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Nanoparticles as Targeted Drug Delivery Systems – A Novel Approach in Cancer Therapy

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Short Commentary

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ABSTRACT

Drug delivery is the administration of a therapeutically active substance into the body of the patient using a route of administration which will give maximum therapeutic effect. Targeted drug delivery designs the drug delivery systems in such a way that the dosage form releases the active ingredients in the targeted area which will result in reduced side effects and helps in achieving maximum therapeutic benefit

Nanoparticles as drug delivery systems are now playing a major role in the area of targeted drug delivery systems especially in the treatment of cancer. Nanoparticles indicate nanostructures with intermediate size between microscopic and molecular structure. Nanoparticles can exist in different shapes of spherical, filamentous, tubular, and irregular. They even have applications in various other fields related to cosmetics, cancer therapy, food additives etc.

INTRODUCTION

Drug delivery is the administration of a therapeutically active substance into the body of the patient using a route of administration which will give maximum therapeutic effect [1].

The major challenges in field of drug delivery are to target the drug at specific site achieving maximum desirable therapeutic gain and safety [2]. Targeted drug delivery designs the drug delivery systems in such a way that the dosage form releases the active ingredients in the targeted area [3] which will result in reduced side effects and helps in achieving maximum therapeutic benefit [4].

ADVANTAGES

Nanoparticulate drug delivery offers enormous advantages [5]

- Reduced toxicity and side effects [6]
- The availability of the drug at the site of action results in increased bioavailability and efficiency of treatment [7]

Nanoparticles are also advantageous for the delivery of poorly water soluble drugs as they improve the uptake of such drugs and increase their bioavailability [8].

Nanoparticles as drug delivery systems are now playing a major role in the area of targeted drug delivery systems. Nanoparticles indicate nanostructures with intermediate size between microscopic and molecular structure [9]. Nanoparticles can exist in different shapes of spherical, filamentous, tubular,

and irregular [10]. They even have applications in various other fields related to cosmetics, cancer therapy [11], food additives etc. [12].

Nanoparticles exhibit the characteristics of crystalline and amorphous nature and adsorb or encapsulate the drug which has to target to a specific site [13].

The various types of nanoparticulate drug delivery systems include Nano-based Drug delivery systems constitutes of a significant portion of nanomedicine which includes drug-polymer conjugates, polymeric nanoparticles, solid-lipid nanoparticles, liposomes, dendrimers and polymer micelles etc. [14]

Oral formulation of insulin using nanoparticulate technology is one of the greatest achievements which has increased patient comfort and compliance among the diabetic patients [15]

POLYMERS

There are several classes of polymers which are used in the formulation of nanoparticles. These polymers help in designing the dosage form in such a way that they release the drug at the targeted site at a predetermined rate and at the targeted site [16].

The various classes of polymers used in the formulation of nanoparticles [17]

1. Polysaccharides – Starch, Chitosan
2. Proteins – Gelatin, Albumin
3. Lipids

NANOPARTICLES & CANCER THERAPY

One of the most widely used approaches to treat cancer is the use of radiation that helps in degenerating the cancerous tissue and prevents the of tumor cells [18]. The use of these radiations can has many side effects on non cancerous tissues as they fail to differentiate between healthy tissues and malignant tissues [19].

Several approaches have been designed in using nanoparticles for targeting cancerous cells during the treatment of cancer.

The intratumoral heterogeneity of cancer cells stands as a hindrance in developing effective treatment agents for cancer [20].

The drugs can be targeted to specific sites using two mechanisms [21]

- Active targeting
- Passive targeting

Approaches using nanoparticles as targeted drug delivery systems in the treatment of cancer

1. Aptamer based nanoparticles in targeting the specific cancerous cells [22]
2. Theranostic Nanoparticles is a very challenging approach which helps in simultaneous MRI imaging of cancer cells and also treating them [23].
3. Thiolated chitosan nanoparticles are currently gaining great importance due to their because of their high mucoadhesiveness and extended drug release properties [24].

CHALLENGES DUE TO NANOPARTICULATE DRUG DELIVERY

Nanoparticulate drug delivery exhibits challenges like increased drug resistance over the treatment and the stability and pharmacokinetic properties of the drugs can be affected [25].

