Xournals

Academic Journal of Nanotechnology

ISSN UA | Volume 01 | Issue 01 | June-2018

Role of Nanotechnology in Cancer Treatment

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Available online at: www.xournals.com

Received 30th January 2018 | Revised 28th April 2018 | Accepted 19th May 2018

Abstract:

The nanotechnology is the study and the use of structures between the 1 nanometer and 100 nanometers. This technique is advanced and reformed technology for the present generation and more in use at various factors. Nanotechnology focus on the convergence and coalescence of numerous scientific disciplines and other general application of it. The present paper deals with the study of role of the nanotechnology in the cancer treatment where it is important to deliver the information regarding cancer and its occurrence in the body. The paper highlight on the Nano-particles that are rapidly developed and helpful in overcoming with various limitations of traditional drug delivery system and are helpful in dealing with different therapeutics for the treatment of cancer. This entire paper review on the ability of cell recognizing of Nano-particles by unique identifying characteristics and their changes from the anticancer therapies. The use of the recent development of the nanotechnology shows the transformation of the cancer therapeutics.

Keywords*: Nanotechnology, Convergence, Drug delivery System, Cancer therapeutics*

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Introduction

In today's time, cancer is considered as one of the most serious fatal disease with the outcome of killing of millions of people every year. Cancer is known to be the uncontrolled proliferation of cells where the apoptosis is usually disappeared and contain very complex treatment process. The complexity reveals genetic and phenotypic levels which shows clinical diversity and the therapeutic resistance. The cancer treatment include the chemotherapy, surgical removal, hormone therapy and radiation. The chemotherapy is one of the common treatment for the cancer patient which delivers the anticancer drugs systematically and the patient for quenching the uncontrolled proliferation of the cancerous cells. The significant role of cancer therapeutics depends on main challenge so as to differentiate the cancerous cells and the normal body cells. It depend upon the conventional chemotherapy fails to target the cells of cancer which selectively without the interaction with the normal body cells. Nanotechnology is defined as the science which deals with the range of size from few nanometers to hundred nanometer which is dependent on their intended use.

It is really promising in the case of cancer diagnosis and cancer treatment so as to enter the tissue at molecular level. The term cancer nanotechnology deals with the enthusiastically implemented and estimated treatment cancer which shows the major advance in the detection, treatment, and diagnosis of the related diseases. Nanoparticles are basically designed so as to assist the therapeutic agent to go through the biological barriers to mediate the molecular interactions and other relevant molecular changes **(Sutradhar and Amin, 2014)**

Role of Nano-technology in the treatment of Cancer

It is a well-known fact that the technology is known for the basic keywords in the people's time. A very significant sub-division of technology named as nanotechnology plays important role in the treatment of the cancer. With the involvement nanotechnology consisting more user devices and appropriate drugs for the disease and the better materials for the construction process. These Nanotechnological developments useful for the better diagnosis of cancer patient as nanotechnology uses efficient drug delivery to the tumor cells and other molecular targeted cancer therapy.

- Firstly, it can be used for the improved cancer diagnosis, as one of the major use of optical nanoparticle which allow for the cancer treatment. The classical method use i.e. X-rays and tomography include mutagenic agents selectively on those cells who basically cause cancer. The X-ray in the cancer diagnosis itself causes the cancer once and hence it is important to eliminate the concern and optical nanoparticles in the relation of diagnosis for the technique that can be implemented. In the connection with the optical nanoparticles, ICG i.e. Indocyanine Green is also useful in the diagnosis of cancer. The molecules of ICG interact with the protein of plasma-like albumin, globulins, and lipoproteins which help the ICP to be there in the bloodstreams. It is also highlighted that the ICG molecules have amphiphilic property which help in the interaction with the hydrophilic and amphiphilic property. Hence with the use of this, tumors and tumor-free areas can easily detected in the cancer treatment.

- Secondly, the aspects of nanotechnology is useful as the more efficient drug delivery system for the treatment of the tumors. It is reported that one of the major task of passive liposomal drug delivery is for the cancer cells. The molecules of liposome are very much helpful in the diffusion into the cells and their structures and cell membrane can network very well while the process of uptake of drug. The effect of EPR i.e. Enhanced Permeation and Retention in liposomes to remains the bloodstream for a longer time period and collected from the tumor cells. This effect permit up to ten times the amount of drug which is delivered to tumor cells than that of the free drug method. The liposomal drug with that of the RES i.e. Reticular Endothelial System collectively break away the immune recognition and the drugs are able to present in the bloodstream.

