and there are several different types of cancer, such as breast cancer, lung cancer, prostate cancer, colon cancer and many others [4,5].

Applications of nanomedicine in cancer

Nanomedicine has been shown to have great potential in the fight against cancer. Some of the applications of nanomedicine in cancer include:

Early diagnosis

Nanomaterials can be designed to detect in a highly sensitive and specific way early biomarkers of cancer in blood or other body fluids, which allows an early and accurate diagnosis of cancer, which can improve survival rates [6,7].

Citation: Hunis A. Nanomedicine and Cancer. J Rehab Pain Med. 2023;1(2):97-103.
DOI: https://doi.org/10.37191/Mapsci-JRPM-1(2)-010

Targeted therapy

Nanomaterials can be designed to selectively target cancer cells and release drugs or therapeutic agents directly into them. This minimizes side effects and increases the effectiveness of treatments, since higher doses can be administered directly at the tumor site [8,9].

Medical imaging

Nanomaterials can be used as contrast agents in medical imaging techniques such as magnetic resonance imaging (MRI) and positron emission tomography (PET), which allows accurate detection and monitoring of the tumor [10,11].

Combination therapy

Nanomaterials can be designed to carry multiple therapeutic agents, such as drugs and nucleic acid molecules, in a single system, which allows combination therapy to address different mechanisms of the disease and increase the effectiveness of treatment [12,13].

Immunotherapy

Nanomaterials can be used to improve cancer immunotherapy by improving the presentation of antigens and activating the immune system against cancer cells [14].

Prevention and monitoring

Nanomaterials can also be used for the prevention and monitoring of cancer, such as the controlled release of chemo preventive agents and the continuous monitoring of biomarker levels for the dete.

Is nanomedicine very expensive?

Nanomedicine, being an emerging technology that involves the manipulation and application of materials at the nanometric level, can have associated costs. However, the cost of nanomedicine can vary depending on many factors, such as the complexity and type of nanomaterial used, the manufacturing and production processes, the regulation and approval of nanomedical products, and the availability of resources and technologies in different regions and countries [15,16].

In general, research and development in the field of nanomedicine may require significant investments in terms of infrastructure, specialized equipment, highly trained personnel and material costs. Clinical trials and regulatory approval can also be an expensive and lengthy process. In addition, large-scale production and manufacturing costs of nanoproducts may be higher compared to conventional products due to the need to maintain specific quality and safety standards in production at the nanometer level [17,18].

However, it is important to keep in mind that the costs associated with nanomedicine can also be offset by the possible benefits in terms of greater efficacy and safety in treatments, more accurate diagnoses, more targeted therapies with fewer side effects and a better quality of life for patients. In addition, with the advancement of technology and the maturity of the field of nanomedicine, costs are expected to decrease over time, which can make this technology more accessible in the future [19,20].

Citation: Hunis A. Nanomedicine and Cancer. J Rehab Pain Med. 2023;1(2):97-103.
DOI: https://doi.org/10.37191/Mapsci-JRPM-1(2)-010

It is important to note that the cost of nanomedicine can vary depending on the region and the health system in each country. In some cases, the costs may be covered by the health insurance system or by research and development funding programs. Therefore, the accessibility and availability of nanomedicine may vary depending on the geographical location and socioeconomic context. In summary, although nanomedicine may have associated costs, its potential to improve the diagnosis and treatment of cancer and other diseases is promising. Investment in research and development in this field continues to evolve and costs are expected to be optimized over time, which could make nanomedicine more accessible in the future.

What tumors respond to nanomedicine?

Nanomedicine has shown potential for the treatment of various types of tumors. Some of the tumors that have been the subject of research and study in the context of nanomedicine include:

Solid tumors

Nanomedicine has been investigated for the treatment of various solid tumors, such as lung cancer, breast cancer, prostate cancer, colon cancer, ovarian cancer, pancreatic cancer, among others. Nanomaterials, such as nanoliposomes, nanoiosomes, gold nanoparticles, carbon nanotubes, and polymeric nanocomplexes, among others, have been used for the administration of drugs in a specific way and aimed at solid tumors, which can improve the effectiveness of treatment and reduce side effects [21].

