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# Cancer Nanotechnology

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Since the time of the discovery and nomenclature by the Greek physician Hippocrates (460-370 BC) "cancer" emerged as a deadly disease of the modern days [1]. On an average, cancer contributes to 13% of the total deaths, worldwide. A series of genetic and epigenetic changes termed as carcinogenesis was proposed to be triggered by the combination of environmental and genetic factors, during various stages in the development and progression of the disease [2]. Over the years outstanding research was done in order to understand and cure complex malignancies [3]. The past three decades have observed a profound knowledge of cancer genes, but this has not translated into equivalent benefits to cancer patients. Certainly, a vast majority of the cases of increased success mostly reflect early diagnosis or prevention, rather than improved treatment [4]. Conventional and new generation chemotherapy for cancer treatment has its own disadvantages in eradicating the cancer. Although chemotherapy improves disease-free and overall survival in cancer patients, it involves a number of side effects during the course of the treatment or after the completion [5]. Thus, in order to protect normal cells and organ function, tumour-targeted therapy should be aimed at eliminating cancer cells, while at the same time sparing the normal tissue. In this regard genetic engineering and molecular biology have come up with bio macromolecules that could serve the purpose of specific targeting [6,7]. However, short plasma lives of most of these bio macromolecules open new doors for further research in novel drug delivery platforms for prolonged sustainability and aid from the internal locale.

Recent advances in nanotechnology have offered a new hope for the oral and systemic delivery of the fragile therapeutic molecules. Nanotechnology has the potential to offer solutions to several of the aforementioned obstacles [8]. The physicochemical characteristics of the materials including polymers, metals, and semiconductors offer distinct advantages for *in vivo* applications. Altered properties could be increased surface area, optical, electronic, magnetic and structural properties as well as quantum effects dictated by the nanometer scale that are not available from individual molecules or bulk solids. Properties such as self-assembly, stability, specificity drug encapsulation and imaging contrast of the nanoparticles have already been used clinically to provide targeted cellular/tissue delivery of chemotherapeutics, to improve drug bioavailability, to sustain drug effect in target tissue and to diagnose disease [9].

Pathological angiogenesis originates around the cancer tissue, with the help of pro-angiogenic mediators such as vascular endothelial growth factors that are secreted by the tumour tissue. This will further assist the cancer in using the blood supply for enhanced nutritional and oxygen supply offered by this porous and leaky vasculature having nanopores of about 500nm around the malignant area. Thus, this widespread breakdown of vessel integrity within the tumour results in extensive leakage of bloodstream components and could be exploited in making the NCs in the circulation infiltrate inside the tumour tissue, which is known as enhanced permeability and retention (EPR) effect [10]. Further random drifting of the nano sized particles (Brownian momentum) such as the NCs in addition to receptor mediated endocytosis collectively enhances anti-tumour efficacy of the loaded drug.

To minimize the drawbacks and enhance the specificity, targeted delivery is very useful. In recent years several tumour markers have been discovered which indicates presence of cancer [11,12]. Aptamers lead amongst the small molecules in the race for developing targeted delivery vehicles [13]. Aptamers have low immunogenic potential, small size, greater tissue penetration and can be generated against any target with a very high specificity and sensitivity [14]. Chimeric forms of aptamers or aptamer conjugated with nanoparticles have attained far more success in targeted drug delivery for a wide range of diseases than the traditional and orthodox delivery methods [12-15]. In near future aptamers will bring a revolutionary drift in the field of cancer and other chronic diseases targeted delivery.

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