- Thirdly, this nanotechnology is useful for the better cancer imaging and is consider one of the important usage of the cancer imaging termed as tomography with contrast to agents. The CT i.e. Computer Tomography is known for the widespread method of imaging which measure in the process of imaging and analysis the ratio density of matter. This shows a significant effect on the health of an individual. In this, Nonionizing method for the differential use on the scattering and absorption of light waves with that of the other types of tissue called as Optical Coherence Tomography. The tomography is not only responsible but also there is the involvement of Photoacoustic tomography which is utilized for the better cancer imaging. The method is dependent on inherent light absorption contrast features of biological tissues. It is important to use the PAT i.e. Photoacoustic tomography without nanocages

as the signals of photoacoustics are usually lower when only blood is used **(Aliosmanoglu and Basaran, 2012).**

Nanoparticles for Tumor Targeting and Delivery

Nanoparticles are used for the anticancer drug delivery which is formed by the variety of materials consist of polymers, liposomes, dendrimers, carbon nanotubes, metals (gold and iron oxide).

- **Polymorphic Nanoparticles**

The polymers which are used for the preparation of Nano particles are follows under two main categories named natural and synthetic polymers. The formation of the polymorphic nanoparticles involve the two parts i.e. the hydrophobic core (serves as the container for anticancer agents) and other is hydrophilic shell (which stabilize the nanoparticle). The drug is basically loaded into polymeric nanoparticles by the two basic methods physical entrapment and chemical conjugation. The hydrophobic interaction with the core of the polymeric Nanoparticles and drug molecule is entrapped nanoparticle core. It shows the drug molecule conjugated covalently onto polymer and the related chemical properties is connection between drug and polymer which is critical. The intracellular level of the glutathione is higher in the extracellular level.

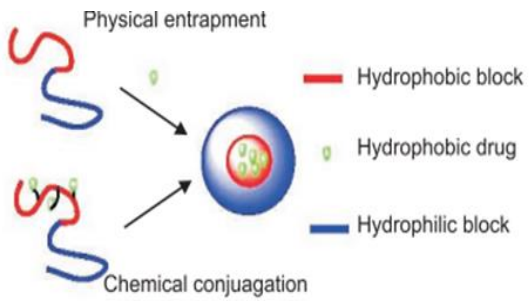

Figure 1. Polymer-Based Nano-particles

- **Liposomal Nanoparticles**

It is self-assembling spherical particles with membrane formed of phospholipid bilayers. It can range from 25 nm to 10 nm on the basic preparation method. The synthesis of the liposomal nanoparticles shows the drug delivery systems depending on unmodified liposomes by the short blood circulation time. The second generation of the polymer coated liposomes can increase blood circulation times from the several minutes up to 3 days.

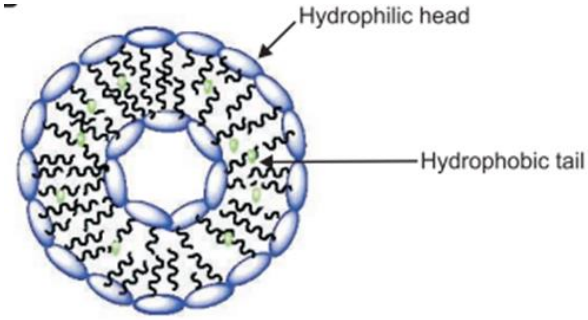

Figure 2. Liposome Based Nano-particles

- **Gold and Iron Oxide Nano-particles**

The concepts of nanotechnology use to the development of new generation of anti-cancer drug delivery systems. This Nano-particles can be synthesized through reduction of HAICI with narrow polydispersity. The important factor of gold nanoparticles is gold concentrations and are naturally low in animal bodies. Iron oxide nanoparticles have used as imaging for clinically agents for MRI. The merit of nanoparticles system is they delivered in targeted manner for desired region by using external magnetic field.

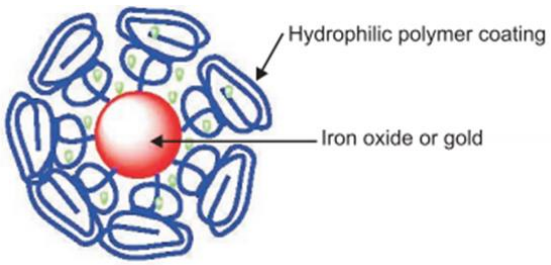

Figure 3. Iron oxide or gold Nano-particles

Advantage of Nanoparticles

- It is dose proportionality
- It shows decreased toxicity
- Nano-particles shows increased bioavailability
- Represent in small dosage form (Small tablet)
- It is used in increased active agent surface area which conclusively shows faster dissolution of active agent in aqueous environment as human body.
- Stable dosage form of drugs that are either unstable or unacceptably low bioavailability in non-particulate dosage form.

Review Literature

Moghimi, Hunter, and Murray (2005) discussed about the application of nanotechnology for the treatment, control and diagnosis and monitoring of the bio-logical systems which recently referred as Nano-medicine. This involve the identification of cells and receptors targets related with some specific clinical condition and the decision of correct Nanocarriers so as to attain the required response with the minimal side effects. They basically highlighted balanced methods in the designing and surface engineering of the Nano scale vehicles and the things for the site-specific drug delivery and the medical imaging after the parental administrations.

