Advancing Glioblastoma Treatment: Ultra-Small Superparamagnetic Iron Oxide Nanoparticles for Tumor Imaging and Radiosensitisation

J. Charmi[1], *V. Milanova*[1], *N. Dmochowska*[1], *G. Rollo-Walker*[1], *P. Janowicz*[2], *D. Waddington*[2], *B. Thierry*[1]*

[1]Future Industries Institute, University of South Australia, Adelaide, South Australia 5095, Australia.
[2]ACRF Image X Institute, Sydney School of Health Sciences, Faculty of Medicine and Health, The University of Sydney, Sydney, New South Wales, Australia
jalil.charmi@mymail.unisa.edu.au and *benjamin.thierry@unisa.edu.au*

The treatment of brain tumors typically involves maximal safe surgical resection followed by radiotherapy and chemotherapy, with MRI-based imaging playing a crucial role in treatment planning. However, conventional gadolinium-enhanced MRI has limitations, particularly in accurately delineating tumor margins, and concerns have been raised regarding gadolinium deposition in the brain. Iron oxide nanoparticles, such as Ferumoxytol, have been explored as alternative MRI contrast agents[1,2]. In this study, the FerroTrace platform, a clinical-stage iron-based nanoparticulate MRI agent, was redesigned for brain tumor imaging and evaluated for its radiosensitisation properties. The synthesized FRN-110 nanoparticles (27 nm hydrodynamic diameter) demonstrated high colloidal stability[3] and effectively enhanced MRI contrast in patient-derived orthotopic brain tumor models, with peak hypointensity on T2-weighted imaging observed at 15 minutes post-injection. In vitro, FRN-110 at 10 µg/ml significantly reduced U87 glioblastoma cell viability following 8 Gy irradiation, with a synergistic radiosensitization effect observed in combination with pharmacological ascorbate at 2 Gy. Comparisons with gadolinium showed no difference in tumor contrast enhancement at 15 minutes post-injection. These findings highlight FRN-110's potential as a dual-function MRI contrast agent and radiosensitizer, warranting further investigation.

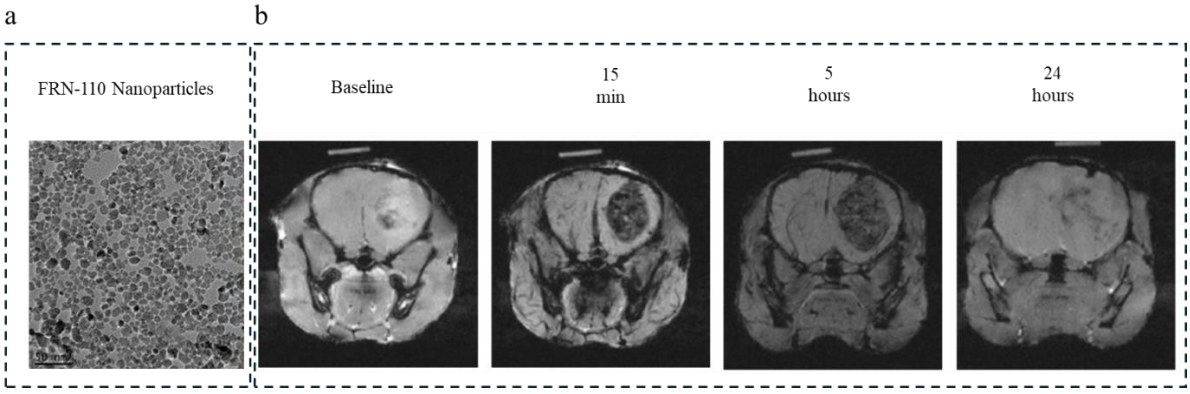

Figure 1: (a) Transmission electron microscopy analysis of the morphology of FRN110. (b) Longitudinal tracking of FRN110 in the mouse brain over 24 hours using T2-weighted MRI.

References:

[1] Wongsawaeng, D.; et al. *The Neuroradiology* **2024**, 37.4, 473-482.
[2] Janowicz, W.; et al. *bioRxiv* **2025**, 2025-02.
[3] Dmochowska, N.; et al. *Small* **2023**, 19.21, 2204956.