Brain tumor

The blood-brain barrier, which is a protective barrier that limits the entry of substances into the brain, makes it difficult to treat brain tumors. Nanomedicine has shown the potential to overcome this barrier and selectively deliver drugs to brain tumors, such as gliomas and other tumors of the central nervous system [22].

Hematological tumors

Nanomedicine has also been investigated for the treatment of hematological tumors, such as leukemia and lymphoma. Nanomaterials can be used for the administration of specific drugs to cancer cells in the blood or lymph nodes, which can improve the effectiveness of the treatment and reduce side effects. Tumors resistant to conventional treatments: Nanomedicine has also been investigated as a strategy to overcome resistance to conventional treatments in some tumors. For example, nanomaterials have been developed that can encapsulate drugs and release them in a controlled way in cancer cells, which can help overcome resistance mechanisms and improve the response to treatment [23].

It is important to keep in mind that nanomedicine is a constantly evolving area of research and the clinical use of nanoproducts in the treatment of cancer is still in the research and development phase. The selection of the type of nanomedicine and its application in a specific type of tumor depends on multiple factors, including the stage of the cancer, the location of the tumor, the availability of nanomaterials and the regulations and approvals in each country.

Citation: Hunis A. Nanomedicine and Cancer. J Rehab Pain Med. 2023;1(2):97-103.
DOI: https://doi.org/10.37191/Mapsci-JRPM-1(2)-010

Clinical trials and regulatory approval are important stages in the development of nanomedicine for the treatment of cancer and other disorders, and more research is required to fully determine its efficacy and safety in clinical practice.

Is nanomedicine regulated by the FDA, EMEA, and other regulatory entities worldwide?

Nanomedicine is subject to regulations by various regulatory entities worldwide, including the Food and Drug Administration (FDA) in the United States, the European Medicines Agency (EMA) in the European Union, and other regulatory agencies in different countries and regions.

The regulation of nanomedicine is based on the same regulatory principles that apply to other pharmaceuticals and medical devices, but it also has specific considerations due to the unique characteristics of nanomaterials and their application in medicine. Nanomaterials used in nanomedicine may have different properties from conventional materials, which can affect their toxicity, biodistribution, and other pharmacokinetic and pharmacodynamic characteristics.

Regulatory agencies evaluate the safety, efficacy and quality of nanomedicine products through preclinical and clinical studies, and establish requirements for obtaining marketing authorizations. This involves the presentation of scientific data and clinical evidence that demonstrates the safety and efficacy of the product, as well as compliance with quality and manufacturing standards.

It is important to keep in mind that the regulation of nanomedicine may vary in different countries and regions, and may be constantly evolving due to the rapid advancement of technology and science in this field.

Therefore, it is essential that researchers, developers and manufacturers of nanomedicine products comply with the regulatory requirements applicable in each jurisdiction and obtain the necessary authorizations prior to the commercialization and clinical use of nanomedicine products [24].

What drugs are used in nanomedicine and how are they administered, orally, parenterally?

Nanomedicine uses a wide variety of drugs, including chemotherapeutic drugs, targeted agents, immunotherapy agents and other types of drugs. These drugs can be encapsulated, conjugated or adsorbed into nanomaterials to improve their biodistribution, stability and therapeutic efficacy. The administration of nanomedicine drugs can be done through various routes, including:

Oral administration

Nanomedicine drugs can be formulated in the form of tablets, capsules or oral solutions to be ingested orally.

The nanomaterials used in these formulations can improve the oral bioavailability of drugs, protect them from degradation in the gastrointestinal tract and facilitate their absorption into the bloodstream.

