Abstract Information

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Participation :	symposium
Title of the Symposium :	Emerging regenerative medicine for CNS repair
Category :	Academic/Researcher
Thematic Area :	Neurodegeneration, Neuroplasticity, and Repair
Title :	Regenerative implants in Stroke and TBI

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Abstract :

Background: The limited capacity of brain tissue to regenerate after acute injury, hampered by cell death, edema and inflammation, has led to an interest in promising and innovative approaches such as implantable regenerative scaffolds designed to improve brain plasticity. Either guiding or non-guiding, degradable or non-degradable, fabricated by molding or 3D printing, these scaffolds can be tailored to match the intricate architecture of the brain. Methods: we performed in vivo biocompatibility assessments after a brain lesion on distinct biomaterials, a non-degradable one, silicone (PDMS) and bioeliminable or bioresorbable materials: Poly(ethylene glycol) diacrylate (PEGDA), Polycaprolactone (PCL) and a PEGDA mixed with gelatin methacrylate (PEGDA-GelMA). These implants were inserted in a brain lesion, one week after the insult. Results: We made twice the proof of concept the guiding PDMS implants seeded with neural cells improved grip force in rats (1,2). They improved formation of neotissue within the lesion and neovascularization (3,4). Security of this therapeutic strategy was proven: no tumor, no fibrosis, no inflammation, and a reduced glial reaction was observed. With 3D printing, a scaffold with a complex shape was printed with patterns, spatial resolution and porosity adapted to cerebral cortex reconstruction (5). In vivo evaluations were complemented by behavioral monitoring, affirming the safety of these degradable materials. High-resolution T2 MRI imaging effectively captured scaffold structures and demonstrated their non-invasive utility in monitoring degradability. ASL MRI imaging quantified cerebral blood flow and was positively and significantly correlated with lectin immunofluorescent labeling. It may be used to non-invasively monitor progressive

revascularization of implants. PEGDA produced an intense foreign-body response, PCL provoked a controlled inflammatory reaction and facilitated cell migration into the scaffold, although it induced a fibrotic response. Conversely, the PEGDA-GelMA composite emerged as a promising candidate for intracerebral implantation. Conclusion: Behavior, MRI monitoring and histology allowed a thorough following of biomaterial biocompatibility. The collective findings position PDMS and PEGDA-GelMA as convincing biomaterial options as a basis for treating severe brain lesions. 1. Vaysse. Biomaterials 2015; doi: 10.1016/j.biomaterials.2015.04.019. 2. Davoust, StemCellRes&Ther 2017. DOI 10.1186/s13287-017-0702-3. 3. Le Friec, NeuralPlasticity 2017. DOI 10.1155/2017/2545736 4. Accardo; BrainResearchBulletin. 2019. DOI 10.1016/j.brainresbull.2019.07.020 5. Clauzel, RegenerativeTherapy 2024 doi:10.1016/j.reth.2024.10.004