HUG
Hôpitaux Universitaires de Genève

POLYNUCLEAIRES -PROTHESE ARTICULAIRE

DESC, Maladies Infectieuses
Bégin, 04.10.2004

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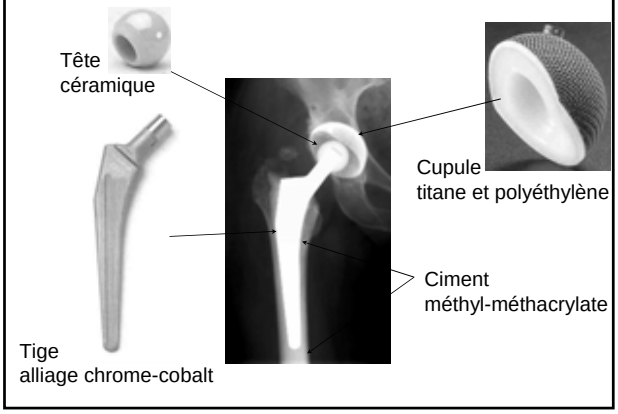
Division des Maladies Infectieuses
& Département d'Orthopédie

Prothèse de hanche: composants



Natural history of prosthetic implant (1)

1 Implantation of joint prosthesis

2 Follow-up (5-30 years)

-without complication (70-75%)

-complication (25-30%)
- **» aseptic loosening » 20-25%**
- **infection 1-2%**
- **other complications 5%**

3 Death of patient (no further complications!)

Natural history of prosthetic implant (2)

Complications after **1,434 Charmley arthroplasties, follow-up 33 years**

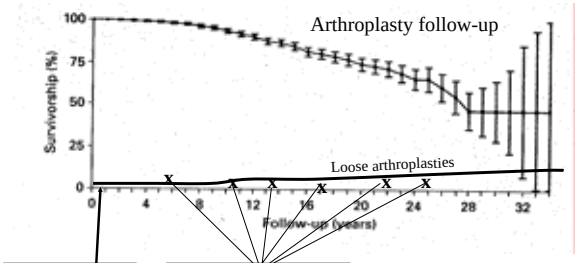
	N	%
During follow-up		
Dislocation	24	1.7
Deep infection	24	1.7
Loose cup	261	18.2
Loose stem	93	6.3
Fractured stem	25	1.7
Other (including trochanteric explorations)	69	4.8
Unexplained pain	3	0.2

1.7% Infection

22.5% Loosening

Wroblewski BM, JBJS Br 2002.

When does prosthetic infection occur ?

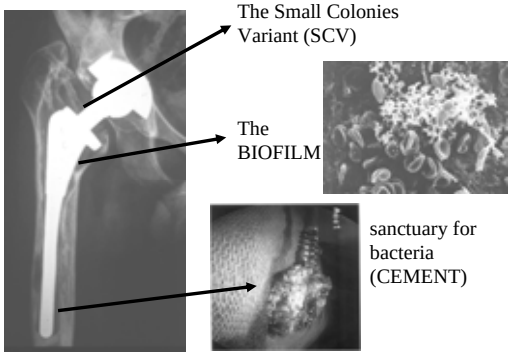


Type I
Acute and early just after surgery (< 1 m)

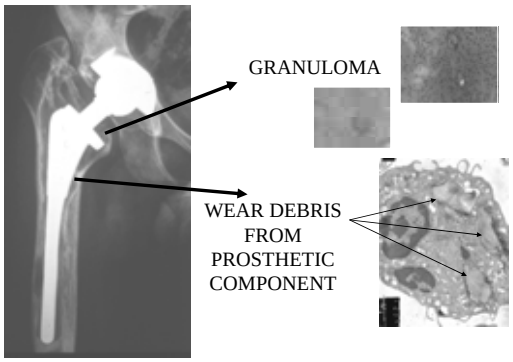
Type II
Chronic and later prosthesis with pain

