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Silver concentrations following extremity reconstruction using silver-coated MUTARS megaprostheses

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Introduction: Silver-coated megaprostheses have been shown to reduce the infection rate following extremity reconstruction after tumour resection or in case of revision arthroplasty. Nevertheless, there is less information about systemic silver exposure and possible side effects. The aim of the study was to report the blood silver concentrations during a follow-up up to ten years.
Materials and Methods: Between 2004 and 2014, 31 patients (17 female and 14 male) received MUTARS megaprostheses with galvanised silver coatings (Implantcast, Buxtehude, Germany). The mean age at operation was 48 years (range, 10-81). Ten patients received the prosthesis after resection of a malignant soft-tissue or bone tumour. Twenty-one silver-coated implants were used for revision surgeries as prophylaxis against recurrent infection or in case of poor soft tissue coverage. The mean postoperative follow-up ranged from one to 130 months (mean, 48). There were 12 proximal, six distal, five total and one intercalary femoral reconstructions. Furthermore, five proximal tibias and one proximal humerus were replaced. In one case a sliver-coated arthrodesis nail for the knee was used. Blood for silver concentration determination was taken from every patient within the first days following surgery as well as at every six months at outpatient treatment. The concentration of silver was determined using inductively coupled plasma mass spectrometry (ICP-MS, Agilent 7500ce; Agilent, Waldbronn, Germany) after microwave-assisted digestion with nitric acid in a microwave-heated autoclave (MLS ultraClave III; MLS-Mikrowellenlaborsysteme, Leutkirch, Germany).
Results: During the follow-up three patients died of disease, four died due to an unrelated cause and one patient was lost to follow-up. Overall, 23 patients were available for determination of blood silver concentrations; most of them appeared routinely to the outpatient care, whereas some appeared every once in a while. Nevertheless, within the follow-up we could observe a slight increment of systemic silver concentrations with a decrease after a peak at 30 months. Thereafter, we found an undulation course of blood concentrations with two further peaks which might be caused by several cases of re-infections and massive release of silver ions from prostheses' surface (Table 1 & Figure 1). In this series, we had four cases of local agyria without any correlation between local and systemic silver concentrations and implant size as well as differences in silver concentrations between affected and non-affected patients, which has been shown by Glehr et al. in 2013.
Discussion: There are several studies in the literature reporting outcome and implant survival of silver-coated megaprostheses but less is known about systemic silver exposure and long term effects. In the current series we observed an undulating course of silver concentrations in the blood of our patients which might be caused by several cases or re-infections or other implant-associated complications leading to an increased release of silver ions from the prosthesis' surface. We could not identify any systemic complications like polyneuropathia or other toxic reactions, except of local agyria. Therefore, we can state that silver-coated implants seem to be a save solution in case of megaprosthetic reconstruction following tumour resection, in case of revision surgery as prophylaxis against re-infection or in case of poor soft tissue coverage. Nonetheless, we recommend monitoring of silver concentrations in the blood.