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REFERENCES

1. Rasool Hassan BA. Overview on Drug Delivery System. *Pharmaceut Anal Acta*. 2012;3:e137.
2. Chen G. Nanotube-Based Controlled Drug Delivery. *Pharmaceut Anal Acta*. 2012;3:e136.
3. Naga Anusha P and Siddiqui A. Nanomedical Platform for Drug Delivery. *J Nanomedic Nanotechnol*. 2011;2:122.
4. Mostafavi SH and Jayachandra Babu R. Nano-Sized Drug Delivery. *J Mol Pharm Org Process Res*. 2013;1:e108.
5. Ahmad A. Nano-Sized Drug Delivery. *J Mol Pharm*. 2013;1:e108.
6. Gou M. Promising Application of Nanotechnology in Anticancer Drug Delivery. *Drug Des*. 2013;2:e117.
7. Bregni C and Carlucci A. Nanomedicines in Cancer Therapy. *J Mol Pharm Org Process Res*. 2013;1:101.
8. Syed A et al. Extracellular Biosynthesis of Monodispersed Gold Nanoparticles, their Characterization, Cytotoxicity Assay, Biodistribution and Conjugation with the Anticancer Drug Doxorubicin. *J Nanomed Nanotechnol*. 2013;4:156.
9. Yao Y and Costa M. Genetic and Epigenetic Effects of Nanoparticles. *J Mol Genet Med*. 2013;7:86.
10. Rada EC. Nanoparticles: Opportunities and Threats. *J Bioremed Biodeg*. 2014;5:e143.
11. Singh M et al. Drug Delivery System for Controlled Cancer Therapy Using Physico-Chemically Stabilized Bioconjugated Gold Nanoparticles Synthesized from Marine Macroalgae, *Padina Gymnospora*. *J Nanomed Nanotechnol*. 2014;S5:009.
12. Yu L. A Perspective: Nanoparticle Plus Analytical Chemistry = “Nanalytical Chemistry”? *Biochem Physiol*. 2012;1:e104.
13. Barakat NS. Target Nanoparticles: An Appealing Drug Delivery Platform. *J Nanomedic Nanotechnol*. 2012;S4:009.
14. Nayak UY. Role of Nano-Particles in Drug Therapy-Drug Delivery Approach. *Drug Design*. 2013;S5:e001.
15. Ahmad A. Oral Nano-Insulin Therapy: Current Progress on Nanoparticle-Based Devices for Intestinal Epithelium-Targeted Insulin Delivery. *J Nanomedic Nanotechnol*. 2012;S4:007.
16. Gavasane AJ and Pawar HA Synthetic. Biodegradable Polymers Used in Controlled Drug Delivery System: An Overview. *Clin Pharmacol Biopharm*. 2014;3:121.
17. Anwunobi AP and Emeje MO Recent Applications of Natural Polymers in Nanodrug Delivery. *J Nanomedic Nanotechnol*. 2011;S4:002.
18. Kondrashina OV. A Targeted Drug Delivery System of Gd³⁺ for Neutron Capture Therapy against Cancer is Metal organic Magnetic Nanoparticles. *J Nanomedicine Biotherapeutic Discov*. 2013;3:116.
19. Shroff K and Vidyasagar A. Polymer Nanoparticles: Newer Strategies towards Targeted Cancer Therapy. *J Phys Chem Biophys*. 2013;3:125.
20. Burke AR, Singh RN, Carroll DL, Torti FM, Torti SV. Targeting Cancer Stem Cells with Nanoparticle-Enabled Therapies. *J Mol Biomarkers Diagn*. 2012;S8:003.
21. Nguyen KT. Targeted Nanoparticles for Cancer Therapy: Promises and Challenges. *J Nanomedic Nanotechnol*. 2011;2:103e.
22. de Aguiar Ferreira Cv and de Barros ALB. Aptamer Functionalized Nanoparticles for Cancer Targeting. *J Mol Pharm Org Process Res*. 2013;1:105.
23. Barros ALB and Soares DCF. Theranostic Nanoparticles: Imaging and Therapy Combined. *J Mol Pharm Org Process Res*. 2014;2:e113.

24. Saboktakin MR, Tabatabaie RM, Maharramov A, Ramazanov MA. Synthesis and Characterization of Biodegradable Thiolated Chitosan Nanoparticles as Targeted Drug Delivery System. *J Nanomedic Nanotechnol.* 2011;S4:001.
25. Pantidos N and Horsfall LE. Biological Synthesis of Metallic Nanoparticles by Bacteria, Fungi and Plants. *J Nanomed Nanotechnol.* 2014;5:233.