Type III:
Acute and late hematogenous route prosthesis without pain

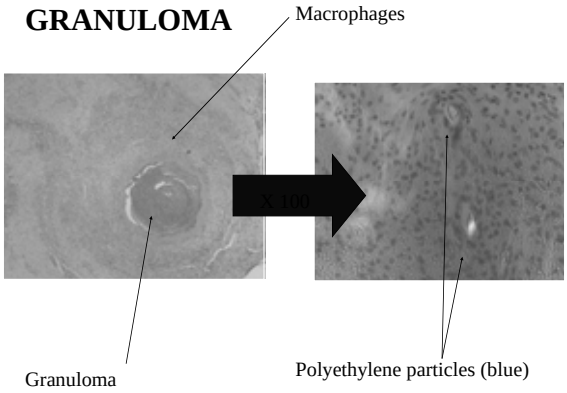
ACTUAL PATHOPHYSIOLOGICAL HYPOTHESES OF PROSTHETIC JOINT INFECTION (1)

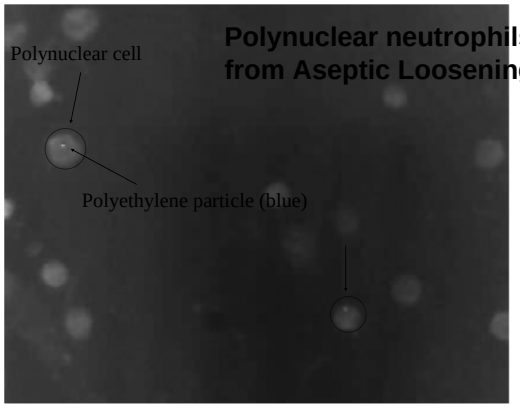


OTHER PATHOPHYSIOLOGICAL HYPOTHESES OF PROSTETIC JOINT INFECTION (1)

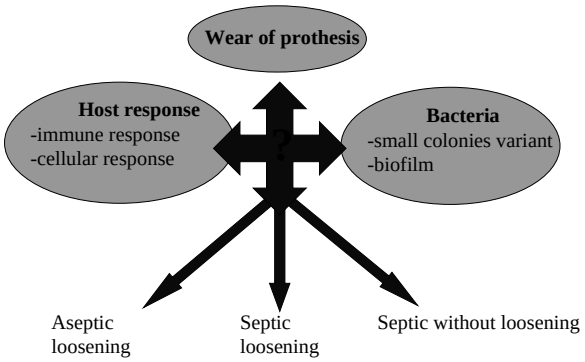


GRANULOMA

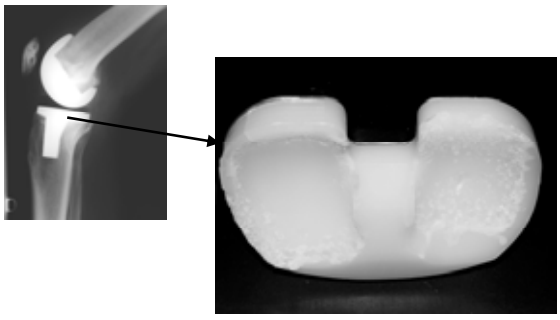




QUESTION ?



Aseptic Loosening (macroscopic analysis)



