IBEC-VHIR INTERNATIONAL PhD PROGRAMME

Position

1. Project Title/ Job Position title:
   COMPASS: Customized Organ-on-chip for Microfluidic Personalized Anemia and Sickle cell Solutions

2. Research project / Research Group description

The deep phenotype characterization of single red blood cell behaviour in flow through combined microfluidic and machine learning analysis would allow the identification of novel biomarkers for scoring of severity, disease's progression and response to treatment in sickle cell disease (SCD) and other rare anemia disorders (RAD).

The COMPASS project aims to develop a microfluidics organ-on-a-chip based platform integrating fit-for-purpose modules to enable biomarkers detection and personalized therapy screening in SCD and RADs.

Specific Objective 1_Diagnosis: Accelerate new generation diagnosis of patients affected by (ultra) RADs based on in deep characterization of RBC behaviour in flow (TRL3 → TRL6)

Specific Objective 2_Monitoring: Develop personalized RBCs profiles to identify biomarkers of severity, prognosis and response to treatments in RADs under normoxia (TRL3 → TRL6) and hypoxia conditions in RADs and SCD respectively (TRL2 → TRL6)

Specific Objective 3_Drug profiling: Develop an in-vitro module for testing new drugs and combination of drugs for personalized treatments and drug efficiency monitoring. (TRL2 → TRL6)

Research Group Description

IBEC: Nanobioengineering group

The Nanobioengineering group activities include the engineering and biochemical functionalization of biomaterials integrated with microfluidics systems. The bioengineered microdevices are used to study cell responses to biomolecular compounds applied to Organ-on-Chip devices for the study of organ physiology, disease etiology, or drug screening.

VHIR: Childhood Cancer and Blood Disorders – Rare anemia disorders Laboratory

The Rare anemia disorders Laboratory at VHIR is focused on the development and validation of novel diagnostic, exploratory and functional tests in order to identify new disease mechanisms, discover novel biomarkers, improve disease classification, and investigate differences in response to therapy.

3. Job position description

The PhD candidate will be incorporated to the existing research line on organ-on-a-chip development in RADs.

RADs are mild to life threatening chronic blood-transfusion dependant diseases due to red blood cell defects. The recent availability of new therapeutic options makes even more crucial the development of innovative strategies for phenotypic characterization to develop predictive scores and enable personalized medicine.

The PhD candidate doctoral thesis will leverage a first prototype of a microfluidics organ-on-a-chip device already developed mimicking the spleen inter-endothelial slits functionalities and integrating machine learning data analysis to evaluate the premature loss of RBCs' plasticity in patients with SCD and RADs.

Advance beyond the prototype/state-of-the-art:

- Validation/demonstration of the prototype in laboratory (IBEC) and relevant environment (VHIR) in a cross-sectional (SO1) and longitudinal (SO2) cohort of patients affected by RADs.
- From proof-of-concept to prototype validation/demonstration of new modules for analysis in hypoxia conditions and personalized drug testing profile (SO2, SO3)

The PhD candidate will develop her/his thesis project at IBEC and VHIR premises under prof Samitier (IBEC) and Dr Mañú (VHIR) supervision. She/he will be also in close cooperation with the Pediatric Hematology Department at HUVH supervised by Dr Collado.

The candidate will be in charge of the following tasks to obtain her/his doctoral thesis:

- Organ-on-a-chip development and optimization
- Red blood cells samples pre-processing
- Trials execution
- Machine learning analysis of ROIs from videos
- Optimization of protocols for drug dosing and screening and individual patients profiling

Group Leader IBEC

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