CIRUGÍA ESPAÑOLA

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Original article

Prosthetic infection after hernioplasty. Five years experience

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ARTICLE INFORMATION

Article history:
Received May 19, 2008
Accepted September 22, 2008
On-line February 6, 2009

Keywords:
Mesh-related infections
Hernia repair
Inguinal hernia
Ventral hernia

A B S T R A C T

Introduction: Prosthesis infection is an infrequent but important complication in abdominal wall surgery. The aim of this study is to evaluate the incidence and risk factors for the infection of the prosthesis after hernia repair, as well as the treatment to apply.

Material and method: Between January 2002 and December 2006, we performed 1055 prosthetic hernia repairs: 761 inguinal hernias (72.1%), 74 umbilical hernias (7%), and 220 ventral hernias (20.9%). We prospectively analysed preoperative, intraoperative, and postoperative variables, as well as the incidence of infection of surgical wound and of prosthesis. We used ASA classification for preoperative anaesthetic evaluation.

Results: The overall percentage of infection of the prosthesis was 1.3%. Infection was observed in 11 repairs with polypropylene mesh (PPL), in 4 with PTFE mesh, and 1 case in combined mesh. Risk factors of mesh infection were: obesity (P=.002), diabetes (P=.020), the type of repair (P=.047), emergency surgery (P=.001), the type and size of mesh (P=.003; P=.007) and time of surgery >180 min (P<.001). Seven of the 11 patients with infection of PPL prosthesis were resolved with conservative treatment, whereas all the cases with PTFE infection or mixed mesh needed removal to solve the problem.

Conclusions: Several factors are involved in producing a prosthesis infection. Whereas antibiotic treatment and surgical drainage of the infection can be sufficient in most PPL mesh infection, PTFE prostheses need to be removed prematurely in order to halt the infection process.

Infección de la prótesis en la reparación herniaria. Nuestra experiencia en 5 años

Palabras clave:
Infección de prótesis
Reparación herniaria
Hernia inguinal
Eventración

R E S U M E N

Introducción: La infección de la prótesis es una complicación infrecuente pero importante en la cirugía de la pared abdominal. El objetivo de este estudio es valorar la incidencia y los factores de riesgo influyentes en la infección de la prótesis tras la reparación herniaria, así como el tratamiento a aplicar.

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Material y método: Entre enero de 2002 y diciembre de 2006, se realizaron en total 1.055 reparaciones protésicas herniarias: 761 hernias inguinocrurales (72,1%), 74 hernias umbilicales (7%) y 220 eventroplastias (20,9%). Se analizaron de forma prospectiva variables preoperatorias, intraoperatorias y postoperatorias, así como la incidencia de infección de herida quirúrgica y de prótesis. Se utilizó la clasificación ASA para la valoración preoperatoria anestésica.

Resultados: El porcentaje de infección del biomaterial en general fue del 1,3%. Observamos infección en 11 reparaciones con prótesis de polipropileno (PPL), en 4 con PTFE-e y 1 caso en prótesis combinada. Fueron factores de riesgo en la infección del biomaterial: la obesidad ($p = 0,002$), la diabetes mellitus ($p = 0,020$), el tipo de reparación ($p = 0,047$), la intervención de urgencia ($p = 0,001$), el tipo y el tamaño de la prótesis ($p = 0,003$ y $p = 0,007$) y el tiempo quirúrgico > 180 min ($p < 0,001$). De 11 pacientes con infección de prótesis de PPL, 7 respondieron al tratamiento con curas, mientras que todos los casos con infección de PTFE-e o prótesis mixta necesitaron de su extirpación para resolver el problema.

Conclusiones: Existen numerosos factores de riesgo que influyen en la tasa de infección del biomaterial. Mientras que la terapia antibiótica adecuada y el drenaje quirúrgico de la infección pueden ser suficientes en la mayoría de las infecciones de prótesis de PPL, las de PTFE-e requieren extirpación precoz para acabar con el proceso infectivo.

Introduction

One of the main problems emerging after the establishment of hernial repair by prosthetic methods has been the possibility of synthetic biomaterial infection, which can be observed in up to 8% of cases.[1-3] Although the majority of wound infections observed after a hernioplasty are superficial and respond well to antibiotic treatment, combined or not combined with surgical drainage, deep tissue infection with affected prosthetic material is a serious complication which in many cases requires withdrawal of biomaterial to allow resolution. Furthermore, the possibility of hernial recurrence is a predictable consequence of such withdrawal, which occurs in a significant number of cases.[4]

The objective of this study is to analyze incidence, risk factors, and the tendency of prosthesis infection to continue after hernial repair, by discussing our experience with this issue during the past 5 years.

