S1: Vessels and Hemorheology

S1-1 Hemorheological parameters and mortality in critically ill patients

Beata Csiszar, Kinga Totsimon, Peter Kenyeres, Kalman Toth, Zsolt Marton

1st Department of Medicine, University of Pecs, Medical School, Hungary

Purpose: Prognostic scores for mortality of intensive care patients estimate clinical outcome using several anamnestic, physiological and biochemical parameters. In altered hemodynamic conditions of critically ill patients, hemorheological variables may play a significant role in appropriate tissue perfusion. We investigated if hemorheological parameters are altered in critical status and if they could be markers of mortality.

Methods: 112 patients (67.8±12 years, 58 males) treated in an intensive care unit with different non-surgical diseases were investigated. Routine laboratory parameters and prognostic scores were determined and hemorheological variables (hematocrit, plasma and whole blood viscosity, red blood cell aggregation and deformability) were measured on the 1st and the 2nd day after admission.

Results: ICU prognostic scores predicted 35.2-41.3% mortality rate. Real mortality in intensive care unit was 37.5%, while 30-day mortality was 46.6%. Whole blood viscosity (WBV) and red blood cell (RBC) deformability were lower, red blood cell aggregation was higher in septic than in nonseptic patients ($p<0.05$). In septic patients calcium was increased, osmolality was decreased, while in nonseptic patients WBV and RBC aggregation were higher in non-survivors compared to survivors ($p<0.05$). Worsening of RBC deformability from day 1 to day 2 predicted higher mortality ($p<0.05$).

Conclusion: Calcium and osmolality level were associated with outcome in sepsis. Whole blood viscosity, red blood cell aggregation and change in red blood cell deformability could predict mortality in nonseptic patients and they may add prognostic information over the ICU scores. Further investigations are needed to evaluate the benefit of our findings in clinical practice.

S1-2 Leukocyte antisedimentation rate (LAR) and pituitary adenylate cyclase-activated polypeptid (PACAP) in polytrauma and burn victims. A preliminary study

Csaba Loibl[a] , Csaba Csontos[a], Livia Szelig[a], Lajos Bogar[a], Patricia Kovacs[a], Andrea Pankaczi[a], Szilard Rendeki[a], Martin Rozanovic[a], Marianna Matancic[b], Timea Nemeth[c], Beata Lelesz[d], Jozsef Nemeth[d] , Attila Miseta[e], Dora Reglodi[f], Andrea Tamas[f]

[a]*University of Pécs, Medical School, Department of Anaesthesia and Intensive Care, Hungary*

[b]*University of Pécs, Medical School, 1st Department of Internal Medicine, Hungary*

[c] *University of Pécs, Medical School, Department of Languages for Specific Purposes, Hungary*

[d] *University of Debrecen, Department of Pharmacology and Pharmacotherapeutics, Hungary*

[e] *University of Pécs, Medical School, Department of Laboratory Medicine, Hungary*

[f] *University of Pécs, Medical School, Department of Anatomy, MTA-PTE PACAP Research Team, Centre for Neuroscience, Hungary*

Introduction: Polytrauma and severe burn injury result in cellular necrosis that leads to immediate immunoreactions. Secondary infectious complications further increase leukocyte activation and consequent leukocyte swelling. It can be monitored with leukocyte antisedimentation rate (LAR). Pituitary adenylate cyclise-activated polypeptid (PACAP) has several functions, including antiapoptotic, antioxidant and antiinflammatory effects.

Objective: Our aim was to evaluate the role and the comparison of conventional (serum C-reactive protein: CRP, procalcitonin: PCT) and non-conventional (LAR, PACAP-38) markers in polytrauma and burn victims.

Methods: In our preliminary study patients were followed for 5 days (T1-T5) after admission to a critical care unit immediately with severe polytrauma or burn injury. Serum PACAP-38 concentration was measured with RIA and sandwich-type ELISA, while LAR, CRP and PCT levels were determined with conventional laboratory methods. Results: 13 patients with polytrauma and 5 with burn injury were involved. LAR and CRP kinetics showed elevating tendency at T3 ($p<0.05$) in both groups, and LAR from T4 ($p<0.001$) in both groups, respectively. PACAP-38 levels showed significantly higher levels at T4 ($p<0.01$) in polytrauma patients only. PCT failed to indicate any consistent kinetics. Positive correlations were found between LAR and CRP ($p<0.05$) as well as CRP and PCT ($p<0.05$) in both groups.

Conclusions: LAR was proved to reliably reflect acute phase reaction. PACAP demonstrated a neuroprotective role in survivors of serious brain injury. The role of elevated PACAP levels could provide its protective function to restore the physiological functions of the body in patients with critical conditions.

S1-3 Do AB0 and Rh blood groups influence hemorheological parameters in vascular patients?

Katalin Koltai[a], Dóra Endrei[a], Gábor Késmárky[a], Katalin Biró[a], Zsolt Márton Pécs[a], Gergely Fehér[b] , Dávid Kovács[a], Imre Boncz[c] , Antal Tibold[b], Kálmán Tóth[a]

[a] *University of Pécs, Medical School, Ist Department of Medicine, Hungary*
[b] *University of Pécs, Medical School, Centre for Occupational Medicine, Hungary*
[c] *University of Pécs, Medical School, Faculty of Health Sciences, Institute of Health Insurance, Hungary*

Background: The AB0 blood group system influences the risk of thrombotic cardiovascular adverse events, and excerts a profound effect on hemostasis. Non-0 blood type has been

associated with a higher risk of developing cardiovascular adverse events. We aimed to clear whether the differences in thrombotic risk between blood groups may be associated with hemorheological differences.

