



TARGETING SELECTIVE TUMOURS BY DEPLOYING MAGNANO PARTICLES THROUGH NANJECTS: RECENT DRUG DELIVERY

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ABSTRACT

About 1.2 million new cancer cases have been diagnosed in 1998 worldwide and 2.5 million cases have been recorded in 2009 in India alone. Cancer is thus a major leading public problem that always remains first cause of death in both developed and developing countries (K.U. Devi 2009). Various promising treatment modalities for cancer starts from surgery or tumour removal, radiation, chemotherapy, immunotherapy, targeted therapy, employing hormones till stem cell transplantation procedures. Still, cancer is not completely eradicated from the body. One of the prime cons of these therapies is they over act during the treatment process. It damages the homeostatic balance of leading to increase in mortality rates widely across the world. Beyond the management of cancer the worse phase is pain experienced during the treatment of cancer. Such unrelieved pain has impact on their sleep, daily activities, food intake and at times their chronic pain leads them to commit suicide. Thus researchers have recently engineered a neo technique by impregnating Magnano particles into micro needles less than a hair follicle diameter to counteract tumour cells. Healthy cells will not be facing the damage amidst the targeted drug delivery to the cancerous cells. These non-toxic Magnano vehicles can overcome the debilitating systemic toxicities caused by cytotoxic chemotherapies. Moreover nano fine particles opt the Trojan horse mechanism to initiate tumour death. Its advanced property of possessing extensive surface-to-volume ratio is projected in its functionality through surface chemistries, especially when these nanoparticles are received in combinatorial with micro magnets. Thus Nanjects not only avoid side effects caused during cancer therapies but is also applicable for vaccine delivery which can eventually overcome fear and stress in Trypanophobia individuals.

KEYWORDS: *Cytotoxicity. Chemotherapy, Drug Delivery, Magnano particles, Nontoxic carriers, Nanjects, Tumours.*



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INTRODUCTION

Cancer is the prime major public health problem which has an account of 2.5 million cases in India alone ¹Integrative cancer treatment focuses on a comprehensive model that emphasizes scientific understanding of alternative medicine therapy. TCRT (Technology in Cancer research and treatment) focuses on development in the counteraction, detection, medical care and monitoring of cancer. Technologies recently are more focussing on less side effects during and after cancer treatments. Beyond these injections during any treatment it creates a new stress. Thus a novel approach to release drugs via injections without syringes is Nanjects that can devastate malignancy by acting on target specific sites of cancer. Injections are always considered to be most effective method to treat any infection as it is easily permeable to the site of infection through body fluids. Magforce – Nano cancer therapy is a unique drug delivery system that recruits more than 17 trillion avalanches of magnetic nanoparticles. Such a high intensity makes the treatment possibly effective. This is one of the most alacritous routes to deliver drugs since even biological barrier systems such as stomach acids or cellular uptake cannot degrade these nanoparticles thus they can pass into the bloodstream directly (Brigger *et al*, 2002). Using injections has significant risks associated with infections especially with regular injection users such as people with diabetes who are increasingly susceptible to this. Another risk goes when syringes are reused without proper sterilization (K.U. Devi 2009). This increases the susceptibility to bacterial infections as well as blood borne pathogens or viruses such as HIV, Hepatitis B or C as poor injection practices such as reusing needles without sterilisation is common still in our public health sectors (Simson *et al*, 1999).

ABOUT NANJECT

Chemoprevention is emerged as a good novel therapy in the recent years and involves the use of natural, synthetic and semi-synthetic methods to suppress and inhibit the malignant transformation (Hong and Sporn, 1997). Particles of nanometer range, so called nanoparticles is the recent mode of cancer drug delivery. As these micro particle can access cancer cells directly and deliver the anticancer drugs as they can seep through fenestrations of the tumor vasculature. Nanoparticles for cancer therapy involves polymeric carriers (Moghimi 2006; Pridgen *et al*,