Citation: Hunis A. Nanomedicine and Cancer. J Rehab Pain Med. 2023;1(2):97-103.
DOI: https://doi.org/10.37191/Mapsci-JRPM-1(2)-010

Parenteral administration

Nanomedicine drugs can also be administered parenterally, that is, through intravenous, intramuscular or subcutaneous injections. In this case, nanomaterials can be used as vehicles to transport drugs directly into the bloodstream, which allows a more homogeneous and controlled distribution of drugs in the body.

Topical administration

Nanomedicine drugs can also be applied in the form of creams, lotions or gels on the skin or mucous membranes for the treatment of dermatological or mucosal diseases, such as skin cancer or mouth cancer. Nanomaterials can help improve the penetration of drugs into the skin or mucous membranes and increase their therapeutic efficacy.

Other routes of administration

In addition to the aforementioned routes, nanomedicine drugs can also be administered by inhalation, intranasal, intraocular, among others, depending on the type of disease and the therapeutic purpose.

It is important to note that the choice of the route of administration of nanomedicine drugs depends on the type of nanomaterial used, the type of disease to be treated, the pharmaceutical form and other relevant factors.

The administration of nanomedicine drugs should be carried out under the supervision of trained health professionals and following the appropriate indications and dosage guidelines.

References

1. Kola I, Landis J. Can The Pharmaceutical Industry Reduce Attrition Rates? Nat Rev Drug Discov. 2004;3(8):711-6. PubMed | CrossRef
2. Meng H, Xue M, Xia T, Zhao YL, Tamanoi F, et.al. Autonomous In Vitro Anticancer Drug Release from Mesoporous Silica Nanoparticles by Ph-Sensitive Nanovalves. J Am Chem Soc. 2010;132(36):12690-7. PubMed | CrossRef
3. Krown SE, Northfelt DW, Osoba D, Stewart JS. Use of Liposomal Anthracyclines in Kaposi's Sarcoma. InSeminars in Oncol. 2004;31:36-52. WB Saunders. PubMed | CrossRef
4. Gabizon A, Isacson R, Rosengarten O, Tzemach D, Shmeeda H, Sapir R. An Open-Label Study to Evaluate Dose and Cycle Dependence of The Pharmacokinetics of Pegylated Liposomal Doxorubicin. Cancer Chemother Pharmacol. 2008;61:695-702. PubMed | CrossRef
5. Moghimi SM, Hunter AC, Murray JC. Nanomedicine: Current Status and Future Prospects. FASEB J. 2005;19(3):311-30. PubMed | CrossRef
6. Akhter S, Ahmad I, Ahmad MZ, Ramazani F, Singh A, et al. Nanomedicines as Cancer Therapeutics: Current Status. Curr Cancer Drug Targets. 2013;13(4):362-78. PubMed | CrossRef
7. Lin M, Yao W, Xiao Y, Dong Z, Huang W, et al. Resveratrol-Modified Mesoporous Silica Nanoparticle for Tumor-Targeted Therapy of Gastric Cancer. Bioeng. 2021;12(1):6343-53. PubMed | CrossRef
8. Solomon R, Gabizon AA. Clinical Pharmacology of Liposomal Anthracyclines: Focus on Pegylated Liposomal Doxorubicin. Clin Lymphoma Myeloma. 2008;8(1):21-32. PubMed | CrossRef
9. Harris D, Hermann K, Bawa R, Cleveland JT. Strategies for Resolving Patent Disputes Over Nanoparticle Drug Delivery Systems. Nanotech L and Bus. 2004;1:372.
10. Landen CN, Kinch MS, Sood AK. Epha2 As a Target for Ovarian Cancer Therapy. Expert Opin Ther Targets. 2005;9(6):1179-87. PubMed | CrossRef

Citation: Hunis A. Nanomedicine and Cancer. J Rehab Pain Med. 2023;1(2):97-103.
DOI: https://doi.org/10.37191/Mapsci-JRPM-1(2)-010

