ABSTRACT

Background: The aortic and pulmonary allograft heart valves (AHV) are used in the cardiac surgery for replacing the impaired semilunar valves. They are harvested from donor hearts and cryostored in tissue banks. The expiration period was set to 5 years arbitrarily. We hypothesized that their mechanical and structural properties do not reasonably deteriorate after this period.

Methods: A total of 64 human AHV (31 aortic and 33 pulmonary) of different length of cryopreservation (fresh, 0-5, 5-10, over 10 years) were sampled to different tissue strips (artery, leaflet, ventriculo-arterial junction, arterial ring) and tested by tensile test with loading velocity 10 mm/min until tissue rupture. Neighbouring regions of tissue were processed histologically and evaluated for elastin and collagen area fraction. The results were evaluated statistically.

Results: In aortic AHV, the physical deformation response of wall samples to stress did not changed significantly neither during the process of cryopreservation nor during the first 10 years of storage. In pulmonary AHV, the ultimate strain dropped after 5 years of cryopreservation indicating that pulmonary artery was significantly less deformable at the time of rupture. On the other hand, the ultimate stress was equal during the first 10 years of cryostorage. The changes in collagen and elastin amount in the tissue samples were not associated with mechanical impairment.

Conclusion: Neither elasticity, stiffness and solidity nor morphology of aortic and pulmonary AHV did not change reasonably by cryopreservation and during the first 10 years of cryostorage. This evidence suggests that the expiration period can be extended.

Keywords: heart valve allograft, homograft, cryopreservation, tissue banking, mechanical characteristics, structural changes