Importance of Biomechanical Properties of Three Different Patch Materials for Closure of Ventricular Septal Defect in Infancy

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Introduction. Ventricular septal defect (VSD) of heart is the most common congenital heart defect in childhood, prevalence 30–40% from all heart defects. Prevalence per 1000 live births is about 1.8–6.5. Different types of VSD patch materials such as polytetrafluorethylene materials, xenopericardial material and autopericardium are used widely in congenital heart surgery. Patch materials with biomechanical properties (BM) closer to native tissues biomechanical properties are more suitable for VSD closure in infancy.

Aim. The aim of this study is to evaluate biomechanical compatibility of different patch materials to heart myocardial biomechanical properties for VSD closure in infancy.

Material and Methods. Patch materials for closure of ventricular septal defect include 1) biosynthetic patch materials: ePTFE Gore Tex Cardiovascular patch and Knitted polytetrafluorethylene BARD PTFE; 2) biological patch material: xenopericardium XAG 420. 5 specimens of each group of patch materials on longitudinal tensile testing machine *ZWICK-ROELL* were investigated. For all specimens we performed uniaxial tensile test to examine deformability and strength. Stress-strain relationship was recorded at elongation rate 5 mm/min. Ultimate stress σ_{max} (MPa) and ultimate strain ε_{max} (%) were determined at the peak of stress-strain curve. The stiffness of the material was assessed as the slope of the linear range of the stress-strain curve, and was expressed as a tangential modulus of elasticity E (MPa). For all specimens the ultimate stress and ultimate strain were calculated. For all the obtained data, statistical analysis was done using *SSPS Statistics 17.0 MS Excel*. For each group of specimens the mean value of ultimate strain, ultimate stress and modulus of elasticity were calculated. Analysis of sample groups was performed using *Student t* test.

Results. GoreTex ePTFE patch material modulus of elasticity is E = 84.46 ± 11.8 MPa; Ultimate strain ε_{max} = 16.62 ± 1.76%; Ultimate stress σ_{max} = 8.62 ± 0.21 MPa. For xenopericardial patch material modulus of elasticity is E = 70.8 ± 9.22 MPa; Ultimate stress σ_{max} = 6.63 ± 1.03 MPa; Ultimate strain ε_{max} = 10.50 ± 1.52%; For BARD patch material modulus of elasticity E = 15.12 ± 0.74 MPa; Ultimate stress σ_{max} = 9.32 ± 1.03 MPa; Ultimate strain ε_{max} = 48.12 ± 2.60%

Conclusions. The biomechanical properties of xenopericardium are different from synthetic biomaterial *Gore-Tex* and *Bard* materials. Biomechanical properties of xenopericardium are closely comparable to native human pericardial BM properties than *Gore-Tex* and *Bard* patch materials. The xenopericardial material is indicated for closing of moderate and large size VSD for patients in infancy. Polytetrafluorethylene patch materials are suitable for VSD closure for patients after the age of 2 years. *BARD* patch material is indicated for VSD closure for patients in infancy if defect is muscular or is more than 4 mm away from valvular structures.