

Extracorporeal Shock Waves Induce Production of Bone Growth Factors in Osteoblasts

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The molecular events following shock wave treatment of bone are to a large extent unknown. Nevertheless patients with osteonecrosis and non unions are already treated partly successfully with extracorporeal shock waves. In our study we isolated osteoblasts from bone pieces of patients undergoing knee or hip replacement surgery, subjected the cultured cells to shock waves and investigated the supernatants for bFGF, TGFbeta1 and VEGF.

After collagenase treatment cells were cultivated and characterised using FACS analysis. 95% of the cells were CD 44+ and CD 34-, CD14-, CD3- and CD 4-. After conditioning with an osteogenic medium containing Dexamethasone, Ascorbate and Beta-Glycerolphosphate cells showed a homogenous mineralisation-pattern in the v. Kossa staining.

These cells were subjected to 250 or 500 shock waves at 25 kv using an experimental electrohydraulic lithotripter (Dornier XL 1). After shock wave treatment cell viability was determined and cells were seeded at 100000 cells in 12 well plates. After 24, 48 and 72 h the cell number was determined and the supernatant was frozen. The levels of the bone and vascular growth factors bFGF, TGFbeta1 and VEGF were examined using ELISA. A control group was treated in the same way without receiving shock waves.

After 24 h there was a significant increase in bFGF levels ($P < 0.05$) with significant correlation ($P < 0.05$) to the number of impulses. TGFbeta1 showed an time dependent increase with a peak at 48 h which was not significantly different from the control group. VEGF showed also a tendency to be shock wave induced but with no significance.

For the first time it was shown that bFGF as an important growth factor in new bone formation is produced by human osteoblasts treated with shock waves.

This may be one piece in the cascade of new bone formation following shock wave treatment and may lead to a more specific application of shock waves in orthopaedic surgery.