RESEARCH ARTICLE

NANOTECHNOLOGY – A BOON IN DIAGNOSIS OF ORAL CANCER

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ARTICLE INFO

ABSTRACT

In the year 1959, Richard Feynman Nobel Prize winner and an American physicist introduced the concept of nanoscience. It is the study of manipulating substance or matter on an atomic and molecular scale used across a variety of areas such as science, surgery, engineering, robotics, medicines and in almost every field for sake of increasing knowledge and improving efficiency in work. It allows development of new materials with enhanced properties. It can be used in the diagnosis of tumors along with all the imaging techniques used such as tomography. It provides surplus lead in both diagnosis and treatment of cancer.

INTRODUCTION

Cancer cells are continuously dividing cells that fail to differentiate into specialized cells of the body. They can be benign or malignant. It can be carcinoma (from epithelial tissue), sarcoma (from muscle, bone, and cartilage), leukemia (from bone marrow), lymphoma and myeloma (from lymph node or spleen). There in imbalance in proto-oncogenes and tumor suppressor gene. Despite of advances, there are 10 million cases reported all over world[1]. Oral cancers occur because of mutations in the gene and alcohol use and tobacco use. In Developed countries, after stroke and heart disease, cancer is the third disease leading to death of individual[2]. The tasks that were performed by hands were replaced by microscopic devices in nanotechnology. These tiny micro devices are known as nanoassemblers, used to perform particularized jobs that could be controlled by computer. Smaller than the nucleus present in the cells, nanoassemblers could fit into places that is unreachable by any other technology[3]. They have increased surface area due to their smaller size. Electrical, optical and magnetic properties are altered[1].

ADVANTAGES OF NANOPARTICLES

Nanoparticles has showed miracles in field of medicine and aid in precise medical care of disorder. Various other uses of nanoparticle are drug and gene delivery[6], recruitment of bug[7], discernment of destructive proteins[7], profiling of DNA structure[8], regenerative medicine[9], separation of biological molecules and cells[10]. Nanoparticles are biocompatible, biodegradable, non cytotoxic, less invasive, increased contrast, fluorescence of high quality and energy.

DIAGNOSIS OF ORAL CANCER

Oral cancer spreads rapidly, is aggressive in nature and invades local tissue, shows metastasis and high morbidity rate[4].

- Nanomaterials combined with optical detection techniques like fluorescence is the most common method of detection for cancer cells as the nanomaterials either fluorescence or change the optical properties[5].
- Independent or discrete cancer cells can be located by. using distinct cross-linkers (specific antibodies) against cancer cells. Targeted quantum dots(lipid coated) can be used to assess multiple specific dots glows in the presence of visible radiation, they attach to proteins associated with cancer cells[11].
- Nanotubes: Nanotubes are used to detect and assess the location of affected genes in the human body. Nanotubes are made up of carbon rods.
- Nanoscale cantilevers: Attaches with virus- associate molecules[12].
- Cantilever array detector: Mass detection ultrasensitive technology[13].
- Nanopores: It making DNA sequencing highly efficient.
- Nanoelectromechanical Systems: These systems combine electrical and mechanical both functions on the nanoscale. They have small mass, higher surface area to volume ratio so they are used to detect forces at atomic level.

- Multiplexing modality: observing large numbers of different biological molecules simultaneously[13].
- Bio-MEMS {micro/nano electro-mechanical systems} along with nanomaterials and biomolecular markers is used as a diagnostic assay in virus therapy. This helps to study the fundamental biological mechanisms that checks health and disease. Nanomedicine act as artificial cells and help in therapeutic imaging and targeted molecular drug delivery[11].

NANOTECHNOLOGYIN ORAL CANCER TREATMENT: In the past, the anticancer drugs which were used affected both cancer and normal cells and had side effects. Nanoparticles are useful in smart drug delivery which means increase in concentration of medicine in target tissue without affecting other tissues or normal cells of the body due to this large amount of the drug enters the target cell and results in its destruction. The investigation number along with nanotechnologically modified drugs is increasing day-to-day with positive results. Nanotechnology can be used for high grade identification of cancer, more efficient smart local drug delivery to target cells and molecular targeted cancer therapy[14]. Nanotechnology does not cause after effects by obliterating the normal cells, it only kills target cells so it is site specific.ss It acts as a miracle in improving cancer treatments by its two main properties: enhancing properties of pharmaceutical agent (increased stability, synergism, decrease side effects) and site specific that is it targets directly the tumor cells[17].

Smart delivery systems in Nanoscience

- Spherosomes
- Smartgels
- Mesophase liquid crystal
- Microparticles
- Gold microparticles

Spherosomes- also called liposome. Multiple studies have been done to test its efficacy for chemotherapy smart drug delivery system and lipoplexes have been found to be effective and efficient in local drug delivery system without destroying the normal cells of the body[18]. Drug packed with spherosomes are separated by Reticulo endothelial system. Therefore spherosomes are coated with poly ethylene glycol. PEG prevents unloading. It was proposed that PEG loaded spherosomes has greater deleterious effect[19]. Smart gels- it is complex lattice of water attracting polymeric chains spread in water and it swells and release drug[20]. The smart gel system identified for treatment of oral cancer efficiently and effectively is PeCe smart gel system[21].Mesophase liquid crystal-it shows unique property between solid and liquid. It is proved to be very effective in therapy of cancers including oral cancers as it change drug delivery outline and reduce the side effects of the given chemotherapeutic drugs[20]. Micro particles- Micro particles can control the drug targeted delivery and allow constant flow of drug at the targeted lesion. Gold micro particles- They are also used to deliver drugs to target cells. Researches have confirmed that they cross nuclear membrane and are responsible for apoptosis. They show cytotoxic effect. Other nanoparticle- Upconversion Nanoparticles has advantage of increase penetration as compared to conventional nanoparticles[22].

