PriMera Scientific Surgical
Research and Practice
Volume 4 Issue 4 October 2024
DOI: 10.56831/PSSRP-04-138
ISSN: 2836-0028

PriMera Scientific Publications

Nanoparticles and their Application in Cancer Therapy

Type: Editorial
Received: July 24, 2024
Published: October 03, 2024

Citation:
Dina Louis. "Nanoparticles and their Application in Cancer Therapy". PriMera Scientific Surgical Research and Practice 4.4 (2024): 01.

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Keywords: Nanoparticles; Cancer therapy

Cancer is wide spread all over the world. Globally, 19,976,499 cancer cases have been diagnosed in 2022. Cancer treatment is mainly based on surgery, radiotherapy and chemotherapy. Chemotherapy is usually associated with drug resistance as well as toxicity. Accordingly, drug targeting is considered to be a good alternative to reduce the undesired effects. Nanoparticles (NPs) have an advantageous property of selectively targeting tumor cells. Nanoparticles are characterized by their size which ranged from 1 to 1000 nm, and could be prepared by size reduction of large particles (top-down methods), or assembling of particle with sub-nano size (bottom-up methods). NPs were used to target not only drugs, but also genes and diagnostic agents to the tumor cells. Such targeting increases drug concentration in the cancer cells.

Several nanotechnologies have been employed to target drugs in cancer treatment as micelles, dendrimers, liposomes, polymeric nanoparticles, exosomes, inorganic nanoparticles and hybrid nanoparticles. In general, these NPs are employed to encapsulate both hydrophilic and hydrophobic drug substances.

Several anticancer drugs have been formulated as NPs. For example, Doxorubicin was formulated as micelles which enhanced its accumulation at the tumor site. Cationic liposomes have been used to successfully deliver drug in glioblastoma. The use of polylactide (biodegradable polymer) in developing polymeric nanoparticles allowed the retention of the drugs and their accumulation at the tumor sites. The surface groups and the internal cavities characterizing dendrimer NPs allowed the encapsulation of many anti-cancer drugs. Also, drugs can be incorporated to proteins in protein NPs via covalent bonding, electrostatic interaction or hydrophobic interactions. The most widely used protein NPs are those based on albumin which are safe carriers to anti-cancer drugs as Paclitaxel. In addition, inorganic NPs showed promising results in the field of cancer immunotherapy as in case of selenium- based nanoparticles.

These several types of NPs have proved promising results in drug targeting to improve the quality of cancer treatment and minimize toxic side effects on healthy cells.