Hemodynamics: Wall shear rate/blood flow values in human and mouse vessels

Biorheology Subcommittee

Person responsible (Chair / Principal Investigator): Mikhail Panteleev and Pierre Mangin

Description Abstract

Background:

It is widely recognized that hemodynamics is central in the process of hemostasis and thrombosis. Blood flow is the actual driving force for platelet aggregation and profoundly affects blood coagulation as well. Over the last 50 years, the development of numerous assays comprising flow has helped to better delineate the importance of shear in the function of blood platelets with insight at both the cellular and molecular levels. Parallel plate flow chambers, glass microcapillaries and the more recently developed microfluidic flow devices represent remarkable tools that allow to closely mimic the rheological conditions found in various physiological and pathological settings in vivo. Their use in the field of hemostasis and thrombosis has tremendously increased in the last couple of years notably due to the development of commercial flow devices. To understand the adhesive behavior of platelets under various hemodynamic conditions found in veins, arteries, arterioles, in the microcirculation under normal or pathological conditions it is critical to have clear references. Unfortunately, there is no article that compiles the blood flow values found in the main vessels in humans and mice. Moreover, there is often a confusion concerning the flow values found in arteries, notably in large arteries as well as in the microcirculation. This lack of accepted reference values represent a major obstacle in the field of hemostasis and thrombosis, because the results of the in vitro experiments critically and qualitatively depend on the flow conditions. The differences in the regulation of arterial thrombosis and hemostasis could originate in their different biorheology rather than in their biochemistry.

Objective:

The main objective of this work is to provide a repertoire of blood flow values found in various human and mouse vessels under physiological and pathological conditions. Such a work will be particularly helpful for researchers using blood flow assays to choose relevant hemodynamic conditions to perform their experiments.

This article will be subdivided in three main sections:

1) We will discuss and recommend hemodynamic parameters that are best suited to define/characterize a given blood flow and that should be used to reproduce it in vitro. We will also discuss the relevant parameters allowing to compare hemodynamic conditions between different vessels.
2) We will provide a repertoire of the blood flow conditions found in numerous human and mouse blood vessels which are most relevant for the studies of the researchers in the field of hemostasis and thrombosis.

3) The last section will contain various recommendations that will aim to help researchers in the field to use relevant hemodynamic conditions to conduct their studies.

Design and methodology (Data expected to collect, sample size and statistical analysis):

Describe concisely the research design and methods for achieving these goals. Suggested length 2-3 paragraphs

N/A

Study population (Inclusion, exclusion, eligibility) (patient population; recruitment of participating institutions/physicians and subjects; minimum number needed; expected number):

N/A

Expected timeline:

- **Project stage/set up:**
  - Launch: **November 2018**
  - Duration: **1 year**
  - Finalization/analysis:
  - Reporting

Expected outcomes (ie. publications):

- **Publication type (SSC Communication, Guidance document or original article):** **original article**

Description of project set/up and management, needed infrastructure and resources (summary):

This project will be a close collaboration between the groups of Mikhail Panteleev (Moscow State University) and Pierre Mangin (Inserm U1255, Strasbourg). No external resource is required.

Possible references: