Properties of the human umbilical vein as a living scaffold for a tissue-engineered vessel graft.

Abstract:

Umbilical cords are usually discarded after delivery, even though they contain a set of functional vessels. We investigated whether the human umbilical vein (HUV) is suitable as a storable scaffold for the tissue engineering of small-caliber vessel grafts. Isolated HUVs were cryopreserved by freezing or vitrification. The reaction of the vessels to vasoactive compounds and the mechanical properties were determined in an organ bath. Mitochondrial metabolism, release of antithrombotic compounds, and platelet adhesion were measured on the luminal vessel surface. Seeding with endothelial cells was tested on denuded HUVs. The vessels showed a weak response to norepinephrine but were readily contracted by serotonin and by the thromboxane A2 mimetic U46619. Endothelium-dependent vasorelaxation was weak, reaching significance only for histamine. However, the vessels relaxed to sodium nitroprusside, and to acetylcholine if sandwiched with human saphenous vein. Cryopreservation did not change the mechanical properties in the relevant tension range. Vasoconstriction to potassium chloride and serotonin were reduced after freezing (22.9+/−7.6%, 27.7+/−10.2%) and after vitrification (2.6+/−5.8%, 4.3+/−7.1%). The mitochondrial metabolism was also attenuated after freezing (57.9+/−25.9%) and after vitrification (21.7+/−6.7%). Prostacyclin release...
was elevated after both cryopreservation procedures (4.0-fold, 3.9-fold), whereas there was no significant change in the adhesion of platelets. Denuded HUVs could readily be seeded with isolated endothelial cells before and after freezing. We conclude that HUV is suitable as a storable living scaffold with antithrombogenic properties.