#2886 - Posters

Reversibility Of MoM Wear Products Related Decrease In The Osteogenic Capacity Of Mesenchymal Stromal Cells In Vitro

General Topics / Implants, Biomaterials & Registry Study

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Background
Metal-on-metal (MoM) couplings have raised public and regulatory concern about their safety and use. Recently, it was reported that bone marrow chromium (Cr) and cobalt (Co) concentrations were elevated as a result of MoM wear. Consequently, bone marrow residing mesenchymal stromal cells (MSCs) were impaired in their osteogenic capacity after exposure to MoM wear products, thus promoting periprosthetic osteolysis and aseptic loosening. We were able to confirm these findings by treating MSCs of non-exposed patients with Cr(III) and Co(II) in vitro. We found a substantial decrease in MSCs' cellular alkaline phosphatase (ALP) activity following Co(II) exposure.

Objectives
We hypothesized that this decline of cellular ALP activity could potentially be reversible if further exposure to MoM wear products was thoroughly avoided.

Study Design & Methods
The study was approved by the local ethical committee (EA1/194/13); all donors gave written informed consent. MSCs were isolated from bone marrow of patients undergoing primary THA. In brief, 4.8 x 103 cells from passage two were seeded on 24-well tissue culture plates and exposed to 10 mg/L Cr(III), Co(II) or Cr(III) plus Co(II) respectively. In vitro exposure was sustained by media change at day four of cell culture. At day seven the cells were split and exposure was suspended in the course of the following cell culture passages. Cellular ALP activity was determined at day seven of every passage, normalized to cell number and referred to the corresponding untreated control.

Results
The exposure to clinically relevant amounts of Cr(III) did not lead to decreased MSCs' ALP activity during the exposure period and after suspending Cr(III) exposure (Fig.1). In contrast, after exposure to clinically relevant amounts of Co(II) and after combined Co(II) and Cr(III) exposure, we found ALP activity to be significantly diminished. This decline of ALP activity was already observed after an exposure duration of 24 hours and was found to be persistent over a period of 28 days after initial exposure (Fig.1). Beyond 35 days after initial exposure we did no longer observe a significant decrease of the MSCs' ALP activity.

Conclusions

The precursors of bone forming osteoblasts, the MSCs, are decreased in their ALP activity by exposure to Co(II) in clinically relevant concentrations. This effect might contribute to the pathomechanism of periprosthetic osteolysis, which ranks among the most common causes of failure of MoM hip endoprostheses and of subsequent revision arthroplasty. Our in vitro data indicate that the impairment of the ALP's activity is reversible if further exposure to MoM wear products is avoided thoroughly. Thus, a careful debridement eliminating all potential depots of MoM wear may potentially enhance bone quality and consequently improve outcome of revision surgery following MoM implant failure.