

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.JournalofSurgicalResearch.com

Age- and gender-related hemorheological alterations in intestinal ischemia-reperfusion in the rat

Anita Mester, MD, Zsuzsanna Magyar, MD, Akos Molnar, Viktoria Somogyi, MSc, Bence Tanczos, MSc, Katalin Peto, MD, PhD, and Norbert Nemeth, MD, PhD, DSc*

Department of Operative Techniques and Surgical Research, Institute of Surgery, Faculty of Medicine, University of Debrecen, Debrecen, Hungary

ARTICLE INFO

Article history:

Received 12 July 2017

Received in revised form

15 December 2017

Accepted 29 December 2017

Available online xxx

Keywords:

Aging

Gender differences

Intestinal ischemia-reperfusion

Red blood cell aggregation

Red blood cell deformability

ABSTRACT

Background: Intestinal ischemia-reperfusion (I/R) is a life-threatening clinical disorder. During I/R, the microrheological parameters of blood (red blood cell deformability and aggregation) worsen, which may contribute to microcirculatory deterioration. Age and gender also have a great influence on hemorheological parameters. We aimed to investigate the gender and age-related microrheological alterations during intestinal I/R.

Materials and methods: After the cannulation of the left femoral artery, median laparotomy was performed in CrI:WI rats under general anesthesia. In the young control animals there were no other interventions (female $n = 7$; male $n = 7$). In the young (female $n = 7$; male $n = 7$) and older I/R groups (female $n = 6$; male $n = 6$), the superior mesenteric artery was clipped for 30 min, and a 120-min reperfusion period was observed afterward. Blood samples were taken before and at the 30-min ischemia, in the 30th, 60th, and 120th min of the reperfusion. Hematological parameters, erythrocyte deformability, and aggregation were determined.

Results: Hematocrit increased significantly in the younger female I/R group. Red blood cell count was higher in male and older animals. In case of white blood cell count, male animals had higher values compared with females. Platelet count elevated in the younger male and older female I/R animals. Red blood cell deformability worsened, mainly in the male and older I/R groups. Enhanced erythrocyte aggregation was seen in all groups, being more expressed in the female I/R groups.

Conclusions: Microrheological parameters show gender and age-related differences during intestinal I/R. These observations have importance in the planning and evaluation of experimental data.

© 2018 Elsevier Inc. All rights reserved.

Introduction

Intestinal ischemia-reperfusion (I/R) is a life-threatening clinical disorder associated with several conditions, such as

necrotizing enterocolitis, volvulus, trauma, mesenteric thrombi/emboli, or cardiopulmonary diseases.¹ It affects all age groups, from infants to elderly patients, and the survival rate has not improved over the last decades.²⁻⁴ High mortality

* Corresponding author. Department of Operative Techniques and Surgical Research, Institute of Surgery, Faculty of Medicine, University of Debrecen, Nagyerdei krt. 98., H-4032 Debrecen, Hungary. Tel./fax: +36 52-416-915.

E-mail address: nemeth@med.unideb.hu (N. Nemeth).

0022-4804/\$ – see front matter © 2018 Elsevier Inc. All rights reserved.

<https://doi.org/10.1016/j.jss.2017.12.043>

and morbidity is due to bacterial translocation, systemic inflammatory response syndrome (SIRS) and remote organ failure caused by intestinal ischemia.⁵

During I/R injuries, a number of pathophysiological processes may occur, including a decreasing oxygen and adenosine-triphosphate (ATP) supply, energy production through an anaerobic metabolism, accumulation of lactic acid, lowering intracellular pH, and formation of reactive oxygen species (ROS).⁶⁻⁸ It is known that these changes may cause significant alterations in the flow properties of blood, mainly in erythrocyte aggregation and deformability (microrheological parameters).^{9,10} Erythrocyte aggregation is a reversible process when red blood cells (RBCs) form three-dimensional aggregates ("rouleaux" formation). Red blood cells are able to adopt a new cell shape in response to deforming forces, which is crucial for passing through capillaries that can be smaller than the cells themselves. Thus, the microrheological parameters of blood are important determinants of the microcirculation, and their investigation continues to be an interest of experimental and clinical research.¹¹ (Fig. 1)

I/R injuries are more prevalent in the aging population. This is in part attributable to the comorbidities that are common in elderly patients, e.g., hypertension, diabetes, or obesity. However, aging is an independent risk factor, which may cause deterioration in the cardiovascular system in itself.^{12,13}

