

Cancer treatment by nanotechnology – an overview

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Abstract - Nanotechnology found various applications in every field. Scientist and researchers did hard work to involve nanotechnology in medical science. This work brings so many methods to heal the numerous cancer by effective way. The nanotechnology is not limited to only treatment and drug delivery; it can be used for diagnosis purpose also. In this article various methods of diagnosis and treatment are given. Recently the scientists of Houston Methodist Research Institute invent *Inject able- nanoparticle generator* which gives astounding results in cancer treatment.

Keyword-- nanoparticles, cancer, diagnosis.

I. INTRODUCTION

Every year so many people are died by cancer over the world. Cancer is the disease caused by uncontrollable and irregular growth of cells. This disease becomes very dangerous if it is Metastases .That means cancer is originate at one place and spread on vital organs like lungs and brain .To cure such disease scientist develop various methods for diagnosis and treatment .As we know some common method are used to cure cancer like chemotherapy , radio therapy ,etc..These methods have good efficiency to cure cancer .But during treating cancer cells it also affect the healthy cell . That causes various type of side effect occurs during treatment and after treatment. Another case is that about 99% of drug which given to cure cancer are absorbed by healthy cells, which damages the healthy cells and make the drug delivery ineffective.

To avoid such situation scientist implements the new technology i.e. ‘nanotechnology’ to cure cancer. The goal of this technology to prohibit all the disadvantages of traditional method and give effective diagnosis and treatment.

II. LITERATURE REVIEW

- U.S. Department of Health & human services, National Institute of Health ,publish a paper on ‘Cancer nanotechnology plan 2015 ‘ in which they discuss various new drug delivery method for cancer treatment.
- The another research by Todd J. Harris, Geoffrey von Maltzahn ,and Sangeeta N. Bhatia on multifunctional nanoparticles for cancer therapy.
- Recently in march 2016 the scientist of Houston Methodist Research Institute invent iNPG for effective drug delivery .

III. WHAT IS NANOTECHNOLOGY?

The word nano comes from Greek which means very small .The size of nano particle nearly equal to 1 billionth of meter (10^{-9} meter).The properties of nano particle are significantly different from the material from the material from which it extracted, Due to this reason they have their uniqueness. Because of their small size and various different properties they are used in various applications like textile, automobiles, paints cosmetics, etc.

Now the nanotechnology gets involved in medical science also. In last few years the various forms of nano material like nano particle, quantum dots, nano tubes, nano wires are used in diagnosis and treatment of cancer.

IV.DIAGNOSIS OF CANCER OF CANCER BY NANOTECHNOLOGY

It is very difficult to cure the cancer in last stage. It is nearly equal to loss the life of person in last stage .To avoid this situation it is very necessary to detect the disease at early stages. There are several traditional methods are used to detect the cancer like X- Ray tomography or mammography. Mammography uses mutagenic agents on the cell that causes cancer. (1)(Sadoqi et.at.) express that using harmful substances. The X-Ray method itself related to the cause of cancer.

Nanotechnology has the better diagnosis than above two methods with fewer side effects. There are various ways of diagnosis of cancer by nanotechnology which are as follows:-

a) ICG (indocyanine green)

This method uses the binding properties of ICG for the diagnosis of cancer. In this method, ICG interact with plasma protein like lipoprotein ,albumin, globuline. As the ICG have special property like fluorescent make it used for diagnosis of cancer .

b) Quantum Dots :-

Quantum dots (QDs) are semiconducting, light-emitting nanocrystals. They have the property of powerful molecular imaging . QDs are an exciting material to work with due to their unique optical properties compared to traditional organic fluorescent labels . Organic fluorescent dyes have several drawbacks that have limited their usefulness as molecular imaging tags. Their low photo bleaching threshold and broad absorption/emission peak width have hindered their use in long term imaging and multiplexing (detecting multiple labels simultaneously) (6) QDs have properties that overcome these limitations of the organic fluorescent dyes including high resistance to photo bleaching broad-band absorption with narrow emission bands ranging from UV to NIR and size tunable emission bands.. These exceptional optical properties of QDs have made them an exciting field of study for many researchers in search of molecular imaging tools for better cancer diagnosis.

c) Carbon nano tubes (CNT)

CNT was first discovered by Fullerenes. After this discovery CNT was again re-discovered by Iijima in 1991(73). Since from re-discovery CNT has been widely used in various applications because of their interesting property. The conductance of the semiconducting CNT changes when biomolecules are adsorbed on the walls, causing changes in local electrostatic environment. Many exceptional properties of CNTs allow them to be applied for sensing biomarkers electrochemically; CNTs provide high surface-to-volume ratios, mediate fast electron-transfer and can be functionalized with almost any desired chemical species. It is also of great advantage to use carbon nanotubes because label-free detection of cancer biomarkers is possible.

d) Carbon Nano Wires

Various nanowires have also been applied to cancer detection . These nanowires include various types such as silicon nanowires (3-4) In_2O_3 nanowires (5) gold nanowires conducting polymer nanowires.

