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Neurodegeneration research: From molecules and big animal models to human beings

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Appropriate connections or interactions among different neural cell types are essential for the correct and efficient functioning of the nervous system during development and regeneration after trauma or degeneration. The aim of my research is to understand the molecular events that mediate communication among neural cells in the nervous system during development, myelination, learning and memory, degeneration and regeneration. These studies have yielded insights into the therapeutic potential of cell signalling molecules to ameliorate or even ablate the detrimental consequences of nervous system injury and neurodegenerative diseases including stroke, traumatic brain injury, spinal cord injury, Alzheimer Disease (AD) and Multiple Sclerosis (MS). Using genome-wide chromatin immunoprecipitation approaches, we found that AICD is specifically recruited to the regulatory regions of several microRNA genes and acts as a transcriptional regulator for miR-663 by which suppresses neuronal differentiation in human neural stem cells. We have generated transgenic pigs expressing mutant G93A hSOD1 and showing hind limb motor defects which are germline transmissible and motor neuron degeneration in dose- andage-dependent manners. Furthermore, in a case report we present the treatment of aggressive MS patient with multiple allogenic human umbilical cord-derived mesenchymal stemcell and autologous bone marrow-derived mesenchymal stem cells over a 4 years period. The treatments were tolerated well with no significant adverse events. Clinical and radiological disease appeared to be suppressed following the treatmentsand support the expansion of mesenchymal stem cell transplantation into clinical trials as a potential novel therapy forpatients with aggressive MS.

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Stem cells and 3D bio-printing in regenerative medicine

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3D bio-printing is the process of generating spatially-controlled cell patterns using 3D printing technologies where cell function and viability are preserved within the printed construct. Using 3D bio-printing for fabricating biological constructs typically involves dispensing cells onto a biocompatible scaffold using a successive layer-by-layer approach to generate tissue-like three-dimensional structures. Given that every tissue in the body is naturally compartmentalized of different cell types, many technologies for printing these cells vary in their ability to ensure stability and viability of the cells during the manufacturing process. The use of stem cells for 3D bio-printing will break many obstacles for next step development of the technology. The combination of stem cells and 3D bio-printing will bring regenerative medicine to a new horizon. The new breakthrough in the technique and its feasibility for clinical applications and novel models of commercialization will be presented with successful sampler business entities.

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