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Bafghi A[1], Carsenty-Dellamonica H[2], Trastour C[3], Piche M[4], Michiels J F[4], Dellamonica P[2], Amiel J[5], Gugenheim J[6], Iannelli A[6], Bongain A[1]

1. Service de Gyneco Obstetrique, 2. Service de Maladie Infectieuse, 3. Service de Gynecologie, 4. Service Anathomopathologie, 5. Service d'Urologie, 6. Service de Chirurgie Viscerale

IN VITRO STUDY OF INTERACTIONS BETWEEN BACTERIA AND PROSTHESES USED IN VAGINAL SURGERY

Hypothesis / aims of study

Colonisation of prostheses, that means infection of foreign bodies, shows the following steps: adhesion, accumulation and persistence of bacteria upon material surface (1). Adhesion is the main event in bacteria colonisation. Adhesion of bacteria is firstly reversible, linked to physical and electrical properties. It becomes irreversible when bacteria produce slime and biofilm, which allow bacteria to adhere firmly and for the long-term (1). The aim of this study is to compare adhesion of several bacteria to different types of prostheses, which are used in vaginal surgery.

Study design, materials and methods

Seven types of prostheses were studied:

- five prostheses in polypropylene: 1 low and 1 high grammage monofilament, 1 multifilament, 1 non-knitted and non-woven and 1 monofilament with collagen,
- one prosthesis with collagen of porcine origin,
- one polyester prosthesis with polyurethane.

Bacteria were chosen according to their adhesion ability to Biomaterials (BM). Colonies were obtained from infected urogynecological prostheses or catheters. Three types of germs were selected: *Staphylococcus aureus, Pseudomonas aeruginosa, Echerichia coli*. Four samples, 5 X 5 mm in length, of each type of prostheses were infected with 10^6 CFU/ml of each bacterium and cultured at 37°C.

- Two samples were used for bacteria counting to BM: detachment of bacteria with trypsine at 1, 2 4 and 6 hours and culture at 37°C during 24 hours. Counting of colonies from each sample at day 1.

Two samples were used to study the different types of bacteria fixation on prostheses: Gram coloration and nitro blue terazolium (colouring alive cells), and study with optical microscope.

Results

Counting of attached bacteria:

- Six hours after inoculation, polypropylene non-woven prostheses got the most bacteria attached, followed by multifilament and high grammage monofilament prostheses; low grammage monofilament protheses had the lowest fixation rate (Figure 1).
- Kinetic studies of adhesion showed differences between prostheses. More bacteria adhered to polypropylene prostheses at 1 and 2 hours, whereas after, fixation was more important for non-woven prostheses than multifilament prostheses (Figure 1).
- *Staphylococcus aureus* had higher affinity for prostheses with collagen (Figure 2).
- Bacteria affinity varies according to the type of prosthesis: Pseudomonas and E.coli had higher affinity for prostheses with porcine collagen and polyester.

Type of fixation:

On all types of multifilament prostheses (polypropylene, polyester), non-woven and porcine collagen, bacteria were attached diffusely along filaments, whereas on monofilament prostheses, fixation appeared only on knots and not along the filaments between knots.

Interpretation of results

Infection rate of BM used in vaginal surgery varies greatly between prostheses (2, 3). Our *in vitro* results showed that infection is linked to molecular type, manufacture type, bacterial properties, and grammage of each prosthesis. High grammage monofilament prostheses are more likely to be infected. Moreover, *Staphylococcus aureus* has specific receptors for collagen and adheres more easily on prostheses with collagen. Also, polypropylene monofilament are more often infected than collagen. Knowing mechanisms of bacteria adhesion may influence our clinical practice. Indeed, Neuman *et al.* reported a case of abscess on monofilament tape, treated by drainage alone without removal of the tape. On the

contrary, Game et al. advocated removal of all infected non-woven meshes (2, 3). This may be explained by a larger fixation of bacteria on this type of prostheses compared to monofilament prostheses.

Concluding message

In vitro studies are interesting to evaluate the type of BM used in vaginal surgery. Knowing interaction between bacteria and prostheses would allow a better understanding of infection mechanisms in order to optimise BM quality and treatment of infection. We think that all multifilament prostheses should be removed when infected, whereas conservative treatment may be tried for monofilament prostheses (with partial excision if erosion).

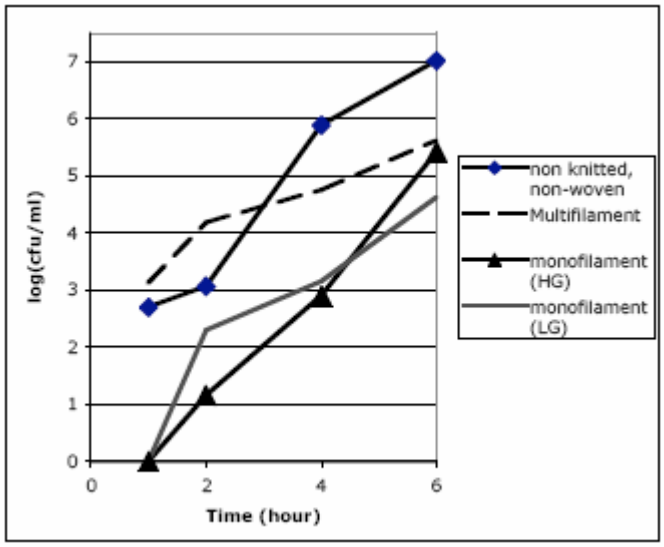

Figure 1 : Interaction between polypropylene/pseudomonas
(LG : Low grammage, HG : High grammage)

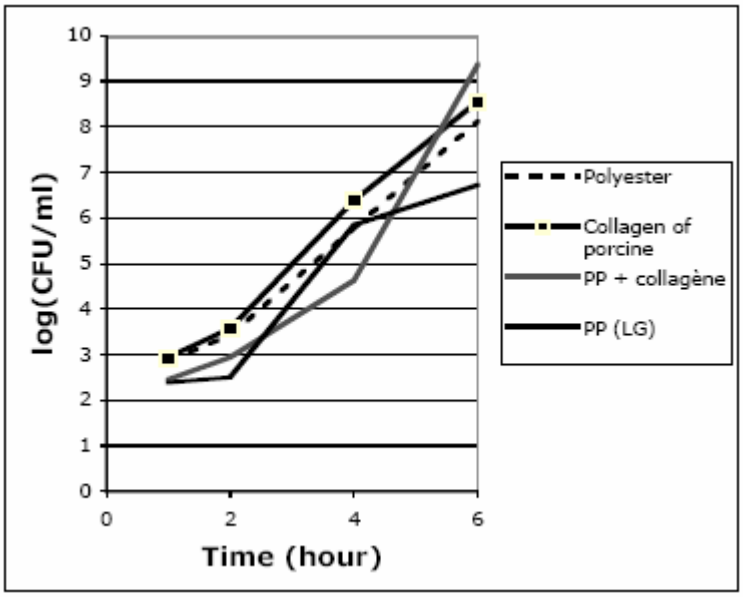

Figure 2 : Interaction between Staphylococcus Aureus and different types of prostheses
(PP : polypropylene ; LG : Low grammage)