The proper delivery pressure for cardioplegic solution in neonatal cardiac surgery – An investigation of biomechanical and structural properties in neonatal and adult coronary arteries

Introduction: One of important issues in pediatric cardiac surgery is myocardial protection. When cardioplegic solution is injected into coronary arteries with a pump to ensure myocardial protection, it is necessary to determine the correct delivery pressure to avoid damage of the heart.

Methods: We investigated 12 coronary artery specimens without cardiac pathology retrieved from autopsies of neonates 9.3±9.7 days old and weight 3.99±0.7 kg and compared them to seven adult specimens with no detected atherosclerosis. Specimens were pressurized from 0 to 200 mmHg with the step of 20 mmHg, while maintaining the length of the sample in situ. Structural damages were investigated afterwards with light microscopy and immunohistochemistry.

Results: There was a rapid increase of strain until the inner pressure reached 80-100 mmHg, whilst the increase of stress in the wall of neonatal coronary arteries was less rapid. When the internal pressure exceeds 100 mmHg, the strain of the arterial wall increases much slower, but the wall stress and modulus of elasticity begin to increase rapidly - the structural elements of the arterial wall have been straightened and possible damage may appear. Results were compared with biomechanical properties of arterial wall of adults and differences had been found. Morphologic examination of tensile properties revealed prominent affection of the vascular wall of neonates with accentuated redistribution (loosening) of medial myocytes and adventitial vasa vasorum after being pressurized with the inner pressure of over than 100 mmHg.

Conclusions: Our experimental results show that the delivery pressure of the cardioplegic solution in neonatal coronary arteries should not exceed 100 mmHg. A raised inner pressure may increase the risk of structural damage of the vascular wall leading to the injury of myocardium.

Biography
Normunds Sikora has completed his Residency in Cardiac Surgery in 2008. Afterwards, he finished his PhD in Riga Stradins University. He has done efforts to improve the quality of cardiopulmonary bypass in cardiac surgery in Latvia working as Cardiac Surgeon and Specialist in cardiopulmonary bypass in Clinic for Pediatric Cardiology and Cardiac Surgery, Children’s University Hospital, Riga, Latvia. He is also an Assistant Professor in Riga Stradins University, Department of Surgery. He has established Latvian Society of Cardiopulmonary Bypass being its President currently. He is a National Delegate in European Board of Cardiovascular Perfusion. He has established National Education Program in Cardiovascular Perfusion being its Director currently. He has over 10 papers in different local and international medical journals.

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