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Influence of mesenchymal stem cells seeding on morphology of tissue-engineered vascular graft based on poly (L-lactide) scaffold

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Objective: The objective of this study was to evaluate the effects of adipose-derived mesenchymal stem cells (AD-MSC) on the formation of tissue-engineered vascular graft (TEVG).

Materials & Methods: Tubular scaffolds 1.1 mm inner diameter were obtained by the electrospinning method on the basis of nano- and microfibers of poly (L-lactide) (PLLA). AD-MSC was seeded on the scaffolds by the developed filtration method. The subsequent culturing for 14 days was carried out in the constructed flow bioreactor. Cell distribution in the scaffold wall was assessed by the fluorescence microscopy. Obtained grafts were implanted into rat aorta: group 1 without AD-MSC (n=36) with follow-up till 16 months, group 2 with seeded AD-MSC (n=28) with follow-up till 12 months. The material was subjected to histological examination, electron microscopy, immunohistochemistry CD 31+, aSMA and morphometric analysis (cell counting, neointima and neo adventitia thickness). To track AD-MSC in vivo PKH-26 labeling and subsequent fluorescence microscopy were performed in 2, 7 and 14 days.

Results: Filtration seeding and subsequent cultivation in the flow bioreactor led to a uniform distribution of AD-MSC in the scaffold wall. Graft patency in the first group was 86%, in the second 96%. All grafts formed neointima, with no signs of hyperplasia in the area of anastomoses. The total resorption of PLLA fibers in group 1 was observed by histological examination, new vascular wall consisted of endothelial lining and connective tissue without smooth muscle cells (SMC); in all cases aneurysm formation was detected. Total cell number of implant wall was more in group 2, including SMC that formed neomedia. Also, the outer connective tissue layer was much thicker. Histology identified the uniform formation of new tissues in group 2 with no signs of aneurysm.

Conclusion: AD-MSC seeding leads to the formation of TEVG, morphologically similar to the natural structure of the vessels.

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