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Angiogenic Potential of Collagen Based Biomaterials Implanted on Chick Embryo Chorioallantoic Membrane as Alternative Microenvironment for in Vitro and in Vivo Angiogenesis Assays

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Abstract : Chick embryo chorioallantoic membrane (CAM) is a well vascularised in vivo experimental model used as a platform for testing the behavior of different implants inserted on it from tumor fragments to therapeutic agents or various biomaterials. Five types of collagen-based biomaterials with 2D and 3D structure (MotifMesh, Optimaix2D, Optimaix3D, Dual Layer Collagen and Xenoderm) were implanted on CAM and continuously evaluated by stereomicroscope for up to 5 days post-implant with an emphasis of their ability to requisite and develop new blood vessels (BVs) followed by microscopic analysis. MotifMEsh did not induce any angiogenic response lacking to be invaded by BVs from the CAM, but it induced intense inflammatory response necrosis and fibroblastic reaction around the implant. Optimaix2D has good adherence. CAM with minimal or no inflammatory reaction, a good integration of the CAM between the collagen mesh's fibers, consistent adhesion of the cells to the collagen fibers,and a good ability to form pseudo-vascular channels filled with cells. Optimaix3D induced the highest angiogenic effects on CAM. The material shows good integration on CAM. The collagen fibers of the material show the ability to organize themselves into linear and tubular structures. It is possible to see blood elements, especially at the periphery of the implant. Dual-layer collagen behaves similar to Optimaix 3D, while Xenoderm induced a moderate angiogenic effect on CAM. Based on these data, we may conclude that collagen-based materials have variable ability to requisite and develop new blood vessels. A proper selection of collagen-based biomaterial scaffolds may crucially influence the acquisition and development of blood vessels during angiogenesis assays.

Keywords : chick embryo chorioallantoic membrane, collagen scaffolds, blood vessels, vascular microenvironment
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