1ère étape

Analyse du tissu périprothètique *in vivo*

⇨ **Biopsie per opératoire / descellement**

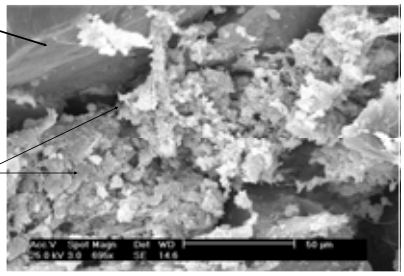
-fixation

-microscopie électronique

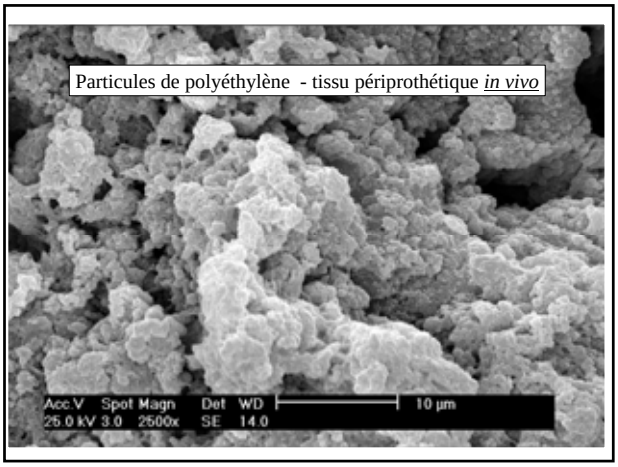
Aseptic Loosening (microscopic analysis)

