EXERCISE HEMORHEOLOGY: MOVING FROM OLD SIMPLISTIC PARADIGMS TO A MORE COMPLEX PICTURE

Brun JF, Varlet-Marie E, Romain AJ, Guiraudou M, Raynaud de Mauverger E.[1]

Abstract

Classic studies on exercise hemorheology evidenced that blood fluidity is impaired during exercise (short term exercise-induced hyperviscosity) and is improved as a result of regular exercise practice (hemorheologic fitness). Extensive description of these events led to the concepts of "the triphasic effects of exercise", "the paradox of hematocrit", and "the hemorheological paradox of lactate". However, some results obtained in training studies do not fit with this classical picture and cannot be explained by a simplistic paradigm based on the Hagen-Poiseuille law. Taking into account the non-linearity of the effects of viscosity factors on blood flow and oxygen delivery helps to elaborate another picture. For example, moderately high values of hematocrit and erythrocyte rigidity induced by high intensity exercise are likely to trigger a physiological vasodilation improving circulatory adaptation (rather than limiting performance as was previously assumed). This may apply to the acute rise in red cell rigidity observed during strenuous exercise, and also to the paradoxical rise in hematocrit or red cell rigidity observed after some training protocols and that did not fit with the previous (simplistic) paradigms. The "healthy primitive lifestyle" hypothesis assumes that evolution has selected genetic polymorphisms leading to insulin resistance as an adaptative strategy to cope with continuous low intensity physical activity and a special alimentation based on lean meat and wild herbs (i.e., moderately high in protein, rich in low glycemic index carbohydrates, and poor in saturated fat). We propose here that this model may help to explain on an evolutionary perspective these apparently inconsistent findings. The pivotal explanation is that the true physiological picture would be that of an individual whose exercise and nutritional habits are close from this lifestyle, both sedentary subjects and trained athletes representing situations on the edge of this model. **[Clin Hemorheol Microcirc. 2013 Mar 11. [Epub ahead of print]]** PMID:3478223

[1] INSERM U1046 «Physiopathologie & Médecine Expérimentale du Cœur et des Muscles», Equipe d'Explorations Métaboliques (CERAMM), Université Montpellier 1, Université Montpellier 2, Département de Physiologie Clinique, Hôpital Lapeyronie CHU Montpellier, France.

PLASMA HYALURONAN AND HEMORHEOLOGY IN PATIENTS WITH SEPTIC SHOCK: A CLINICAL AND EXPERIMENTAL STUDY

Sallisalmi M, Tenhunen J, Kultti A, Tammi M, Pettilä V.[1]

Abstract

Background: Total plasma hyaluronan concentration is increased in septic shock. High-molecular-weight hyaluronan has a high intrinsic viscosity. Excessive release of high-molecular-weight hyaluronan in sepsis may induce hyperviscosity.

Methods: Plasma viscosity and the molecular size of plasma hyaluronan were determined in 20 patients with septic shock and in 20 healthy controls. Ex vivo, the effects of 0.4% and 0.047% high-molecular-weight hyaluronan 1560 kDa, 0.9% saline, and 6% hydroxy-ethyl-starch 130 kDa were compared to plasma and whole blood viscosity and red blood cell aggregation at a systemic hematocrit of 0.4, and at a microcirculatory hematocrit of 0.2.

Results: Plasma viscosity and total plasma protein content were low in septic shock patients on days one and four of treatment. Hyaluronan concentration was 10-fold higher in sepsis on day 1. Molecular weight of hyaluronan was relatively low, mostly 50-500 kDa, and did not change significantly in sepsis. Ex vivo, 0.4% high-molecular-weight hyaluronan 1560 kDa increased blood viscosity but did not promote red blood cell aggregation. Dilutions of 6% hydroxyl-ethyl-starch 130 kDa and 0.047% high-molecular-weight hyaluronan 1560 kDa had comparable effects on blood viscosity and red blood cell aggregation.

Conclusions: Plasma viscosity of the septic patients remained low for four days despite markedly elevated concentration of relatively small-molecular-weight hyaluronan. **[Clin Hemorheol Microcirc. 2013 Feb 4. [Epub ahead of print]]** PMID:23380965

[1] Intensive Care Units, Division of Anaesthesia and Intensive Care Medicine, Department of Surgery, Helsinki University Hospital, Helsinki, Finland.

RED BLOOD CELL FLOW IN THE CARDIOVASCULAR SYSTEM: A FLUID DYNAMICS PERSPECTIVE

AlMomani TD, Vigmostad SC, Chivukula VK, Al-zube L, Smadi O, BaniHani S.[1]

Abstract

The dynamics of red blood cells (RBCs) is one of the major aspects of the cardiovascular system that has been studied intensively in the past few decades. The dynamics of biconcave RBCs are thought to have major influences in cardiovascular diseases, the problems associated with cardiovascular assistive devices, and the determination of blood rheology and properties. This article provides an overview of the works that have been accomplished in the past few decades and aim to study the dynamics of RBCs under different flow conditions. While significant progress has been made in both experimental and numerical studies, a detailed understanding of the behavior of RBCs is still faced with many challenges. Experimentally, the size of RBCs is considered to be a major limitation that allows measurements to be performed under conditions similar to physiological conditions. In numerical computations, researchers still are working to develop a model that can cover the details of the RBC mechanics as it deforms and moves in the bloodstream. Moreover, most of reported computational models have been confined to the behavior of a single RBC in 2-dimensional domains. Advanced models are yet to be developed for accurate description of RBC dynamics under physiological flow conditions in 3-dimensional regimes**. [Crit Rev Biomed Eng. 2012;40(5):427-40]** PMID: 23339650 [PubMed

[1] Department of Biomedical Engineering, The Hashemite University, Zarqa, Jordan. thakir2000@hu.edu.jo