



Internship proposal 2025

Understanding the causes of uterine hypercontractility in endometriosis

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Project description : Endometriosis is a pathology affecting 6-10% of the female population, characterized by the implantation of uterine endometrial nodules either in the body of the uterus (known as adenomyosis) or ectopically, on various organs in contact with the peritoneal cavity such as the bladder, intestines, Fallopian tubes etc. This pathology results in severe pain during menstruation and can lead to infertility. Endometriosis and adenomyosis are associated with **hypercontractility of the myometrium**, the uterine smooth muscle: intrauterine pressures, contraction frequencies and amplitudes are 2-3 times higher in patients than in the controls. Contractile waves present aberrant propagation directions at the different phases of the menstrual cycle. These observations support the etiological theory of retrograde menstruation (Sampson, 1927) as the cause for the appearance of endometrial lesions in the peritoneal cavity (Fig. 1). The morphological signature of hypercontractility is the appearance of a thickened, irregular junctional zone (Fig.1) of the myometrium, which appears distinctly upon MRI or intravaginal ultrasonography examination. The goal of our project is **to understand whether hypercontractility can result from a structural alteration of the architecture of the uterine wall, for example of the smooth muscle, of its innervation, or its hormone receptor distribution.**

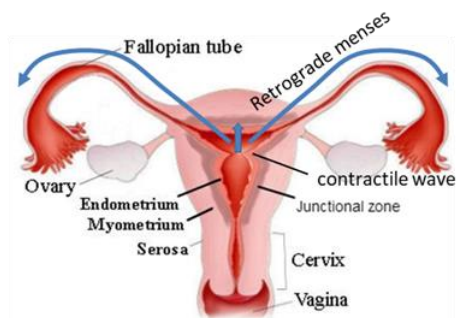


Figure 1. Anatomy of the uterus and contractile waves giving rise to retrograde menstruation that spread the endometrium throughout the body.

The project is supported by the Fondation pour la Recherche sur l'Endométriose (<https://www.fondation-endometriose.org/>). Within the frame of this project, the intern will have access to uterine tissue obtained following hysterectomy operations (removal of the uterus) performed at St Joseph Hospital (Paris 14th) by Dr. Lamau, Dr. Abrahami and Dr. Bautrant in collaboration with the anatomo-pathology department headed by Dr. Adam. The most common causes for hysterectomies are uterine and ovarian cancer (~50%, control group) and aggravated cases of endo- or adenomyosis (~50%). The intern will work hand-in-hand with PhD student Emilie Huon on the project.

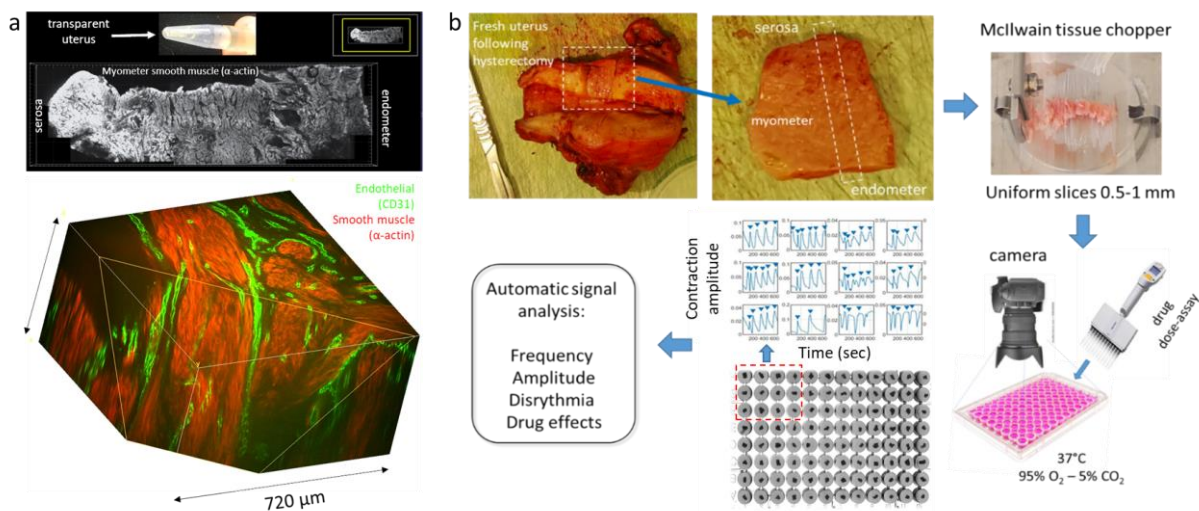


Figure 2. Some of the technics developed in the lab for characterization of uterus structure and contractile function. (a) 2D and 3D tissue-clearing immunohistochemistry of the uterine myometrium. (b) High-throughput uterine contractility assay.

The project aims at deciphering the **structural changes of the myometrium in control vs pathological tissues**. The intern will, together with our assistant engineer, learn to collect tissue from post-hysterectomy uteri at Hopital Paris Saint Joseph, how to process them for immunochemistry and perform fluorescence microscopy imaging of the critical components of the tissue that may be altered in endometriosis: smooth muscle, vascularization, nerve cells and neuron subtypes, hormonal receptors. **Image analysis** will be the major focus of the internship, using either **artificial intelligence techniques** for segmentation, or ImageJ/Matlab software for the quantification of fiber (muscle, nerve, blood vessel) orientation / size / density and its distribution along the thickness of the uterine wall. The intern will further have the opportunity to participate in the development of a new sensor for the non-invasive measurement of intra-uterine pressure in patients.

We are looking for rigorous, motivated students interested in image analysis, preferentially at ease with programming, ImageJ and Matlab. The internship may be followed up by a PhD recruitment