UNIVERSITI TEKNOLOGI MARA

TECHNICAL REPORT

MATHEMATICAL MODELLING OF MAGNETIC CARRIER PARTICLE TRAJECTORIES IN BLOOD VESSEL OF PATIENTS WITH CANCER

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ABSTRACT

Increment in mortality causes by cancer induce researcher for finding new solution in minimizing it. Magnetic Drug Targeting (MDT) is the new therapy for cancer treatment such that it is non-invasive treatment that doesn't require incision of body and at the same time it reduces the side effects from cancer's treatment. The derivation of model for trajectories of magnetic carrier particle based on framework with initial position was obtained. Furthermore, prediction of the volume fraction of magnetic particles required to ensure capture of magnetic carrier particle was also obtained. These models will use Newton's Second law for finding the dominant forces. These forces will be solving by using magnetic dipole moment method and Stokes' law of drag of sphere. Analysis will be resulting to the equation for carrier particle trajectories in blood vessel and prediction of volume fraction required for certain value of radius carrier particle and radius of blood vessel.

1 INTRODUCTION

1.1 Research Background

Cancer is one of the leading causes to mortality. Based on statistics reported by the National Cancer Registry by Ministry of Health Malaysia, only in the year 2006, about 21,773 cancer cases were diagnosed among Malaysians in Peninsular of Malaysia. Cancer seems to be predominant with female compare to male with leading numbers of 11,799 in females and 9,974 in males. Based on Trichopoulos et al. (1996), most of cancer patients are having cancers of lung, breast, prostate, colon and rectum. Human can be expose to the risk of cancer because of the factors such as cigarette smoking, unhealthful dietary habits and exposure to dangerous chemicals at work or in the carcinogen environment. Several cancer treatments available for patient such as magnetic drug targeting, surgical removal of the tumour, radiation therapy, chemotherapy, immunotherapy and etc. However, this project study is only focusing on the Magnetic Drug Targeting (MDT) as a treatment for patients with cancer. Side effects from cancer treatment are always being such a dilemma for the patient such as the chemotherapy treatment that not only annihilate all tumour cells but also the healthy cells. Therefore, magnetic drug targeting method has been developed as a new therapy in order to increase the effectiveness of cancer therapy and to minimize the side effects.

MDT is a new cancer therapy that has been design to target magnetic carrier particle at the specific tumour region. According to Alexiou et al. (2011), medical research often use coated superparamagnetic iron oxide (Fe_3O_4) nanoparticles as a new drug carriers because it is biodegradable. These carrier particles were injected into the body and enter the blood stream nearest targeting tumour. A high potent of infinite external magnets were used to drive the magnetic particles to specific part of tumour. This will lead to high concentration of therapeutic agents accumulate in tumour region and increase the effectiveness of the therapy. Referring to Lü et al. (2001), MDT has proved its safety and effectiveness as a method for targeting drugs to