

Future Aspect of Cancer Treatment: Nanotechnology

Abstract

Cancer is a heterogeneous disorder caused by uncontrolled division of cells of any body organ. Over the years many advancement happened in field of medical science, however still cancer is the leading cause of deaths all over the world.

Nanotechnology is the branch of science in which matter ranging at nanoscale(1-100nm).these small sized particles can interact with intra as well as extracellular biomolecules like DNA,RNA Hb etc.

Keywords: Please add some keywords

Introduction

Cancer is a heterogeneous disorder caused by uncontrolled division of abnormal cells of anybody organ. There are approximately 200 types of cancer described, however these can be clubbed under 5 categories based on the cells of origin –carcinomas (epithelial cells), sarcomas (mesothelial cells), leukemas (blood cells) and brain cancer (neural cells).over the years, there has been lots of advancement happened in the field of medical sciences however cancer is still among the leading causes of deaths all over the world. Globally it is 2nd leading cause of deaths leading to 8.8 million deaths in 2015. in India also the situation is not good. Near about 1.0 million new cases will be double in next 20 years. Also it has a major social, psychological and economic impact on survivors who are receiving treatment. There are many issues related to cancer which need attention to help the patients. These issues may be pertinent to the diagnosis or treatment. During diagnosis, there is unacceptably long delay and certain diagnostic modality is associated with adverse effects such as radiation exposure. Once diagnosed with cancer most of the patients will require treatment with chemotherapeutic agents which carry significant adverse effects. During follow-up also patients require frequent imaging for response assessment and expose the patients to radiation hazards. The technological advancement which can minimize and overcome these hurdles during management of cancer patients is the need of hour. Major causes of cancer are radiation, alcohol, viruses and some chemicals. Very common cancers in males are oral, lungs and stomach while in females cervical, breasts, ovary and oral cancer. There are about 30,000 genes in a human genome out of which only 30 to 40 genes are oncogenes.very common chromosomal aberration causing cancer are chromosome 9 and 22.

Review of Literature

In the year 2010 Wentong et al reported prostate cancer treatment using SERS (SURFACE ENHANCED RAMAN SATTTERING) Assay. They present gold nano popcorn based targeted diagnosis nanotherapy treatment by enhancing the cell surface.

Paola S Moreno et al explained nanotherapy as smart drug delivery system for cancer cells.

A. Ediriwickrema et al presented a different aspect of nanoparticles as safer drug deliver and safe for non target cells.

Technology known for diagnosis and prevention of cancer found effective but most of them are known to damage the healthy parts of body surrounding the cancerous tissue. To overcome such side effects there is a need of an advance technology having potential to increase the selectivity and potency of chemical, physical and biological approach. Nanoscale particles have fundamental structure of life arise inside biological cells: DNA molecules. At this scale materials can take structural, mechanical, optical, thermal, chemical and electrical properties that targets cells exhibits.

Nanotechnology is branch of science which deals with the manipulation of the matter at nanoscale, ranging from 1-100 nanometers all the biological processes inside the body occur at nanoscale such as



Amita Kumari

Assistant Professor,
Deptt.of Education,
S.N.K.P.Govt.P.G. College,
Neem Ka Thana

Seema Garg

Assistant Professor,
Deptt.of Education,
Pt.N.K.S. Govt.College,
Dausa

hemoglobin (nanoparticle) carrying oxygen, DNA, RNA etc. Because of small size these nanoparticles can interact with intra as well as extracellular biomolecules just like other molecules present in the body. The pathological process in the cancer also occurring at nanoscale therefore nanotechnology has been considered as significant technological advancement with great potential in the cancer management. This article will summarize the use of nanotechnology in the management of cancers.

The key role of nanotechnology in the cure of cancers is as follows:

Early detection and diagnosis

In the fight against cancer early detection of tumor prove to be very beneficial .nanotechnology excellence the earlier and precise diagnosis of cancerous cells Nanodevices specifically with the use of gold nanoparticles are in use as biomarkers. These found effective to detect the cancer- associated protein circulating tumor cells, circulating tumor DNA.

Nanoparicles (NPs) or nanodevices are clinically proved to act as molecular imaging agents to ensure the presence of cancer relevant genetic mutation. This information can be very helpful to choose a treatment or therapeutic plan. Center of cancer Nanotechnology Excellence at Stanford University, part of NCI has developed a system in which gold nanoparticles are used to bind with cancer cells and stand out from the normal cells. According to them by 2018 these clinical trials will be approachable to human.

Role of Nanoparticles in The Treatment Of Cancer

Researchers are investigating a method of using 2 different nanoparticles .one to remove materials on outer surface of cancer cell and block the entry of chemotherapy drugs and second to carry the drugs, this is under clinical trials.

The other nanotechnology treatment plan is to generate the magnetic field around cancer tumor. This helps to stimulate the immune system. For brain tumor nanodiamonds with chemotherapy drug is also under clinical trials. Researchers constructed the nanotrain by connecting different DNA strands to deliver the chemotherapy drug and these different DNA strands are customize to the type of cancer cells. These different researches are involve in the clinical trials of different aspects of nanoparticles. Hopefully in coming years possibilities of destruction of the cancer tumor without affecting the normal cells will enhance as well as early detection of cancer before turning in to tumor will be possible.

