



## **Pulmonary arteries blood flow and elasticity characterization and interaction with the right ventricle and right atrium in patients with Heart Failure with preserved Ejection Fraction (HFpEF)**

### **Consortium:**

AP-HP & INSERM PARCC (Université de Paris) represented by Prof. Elie MOUSSEAUX ( [elie.mousseaux@aphp.fr](mailto:elie.mousseaux@aphp.fr) ) & CASIS – Cardiac Simulation & Imaging Software, represented by Dr Jean-Joseph CHRISTOPHE ( [jjchristophe@casiss.fr](mailto:jjchristophe@casiss.fr) )

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### **Topic presentation**

Heart Failure is a disease affecting at least 26 million people worldwide. Heart Failure with preserved Ejection Fraction (HFpEF) is still not well understood. The PACIFIC consortium, led by SANOFI, with Servier, Assistance Public Hôpitaux de Paris (AP-HP), and 4 SME (Fealinx, Bioserenity, Firalis and CASIS), and finally INSERM-Université de Paris aim at classifying the patients in group of typologies of diseases. The consortium is split in 6 working groups. The working group 2 focus on medical image analysis. In particular, CASIS, with the support of AP-HP and INSERM (PARCC), will be will be strongly involved on part of the project concerning the pulmonary arteries and the coupling between the right atrium, the right ventricle and the pulmonary arteries in MRI. Most HFpEF patients exhibit pulmonary hypertension which is significantly associated with increased morbidity and mortality. To quantify pulmonary arteries hemodynamic and stiffness, and to estimate right ventricular function Magnetic Resonance Imaging has been proven a non-invasive method of choice.

In particular, phase contrast MRI allowed to characterize vortices of blood flow as a marker of pulmonary hypertension. Other markers such as stiffness, Wall Shear Stress or Oscillatory Shear Index have been highlighted of interest. Many approaches to study pulmonary arteries and right ventricular dysfunctions have been explored, but so far, no global parametric study those dysfunctions to characterize typologies of patients with HFpEF has been attempted.

To conduct such study, we propose the following steps:

1. 4D flow reconstruction of pulmonary arteries up to the 3<sup>rd</sup> generation,
2. Comparative hemodynamic study between healthy patients and patients with HFpEF
3. Inclusion of the right side of the heart in the analysis (right ventricle and right atrium).

### **Main objectives**

- Assessment of various parameters of pulmonary artery's hemodynamic and morphology,
- Highlighting of the most relevant markers in the case of HFpEF,
- Classification of HFpEF patients in sub-groups with similar behavior.

### **Expected skills**

The chosen candidate will be enrolled as a CIFRE PhD employee of CASIS. Most of the PhD will take place at the HEGP in collaboration with INSERM (PARCC) in Paris. A high interest in the medical fields and heart physiology is expected. **The chosen candidate should be skillful in:**

Object programming (C++, Python), Image processing for analyzing 3D + time reconstruction of flow and cardiac structure (MRI).