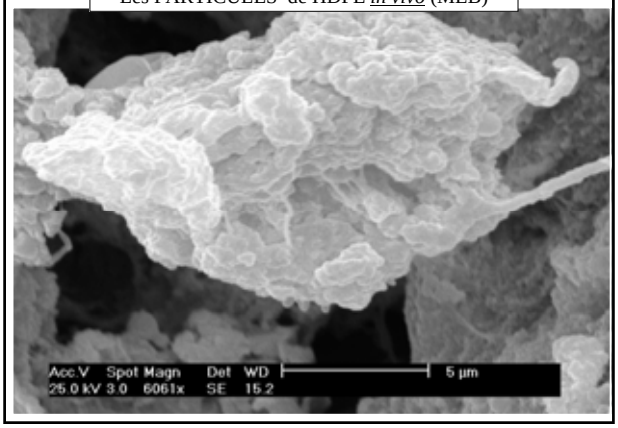
Hip neocapsule

Polyethylene particles



MEB x 695





2ème étape

Fabrication de particule de PEHD *in vitro*

⇨ **difficultés majeures de production de PEHD :**

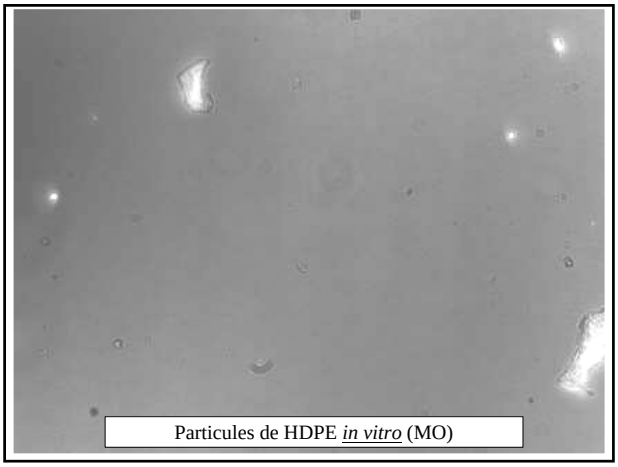
-poudre primaire ≠ poudre secondaire

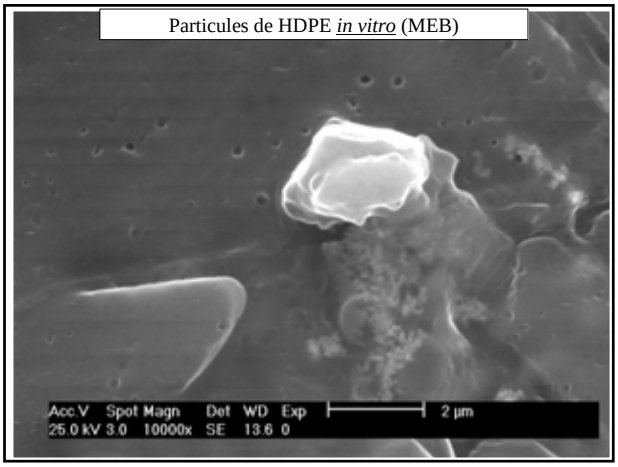
-taille < 1µm

-nombre nécessaire de PE pour expérience > 10^6/ml

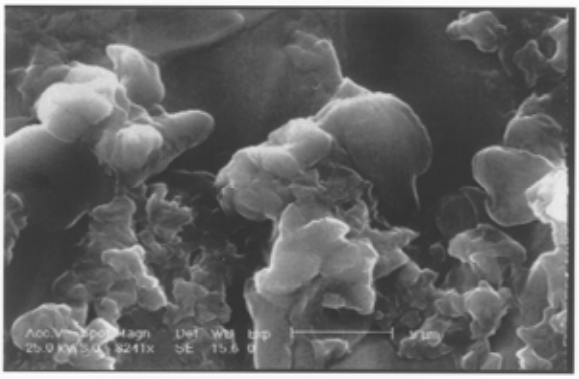
-reproductibilité

-propriétés physiques in vivo ≠ in vitro

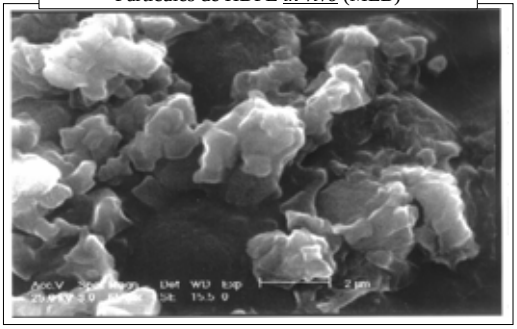




Particules de HDPE *in vitro* (MEB)



Particules de HDPE *in vivo* (MEB)

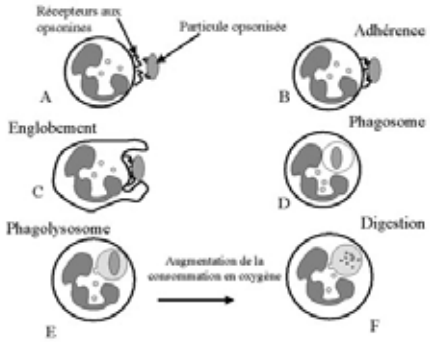


3ème étape

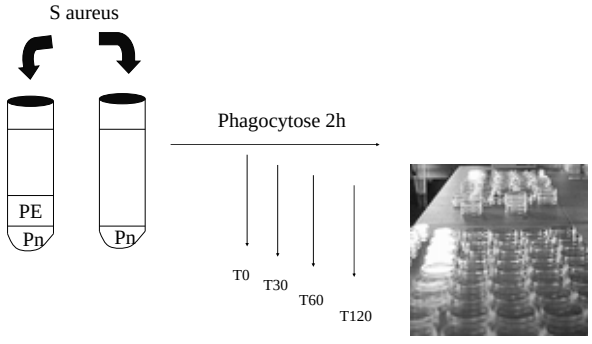
Tests de phagocytose

- **l'effet dose/taille des particules de PEHD**
- **l'influence de la nature de la particule**
- **mécanisme de phagocytose**
- **tests fonctionnels**

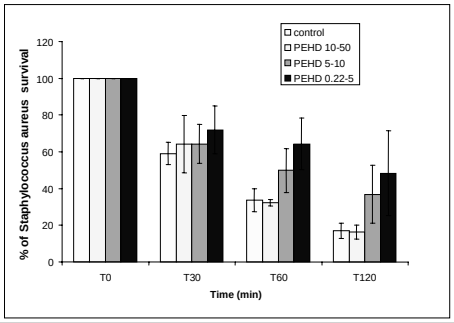
Rappel



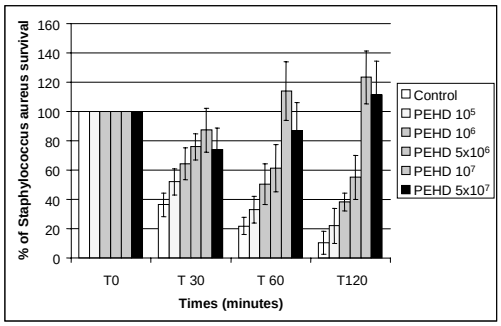
Test de « killing bactérien »