Wang et al (2009) cover the recent developments of nanotechnology which give opportunities to researchers for significantly transformation of the cancer therapeutics. The technology is helpful in the manipulation of physiochemical and biological properties of nanomaterial for the facilitation of more efficient drug targeting. The paper discussed about the multifunctional nanoparticles which is helpful in reduce nanoparticles for the both the detection and killing of cancer cells at a same time. It is also conclusively stated that the clinical investigations is helpful in therapeutic nanoparticles which improve and reduce the side effects which compared with the conventional cancer therapeutic drug.

Haque et al. (2010) discussed about the nanotechnology as the study and use of structures size between 1 nanometer and 100 nanometers. As it is well-known fact, that cancer leads to cause of death among numerous number of people with the range variation of age as below 85 years. It is still under development that nanoparticle that deliver chemotherapy drugs directly to cancer cells. This paper focused by summaries the recent status of the nanotechnology in the cancer therapy.

Misra, Acharya, and Sahoo (2010) stated about the application of nanotechnology for the use of cancer therapy which have received the substantial attention in the recent years. Cancer nanotechnology is defined as an interdisciplinary area for the research in the field of science, medicine, and engineering as upcoming field with the extensive applications. This paper focus on the target-specific drug methods and therapy for the early analysis of the pathologies and the priority research areas with the nanotechnology which plays a significant role. This paper represent the focuses with the approaches of the cancer methodology as the advancement of the cancer therapy factor.

Anajwala, Jani, and Swamy (2010) deliver the information regarding Nano particulate technology with the use in the development of new generation of the more effective cancer therapies which is capable of overcome from the biophysical, biological and biomedical barriers that the body stages against standard intervention. The paper focus on the defining features of the cancer nanotechnology which are embedded in the breakthrough potential for the design and development of the nanoparticle-based drugs. The development of the various nanomaterial and nanotechnology which has enabled the cancer biomarkers detection with the great precision and sensitivity. Hence it is noted that the discoveries of these technologies must be validated critically before the use in the clinical diagnosis.

Patel, Mistri, and Prajapati (2012) stated about the treatment of cancer with the use of nanoparticles as a point of view of drug delivery. It shows the incidence of death from cancer and death form the cardiovascular diseases in which cancer found to more complex. The paper detailed about the Nano medicines characteristics of nanotechnology consisting of drug delivery system and the new therapies of drug-related with cancer. The present paper use the features of Nano medicine so as to generate Nano devices that can function inside the body. The Nano devices are considered as the hybrid of the biological molecules and other synthetic polymers that easily enter cells and organelle so as to interact directly with the DNA and proteins. This paper focus on the key impact on the therapy of cancer.

Sutradhar and Amin (2014) mentioned the study of nanoparticles showing rapid development and straggled for the overcome various limitations of traditional drug delivery system which later come up with the different therapeutics for the treatment of cancer. The paper also discussed about the conventional chemotherapeutics which shows some of the serious side effects with the commotion in the immune system and other related organs with the proliferation cells with the nonspecific targeting. This paper focus on the ability of recognition of cells of nanoparticles with various strategies containing unique identifying properties from previous anticancer therapies. It also consider the drug delivery by nanoparticles inside the cells and also many researchers coined about the elimination of side effects of conventional therapies with the implementation of cancer treatment.

Sebastian (2017) stated about the conventional cancer therapies which are limited to radiations, surgery and other chemotherapy. These conventional treatments are significantly shows the adverse effect and the current cancer treatment emphasis on precise drug delivery for cancer tissues and decrease the adverse effect on the healthy cells. Nanotechnology is defined as the science and engineering of all the controlling matter and to create devices with the original physical,

biological and chemical properties. The paper discussed about the cancer Nanomedicine which possesses the versatility required for the most challenging impediments in the success of treatment of cancer with the use of conventional chemotherapeutic agents. The research is dependent on the identification of the appropriate Nanoparticles after the certain chemotherapeutic agents for drug cytotoxic effect or these effect on nanoparticles itself with the limited amount of electromagnetic energy.

Conclusion

The cancer Nanomedicine shows the versatility use for the most challenging impediments for the treatment success with conventional chemotherapeutic agents. The Nanotechnological studies use in the drug molecules which is helpful in Nanoengineered structures. It prefers to use the better medicine opportunities with the diagnosis, efficient drug delivery and the improved imaging and therapy for the cancer. The present study focus on the application of nanotechnology used in the cancer treatment which shows the exponential growth from the past years. The multidisciplinary field for the nanotechnology as its concept towards reality shows immense applications. The present study elucidate the complex biological process in tumor genesis and the innovation of the nanomaterial with against properties. It is important for the future implications so as to deliver the use of the advanced Nano-techniques in the cancer therapy.

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