



TISSUE REACTION TO ORTHOPAEDIC IMPLANTS, CASE PRESENTATION OF METAL ALLERGIE AFTER PERIPROSTHETIC OSTHEOSINTESIS

Nicolae Marian CIUREA^{1,2}, Mihail NAGEA², Carmen ARDELEAN^{1,3}, Razvan SCURTU², Alexandru Lisias DIMITRIU^{1,2}, Traian PATRASCU^{1,4} and Olivera LUPESCU^{1,2}

¹“Carol Davila” University of Medicine and Pharmacy, Bucharest, Romania

²Orthopedic and Traumatology Clinic, Emergency Clinical Hospital, Bucharest, Romania

³“Victor Babes” National Institute, Bucharest, Romania

⁴“Dr. Ioan Cantacuzino” Clinical Hospital, Bucharest, Romania

Corresponding author: Nicolae Marian CIUREA, E-mail dr.ciureanicolae@gmail.com

Accepted November 19, 2015

Tissular reaction to orthopedic implants has been thoroughly studied, since it can be responsible for invalidating pain, as well as for implant loosening, thus requiring implant removal (which, otherwise, has no specific indications). The reaction is enhanced by certain characteristics of the host, such as age, comorbidities, as well as co-existence of different implants. We present the case of a patient who sustained a periprosthetic fracture (following total knee prosthesis) for which osteosynthesis with titanium plate and screws was performed. Early after surgery pain and swelling appeared, without any sign of infection; synovial proliferation with stable prosthesis was revealed during arthroscopy, but, due to resistant symptoms, arthrotomy was indicated. Fracture had healed, thus allowing plate removal, but, due to loosening, the prosthesis had to be extracted, too, with ExFix stabilisation on cement spacer. Favourable outcome after both implants were extracted proved that the implants were responsible for the pain and swelling, thus justifying the chosen treatment, although this resulted in a fix joint. The microscopical examination confirmed the tissular reaction producing the symptoms. Since each of the implants are hardly responsible for such reactions, we must presume that their association, dictated by the periprosthetic fracture, was the one who induced the rejection symptoms. It is currently unclear whether implant failure modifies the tissues surrounding the implant or if there are microscopically quantifiable alterations of the tissue before the implant fails, but in this case, the reaction generated by the interaction of the two implants can be considered responsible not only for the pain, but for the loosening of the prosthesis, too.

Keywords: orthopaedic, implant, allergie, periprosthetic

INTRODUCTION

Implants used for fracture treatment, as well as prosthesis have been thoroughly tested so as to minimize the risk of rejection, but they still produce tissular reactions, with different intensities¹. If the reaction is minor, no clinical symptoms appear, radiological and clinical healing is obvious, and implant removal is the choice of the patient and of the surgeon. On the opposite, the interaction between the implant/prosthesis and the surrounding tissue can be brutal with persistent pain and swelling, having no other detectable cause (including infection), thus requiring implant removal; abnormal obvious tissue reaction can be detected, including the aspect of metalosis, and the postop outcome is usual rapidly improved, thus demonstrating the reaction to implant as the cause of the symptoms. In this type of situations, implant removal has absolute indications, because the longer the tissular inflammatory response persists, the more severe is the resulting damage, including the bone resorbtion. Other absolute indications for implant removal include infection, implant breakage

and avascular necrosis^{1,2}.

In the absence of such problems, no defined clinical protocols for implant removal have been described so far, and there is no worldwide consensus in this problem¹. Risks and benefits related to patient's age, pathology, anatomical site, and the implant type must be taken into consideration, but routinely implant removal is not accepted as a standard procedure and is performed only after the fracture is definitely healed². The benefits could be: protection for potential future trauma requiring surgery, decreasing the risk of osteopenia, bone weakening or refracture; protection of the growth plate in children, as well as preventing difficult extraction due to bone overgrowth; reducing risks of infection or even carcinogenesis³.

The risks of implant removal are: an iterative fracture, infection of the wound, difficulty in removing the implant, implant breakage, neurovascular injuries, persistent symptoms, postoperative hematoma and inaesthetic scars⁴. Even in situations of intolerance, it is recommended that removal must be postponed until fracture healing, so as to

decrease the risk of re-fracture. Although, there are particular situations when difficulties in assessing fracture healing and overwhelming pain and swelling make removal a mandatory manoeuvre³.

CASE REPORT

History A 71-year-old woman presented to the hospital with persistent knee pain, swelling and pruritus. She had a history of knee surgical procedures - knee arthroplasty for primary knee osteoarthritis 2 years ago. It is very important to underline that after the total knee replacement, the patient was totally pain-free and that she had fully recovered the knee function. One year after the knee replacement she was involved in a traffic accident as a passenger withstanding a periprosthetic distal femoral fracture, for which surgery was indicated, the chosen method being imposed by the presence of the prosthesis. The X rays and the examination during surgery showed the prosthesis' components were stable. The fracture was stabilized with leg screw and titanium reconstruction plate, considering the lower allergic potential of the titanium.



Figure1 Clinical aspect of the knee



Figure 2 Anterio-posterior X Ray at 1 year after the periprosthetic fracture, the fracture has healed



Figure 3 Lateral X Ray

After surgery, persistent pain and swelling considerably affected the patient's life (figure 1), who repeatedly compared this unhappy status to the post-prosthetic one, which allowed her a normal life. We underline this thing because we have to exclude the reaction to the prosthesis itself from the following events

At the 6-month check-up after the periprosthetic fracture treatment the patient presented with persistent pain and swollen knee. An exploratory arthroscopy was performed, with synovectomy. The microbiological examinations before, during the arthroscopy and afterwards through punctures were negative. The patient received also topical and systemic treatment with anti-inflammatory drugs, gabapentin, muscle relaxers and a topical steroid cream, with no significant improvement.

