Backgeround:

The early detection of cancers and the creation of effective non-invasive therapeutic treatments currently show two major challenges in cancer theranostics.[1] Creating non-toxic functional nanoparticulate contrast agents (CAs) for magnetic resonance imaging (MRI) is one of the primary goals for researchers to achieve enhanced resolution in MRI scans. Recently, researchers have discovered that superparamagnetic iron oxide nanoparticles (SPIONs) exhibit excellent relaxation response along with higher relaxivity values and superior colloidal stability, which are demanding to improve the efficiency of MRI performance.[2] Such SPIONs also possess great potential for early detection of cancer cells.

SPIONs having <50 nm in diameter are being used as an important element to develop next-generation MRI CAs for detection and diagnosis of brain tumors.[3] Out of all types of cancer, brain cancer has been found to be the most pernicious one, and its diagnosis/treatment is still a big challenge in terms of efficiency. One of the main goals for the early detection of brain cancer using MRI is to overpass the blood brain barrier (BBB), which is a restrictive barrier that prevents the entrance of many substances to the central nervous system.[4] Early detection of cancer provides the patient the opportunity to receive an effective treatment and also helps prevent metastasis.

Objectives:

The main goal of this project is to diagnose brain cancer at its early stages through our innovative iron-based CAs both *in vitro* and *in vivo*. At the first step of this research project, we expect to deliver our negative CAs across the BBB without inducing its structural damage, which would avoid the uncontrolled passage of noxious drugs.[3] This will be done using our customized in-vitro BBB model, and then will be integrated to one in-vivo BBB model that involves the housing and treatment of healthy and tumor-bearing mice and rats. After screening the

concentration, pH values, size, morphology, capping ligand, and stability of the CAs, we will study their biodistribution within the brain, blood half time, and the receptor-mediated transcytosis, which will be part of the second step of this research project.