Methods: Between 2001 and 2005, we performed hemorheological examinations on subgroups of ASA treated vascular patients. Hungarian National Blood Transfusion Service databases were searched for AB0 and Rh blood groups of those of our patients who had their blood types tested until September, 2017. Blood type data was available for 510 patients who had hematocrit, and for 541 patients who had plasma fibrinogen measured. We found 514 patients who had both blood group analysis and plasma- and whole blood viscosity measurement, and 268 patients who had both red blood cell aggregation and blood type test performed. Plasma-and whole blood viscosity were measured by Hevimet 40 capillary viscosimeter. Red blood cell aggregation was measured by Myrenne aggregometer.

S1-4 Applications of finite element analysis in clinical hemorheology

Varga Peter, Javor Sz, Jancso G, Gedei A, Maroti P, Balazs G

Finite element analysis (FEA) is a well-known, widely used method in the engineering studies. Yet in medical care it is still a novel technique. In a case of the surgical care of a left ventricle (LV) aneurysm, residual LV function and volume are the most crucial factors of the outcome. Planning of these interventions are challenging with conventional methods. Using computational fluid dynamics -a branch of FEA- can provide an effective alternative for these practices.

Materials and Methods: We used high resolution CT images to create a virtual model that is capable of computational planning of different patch scenarios for surgical ventricle restoration (SVR). During the simulation, we took into consideration that the left ventricle is a dynamically moving region, and the hemorheological properties of blood.

Results: Using virtual planning, operative time decreased, good LV function was achieved and mitral function improved significantly.

S1-5 Effects of ischemia-reperfusion and various surgical preconditioning maneuvers on micro-rheological and microcirculatory parameters

Norbert Nemeth[a], Gabor Varga[a], Balazs Szabo[a], Csaba Korei [b], Bela Turchanyi [b], Katalin Peto[a]

[a]*Department of Operative Techniques and Surgical Research, Faculty of Medicine, University of Debrecen, Hungary*
[b] *Department of Traumatology and Hand Surgery, Faculty of Medicine, University of Debrecen, Hungary*

Ischemia-reperfusion is known to alter hemorheological parameters and also having significant impact on the microcirculation. However, numerous questions have not been completely answered yet concerning the time factor, the border of reversibility-irreversibility, preventive and therapeutical possibilities among others. Ischemic preconditioning, being local or performed on remote organs (e.g., extremities), is one of the maneuvers for reducing ischemic-reperfusional damage. Micro-rheological parameters can be altered by several pathways including metabolic, free-radical-related and inflammatory processes. Depending on the affected organ function, the extension and scheduling of the maneuvers these changes can further vary. Experimental models focusing on renal or hepatic ischemia-reperfusion also revealed that optimization of the remote organ ischemic preconditioning protocols still needs further clarification.

S1-6 Renal ischemia-reperfusion-induced micro-rheological and microcirculatory alterations and their influenceability by remote organ ischemic preconditioning

Gabor Varga, Kitti Nagy, Noemi Pal, Gabor Nadubinszky, Balazs Szabo, Bence Tanczos, Viktoria Somogyi, Adam Deak, Katalin Peto, Norbert Nemeth

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

The pathomechanism and the optimal protocol for remote ischemic preconditioning (rIPC) and its effect on hemorheological and microcirculatory parameters have not been clarified yet. We aimed to investigate this issue in a rat model.

On male CrI:WI rats the left femoral artery was cannulated, via median laparotomy the left kidney was exposed, and a 165-minute period was monitored in the sham-operated group (n=7). In the ischemia-reperfusion (I/R) group (n=7) we used microvascular clip to induce a 45-minute renal ischemia followed by a 120-minute reperfusion period. In the rIPC groups a tourniquet was applied around the right hind-limb for 3x10 minutes with 10-minute intermittent reperfusion periods 1 hour (rIPC-1, n=7) or 24 hours (rIPC-24, n=6) prior to the I/R. Blood samples were taken before the renal ischemia phase and during the reperfusion for testing hematological, hemorheological and acid-base parameters. Arterial mean pressure, heart rate, respiratory rate, rectal temperature, organ surface temperature and microcirculation were also recorded.

In rIPC-1 group we measured the highest blood pressure and lactate values with the lowest pH. In I/R group microcirculation of the liver increased during reperfusion ($p<0.05$ vs. base) and the highest leukocyte count ($p<0.01$ vs. all) was found. Erythrocyte deformability worsened in all ischemic group ($p<0.05$ vs. all) with the smallest manner in rIPC-24, however, erythrocyte aggregation markedly increased ($p<0.001$ vs. rIPC-1). The histology showed better results in the rIPC-24 group ($p<0.01$ vs. all).

Renal I/R caused significant changes in the investigated parameters. However, according to the results it cannot be decided which rIPC protocol is more effective for reducing I/R injury in rats.