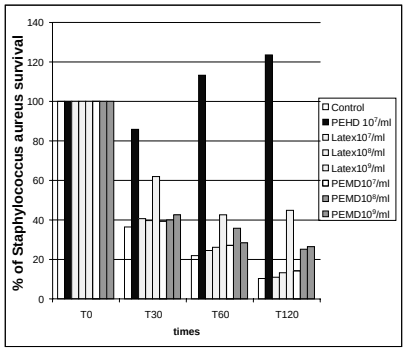
« Killing » de *S.aureus*
par les polynucléaires
en présence de particules de PE HD (0.22-50 µm)

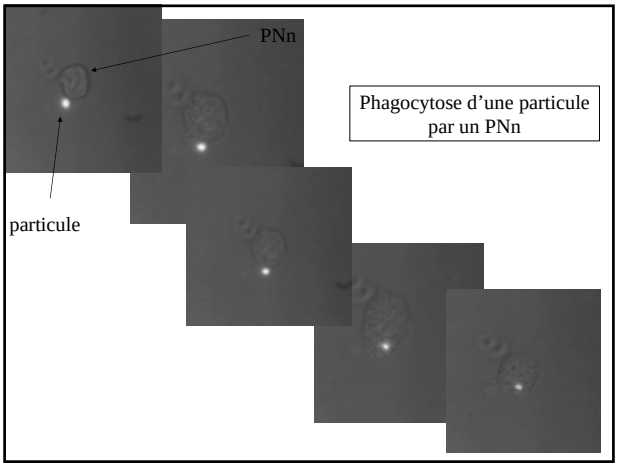


Killing » de *S.aureus*
par les polynucléaires en présence de PEHD
de CONCENTRATIONS DIFFERENTES

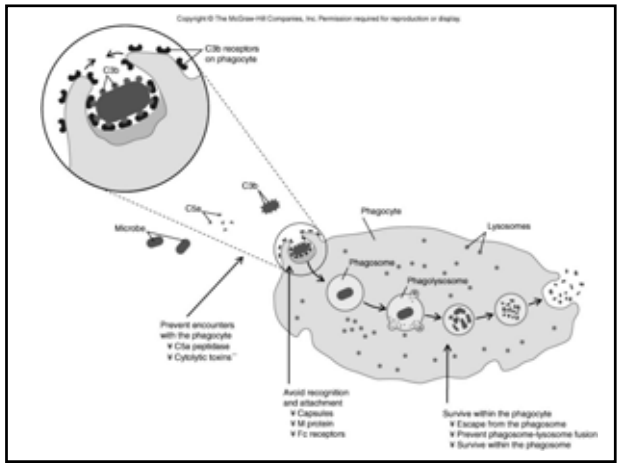


« Killing » de *S.aureus*
par les polynucléaires en présence de particules
de STRUCTURES DIFFERENTES



