Synthetic structures to aid regeneration in the central nervous system

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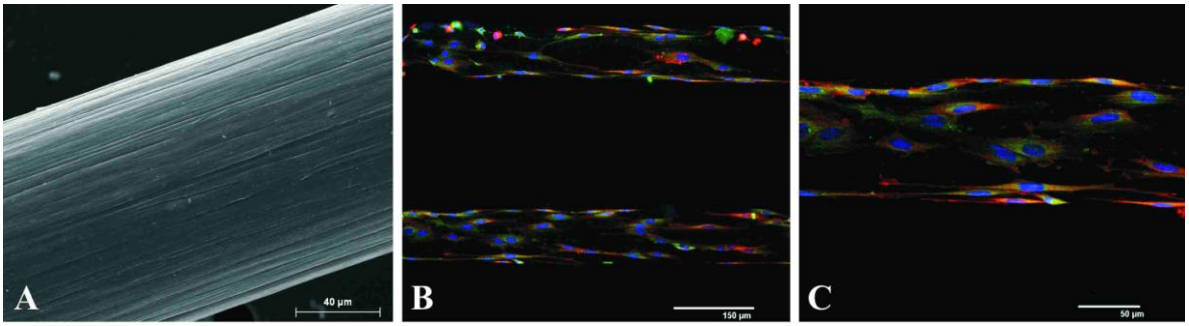
Trauma brain injury, stroke and several neurodegenerative processes entail the loss of neuronal populations and of tissue structures. The very limited regeneration ability of the central nervous system has represented an unsurmountable obstacle for the overcoming of the ensuing disabilities. In this context, the discovery of the pluripotency of various cell types has opened wider possibilities for new therapeutic strategies. Nonetheless, cells supplied to injured or degenerated sites, and even cells migrating to those sites from nearby proliferative regions have proved to be short-lived and have failed to achieve significant improvements. This may be due to an impossibility for these cells to rebuild or restore lost neuronal circuitry connections, and also to the loss of viability of those cells in an aggressive microglial environment at the lesion site. It is in this situation where synthetic biomaterial structures may be of help, in that they may *(i)* host and supply in a neuroprotective environment cell populations for transplant; *(ii)* deliver neurotrophic factors; *(iii)* sustain and stimulate neural progenenitor cell differentiation and axonal growth; *(iv)* provide targeted guidance to axon outgrowth. Success of these synthetic structures has as a prerequisite their biocompatibilty, their integration in the host tissue without eliciting a glial scar that would invalidate their functions, and, possibly, their ability to be vascularized in order to maintain the viability of the biohybrid construct. These demands condition the choices of chemistries and the development of inner architectures and morphologies of the synthetic materials. Our group has been working in the identification of brain-compatible biomaterials and has developed different types of structures suited for implantation in the cortex and in the nigrostriatal tract [1]. The presentation discusses some of the results obtained *in vitro* and *in vivo* in rat model, with special reference to cell differentiation and migration, glial scar formation and angiogenesis.

References

[1] Martínez-Ramos et al. *Tissue Engineering A* 14 (2008) 1365; Soria J M et al. *J Biomed Mater Res Part A* 97 A (2011) 85; Martínez-Ramos et al. (2011, *to appear*)

Figures



Textured PCL microfilament (A) and olfactory ensheathing glial cells grown on them (B and C).