Furthermore, numerous studies support the importance of gender-related differences caused by I/R injuries.¹⁴ It has been shown that male patients are at a higher risk of cardiovascular diseases, and male gender presents a risk factor in trauma, sepsis, and other conditions. The protective effect of estrogen has been identified in several studies; however, the clinical data are still controversial. In addition, only a few studies compared the gender-related responses of microrheological parameters in I/R injuries.¹⁴⁻¹⁷

The aim of our study was to investigate the effects of intestinal I/R on systemic hemorheological parameters in a rat

model. We hypothesized that during intestinal ischemia, the microrheological parameters of the blood worsen, and the degree of these changes differs in male and female, young and older rats.

Materials and methods

Experimental animals and study design

All experiments were performed with the approval of the University of Debrecen Committee of Animal Welfare (permission number: 20/2011 UDCAW) in accordance with national and EU regulations (the Hungarian Animal Protection Act [Law XVIII/1998] and the Directive 63/2010).

Young (4 mo old) male and female and older (18 mo old) male and female Crl:WI rats (Toxi-Coop Ltd., Hungary) were involved in the study. The animals were kept in conventional animal facility and received rat chow (Bábolna rodent-specific CRLT/N) and water ad libitum. The experiments were performed under continuous general anesthesia (thiopental, 60 mg/bwkg, intraperitoneally).

Operative techniques and sampling protocol

Six experimental groups were formed:

- I. Control young males ($n = 7$; 435.9 ± 75.2 g)
- II. Control young females ($n = 7$; 281.7 ± 27.8 g)
- III. Ischemia-reperfusion (I/R) young males ($n = 7$; 333.3 ± 149 g)
- IV. Ischemia-reperfusion (I/R) young females ($n = 7$; 249.3 ± 25.6 g)
- V. Ischemia-reperfusion (I/R) older males ($n = 6$; 622.2 ± 189.6 g)
- VI. Ischemia-reperfusion (I/R) older females ($n = 6$; 548.7 ± 217 g)

In the control groups, the left inguinal region and the middle part of the abdomen were shaved and disinfected with Betadine. After isolation, an incision (~1 cm) was made on the skin above the left femoral artery. The artery was prepared and cannulated (BD Neoflon, 26 G) under operating microscope (Leica Wild M650). Midline laparotomy was performed, and the superior mesenteric artery was gently exposed by traumatic preparation. In addition, laboratory data was used from the database of the department as old controls (females $n = 8$; males $n = 7$).

In the I/R groups, the same preparations were carried out, and the superior mesenteric artery was clamped with microvascular clip for 30 min, then a 120-min reperfusion period was observed.

Blood samples (~0.3 mL each time, anticoagulant: 1.5-mg/mL K₃-EDTA) were taken from the cannulated artery after the surgical preparations (base), at the 30th min of the ischemia, just before the removal of the clip (I-30), at the 30th (R-30), 60th (R-60), and 120th (R-120) min of the reperfusion. In the control groups, the same sampling time points were used. At the end of the experiment, the animals were euthanized.

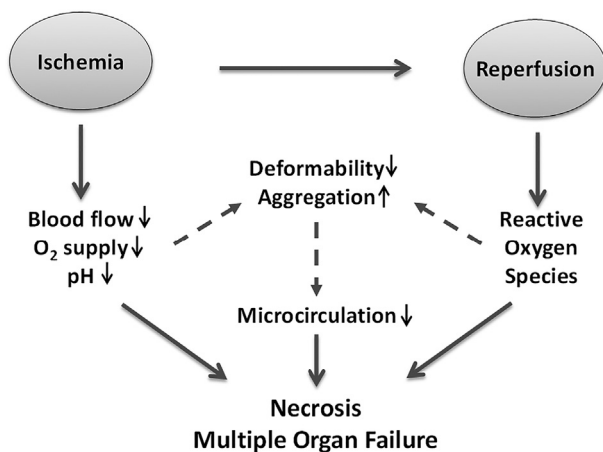


Fig. 1 – Mechanism of ischemia-reperfusion injury. The deterioration of microrheological parameters may lead to the impairment of microcirculation, local, and remote organ failure.

Download English Version:

<https://daneshyari.com/en/article/8835643>

Download Persian Version:

<https://daneshyari.com/article/8835643>

[Daneshyari.com](https://daneshyari.com)