CONCLUSION

Nanoscience will soon lead to the transformation in dental field and human life and its contribution will be more than any other recent inventions. The advantage we get from it as compared to conventional therapy is its multifunctionality. It has so much potential for diagnosis and treatment of oral cancer. In future, if its clinical usage is achieved, it will be a tremendous achievement in human technology ,mortality rate due to cancer will be almost reduced to its half. As earlier detection is possible with nanoparticles , in future treatment of cancer will be very manageable.

REFERENCES

1. Kleihues BW, P. 2003. World Cancer Report. Geneva: World Health Organization Press.
2. Nath A, Singh JK, Vendan SE. 2012. High risk of oral cancer in North India. Curr Sci.
3. Kumar PS, Kumar S, Savadi RC, John J. 2011. Nanodentistry: A paradigm shift-from fiction to reality. *J Indian Prosthodont Soc.* 11:1– (PMC free article) (PubMed) (Google Scholar).
4. Calixto G, Bernegossi J, Fonseca-Santos B, Chorilli M. 2014. Nanotechnology-based drug delivery systems for treatment of oral cancer: A review. *Int J Nanomedicine.* 9:3719–35. (PMC free article) (PubMed) (Google Scholar)
5. Gordon N, Sagman U. 2003. Nanomedicine Taxonomy. Canada. Canadian Institutes of Health Research (CIHR) NanoBusiness Alliance.
6. Mah C, Zolotukhin I, Fraites TJ, Dobson J, Batich C, Byrne BJ. 2000. Microsphere-mediated delivery of recombinant AAV vectors in vitro and in vivo. Mol Ther., 1:S239.
7. Bruchez M Jr, Moronne M, Gin P, Weiss S, Alivisatos AP. 1998. Semiconductor nanocrystals as fluorescent biological labels. *Science.*, 281:2013-6. (PUBMED)
8. Edelstein RL, Tamanaha CR, Sheehan PE, Miller MM, Baselt DR, Whitman LJ, et al., 2000. The BARC biosensor applied to the detection of biological warfare agents. *Biosens Bioelectron.*, 14:805-13. (PUBMED)
9. Mahtab R, Rogers JP, Murphy CJ. 1995. Protein-sized quantum dot luminescence can distinguish between "straight", "bent", and "kinked" oligonucleotides. *J Am Chem Soc.*, 117:9099-100.
10. Yoshida J, Kobayashi T. 1999. Intracellular hyperthermia for cancer using magnetite cationic liposomes. *J Magn Magn Mater.*, 194:176-84.
11. Jaishree V, Gupta PD. 2012. Nanotechnology: A Revolution in cancer diagnosis. *Indian J Clin Biochem.* 27:214–20. (PMC free article) (PubMed) (Google Scholar)
12. Bhardwaj A, Bhardwaj A, Misuriya A, Maroli S, Manjula S, Singh AK, et al., 2014. Nanotechnology in dentistry: Present and future. *J Int Oral Health.* 6:121–6. (PMC free article) (PubMed) (Google Scholar)
13. Saravana KR, Vijayalakshmi R. 2006. Nanotechnology in dentistry. *Indian J Dent Res.* 17:62–5. (PubMed) (Google Scholar)
14. Aliosmanoglu A, Basaran I. 2012. Nanotechnology in cancer treatment. *J Nanomedicine Biotherapeutic Discov.*, 2:107. ✝
15. Bhardwaj A, Bhardwaj A, Misuriya A, Maroli S, Manjula S, Singh AK, et al., 2014. Nanotechnology in dentistry: Present and future. *J Int Oral Health.* 6:121
16. Saravana KR, Vijayalakshmi R. 2006. Nanotechnology in dentistry. *Indian J Dent Res.,*17:62–5. (PubMed) (Google Scholar)
17. Virupakshappa B. 2012. Applications of nanomedicine in oral cancer. *Oral Health Dent Manag.* 11:62–8. (PubMed) (Google Scholar)
18. Calixto G, Bernegossi J, Fonseca-Santos B, Chorilli M. 2014. Nanotechnology-based drug delivery systems for treatment of oral cancer: A review. *Int J Nanomedicine.* 9:3719–35. (PMC free article) (PubMed) (Google Scholar)
19. El-Hamid, E. S. A. A. M. Gamal-Eldeen, and A. M. Sharaf Eldeen. "Liposome-coated Nano doxorubicin induces apoptosis on oral squamous cell carcinoma CAL-27 cells," *Archives of Oral Biology*, vol. 103, pp. 47–54, 2019.View at: Publisher Site | Google Scholar
20. Calixto G Bernegossi J, Fonseca- Santos B, Chorilli, M. 2014. Nanotechnology based drug deliver system of oral cancer A review. *Int J Nanomedicine.*, 9:3719-35.
21. Liboiron BD, Mayer LD. 2014. Nanoscale particulate system for multidrug delivery: Towards improved combination chemotherapy. *Ther Deliv.*, 5:149-71.
22. Li, Q. Y. Wen, X. You et al. Journel of materials chemistry B, vol.4, no. 27 , pp.

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