11. Wang J, Tian S, Petros RA, Napier ME, DeSimone JM. The Complex Role of Multivalency in Nanoparticles Targeting the Transferrin Receptor for Cancer Therapies. J Am Chem Soc. 2010;132(32):11306-13. PubMed | CrossRef
12. Harris JM, Chess RB. Effect of Pegylation on Pharmaceuticals. Nat Rev Drug Discov. 2003;2(3):214-21. PubMed | CrossRef
13. Valencia PM, Pridgen EM, Rhee M, Langer R, Farokhzad OC, et al. Microfluidic Platform for Combinatorial Synthesis and Optimization of Targeted Nanoparticles for Cancer Therapy. ACS Nano. 2013;7(12):10671-80. PubMed | CrossRef
14. Gref R, Lück M, Quellec PF, Marchand MF, Dellacherie EF, et al. 'Stealth'corona-Core Nanoparticles Surface Modified by Polyethylene Glycol (PEG): Influences of The Corona (PEG Chain Length and Surface Density) and of The Core Composition on Phagocytic Uptake and Plasma Protein Adsorption. Colloids Surf B Biointerfaces. 2000;18(3-4):301-13. PubMed | CrossRef
15. Bazak R, Houri M, El Achy S, Kamel S, Refaat T. Cancer Active Targeting by Nanoparticles: A Comprehensive Review of Literature. J Cancer Res Clin Oncol. 2015;141:769-84. PubMed | CrossRef
16. Karve S, Werner ME, Sukumar R, Cummings ND, Copp JA, et al. Revival of the Abandoned Therapeutic Wortmannin by Nanoparticle Drug Delivery. Proc Natl Acad Sci. 2012;109(21):8230-5. PubMed | CrossRef
17. Doles J, Oliver TG, Cameron ER, Hsu G, Jacks T, et al. Suppression of Rev3, The Catalytic Subunit of Polζ, Sensitizes Drug-Resistant Lung Tumors to Chemotherapy. Proc Natl Acad Sci. 2010;107(48):20786-91. PubMed | CrossRef
18. Dobrovolskaia MA, McNeil SE. Immunological Properties of Engineered Nanomaterials. Nat Nanotechnol. 2007;2(8):469-78. PubMed | CrossRef
19. Xu X, Xie K, Zhang XQ, Pridgen EM, Park GY, et al. Enhancing Tumor Cell Response to Chemotherapy Through Nanoparticle-Mediated Codelivery of Sirna and Cisplatin Prodrug. Proc Natl Acad Sci. 2013;110(46):18638-43. PubMed | CrossRef
20. Lim JM, Swami A, Gilson LM, Chopra S, Choi S, et.al. Ultra-High Throughput Synthesis of Nanoparticles with Homogeneous Size Distribution Using a Coaxial Turbulent Jet Mixer. ACS Nano. 2014;8(6):6056-65. PubMed | CrossRef
21. Myc A, Douce TB, Ahuja N, Kotlyar A, Kukowska-Latallo J, et al. Preclinical Antitumor Efficacy Evaluation of Dendrimer-Based Methotrexate Conjugates. Anticancer Drugs. 2008;19(2):143-9. PubMed | CrossRef
22. Etheridge ML, Campbell SA, Erdman AG, Haynes CL, Wolf SM, et al. The Big Picture on Nanomedicine: The State of Investigational and Approved Nanomedicine Products. Nanomed Nanotech Biol Med. 2013;9(1):1-4. PubMed | CrossRef
23. Hahn WC, Weinberg RA. Modelling the Molecular Circuitry of Cancer. Nat Rev Cancer. 2002;2(5):331-41. PubMed | CrossRef
24. Robert NJ, Vogel CL, Henderson IC, Sparano JA, Moore MR, et al. The Role of the Liposomal Anthracyclines and Other Systemic Therapies in the Management of Advanced Breast Cancer. Semin Oncol. 2004;(31):106-146. WB Saunders. PubMed | CrossRef

Citation: Hunis A. Nanomedicine and Cancer. J Rehab Pain Med. 2023;1(2):97-103.
DOI: https://doi.org/10.37191/Mapsci-JRPM-1(2)-010