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ROLE AND BIOMEDICAL APPLICATION OF METAL NANOPARTICLES IN CANCER IMMUNOTHERAPY

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A B S T R A C T :

Metallo immunotherapy place a major role in cancer treatment that enhances antitumor safe responses by using the distinctive immunomodulatory properties of metal particles. Metal particles can overcome the present challenges associated with cancer immunotherapy. Various metallic nano particles have been widely used in several biomedical application. Significant inert nature and nanoscale structures with size similar to many biological molecules had attracted a lot of application in biomedical field. Different types of intrinsic characteristics which include electronic, optical, physiochemical and surface plasmon resonance can be changed by altering the certain particle characteristics like size, shape, environment, aspect ratio and functionalization property which make them applicable in various field of biomedicines. This review highlights the importance of metal nanoparticles in cancer imaging and therapeutics.

Keywords: Cancer, metal nano particles,

INTRODUCTION:

Cancer is one of the biggest health concerns faced by world today. There are different kinds of conventional treatment methods including surgery, chemotherapy, and radiation therapy, but this often faces limitation in terms of efficacy and selectivity. Nowadays cancer immunotherapy was found to be a promising approach to combat cancer, boosting the bodies immune system to recognize and attack cancer cells. Various metal nanoparticles have been used which including gold, silver, and iron oxide. These nanoparticles were found to improve the efficacy of cancer immunotherapy. Due to their size, shape, charge, and surface modification metal nanoparticles are found to be promising tool in cancer treatment. Other than non-metallic nanoparticles these were easily been taken up inside the cells often provide an advantage for cancer therapy. Nanometallic particles that shows different properties and functions have been used. Effective cell surface interaction with different components of the cells can be achieved by the small size of the particles. The most useful biomedical applications of metal nanoparticles are drug delivery, diagnostics, bioimaging, cancer therapy, catalysis, hyperthermia, photoblation therapy, and biosensors.

The abnormal growth of cells beyond that of normal cells can invade adjoining parts of the body and spread to the other tissues was referred to as cancer metastasis. It was one of the major problems affected around the globe that may leads to death. More than 100 types of cancer exist. Healthcare providers classify them based on the type of tissue they affect and where they start in your body. Targeting malignancies by using nanomedicines can act as a reliable tool for the treatment of cancer. Nanocarriers like metal nanoparticles can deliver numerous anticancer drugs that have the same therapeutic mechanism which makes them as an ideal candidate for cancer treatment.

Metal nanoparticles for biomedical application in cancer

Metal nanoparticles are prepared by altering its functional group as a result its forms conjugates with drugs and ligands, which offers a wide range of possible application in biotechnology, targeted drug delivery, magnetic separation, vehicle for gene and drug delivery, diagnostic imaging. These nanoparticles are overcome the challenges of conventional chemotherapy and can be used as a potential carrier and contrast agent in anticancer therapy. Different types of metal nanoparticles like magnetic nanoparticles (Fe3O4), gold nanoparticles (AuNPs), silver nanoparticles (AgNPs) were been used in different imaging techniques.

1. **Biosensors**

   Biosensors are widely used in oncology research. A biosensor is an analytical instrument used for analysis of biological samples. It converts a biological, chemical or biochemical response into an electrical signal. Metal nanoparticles are used in the application of biosensoring as they easily conjugate with recognition molecules like antibodies which forms on the surface of biomolecules for detection. Metal nanoparticle has a high resolution for detecting tumor cells. By using a sensitive DNA impedance sensor was formulated for the detection of chronic lymphocytic leukaemia. Optical micro fiber biosensor utilizes silver nanoparticles for the identification of alpha-fetoprotein detection in blood samples.

2. **Bioimaging**

   Imaging techniques are very important in the field of diagnosis and treatment of disease. Nanomedicine has a significant role in bioimaging which include tumor cell imaging process. The nanoparticles have a direct or indirect activity in the process of imaging. NPs can detect the tumor cells using specialized devices including thermal analysers, MRI and fluorescence microscopy in case of direct action. NPs like Au, Ag and para magnetic iron NPs can show the presence of chromogen or fluorescence in the biological system. Bioimaging analysis utilises the fluorescent silica NPs functionalized using dye, rhodamine 101to target the cancer cells. Semiconductor nano crystals containing cadmium selenium and tellurium shows less toxicity when compared to the nanoparticles containing nano metals.

3. **Photoblation**

   Photoblation includes photodynamic and photothermal therapy. This therapy is prominently used for the targeting of tumor cells. By the increased intensity of photoblation NIR resonant Au-Au sulphide NPs (GGS-NPs) were developed as two-fold contrast and treatment agents for cancer therapy. By using encapsulation technique tantalum oxide were incorporated in to polypyrrole as a nanotheranostic agent for the bio model imaging guided photothermal ablation of cancer cells.

4. **Hyperthermia**

   Heat is considered as an important mode for the ablation of tumor cells. Hyperthermia usually accompanies with a temperature range from 41℃ to 50℃ if its temperature rise more than 50℃ it is referred to as thermoablation. Improvement in blood circulation inside the cancer cells results in enhanced oxygenation and perfusion of the hypoxic cancerous core is often a result of hyperthermia. Camptothecin loaded thermoresponsive metal nanoparticles coated using polymer quickly killed tumor cells due to the thermal effect of MIH agent.

5. **Drug delivery and tumor targeting**

   Most of the drugs which are used to treat cancer can diffuse quickly in to tissues and possess large clearance from the body. As a result, less amount of active drug reaches the target site and can also cause multidrug resistance. Targeting can be achieved by using metal nanoparticles. This targeting can either be active or passive.

EXAMPLES OF METAL NANOPARTICLES

1. Gold nanoparticles :- Because of their small size, these particles can enter tissues and attack immune cells, like lymphoid tissues, making them useful in immunotherapy .
2. Silver nanoparticles: -They work by disrupting the cell cycle and triggering the production of reactive oxygen species which in turn kills all the cancerous cells.
3. Copper nanoparticles: -Copper catechol-based metal organic frameworks like nano copper formulations are developed to induce cell death in tumour cells.
4. Graphene nanoparticles: -These nanoparticles can convert light to heat thereby killing the cancer cells.
5. Silica nanoparticles: -They allow precise delivery of drugs thereby helping in the specific targeting of cancer cells.
6. Iron nanoparticles: -They can generate heat in response to an alternating magnetic field, killing cancer cells.

CONCLUSION:

Because of the remarkable and adaptable physical and chemical properties, metal nanoparticles have been the focus of extensive research. They have the potential to revolutionize cancer immunotherapy by providing targeted, efficient and effective delivery of therapeutic agents. Further research is needed to fully realize their potential and translate them into clinical applications.

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