

**Abstract Number:** 11263

**Title:** Systemic Silver Ion Levels And Clinical Results In Silver-Coated Megaprotheses

Giovanni Beltrami<sup>1</sup>, Daniel A. Müller<sup>2</sup>, Guido Scocciati<sup>1</sup>, Rodolfo Capanna<sup>1</sup>

<sup>1</sup>Orthopaedic Oncology Unit, Careggi University Hospital, Florence, Italy

<sup>2</sup>Department of Orthopaedics, Balgrist University Hospital, Zurich, Switzerland

Giovanni Beltrami: giovannibeltrami@virgilio.it  
Daniel A. Müller: daniel.a.mueller@me.com  
Guido Scocciati: guido.scocciati@alice.it  
Rodolfo Capanna: rodolfo.capanna@gmail.com

## BACKGROUND

High infection rates are still an unsolved problem in reconstructions after bone tumor resections using megaprotheses. Several changes in the perioperative management, such as operating theatres improvement, antibiotic loaded cement, aggressive antibiotic prophylaxis, as well as shortening of the operation time and reduction of blood loss have lowered the infection rate in recent years to some extent. Ideally, the implant itself would have properties to avoid bacterial growth on the surface. For this purpose, silver coating of orthopaedic implants was introduced to reduce infection rate due to local antibacterial effect of the silver. Considering the high risk of infection in orthopaedic oncological reconstructions, this innovation could be particularly interesting for megaprotheses, but only few data is available in the literature.

## QUESTIONS/PURPOSES

Does a silver coated prosthesis help to prevent an infection in high risk patients? What is the infection recurrence rate using a silver coated prosthesis in the setting of an infection associated implant revision? How does release of silver ions in blood and urine change over time? Are there systemic side effects due to free silver ions?

## PATIENTS AND METHODS

A consecutive case series of 37 patients, who underwent a revision surgery using a megaprosthesis with peripheral silver-added layer of titanium alloy between 2010 and 2014, was retrospectively reviewed. A detailed cross-section of the titanium silver alloy is shown in figure 1. A proximal femur replacement was performed in 15 patients (41%), a distal femur replacement in 14 patients (38%), a knee arthrodesis in 6 patients (16%) and a total femur in 2 patients (.5%). The initial surgery had been performed for oncological diseases in 16 patients (43%) and for failed joint replacements or trauma surgeries in 21 patients (57%). All patients had either a previous infection (23 patients; 62%) or a high risk for infection (14 patients; 38%). We considered patients with immunodeficiency, previous radiation, lymphedema, multiple previous surgeries or vascular insufficiency as high risk for an implant associated infection. The 23 infection cases occurred after a failed total hip or knee arthroplasty in 16 patients and after an osteosynthesis in 7 patients. All the patients received an antibiotic treatment and the infected implants were removed and replaced by a silver coated megaprosthesis. The implant change was done in 16 cases in a two-stage procedure and in 7 cases a one-stage procedure was sufficient.

## RESULTS

After a mean follow up of 22 months (Range: 3-56) two implant failures occurred (5.4%). An aseptic loosening of the stem was observed 24 months after the implantation of the silver coated prosthesis. The second failure was due to a local tumor recurrence after resection of an osteosarcoma of the distal femur. An above knee amputation was the only left surgical option. One recurrence of infection (2.7%) was detected after 24 months. A surgical debridement without removing the implant was sufficient for complete eradication of infection. Furthermore, two patients (5.4%) are under close clinical observation as they developed a secreting wound, but without bacterial growing in the samples.. Among the 14 high risk patients (38%) without history of infection no complications were observed.

None of the patients showed clinical signs of argyria or systemic side effects related to systemic silver release. The silver level in the blood was 0,1 to 7,5  $\mu\text{g/L}$  in the first year after surgery, 0.02 to 5  $\mu\text{g/L}$  in the second year and 0.1 to 0.7  $\mu\text{g/L}$  in the third year. In urine levels of 0.24 to 9  $\mu\text{g/L}$ , 0.8 to 20  $\mu\text{g/L}$  and 0.3 to 3.7  $\mu\text{g/L}$  were measured after the same time points. .

## CONCLUSIONS

In this presented series promising preliminary results of silver coating in megaprotheses were observed in terms of infection control in a high risk group of patients, mostly affected by previous infections. The circulating silver levels in blood and urine confirm persistence of silver coating activity still after three years and at the same time the safety. Though, the continuous release of silver in the blood system was very low and didn't cause any side effects. The results confirm the safety of silver coated megaprosthesis.

## FIGURES

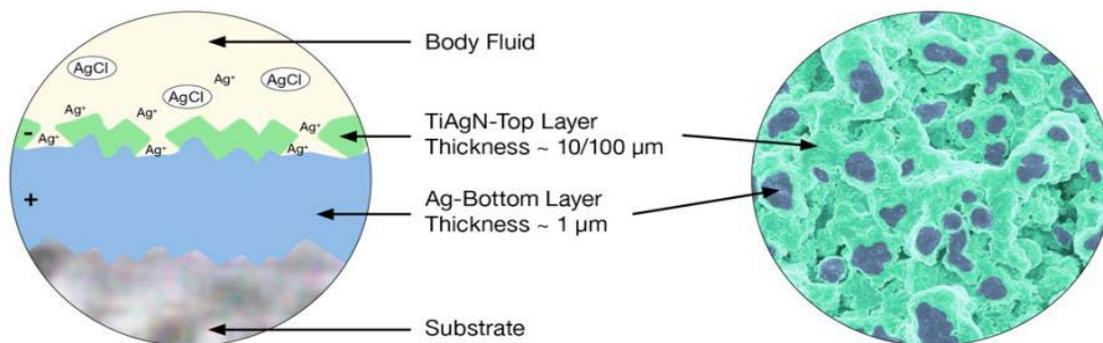


Figure 1: Cross section of the implant coating consisting of a silver titanium alloy.