tissues or the bone marrow, expanded and transduced with lentiviral vectors encoding the human or species specific NIS genes. NIS function in transduced MSC was first validated in vitro; NIS expressing MSC (MSC_NIS) from multiple species concentrated high levels of I-125 with no side effects. The sensitivity of cell detection was determined by transplanting a known number of MSC_NIS subcutaneously into mice. We can reliably detect 2x105 MSC_NIS in mice using the newly acquired U-SPECT II machine. Canine MSC derived from the bone marrow were surprisingly robust; viable cells were still detected (albeit lower numbers) at day 28 in the athymic mice. In contrast, NIS signals from adipose tissue derived rat or human MSC disappeared by day 7 post transplantation. Using PET imaging and F18-TFB, sensitivity of imaging could be significantly improved to detect lower numbers of cells. We are currently evaluating the use of NIS for tracking natural killer cells and transplanted hemapoietic stem cells and results will be presented.

5

INDIVIDUALIZED DECELLULARIZATION FOR TISSUE ENGINEERING TISSUES AND ORGANS IN ANIMALS AND HUMANS

S. Sjöqvist, G. Lemon, M. Lim, R. Amin, P. Macchiarini
ACTREM, CLINTEC, Department of ENT, Karolinska Institutet, Stockholm, Sweden

Tissue engineering is an emerging field which offers promising therapeutic options for many patients with incurable diseases. One method of producing a scaffold for TE is decellularization, which aims to remove immunogenic elements from a donor organ without compromising its inherent structural and biomechanical properties. Presently, optimizing a suitable decellularization protocol for a particular organ is a time-consuming, trial-and-error based task. The resulting protocol is then used for all organs of the same type, without considerations of donor differences. To this end, we have developed a system based on mathematical modeling, which tailors the decellularization to each individual organ. The system uses real-time image analyses to predict complete decellularization while also changing reagents automatically in order to eliminate operator-variability. We verified the system using organs from rat esophagus and small intestine. The produced biological scaffolds' architecture was evaluated by histology and electron microscopy, retained ECM-protein composition by immunohistochemistry and residual DNA content by nucleic acid staining and quantification. Biomechanical evaluations of native and decellularized tissue were performed to study the impact on mechanical strength. Prematurely stopping the decellularization resulted in inadequate removal of cell nuclei. We further validated the prediction model using human esophageal samples. In conclusion, by tailoring the decellularization to each individual organ our novel method improve the quality of produced scaffolds. The method is likely to be of greatest importance for human samples, where donor differences are considerable.

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BM-MSC ACCELERATES ACUTE STROKE RECOVERY IN A RANDOMIZED PLACEBO-CONTROLLED CLINICAL PHASE II/III STUDY

N. Mohamed Ibrahim[1], H. Tan[1], S. Chin[2], Z. Law[1], N. Ismail[3], N. Amran@Azman[2], S. Cheong[2,4], S. S. Abdul Wahid[1,3]
[1]Department of Medicine, Faculty of Medicine, Universiti Kebangsaan Malaysia Medical Centre, Kuala Lumpur, Malaysia, [2]Cytopeutics, Selangor, Malaysia, [3]Cell Therapy Centre, Faculty of Medicine, Universiti Kebangsaan Malaysia Medical Centre, Kuala Lumpur, Malaysia, [4]Tunku Abdul Rahman University, Selangor, Malaysia

Background: We previously demonstrated that mesenchymal stromal cell (MSC) may be transdifferentiated into neuron-like cells. MSC may also help attenuate cerebral oedema and hasten recovery following acute stroke. Furthermore, the blood-brain barrier is semipermeable in the acute stroke period which allows MSC to be administered intravenously.
Methodology: Seventeen patients with acute middle cerebral artery stroke were recruited and randomized to receive best medical care plus autologous bone marrow-derived MSC (Group A-MSC; n = 9) or best medical care alone (Group B- Placebo; n = 8). There were no significant differences in age or comorbidities. Group A patients received 100–200x10^6 MSC intravenously at 1 month after acute stroke. The internationally-validated scales of Barthel index (BI), National Institutes of Health Stroke Scale (NIHSS) and Modified Rankin Score (mRS) were used to record the disability and functional progress at baseline (stroke onset), 6 weeks, 3 months, 6 months and 12 months follow up.
Results: All patients were severely disabled following acute stroke (Baseline [Mean ± 1SD] for mRS [4 ± 1]; BI [14 ± 17] and NIHSS [17 ± 6], no difference between both arms. One patient died in each group due to sudden death (Group A) and septicaemia secondary to pressure sores (Group B). Both groups showed improvement in NIHSS, BI and mRS over time but the improvement was only significant in Group A. Intergroup comparison revealed that mean BI was higher for Group A at 6-weeks follow-up when compared to Group B (70 ± 31 vs 26 ± 38, P = 0.041). There were continuing improvement in BI in Group A at 6 and 12 months compared with Group B but not significant [6 months (85 ± 11 vs. 55 ± 46, P = NS) and 12 months (91 ± 8 vs. 67 ± 58, P = NS)].
Conclusions: MSC administered intravenously in the sub-acute period following severe stroke is safe and efficacious, and results in accelerated recovery in the initial period. More studies are warranted.

