European Cells and Materials Vol. 7. Suppl. 2, 2004 (page 43) ISSN 1473-2262

Unexpected Tissue Engineering: Cartilage neoformation in long-term HydroCoil®- occluded experimental aneurysms

M. Killer[1], B. Richling[1], B. Minnich[2], A. Lametschwandtner[2], & H. Plenk Jr.[3]

[1] *Dept. Neurosurgery, Christian Doppler Medical Center, Paracelsus Medical University Salzburg,*

[2] *Institute for Organismal Biology, University of Salzburg,*

[3] *Bone &Biomaterials Research, Intitute of Histology and Embryology, Medical University Vienna, AUSTRIA*

INTRODUCTION: The long-term stability of coil-occluded aneurysms, especially in wide-necked aneurysms is rather poor. To minimize the recanalization rate mutiple coil modifications were introduced. In the new HydroCoils®(1), a hydrogel coating expands up to nine times by volume after deployment and is able to create a better filling volume of the aneurysm than with pure platinum coils. In our HydroCoil®-studies, the in vivo stability of occlusion in flow exposed aneurysms was evaluated angiographically, and the aneurysm healing and foreign body responses to this new endovascular tool were assessed histologically. We present the unexpected occurence of cartilage neoformation in these aneurysms one year after coiling.

MATERIAL & METHODS: In 42 rabbits wide-necked flow exposed carotid bifurcation aneurysms were constructed microsurgically. After a minimum healing of 3 weeks 21 aneurysms were treated with ComplexCoils® as basket coils, and HydroCoils® (MicroVention Inc., Aliso Viejo, CA, USA) as filling coils. In the other 21 cases HydroCoils® alone were used. After 6, 9 and 12 month the rabbits were again angiographed before sacrification. The aneurysm – parent artery – complexes were embedded into methyl-methacrylate, diamond saw-sections cut and ground to a thickness of 100 µm, surface-stained and evaluated by light microscopy.

RESULTS: Angiographically, the amount of filling of the aneurysms was dramatically increased, compared to pure platinum coils. Histologically, vascularized granulation tissue of varying density was growing from the walls of the aneurysms towards the center of the sac, and was also observed in the clefts between HydroCoils®. Especially in the long-term results after one year, neoformation of cartilage was observed there in 5 of 12 cases (Fig.1). The successful healing of the aneurysm was confirmed by the formation of an endothelium-covered new vessel wall at the aneurysm orifice.

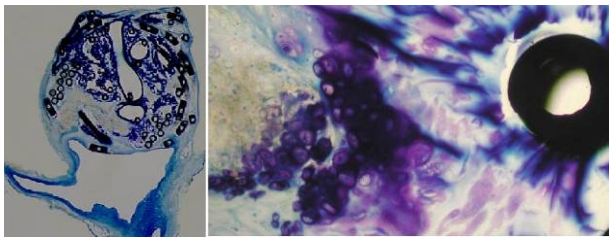

Fig. 1: Ground section of a 1 year HydroCoil® – occluded aneurysm with the coils in-situ (left), and cartilage neoformation in the hydrogel-coating at higher magnification (right).

DISCUSSION & CONCLUSIONS: The healing of embolized aneurysms is largely dependend on the nature and amount of the embolizing material. Aneurysms coiled with pure platinum coils are filled only with a small amount of material. Recanalization of the organized thrombus is caused mainly by hemodynamic factors. Blood pulsation pushes away coils placed at the aneurysm neck, and leads to compaction of coils and consecutive recanalization. The hydrogel coil works by expanding during the treatment session to fill spaces between coils and better obliterate the aneurysm. The mechanical forces of the blood flow, and the hydrogel as flow absorber, but also potential trigger of stem cells to form cartilage (2,3) may have resulted in this unexpected neoformation of cartilage in HydroCoil®-occluded aneurysms. This seems to represent better thrombus stabilization and healing with so far reduced chances for recanalization.

REFERENCES:

[1]Kallmes DF et al. (2002) New Expandable Hydrogel-Platinum Coil Hybrid Device for Aneurysm Embolization. *Am J Neuroradiol* **23**: 1580-88. [2]Archer CW et al.(2003) The chondrocyte. *Int J Biochem Cell Biol* **35**: 401-4. [3]Williams CG et al. (2003) In vitro chondrogenesis of bone marrow-derived mesenchymal stem cells in a photopolymerizing hydrogel. *Tissue Eng* **9**: 679-88.

ACKNOWLEDGEMENTS: These studies were supported by *MicroVention Inc*.