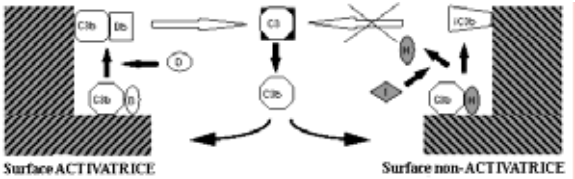


Phagocytose d'une particule
par un PNn



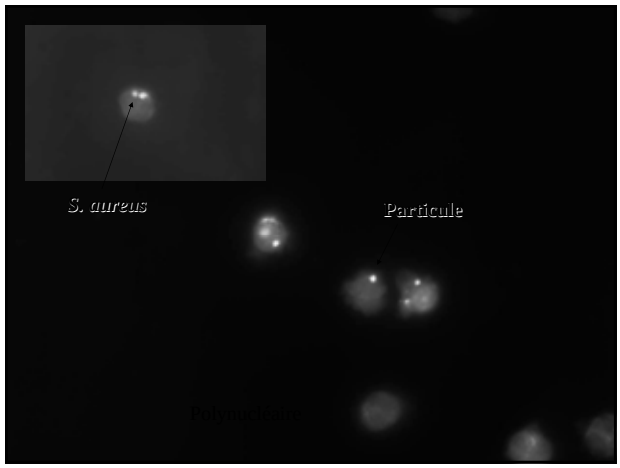
Complément

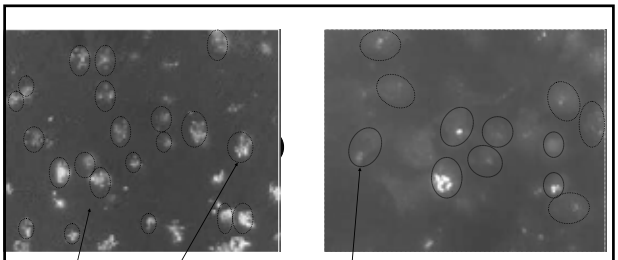
- **majoration de la dose de sérum humain 5-10-20% : idem**
- **dosage du complément Avant-après phagocytose: N**
- **Anticorps anti-récepteurs : normaux**



Phagocytose

- **inhibition extra ou intra cellulaire ?**
- **phagocytose sélective ?**





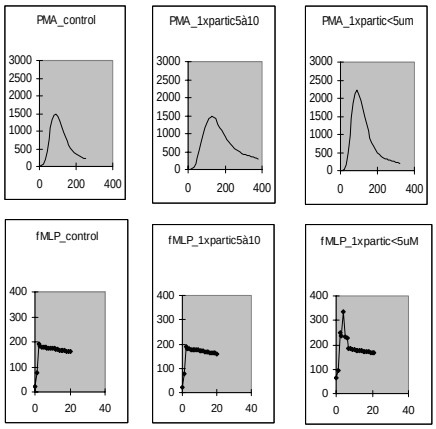
Polynuclear cell
Staphylococcus (green-FITC)

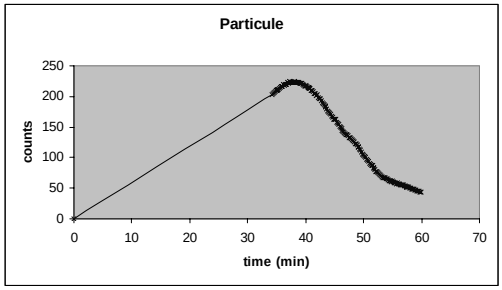
Polyethylene particle (red-rhodamin)

Double-staining fluorescence assay to measure polynuclear phagocytosis of Staphylococcus aureus in presence or absence of polyethylene particles

Test de fonctionnalité du métabolisme oxydatif des polynucléaires et la dégranulation

- **test qualitatif: NBT test MPO: myéloperoxydase**
- **tests quantitatifs: production de superoxyde**
  - **f-MLP (N-Formyl-Met-Leu-Phe)**
  - **PMA (Phorbol 12-Myristate 13-Acetate)**

