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Age Related Differences in the Collagen Structure and Strength of Pericardium

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Heart valve leaflets can be replaced using bioengineered leaflets from bovine pericardium tissue. The strength and thickness of the material is of crucial importance for both the percutaneous delivery of the leaflet replacement and the long life in service that is required of the biomaterial. Neonatal pericardium is thinner than adult pericardium giving it a physical advantage for heart valve leaflet production but any differences in the strength of the tissues remains unknown. Small angle X-ray scattering was used to characterise the collagen structure of adult and neonatal pericardium and results were compared with the mechanical properties. When compared with adult pericardium, neonatal pericardium was found to have a higher degree of alignment (neonatal OI = 0.78, adult OI = 0.62), a higher elastic modulus (neonatal elastic modulus = 83.7 MPa, adult elastic modulus = 19.1 MPa), and a higher normalised ultimate tensile strength (neonatal tensile strength = 32.9 MPa, adult tensile strength = 33.5 MPa). This research shows that the higher alignment of the collagen fibrils provides the structural foundation for the superior strength of the neonatal pericardium. The physical properties of neonatal pericardium indicate it would be a suitable material for the heart valve leaflet replacements.

Keywords

collagen, SAXS, pericardium, orientaton index, elastic modulus, tensile strength.

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