BONE MARROW CONCENTRATE – OPTIMAL FOR BONE REPAIR!

M. Jäger, M. Herten, E. Jelinek, U. Fochtmann, J. Fischer, R. Krauspe

Research Laboratory for Regenerative Medicine and Biomaterials, Department of Orthopaedics, Duesseldorf, Germany

INTRODUCTION: Mesenchymal stem cells (MSC) provide a valuable cell source for regenerative therapies with their potential clinical application in cartilage and bone regeneration. Although autologous bone grafting is still the "gold standard" to heal critical size bony defects, it is associated with significant donor site morbidity. We present clinical and experimental data of autologous bone marrow aspiration concentrate (BMAC) in patients with local bone defects [1].

METHODS: Bone defects in 48 patients were treated with autologous BMAC (SmartPrep2™ Harvest Technologies) and cancellous bone graft (50% BMAC & 50% bone graft,). Prior to transplantation BMAC was incubated on bovine hydroxyapatite (HA) carrier (Orthoss® Geistlich) or a collagen membrane (Gelaspon® Chauvin Ankerpharm). Bone regeneration was determined clinically & roentgenologically. The number of BMA and BMAC mononuclear cells was controlled by cell counter. MSC character was controlled by flow cytometry for a positive staining of CD44, CD73, CD90, CD105 and a negative one for CD45 and CD34 [2]. Colony forming units (CFU-F), cellular adherence and proliferation on both scaffolds was analyzed (LDH-assay, HE staining). To evaluate osteogenic potential BMAC were cultivated for 28 d either with or without osteogenic mixture (DAG) [1].

RESULTS: All of the 48 patients showed new bone formation/healing during follow up. There was no servere perioperative complication. However, one patient showed persisting hematoma, and three other individuals had prolonged wound secretions (three required revision surgery). The average concentration factor for BMAC was 5.6 (SD: 0.8). In vitro CFU appeared earlier and were larger suggesting a higher regenerative potential in BMAC. It was shown that BMAcells adhered on the scaffold, proliferated and displayed osteogenic differentiation with and without DAG supplementation.

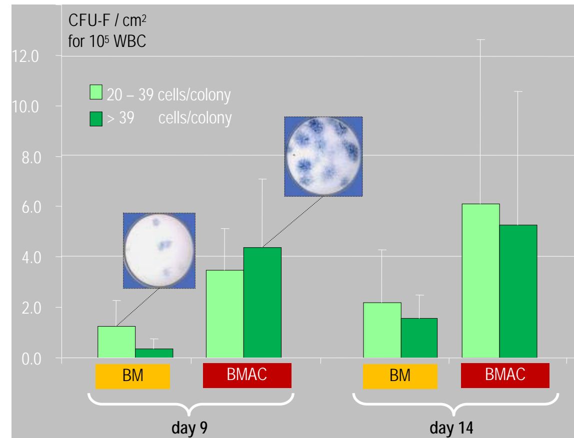

Fig. 1: The graph shows the number of CFU-F per cm^2 in 1x10^5 WBCs from BMA or BMAC. The proliferation capacity of BMAC-derived CFU-F is superior compared to BMA. Hemalaun staining show typical CFU-F of bone marrow cells on culture plates.

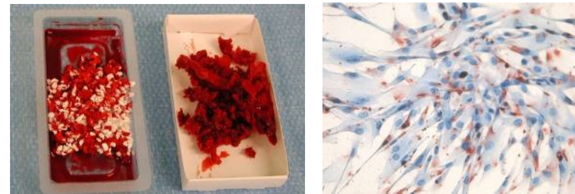

Fig. 2: BMAC cultivated with HA prior to transplantation. Immunocytochemical staining (red) for osteocalcin combined with Hemalaun staining for the cell nucleus (blue) indicate an osteoblastic in vitro-differentiation.

DISCUSSION & CONCLUSIONS: Our interim data showed that application of BMAC is easy to handle, a safe procedure and successful in treatment of local bone defects. However, additional supplements (growth factors) might be able to improve the clinical outcome of BMAC.

REFERENCES: [1] Jaeger et al. Curr. Stem Cell Res Ther 2009 4(1):34-43. [2] Dominici et al (2006) Cytotherapy 2006 8(4):315-7.

ACKNOWLEDGEMENTS: We would like to thank Ms Sabine Lensing-Höhn for her excellent technical support and Geistlich for the provision of the scaffolds.