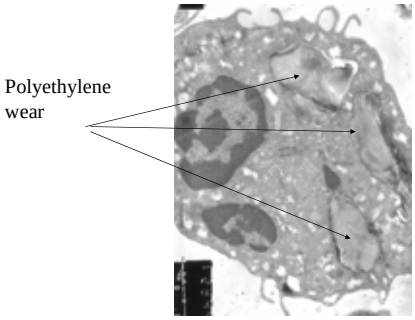




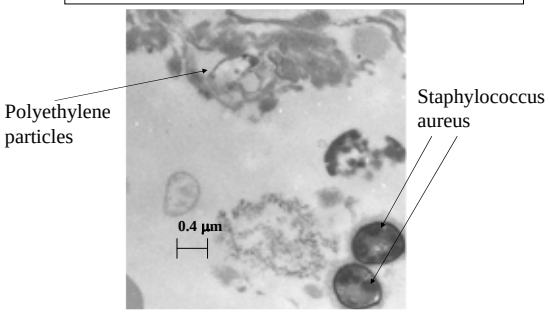
4ème étape

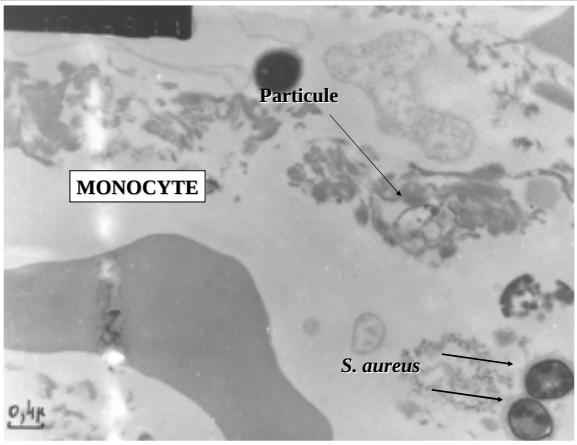
Confrontation clinique
avec étude in vivo
de polynucléaires périprothétiques
d ’une prothèse infectée

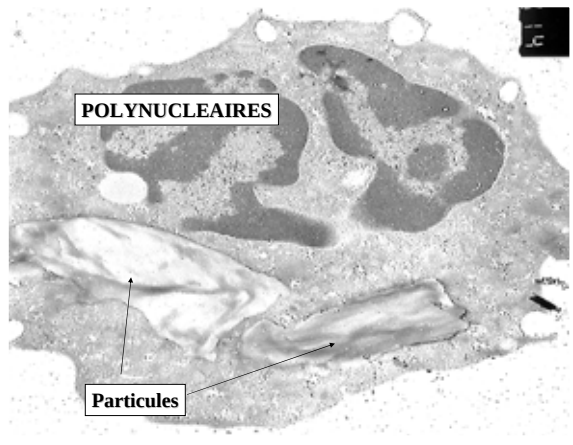
Polynuclear neutrophils from Aseptic Loosening (microscopic analysis)

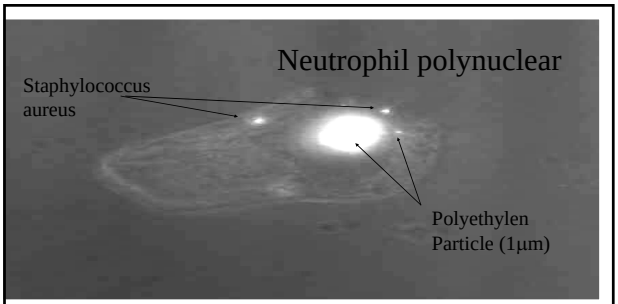


Macrophages from Septic Loosening (microscopic analysis)









MERCI

DISCUSSION (1)

Prosthetic loosening and infection

Tunney (JCM 1999)
Revision of 120 prosthetic hip implants
- Standard culture 22%
- Bacterial 16S rRNA gene 72% ?
- Often Propionibacterium acnes or CNS

What is the reality ?

DISCUSSION (2)

The different hypotheses such as small colonies variant, biofilm, and sanctuary for bacteria, are probably not the only mechanism responsible for infection of a prosthesis.

How can salvage of a prosthesis, or a one-stage exchange, be effective in the presence of bacteria ?

CONCLUSION(1)

A correlation between different factors :

wear of the prosthesis
bacteria
host response

seems to be present

CONCLUSION(2)

The difficulty is to know exactly

•Are bacteria present so frequently ?

•What is the implication of bacteria
in the host reaction to small or large particles ?

•When do bacteria arrive
during the loosening of a prosthesis ?