STRATEGIES AND INDICATIONS
WHEN TO USE SILVER

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DISCLOSURE

• IMPLANTCAST

SILVER IN TUMOUR PROSTHESIS?

ALWAYS!
Silver is safe!

Silicon-coated megaprostheses in a rabbit model—an analysis of the infection rate and toxicological side effects

Gregory Colleter, Jürgen Mader, Thomas Honegger, Marco Hummelen, Michael Ernst, Andreas Greiner, Thomas Gasser, Michael Woester, and Gregorio Edersee

Lack of toxicological side-effects in silver-coated megaprostheses in humans

Zoëch Bergler, Marco Hummelen, Thomas Gasser, Michael Ernst, Andreas Greiner, Christian Rodewald, Guile Scilla, and Gregorio Edersee

Reduction of Periprosthetic Infection With Silver-Coated Megaprostheses in Patients With Bone Sarcoma

• retrospective studies
  • 29 silver-coated Mutars proximal tibia EPR
  • 41 non-SC Mutars proximal tibia EPR (Titanium)

Infection rate: SC 6.9% Non SC 17.1%
The risks and benefits of radiotherapy with massive endoprosthetic replacement

Between 1986 and 2001, 1064 patients underwent revision of a bone tumour with endoprosthetic replacement. All patients who had radiotherapy were identified. Their clinical charts were reviewed from their records. 1043 patients (98.6%) had a disease recurrence, 73 pre-operatively and 16 post-operatively. The mean post-operative Musculoskeletal Tumour Society score of localised patients was significantly lower than that of those without radiotherapy (71.7 vs 79.1). The infection in the group who had not been irradiated was 12.2% compared to 28.9% in those who had pre-operative irradiation. The 2-year survival rate was 73% for patients without radiotherapy and 68% for those who had pre-operative radiotherapy. The rate of local recurrence at two years was 15% for patients without radiotherapy and 5% for those who had pre-operative radiotherapy and 10% for those who had post-operative radiotherapy. The infection rate was 8% for those who did not have radiotherapy and 7% for those who did. Radiotherapy increased the risk of infection (log-rank test, p = 0.03). A total of 10 complications were necessary to control infection, all of which were successful.

Radiotherapy may be necessary for the treatment of a bone sarcoma but increases the risk of infection for which management may be the only solution.

12 yo girl, EWING sarcoma

- Pathological fracture
- Open biopsy in the axillary region
- CT + recon with silver coated EPR
- Post op RT

JBJS Am Mai 2007

TUMOUR PROSTHESIS IN NON ONCOLOGIC INDICATIONS

- 48 patients (13 because of infection)
- 10 reoperations
- Survivorship of the implant: 87% at 1 year
  73% at 5 years

JBJS Am Mai 2007
• review / 9 articles -> 241 EPR of the knee / non neoplastic conditions (mean age: 72, mean FU: 3.3 years)
  - 88 % distal femur fractures
  - 15 % aseptic loosening
  - 16 % infection : success rate: 67 to 80 % (No silver coated implants in this series)

• Reoperation rate: 17 %
• Infection: 15 % at mean 3.3 years when used for salvage TKR for all indications
• aseptic loosening: 5 %
• Periprosthetic fractures: 5 %
• Mortality: 22 % (0 à 47 %)

* Korin MT & al. Systematic Review of endoprosthetic replacement for non-tumour indications around the knee joint. The Knee 2013

** NON ONCOLOGIC NON SEPTIC COMPLEX RECONSTRUCTION **

• Old lady
• 85 yo
• Right THA in 1976
• 2 revisions
• Aseptic Loosening
• Bone loss (prox femur)

** NON ONCOLOGIC NON SEPTIC COMPLEX RECONSTRUCTION **

• Simple revision
• No bone graft
• Silver coated MUTARS
• Cemented retentive cup
TRAUMATIC INDICATION

- 61 yo patient, car accident,
- BMI 32
- Bilateral fracture of the distal femur
  (open fracture on the left side)
- Non union at 1 year
- on the left side
- Pain
- No sign of infection
- normal CRP

EPR distal femur

- Silver coated Mutars
- Immediate stability
- Restauration of function
- Resumed walking

IN SEPTIC REVISION SURGERY

- Complex cases
- Patients with prior multiple operations
- Risk factors: diabetes, obesity,
  chronic renal failure, smoking, steroids…
- Associated disease (AS, Crohn disease, RA,
  psoriasis…)
- Bone destruction
- Germs
- Soft tissue quality
**Materials and Methods**

- retrospective study.
- Patients were included in 2 university teaching hospital (CHU of Tours and CHU of Limoges) over a period of about 9 years.
- Multidisciplinary team
- Reference centres for complex osteoarticular infections (CRIOAC)
- Systematic samples
- Systemic antibiotics
- 23 patients
- 2 stage revision surgery for 22 patients and
- 1 stage revision surgery for one patient.

