Progenitor cell

A progenitor cell is a biological cell that, like a stem cell, has a tendency to differentiate into a specific type of cell, but is already more specific than a stem cell and is pushed to differentiate into its "target" cell. The most important difference between stem cells and progenitor cells is that stem cells can replicate indefinitely, whereas progenitor cells can divide only a limited number of times. Controversy about the exact definition remains and the concept is still evolving.

The terms "progenitor cell" and "stem cell" are sometimes equated.

Neural stem/progenitor cells (NSPCs) have the potential to serve as the basic materials for treating severe neural diseases and injuries. Ultrasound exposure is an effective therapy for nonunion fractures and healing fresh wounds through an easy and noninvasive application. According to the results of a preliminary study, low-intensity ultrasound (LIUS) promotes the attachment and differentiation of NSPCs. However, the parameters of and mechanisms by which LIUS induces NSPC differentiation remain unclear. To the best of Lee et al., knowledge, no published studies have reported and compared the biological effects of dual-frequency and single-frequency LIUS on NSPCs. The purpose of a study was to systematically compare several LIUS parameters, including single-frequency, single-transducer dual-frequency ultrasound, burst, and continuous cycling stimulation at several intensities. Furthermore, synergistic effects of single-/dual-frequency LIUS combined with neural growth factor addition on NSPCs were also evaluated. Based on the results of the cytotoxicity assay, low-intensity (40 kPa) ultrasound does not damage NSPCs compared with that observed in the control group. The morphology and immunostaining results show that all experimental groups exposed to ultrasound exhibit neurite outgrowth and NSPC differentiation. In particular, dual-frequency ultrasound promotes NSPCs differentiation to a greater extent than single-frequency ultrasound. In addition, more complicated and denser neural networks are observed in the dual-frequency group. Neural growth factor addition increased the percentage of neurons formed, particularly in the groups stimulated with ultrasound. Among these groups, the dual-frequency group exhibited significant differences in the percentage of differentiated neurons compared with the single-frequency group. This study may the first to prove that dual-frequency LIUS exposure further enhances NSPC differentiation and the utilization of growth factors than single-frequency LIUS. Moreover, the result also revealed that dual-frequency ultrasound generated higher calcium ion influx and extended the channel opening time. A potential explanation is that dual-frequency ultrasound generates more stable cavitation than single-frequency LIUS, which may stimulate cell membrane mechanochannels and enhance calcium ion influx but does not damage them. This in vitro study may serve as a useful alternative for ultrasound therapy [1)].

Allogeneic Disc Progenitor Cell

Progenitor cells derived from intervertebral disc tissue demonstrated immunomodulatory and regenerative properties in preclinical studies.

Gornet et al. report the safety and efficacy results of a US Food and Drug Administration-approved clinical trial of these cells for the treatment of symptomatic degenerative disc disease.

Methods: Sixty patients with symptomatic single-level lumbar degenerative disc disease (mean age

37.9 years, 60% men) were enrolled in a randomized, double-blinded, placebo-controlled Phase I/Phase II study at 13 clinical sites. They were randomized to receive single intradiscal injections of either low-dose cells (N = 20), high-dose cells (N = 20), vehicle alone (N = 10), or placebo (N = 10). The primary endpoint was mean visual analog scale (VAS) pain improvement >30% at 52 weeks. Disc volume was radiologically assessed. Adverse events (AEs), regardless of whether they were related to treatment, were reported. Patients were assessed at baseline and at 4, 12, 26, 52, 78, and 104 weeks posttreatment.

Results: At week 52, the high-dose group had a mean VAS percentage decrease from baseline (-62.8%, P = 0.0005), achieving the endpoint of back pain improvement >30%; the mean change was also significantly greater than the minimal clinically important difference of a 20-point decrease (-42.8, P = 0.001). This clinical improvement was maintained at week 104. The vehicle group had a smaller significant decrease in VAS (-52.8%, P = 0.044), while the low-dose and placebo groups showed nonsignificant improvements. Only the high-dose group had a significant change in disc volume, with mean increases of 249.0 mm3 (P = 0.028) at 52 weeks and 402.1 mm3 (P = 0.028) at 104 weeks. A minority of patients (18.3%) reported AEs that were severe. Overall, 6.7% of patients experienced serious AEs, all in the vehicle (n = 1) or placebo (n = 3) groups, none treatment related.

Conclusions: High-dose allogeneic disc progenitor cells produced statistically significant, clinically meaningful improvements in back pain and disc volume at 1 year following a single intradiscal injection and were safe and well tolerated. These improvements were maintained at 2 years post-injection.

Clinical trial registration: NCT03347708-Study to Evaluate the Safety and Preliminary Efficacy of Injectable Disc Cell Therapy, a Treatment for Symptomatic Lumbar Intervertebral Disc Degeneration [2)]

Endothelial progenitor cell

Endothelial progenitor cell.

Oligodendrocyte progenitor cell

see Oligodendrocyte progenitor cell.

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Lee IC, Wu HJ, Liu HL. Dual-Frequency Ultrasound Induces Neural Stem/Progenitor Cell Differentiation and Growth Factor Utilization by Enhancing Stable Cavitation. ACS Chem Neurosci. 2019 Jan 4. doi: 10.1021/acschemneuro.8b00483. [Epub ahead of print] PubMed PMID: 30608667.
2)
Gornet MF, Beall DP, Davis TT, Coric D, LaBagnara M, Krull A, DePalma MJ, Hsieh PC, Mallempati S, Schranck FW, Kelly C, Foley KT. Allogeneic Disc Progenitor Cells Safely Increase Disc Volume and Improve Pain, Disability, and Quality of Life in Patients With Lumbar Disc Degeneration-Results of an FDA-Approved Biologic Therapy Randomized Clinical Trial. Int J Spine Surg. 2024 Jun 26:8609. doi: 10.14444/8609. Epub ahead of print. PMID: 38925869.