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A total atherosclerotic occlusion in a rabbit femoral artery with cell-mediated calcium deposits: Intravascular applications of tissue-engineering scaffolds

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Total atherosclerotic occlusions often include significant calcium deposits. Current animal models do not mimic the pathology of gradual occlusion of arteries and lack cell-mediated calcium. The primary goal of our project was to establish an animal model incorporating these features into chronic total occlusions (CTOs). Here, we took the strategy of placing tissue-engineering scaffolds preloaded with cells in arteries to develop a novel CTO model. Primary human osteoblasts (HOBs) were first cultured in vitro on polycaprolactone (PCL) loaded with TGF-β1 to initiate cellular calcification. Then, HOB-PCL construct were placed into a rabbit femoral artery for an additional time period. At the time of sacrifice, angiograms and gross histology of arteries were examined to confirm the occlusion of arteries. Fluorescent staining of calcium and Energy-dispersive X-ray spectroscopy (EDS) evaluated the presence and distribution of calcium inside arteries. Our results showed that rabbit femoral arteries were totally occluded, and calcium was presented at CTO sites. Intriguingly, we observed chronic inflammatory response and recanalization, indicating that our model exhibited important features of clinical CTO cases.

In conclusion, we have successfully established a novel CTO model with cell-mediated calcium in a rabbit femoral artery. This model has exciting prospects for the development of new devices and therapies to treat severe atherosclerotic occlusion.

Biography

This project describes the work done during Beili Zhu's Ph.D. studies. She pursues research under the supervision of C. Mauli Agrawal Ph.D. at Department of Biomedical Engineering and Steven R. Bailey M.D. at Department of Cardiology.