2007). Thus nanoparticles are highly potential to make significant impact on drug delivery (Pridgen *et al*, 2007; Farokhzad and Langer 2009). Nanoparticle drug delivery system involves polymeric nanoparticles, nanoshells, liposomes (Bangham *et al*, 1965). Inorganic or metallic nanoparticles, micelles magnetic and bacterial nanoparticles. Injection such as vaccination is used worldwide every day by the vast majority of people. In addition, adults and children get stabbed accidentally or pricked by syringe needles that are not safely disposed of without covering the needle into the bin. Severe traumatic patients would be in need of daily drug dietary through painful infections, eventually will develop a phobia to needles (Trypanophobia). These types of individuals despite spending a huge sum of money invested for healing to recover from the trauma are more prone to stress due to painful injections. Considering cancer therapy using pharmaceutical drugs, treatment related side effect occurs within 5-6 hours of chemo. Delayed nausea, vomiting, and diarrhoea starts and lasts for more than 24 hours, even for 5-7 days (Shibuya K *et al*, 2002). Late side effects include insomnia, neutropenia, fatigue, and reduced lung capacity, alopecia, early menopause, and constipation, inability to think called chemo brain (brain fog), weight loss and motor incoordination. Global cancer observatory website database for 185 countries and 36 cancers by age and sex revealed cancer as the second leading cause for 18.1 million new cases which might elevate the death rates up to 9.6 million by 2018 (Drucker *et al*, 2001). Followed by 15 million new cases by 2020, most of it will be from developed countries (Ferlay *et al*, 2013) Disparity in mortality observed from last 10 years survey record revealed 7 million and more deaths (Salminen *et al*, 2005). Lung, stomach, colorectal, breast and liver cancers are prevalent in developing nations. Delayed diagnosis, quality less therapy, end stage cancer also contribute to mortality as 80% of patients in developing countries already have incurable disease when first diagnosed. Lives of cancer treated patients are not guaranteed as many healthy cells are also destroyed along with pathogenic cancer cells during chemotherapy leading to severe incoordination in the immune system eventually weakens and increases the susceptibility for new pathogen entry (McCollum AD *et al*, 2002). Therefore to save time, resources and to eliminate potential side effects of chemotherapy, NANJECT delivers magnetic particles engineered along with or without drugs to deliver to targeted area. Thus only cancer affected

cells by these nanoparticles, eventually can avoid the use of painful syringes. Nanjects skin patches appear as thin silicon wafer that has micro projections made up of polystyrene nano beads. When patched, the nanoparticle slips into hair follicles on the skin subcutaneous layers (fatty region) in which many vaccines or drugs are conveyed. The difference is that vaccines damage the subcutaneous fatty layer that contains capillaries that leads to internal bleeding. Nanject nanoparticle sizes are lesser than a hair follicle pore which means that any foreign particle more than the hair follicle size cannot enter into the hair follicle. From subcutaneous layers, medicines are absorbed directly into the bloodstream as capillaries are very selective about what they let into the bloodstream. This is one of the working principles of Nanject making.

WORKING OF NANJECT

The outer cortexes of nanoparticles are coated with protein or peptides in order to make it biocompatible. After coating the nanoparticles, they are again draped with different types of antigens and antibodies which can basically detect the

specifically targeted cancer. The magnetic property bearing nanoparticles that are delivered via these painless nanjects enter the bloodstream, which can be controlled by an external magnetic field device such as an MRI. The patient enters the therapy device (MRI), where alternating magnetic force is produced. This produces heat at an adjusted temperature (controlled hyperthermia) that kills the cancer cells. Later they disposed along with dead cells by the body's natural process without harming the healthy cells. Apart from these Supramagnetic nanoparticles, iron oxide coated nanoparticles (SPIONs) are composed of irons which actually do not maintain any magnetic strength even after the patient is away from magnetic field. Even in post-mortem neuropathological studies of glioblastoma multiforme (GBM) are reported to get treatment by means of this thermotherapy using magforce nanoparticles (Landeghem F *et al*, 2009). Thus this seems to be safe in in-vivo states also (Saboktakin MR *et al*, 2009). scFv – fragments of functionalised with recombinant single chain antibodies can be used to image tumor cells (Vigor KL *et al*, 2010)



Figure 1
Nanjects

ADVANTAGES

The advantage of nanjects is that its numerous invisible, painless microscopic projections plunge into the skin hair follicles to deliver and acquire only the desired targeted tumour cell destruction. Thus Trypanophobic complains can be ruled out and usage of needle drug delivery can be eradicated. The size of the particle diameter is 20nm and is 500 times smaller than a red blood cell. The small size enables easy entry into tumor vasculature via EPR and thus achieve perfect tumor targeting. However, due to limited hands on experience on this technique and little knowledge on cancer cell morphology still challenges are faced in development and application of nanotechnology platform in cancer therapy.

CONCLUSION

Moreover nano fine particles opt the Trojan horse mechanism to initiate tumor death. Its advanced property of possessing extensive surface-to-volume ratio is projected in its functionality through surface chemistries, especially when this nanoparticle is received in combinatorial with micro magnets. Thus nanjects not only avoid side effects caused during cancer therapies but is also applicable for vaccine delivery which can eventually overcome fear and stress in Trypanophobia individuals. The magforce nanject technique will eliminate the use of injections when implemented in all fields where injections were previously subjected for means of treatment. These nanjects can also be deputed for

tumor detection and imaging apart from incorporating therapeutic drugs.

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AUTHORS CONTRIBUTION STATEMENT

Priyanka G designed the main conceptual ideas and written the manuscript. Rajajeyakumar M contributed the scientific proof correction, formatting and drafted the manuscript.

CONFLICT OF INTEREST

Conflict of interest declared none.

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