Monitoring of Relapse

20-80 percent patients undergoing cancer treatments like chemotherapy experience relapse with the help of advance therapy like surgery and chemotherapy survival rates since mid 1970^s have increased, but the chances of recurrent or relapse are sobering. For local recurrence treatment options are available but for metastatic relapse improved treatment strategy is required. To overcome the challenge of relapse safe and inexpensive tumor markers are required. Nanoparticles as novel agents

might be a new way to improve cancer specific mortality.

Objectives of the Study

The most important aim of cancer treatment after diagnosis is to provide proper cure or to alleviate without curing. Now a day's 1/3 or 30 % of all cancers are curable, but if cure is not possible palliative treatment should be considered. Most curable chemotherapy has many limitations. Now its efficacy can be enhanced by using nanotherapy in cancer treatment. Use of nanoparticles in cancer treatment offers some exciting possibilities in destroying tumors with minimal damage to healthy tissue and organs. These are efficient in detection and elimination of cancer cells before they turn in to tumor.

Nanoparticles/nanoproducts can be used alone or along with other treatment therapy in use i.e. chemotherapy, surgery, immunotherapy etc. so nanotherapy can be a better cure for cancer treatment in future as it does not have any adverse effect on healthy cells and cause precise destruction of tumor and found effective in kidney and liver dysfunction.

Major Aspects of Use of Nanotechnology

1. Nanoparticles for drug delivery
2. Targeted chemotherapy (to deliver the tumor killing agent)
3. Nanospectra (application of heat)
4. Nano X-Ray Nanoparticles (Nano-biotics)

Nanoscale devices are 100 to 10,000 times smaller than human cells so very similar to bimolecular such as enzymes and receptors. Such smaller nanoscale devices (>50 nanometer) can easily enter most cells and can provide rapid and sensitive detection of cancer related molecules. Scientists found potential of nanotechnology to generate entirely novel and highly effective therapeutic agents.

In the success of a cancer treatment major physiological barriers are vascular endothelial pores, heterogenous blood supply and heterogeneous architecture of tumor and neighboring cells. These barriers should be overcome for successful drug delivery. Previously using anticancer drugs were less successful and had major side effects nanoparticles have advantage of multidimensional character, which can be useful for targeted drug delivery.

Nanoparticles in Cancer Treatment

So far some nanoparticles are tested for targetted drug delivery to the tumors. Gold nanoparticles found magnetically responsive for drug delivery and other applications. Nanoparticles can be made using a variety of materials including polymers (biodegradable polymeric nanoparticles, dendrimers), lipids (solid-lipid nanoparticles, liposome's), inorganic materials (metal nanoparticles, quantum dots) and biological materials (albumin nanoparticles). Typical metals include for drug delivery applications for are gold, silver, platinum and palladium.

NPs (nanoparticles) can be used simultaneously to carry both for drug delivery and as imaging probes. The first NPs for anti cancer drug delivery was introduced in 1995 named liposome with encapsulated doxorubicin.

Targeted Chemotherapy**(TNF—TUMOUR NECROSIS FACTOR)**

TNF is known for targeted chemotherapy which is in use to deliver the tumor killing agent. The central role of TNF in inflammation had led to efficiency of autoimmune system. main feature of TNF is their incorporation in to antibody based targeted therapies. TNF is attached to a gold particles along with PEG-THIOL(Thiol derivatized polythene glycol).these helps to hide TNF from immune system and it circulates through blood stream without being attacked.

Nanospectra (Application of Heat)

Nanoparticles called Auroshells absorb infra red light from laser and turn in to heat, which thermally destroy the tumor without damage to adjacent healthy tissue. Use of nanospectra for destruction of tumor is known as Aurolase and nanoparticles as Auroshell or nanoshells .these are designed to absorb he different wavelength of light including near infra-red wavelengths that can penetrate human tissue.

NANOBIOTICS (Nano X-Ray therapeutics)

In this therapy nanoparticles are designed to be a safe and effective treatment for radiosensitive and radio resistant tumor and to overcome the shortcoming of X-rays; destruction of healthy tissue. Patented **NBTXR₃** nanoparticles are in use alone or along with other treatment therapy like chemotherapy, surgery and immunotherapy. **NBTXR₃** are crystalline nanoparticles which does not have any adverse effect on healthy cells. It causes precise destruction and found effective in liver and kidney dysfunction.

Conclusion

NP_s found effective in drug delivery to tumor tissues as the drug carried by nanomolecules released to the matrix of tumor tissues and diffuses in to it without affecting non-target cells. like every aspect have pros and cons nanotherapy also comes with some advantages and disadvantages as follows:-

Advantages

1. Nanoparticles enhance the solubility of hydrophobic drugs.

2. Prolonging circulation time to avoid intracellular toxicity.
3. Minimizing non-specific uptake.
4. Preventing side effects.
5. Improving intracellular penetration.
6. Specific cancer targeting.

Disadvantages

1. Drug resistant cells remain ineffective from targeted nanoparticles.
2. Some materials (NP_s) have low toxicity after degeneration.

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