UT AUSTIN PORTUGAL ANNUAL CONFERENCE 2023
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Magnetic Nanoparticles For Cancer Therapy: Collection And Elimination of Circulating Tumor MagTubeCancer

NANOTECHNOLOGIES

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INTRODUCTION

This project addresses a critical need in cancer research by focusing on the capture and elimination of CTCs to prevent metastasis. While various products exist in the market for CTC isolation, they often have limitations, such as processing small blood volumes and prioritizing diagnosis and prognosis over treatment. Metastatic cancer has become an increasingly focal point in recent years, catalyzing the innovation of six new products adept at managing substantial blood volumes. However, these products have proven ineffective in capturing and eliminating significant quantities of CTCs from different types of cancer. This highlights a noticeable gap in the market for a product that can effectively capture and eliminate the majority of CTCs from a patient's bloodstream. This project aims to bridge this gap by developing a magnetic microtube device to capture and eliminate CTCs from large blood volumes efficiently.

MAIN ACHIEVEMENTS

The magnetic device proposed in this project was optimised with established parameters, resulting in an impressive performance. In in vitro experimental studies using only cell culture medium, the device achieved a remarkable retention rate of 89.13% ± 2.43% in a single pass. This retention rate significantly outperforms other devices and those documented in scientific literature and the market. When experiments involved whole blood from human donors, the CTC retention rate was slightly lower at 76%±28.3 in a single pass. This decrease can be attributed to the blood-dense matrix. Nonetheless, this retention level remains noteworthy, especially compared to existing in vivo systems. To reach (>98%) clearance of CTCs, Prof James Tunnell from UT Austin proposed combining magnetic isolation with laser technology. Magnetic gold hybrid particles were successfully prepared and optimised. An I3s PhD and MSc student from i3S conducted several studies at UT Austin group for a short period that yielded promising results, demonstrating the feasibility of using the laser on CTCs selectively.

MAIN OUTCOMES

- Two exchange Portuguese students spend time at UT Austin
- A provisional patent application was requested
- Four posters and two oral presentations were performed in National and International conferences
- A master thesis was concluded

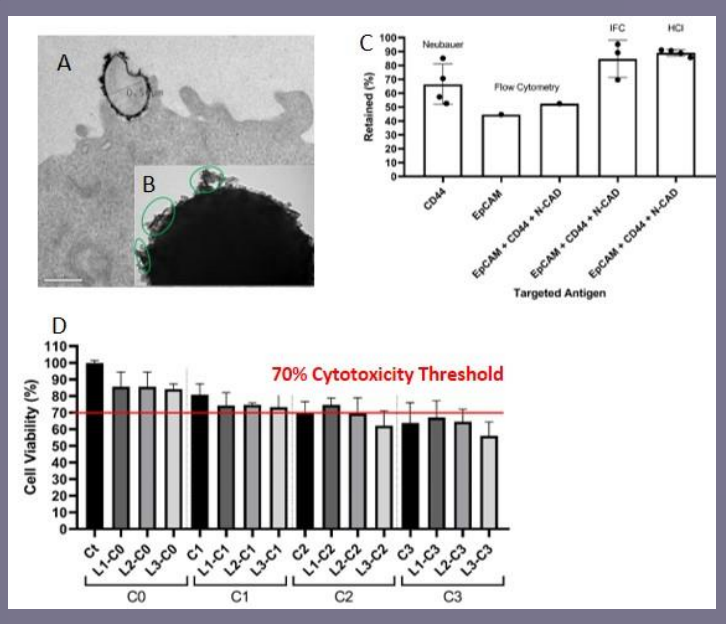

Figure 1: TEM images of magnetic particle uptake by CTC (A) and composite particles (magnetite and gold); C) Comparative summary of CTC retention rates using various counting methods: Neubauer chamber, flow cytometry, imaging flow cytometry (IFC), and high-content imaging (HCI); D) Normalized metabolic activity in resazurin assays with various particle composite concentrations (C0, C1, C2, C3 - 0, 100, 175, 250 µg/mL) and laser energies (L0, L1, L2, L3 - 0, 500, 1000, 2000 mJ).

ACKNOWLEDGMENTS

This research is supported by funding from national resources provided by FCT – Fundação para a Ciência e a Tecnologia, I.P., as part of the UTAP-EXPL/NPN/0059/2021 project. The author, Laranjeira MS, gratefully acknowledges FCT, Portugal, for financial support (norma transitória do DL n.º 57/2016).

UTAustin Portugal
INEB Instituto de Engenharia Biomédica
3S INSTITUTO DE INVESTIGAÇÃO E INOVAÇÃO EM SAÚDE UNIVERSIDADE DO PORTO
fct Fundação para a Ciência e a Tecnologia
TEXAS The University of Texas at Austin

INL INTERNATIONAL IBERIAN NANOTECHNOLOGY LABORATORY