Clinical exam and Imaging at the 4 months check up after the arthroscopy the clinical examination revealed erythema of the lower limb, moderate swelling of the knee and thickened skin; the patient was anxious and affirmed that the symptoms would keep her awake during the night. She underwent neurological, vascular, dermatological and psychiatric examinations, with no pathological findings. The imaging, anterior-posterior (figure 2) and lateral (figure 3) X Rays revealed the tendency to healing of the fracture with no signs of osteolysis and the stability of all orthopedic implants, even on anterior-posterior X rays taken in forced varus and valgus.

Operative intervention Although there were no laboratory or imagistic findings, surgery was indicated as an ultimate treatment due to invalidating symptoms, thus an exploratory open procedure was performed, in order to evaluate the status of the fracture and of the prosthesis. There was bone ingrowth on the plate with no sign of abnormal tissue at this level (figure 4), the fracture had healed so the implant was removed. But, when examining the prosthesis, the femoral component had micro movements when mobilized with a pulley (figure 6).



Figure 4 Intraoperative aspect of the plate and of surrounding tissue

The tissues around the femoral component didn't show any sign of infection but abnormal tissue reaction was present, with a pale-dark tone of the surrounding tissues. Also, at the level of one of the femoral component's pins there was erosion of metal and bone which resembled black powder (figure 5). Due to these abnormal findings, prosthesis had to be extracted, with all the negative consequences, and the knee was stabilized using cement as a spacer and an external fixator (figure 7), although that meant a rigid joint. The abnormal tissue was removed and the histological analysis showed granulomatous foreign body reaction, metal and cement inside the cytoplasm of histiocytes, synovial hyperplasia, indicating micro movements with the appearance of a synovial-like tissue.



Figure 5 Aspect of the bone at the level of the femoral component pin



Figure 6 Assessment of mobility of the femoral component of the prosthesis intraoperatory

Postoperative course After surgery the pruritus disappears suddenly; the pain decreases progressively, with no pain at the two-week check-up, thus suggesting that tissular reaction to implants was responsible for the symptoms.



Figure 7 Postoperative X Ray showing the stabilization with a spacer made of cement and an External Fixator

DISCUSSIONS

It is currently unclear whether implant failure modifies the tissues surrounding the implant or if there are microscopically quantifiable alterations of the tissue before the implant fails. At the time of the periprosthetic fracture's fixation the prosthesis was stable. The traumatic event could have been a catalyser towards the wear of the cement surrounding the prosthesis. The micro movements might have caused cement and metal to erode and spread, irritating and producing this allergic symptomatology. Since there was no sign of intolerance after the arthroplasty, and titanium implants are well known for their very good local tolerability, we must presume none of the implants alone is responsible for the situation, but the interaction between the two of them⁵.

Metal in contact with biological fluids leads to corrosion. The ions released through this process may form complexes with proteins in the blood and stimulate hypersensitivity reactions in atopic individuals. This could lead to cutaneous signs of an allergic response: dermatitis, urticaria and vasculitis⁶.

Also the implantation of two different metals: stainless steel in the prosthesis and titanium in the plate and screws could have lead to a more aggressive corrosion thus release of ions which acted like antigens and created a local allergic inflammatory response, resulting in implant failure.

CONCLUSIONS

Although latest studies indicate that only when a patient has complications should an implant be removed, and there are not generally accepted guidelines, there are certain situations when only implant removal can amend the symptoms. Further research in the microscopic tissular modifications of tissues surrounding implants will highlight the cascade of events that lead to complications. When two different types of implant are used (as imposed by the injuries), the risk of abnormal tissular reaction increases.

Acknowledgement: This work was supported by the European Social Fund through Sectorial Operational Programme - Human Resources Development 2007-2013 , project number POSDRU/1871.5/S/155631, entitled "Doctoral programs at the forefront of research excellence in priority domains: health, materials, products and innovative processes", Beneficiary – "Carol Davila" University of Medicine and Pharmacy Bucharest.

REFERENCES

1. Minkowitz RB, Bhadsavle S, Walsh M, Egol KA. Removal of painful orthopaedic implants after fracture union. *J Bone Joint Surg Am.* 2007, 89 (9); 1906-1912
2. Shrestha R, Shrestha D, Dhoju D, Parajuli N, Bhandari B, Kayastha SR, Kathmandu Univ Med J, 2013, 42, 139-143
3. Mue D.D., Yongu W.T., Elachi I.C., Salihu M.N. Surgeons' Perceptions about Removal of Orthopaedic Implants in Nigeria. *IOSR-JDMS*, 2014, 9, 08-13
4. Ogundele O.J., Ifesanya A.O., Adesanya A.A, Alonge T.O. Removal of orthopaedic implants from patients at the University College Hospital, Ibadan. *Afr J Med Med Sci*, 2013, 42 (2), 151-155
5. Sansone V., Pagani D., Melato M. The effects on bone cells of metal ions released from orthopaedic implants. A review. *Clin Cases Miner Bone Metab*, 2013, 10 (1); 34-40
6. Hallab N., Merritt K, Jacob J.J. Metal Sensitivity in Patients with Orthopedic Implants *JBJS*, 2001, 83A (3), 428-436
7. Morelli C., Barbanti-Brodano G., Ciannilli A., Campioni K., Boriani S., Tognon M. Cell morphology, markers, spreading, and proliferation on orthopaedic biomaterials. An innovative cellular model for the "in vitro" study *Wiley Inter Science*, 2007, 1, 178-183