V. CANCER TREATMENT BY NANOTECHNOLOGY

There are so many different methods to cure various cancer .As the type of cancer changes way to treat the cancer. In India there is specific method used to various cancer using Natural herbs. This method of treatment is giving good results with less side effects .But it require more time to cure the cancer .Due to this many time is not possible to cure the cancer in its last stage . In such cases we need some powerful and effective methods to cure cancer .Scientist get the success in making such technologies to cure cancer in effective way.

Now a day there so many methods are present to cure cancer. Out of these some of those are

- a) CHEMOTHERAPY
- b) RADIATION THERAPY
- c) IMMUNO THERAPY
- d) HYPERTHERMIA
- e) STEM CELL TRANSPLANT

As listed above several of therapy cure cancer but these technologies has various side effects during treatment and after treatment. Due to this we need to new technology to cure cancer. This requirement gives birth to involvement nanotechnology to cure cancer. Now let us see the Gold nanoparticle technique to cure the cancer.

Gold Nanoparticle

Gold nano particles (GNPs) may be programmed to bind with malignant cells using self-assembly methods. A NIR (near infrared region) laser operating at an intensity too low to damage cells is imparted on an area containing healthy cells as well as cancerous cells bound to gold nano particles. In this method gold particle uses thermal ablation method to kill the cancer cell.

As the above method to cure cancer is effective but very costly .This cause the need of new method. This need give birth to new method called 'injectable nano particle generator'.

VI. What is injectable nanoparticle generator?

An injectable nanoparticle generator (iNPG), composed of the active drug- doxorubicin - packaged as thin strands of polymer within a nanoporous silicon material .Once the iNPG enters the tumour, the silicon outer coating naturally degrades, releasing the polymer strands. The strands curl up into nano-scale balls and enter the cancer cells themselves. As the balls move freely around the cell and approach the nucleus, the pH becomes more acidic. This drop in pH triggers the strands to release the doxorubicin, which then kills the cell. The iNPGs were trialled on mice with triple negative breast cancer that had metastasized into the tissues of the lungs.

a) Mechanism of iNPG

The iNPG is like a mothership, Dr. Shen explained, in which the researchers hide doxorubicin (5). Doxorubicin is a chemical which is used to kill the cancer cells in chemotherapy. Doxorubicin-containing nano particles called pDox. The pDox are long chains to which doxorubicin molecules are attached. Because of their size and shape, as well as other properties, the iNPG particles preferentially accumulate in the lungs and liver primary sites for breast cancer metastases. Once the iNPG particles reach the tumour vasculature, the pDox nano particles are released from the iNPGs nanopores. Thermodynamic forces then cause the pDox chains to wrap up into balls, which makes them resemble exosomes small to be taken up by tumour cells and avoid their efflux pumps. Once inside the tumour cell, the pDox particles eventually traffic to vesicles near the nucleus, called endosomes, where the high pH of the endosome causes the doxorubicin to detach and kill the cell.

b) Results of iNPG

1. This research is firstly demonstrated on mice having triple negative metastasis breast cancer. iNPG kill all the tumour cells and increase the lifetime of mice about 5 years, which is nearly equal to 24 years of human life.
2. In chemotherapy, treating drug damages healthy cells also. This method gives the solution for this by only reacting with cancer cells.
- 3.

c) Advantages

1. Use of nanotechnology for cancer treatment is effective and has less side effect than chemotherapy.
2. iNPG gives the effective way to deliver drug directly to cancer cell.

d) Disadvantages

1. Methods used in nanotechnology are specially depend surface chemistry of nano particles.
2. We need biocompatible and stable nanoparticles.

VII. CONCLUSION

In this era, there are 100 types of cancer. But the scientist gets the healing power against these cancer by traditional way or by using nanotechnology. However there is no such method gives no side effect. To achieve this goal they invent iNPG which eliminates worry about side effect. But still this method is not demonstrated on human beings. Thus from all the above we concluded that there is no any type of cancer is not treatable.

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