Regional and multi-parametric characterization of spinal cord impairment in ALS using high and ultra-high field Magnetic Resonance Imaging and electrophysiology

Acronym: (3+7)T – ALS

Principal Investigator: Virginie CALLOT

Grant: 80 000€

Duration: two years

Summary of the research project

Multi-parametric SC MRI has emerged as a good candidate to assess disease severity and to monitor disease progression in Amyotrophic Lateral Sclerosis (ALS). However, most of the techniques developed so far are limited to a single level of investigations (eg. upper cervical spinal cord) and/or moderate spatial resolution, precluding tissue impairment characterization along the cord or within specific regions of interest such as the anterior grey matter.

In this project, we aim at benefiting from recent technical improvements obtained at both high and ultra-high field, especially in terms of spatial coverage and spatial resolution, to further investigate the topological evolution of the disease. More particularly, by combining the ultra-high resolution (up to 200µm) of morphological and structural MRI that can be reached at 7T with structural and myelin-specific MRI that can now be obtained along the whole cervical cord at 3T, we intent to extract robust ALS surrogate biomarkers within specific region of interest of both gray and white matter (such as atrophy of the anterior GM and demyelination of specific sensory/motor tracts) that could be used to improve the early diagnosis, to better describe the tissue impairments, to investigate the propagation patterns and to propose putative model of tissue degenerative dynamic.

7 Tesla MRI at CEMEREM – Hôpital de la Timone, Marseille

These MR biomarkers will be evaluated through a close monitoring of the ALS evolution along a 6-month length period (T0, T0+3 months, T0+6 months), in conjunction with clinical and electrophysiological measurements including Triple Stimulation Technique (TST), Transcranial Magnetic Stimulation (TMS) and the Motor Unit Number IndeX (MUNIX) technique.

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Upon completion, this original pilot study should bring new knowledge about pathological spread and variation in upper (UMN) and lower motor neuron (LMN) involvement at the spinal cord level. It should also help identifying the most relevant spinal cord MR parameters for early diagnosis and prognosis, objective disease progression monitoring and accurate evaluation of therapeutic candidates.

The study will be coordinated by the Reference Center for Neuromuscular Diseases and ALS, directed by Pr. S. Attarian (Timone hospital, AP-HM) and the Spinal Cord MRI team (V. Callot, CNRS) at CRMBM (UMR7339, CNRS/Aix-Marseille University, directed by M. Bernard), within the CEMEREM (Hôpital Timone, AP-HM, directed by Pr. M. Guye).
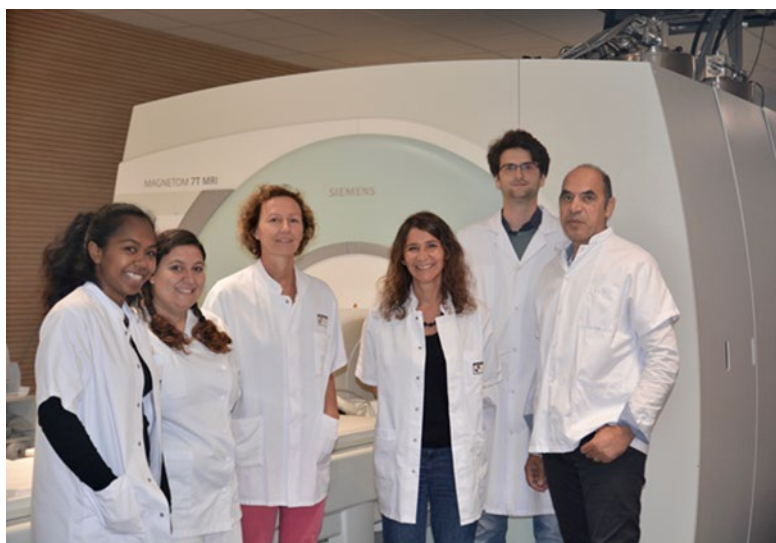
Research team from left to right: Henitsoa Rasoanandrianina (PhD student), Lauriane Pini (MRI technician), Dr Annie Verschueren (neurologist), Virginie Callot (CNRS Research director), Aurélien Massire PhD), Prof. Sharam Attarian, head of neurology department.