**OUR SERIES**

- 18 Mutars® prostheses (ImplantCast, Germany)
- 5 Stannore® prostheses (SIW, UK)
- Location:
  - proximal femur: 10
  - distal femur: 5
  - total femur: 4
  - knee arthrodesis: 2
  - Ice cream cone: 1
  - prox femur + lumic: 1

- n = 23
- 15 males, 8 females
- Mean age: 65.3 year (29-82)
- Mean FU: 43 months (8-120)
- flaps: 6
  - gastroc: 4
  - gluteus magnus: 2
RESULTS

- Mean number of germs / patient: 1.9 (1-10)
- 55% of the germs were Staphylococcus spp
- Staphylococcus aureus: 27.5% (1 MRSA)
- Coag neg Staphylococcus: 27.5%
- Other: Bacillus, Pasteurella multocida, E.coli multi R, Proteus mirabilis, strepto constellatus, Clostridium perfringens spp, E.coli, Entrobacter fecalis, Strepto constellatus, Strepto anginosus, Candida Fekir et Albicans, Bacteroides thetaiotaomicron

RESULTS

- Mean number of operations / patient: 5.3 (3-10) before the silver coated prosthesis was implanted
- 2 LR of infection at a 45 and 60 days (DAIR)
- 2 late LR of infection at 1 and 2 years
- 82.6 % succes at 43 months
- 1 infection with a different germ: Candida glabrata
- Mean MSTS scores: 24 (17-30)
  80% (56-100)
Silver coated tumour prosthesis in complex infection

- Short multicentric series (2 centres)
- Retrospective study, 23 patients

- Complex infected cases
- Huge bone defects
- 83% success at 40 months FU

DISCUSSION

CASES

Case control study to examine the merit of silver-coated tumour prosthesis

- 85 patients TP / 85 patients Ag TP (DB 31 000 patients)
- 106 m, 64 f, mean age: 42.2 (18.4-90.4)
- Location: df: 63, pT: 36, pf: 19, pelvis: 9, tf: 6,ph/k, drill: 2, d R: 2, Diaph: 12
- 50 primary reconstructions,
- 79 one stage revisions, 41 two stage revisions

Results Infection

<table>
<thead>
<tr>
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<th>2 stage success</th>
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<td>Silver</td>
<td>11%</td>
<td>70%</td>
<td>13.3%</td>
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| Non Silver | 22%   | 30%  | 40%                   | 57.1%           | p=0.01
|          | p=0.01    |      |                       |                 |

Résults Infection

Primary rec. DAIR Infection if cutsures 2 stage success

Silver

Non Silver

p=0.01
**COMPLEX 2 STAGE REVISION SURGERY**

85% vs 57%

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**CASE: COMPLEX THA INFECTION**

- 57 yo patient, left THA in 1982
- 8 operations on the left hip
- Infection With Staphylococcus epidermidis
- Vancomycin cement spacer
- Bipolar bone destruction
- 6 weeks of IV Antibiotics
- Hip aspiration: negative

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- Reimplantation at 8 weeks
- Silver coated LUMIC prosthesis +
- Silver Coated Mutars proximal Femur

- FU:
  - dislocation at 6 months
  - revision surgery with bipolar cup
  - no recurrence of infection at 50 months
EXTREME SITUATIONS...

64 yo woman

- Periosteal osteosarcoma
  - left mid femur
- No mets
- 2011: Diaphyseal EPR (SC Mutars)

2011

- Did well in the beginning
- Painful in the last 12 months
2015

- Sharp pain in the thigh
- Local Staging (MRI, CT, X Rays)
- Chest CT, Pet scan: No LR,
  - pulm mets: RFA + CT
- CRP: 9 mg/l

Bone scan

- Aspiration:
  - Staph Warneri, Staph Pastori, Staph capitis

Conclusion: Infection!!

- Staging
- 2 Pulm mets treated
  - with RFA in October 15
- 1 or 2 stage?
  - Diaphyseal EPR?
  - Prox femur?
  - Total femur
78 yo man
Pathological fracture right mid femur under THA
High grade spindle cell sarcoma of bone
No mets
CT
Resection
Use of an adaptor to connect with the stem of a THR

Cemented silver coated prosthesis below

Acute infection with Staphylococcus gallolyticus
DAIR changing all the silver coated modular parts
Amoxicillin 12 g / 6 weeks
Amoxicillin + Ofloxacin for 6 weeks
At 6 months, patient fine
Outcome??

Risk of infection in case of positive cultures: 13% vs 40%
65 yo man, chondrosarcoma 20 years ago

- Resection
- Reconstruction APC
- 7 operations later
- Loosening of inverse prosthesis
- Very painful
- Very limited range of motion
- Revision surgery?

OPTIONS?

Frontal view
Right view

PLAN: CUSTOM MADE IMPLANT WITH EXTRACORTICAL PLATES

- Inverse Prox humerus
- Silver coated Implant
- Pectoralis major Myocutaneous flap
Positive cultures

- At 3 days post op
- Positive cultures: *Staphylococcus epidermidis*
- What would you do??

DON'T PANIC!

MDT discussion:

- Silver coated implant
- AB 6 weeks
- Watch......

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p<0.01
At 11 months

- No pain
- No fever
- Skin and flap perfect
- CRP < 5

CONCLUSION

SILVER COATED TUMOUR PROSTHESIS IN ONCOLOGIC INDICATIONS

- Primary bone tumours
- Metastatic disease
- Associated soft tissue resection (flaps)
- Associated radiotherapy

TAKE HOME 1:

SILVER COATED TUMOUR PROSTHESIS ONCOLOGIC INDICATIONS

YES! HIGH RISK PATIENTS!
TAKE HOME 2:
SILVER COATED TUMOUR PROSTHESIS IN NON ONCOLOGIC, NON INFECTED COMPLEX SITUATIONS

YES!
• Revision surgery with major bone destruction
• Complex fractures in osteoporotic bone

TAKE HOME 3:
Silver coated Tumour prosthesis in complex infected situations?

YES! EFFICIENT METHOD!
BIN THE BUGS!
USE SILVER!

Thank you