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A PHASE 1 PERSPECTIVE: MULTIVIRUS-SPECIFIC T CELLS FROM BOTH CORD BLOOD AND BONE MARROW TRANSPLANT DONORS

P. Hanley[1], M. D. Keller[1], M. Martin Manso[1], C. Martinez[2], K. Leung[2], C. Cruz[1], C. Barese[1], S. McCormack[1], M. Luo[1], R. A. Krance[2], D. Jacobsohn[1], C. Rooney[2], H. Heslop[2], E. Shpall[3], C. Bollard[1]
[1]Cell Enhancement and Technologies for Immunotherapy, Division of BMT, Children's National Medical Center, Washington, District of Columbia, United States, [2]CAGT, Texas Children's Hospital, Houston Methodist Hospital, Baylor College of Medicine, Houston, Texas, United States, [3]MD Anderson Cancer Center, Houston, Texas, United States

CMV, EBV and adenovirus are problematic in patients after stem cell (SCT) and cord blood transplantation (CBT) and are associated with morbidity and mortality. Deficiencies in conventional therapeutics have increased interest in an immunotherapeutic approach to viral disorders. We have developed 2 strategies to grow multivirus-specific donor-derived T-cells (mCTL), one from peripheral blood (PB) of adult CMV-seropositive donors and another from naive cord blood (CB). Using an adenoviral-vector expressing CMVpp65 or overlapping viral peptides for CMV (pp65 and IE-1), EBV (EBNA1 and LMP2), and Adenovirus (Hexon and Penton) presented to T cells by dendritic cells, monocytes, or EBV-LCL, we generated a single culture of mCTL. PB mCTL (Mean SFC:adeno:666, EBV:129, CMV:535) had more spot forming cells (SFC per 100,000 cells) (Mean, adeno: 666, EBV: 129, CMV: 535) than CB mCTL (adeno:117, EBV:95, CMV:67) by IFN-gamma ELISPOT assay but both contained cells specific for at least 1 virus. mCTL derived from both CB and PB contained a mixture of CD4+ and CD8+ T cells with an effector and central memory phenotype. Based on deep T cell receptor sequencing, CB mCTL were more polyclonal than PB-derived mCTL.

Thirteen patients were infused with PB mCTL and 12 patients with CB mCTL. Patients received CTL infusions from 35–384 days post transplant at a range of 5x10^6–2x10^7 cells/m^2 with no toxicity or GvHD >grade II. We observed up to a 160-fold increase in virus-specific T-cells by 4 weeks post-CTL as measured by IFN-g ELISPOT assay. In 25 patients enrolled on these two studies, 16 patients experienced CMV, EBV, or adenovirus viral infections/reactivations before or immediately after mCTL infusion. Nine patients remained free of infection/reactivation. Eight of the patients had a complete response post-mCTL and 5 had a partial response, most coinciding with an increase in virus-specific T cells. Three patients did not respond to therapy. The overall the response rate in both groups was 81%. This study demonstrates that mCTL derived from the PB of seropositive donors as well as the CB of virus naive donors expand in vivo and are active against multiple viruses. Furthermore, by restoring immunity to multiple viruses simultaneously, the need for continued prophylaxis with pharmacotherapy is eliminated, thus, improving the efficiency and cost effectiveness of protecting SCT and CBT recipients from these potentially lethal viruses.

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A BISPECIFIC CHIMERIC ANTIGEN RECEPTOR MOLECULE ENHANCES THE ANTI-GLIOBLASTOMA EFFICACY OF T CELLS THROUGH DUAL IMMUNOLOGICAL SYNAPSE FORMATION

M. Hegde[1], M. Mukherjee[2], Z. Grada[1], A. Pignata[1], D. Landi[1], A. Wakefield[1], K. Fousek[1], K. Bielamowicz[1], S. Navai[1], K. K. Chow[1], V. S. Brawley[1], T. T. Byrd[1], S. S. Krebs[1], S. Gottschalk[1], W. S. Wels[3], M. Baker[4], J. Orange[2], N. Ahmed[1]