Material and method

Between January 2002 and December 2006, we have carried out 1055 prosthetic repairs of the abdominal wall in the Unit of Emergency Surgeries and Abdominal Wall of La Fe Hospital. There were 761 inguinocrural hernias (72.1%), 74 umbilical hernias (7%), and 220 eventroplasties (20.9%). Seventenn point five percent of repairs took place in Emergency, while the rest (82.5%) were scheduled operation, and 26.9% of these cases were outpatient, taking place in the Ambulatory Surgery Unit. The prostheses used in operation were PPL (98%), PTFE-e (1.7%), and combined, Dualmesh® type (0.3%).

A medical record examination was carried out for all patients receiving operation, for those who had antecedents and clinical symptoms of prospective preoperative epidemiological variables, intraoperative findings, and rate of infectious complications. Cases of local and deep infection were analyzed specifically, as well as their risk factors, need for mesh withdrawal, possibility of recurrence, and isolated germs. We excluded patients from the examination who had non-prosthetic herniorrhaphy or those who did not go to scheduled postoperative analyses after surgery. The period of postoperative observation used in the study was completed up to 9 months after surgery.

A complete basic preoperative study was carried out (simple x-ray of the thorax, electrocardiogram, and blood analysis) in 100% of patients. Informed consent for surgery was obtained from each patient. The ASA anaesthetic classification (physical status assessment according to the American Society of Anaesthesiology) was used for assessing anesthetic risk.

Prosthetic repair was carried out with rachi-anaesthesia in 39%, general anaesthesia in 26%, laryngeal mask airway in 25%, and local anaesthesia and sedation in 11%. In all patients, antibiotic prophylaxis with a preoperative dosage of 2 g of amoxicillin-clavulanate was used. In case of allergy to penicillin and/or cephalosporin, second generation quinolone was administered.

For inguinocrural repairs, surgical technique consisted of Lichtenstein hernioplasties in 81.1% of cases and Rutkow-Robbins in 18.9%. In eventrations, repairs were conducted by placing the biomaterial in the supraaponeurotic (87%), preperitoneal/infraaponeurotic (8.3%), and intraperitoneal (3.7%) spaces.

Table 1 – Demographic characteristics antecedents and risk factors analyzed in the series

Variables	Without prosthesis infection (n=1039)	Without prosthesis infection (n=16)	P
Age, mean (SD), y	51.6 (23.2)	53.2 (19.4)	.135
Sex, n (%)			
Males	241 (23.1)	4 (25)	.252
Females	798 (76.9)	12 (75)	
Obesity (BMI>30), n (%)			
Yes	382 (36.7)	13 (81.2)	.002
No	657 (63.3)	3 (18.7)	
Diabetes, n (%)			
Yes	145 (13.9)	4 (25)	.020
No	894 (86.1)	12 (75)	
ASA classification, n (%)			
I	184 (17.7)	1 (6.3)	.320
II	281 (27)	3 (18.7)	
III	535 (51.5)	11 (68.7)	
IV	39 (4.8)	1 (6.3)	
Previous hernial repair, n (%)			
Yes	144 (13.8)	1 (6.3)	.490
No	895 (86.2)	15 (93.7)	
Type of repair, n (%)			
Inguinocrural hernia	759	2 (12.5)	.047
Umbilical hernia	74	0	
Abdominal eventration	206	14 (87.5)	
Place of operation, n (%)			
Emergency	182 (17.5)	9 (56.2)	.001
Scheduled	827 (82.5)	7 (44.8)	
Prosthesis, n (%)			
PPL	1.018 (98)	11 (68.7)	.003
PTFE-e	18 (1.7)	4 (25)	
Mixed	3 (0.3)	1 (6.3)	
Size of prosthesis, n (%)			
Standard (6×11 cm; 7×15 cm)	797 (76.7)	1 (6.3)	.007
Large (15×15 cm)	184 (17.7)	4 (25)	
Very large (30×30 cm or more)	58 (5.6)	11 (68.7)	
Surgery time, n (%)			
<90 min	807 (77.6)	1 (6.3)	<.001
91–179 min	141 (13.5)	8 (50)	
>180 min	91 (9.9)	7 (43.7)	
Time of manifestation of the infection, mean (SD), d	38.5 (31)		

BMI indicates body mass index; SD, standard deviation

The χ^2 or Student *t* test was used according to analysis variables, values of *P*<.05 were considered statistically significant.

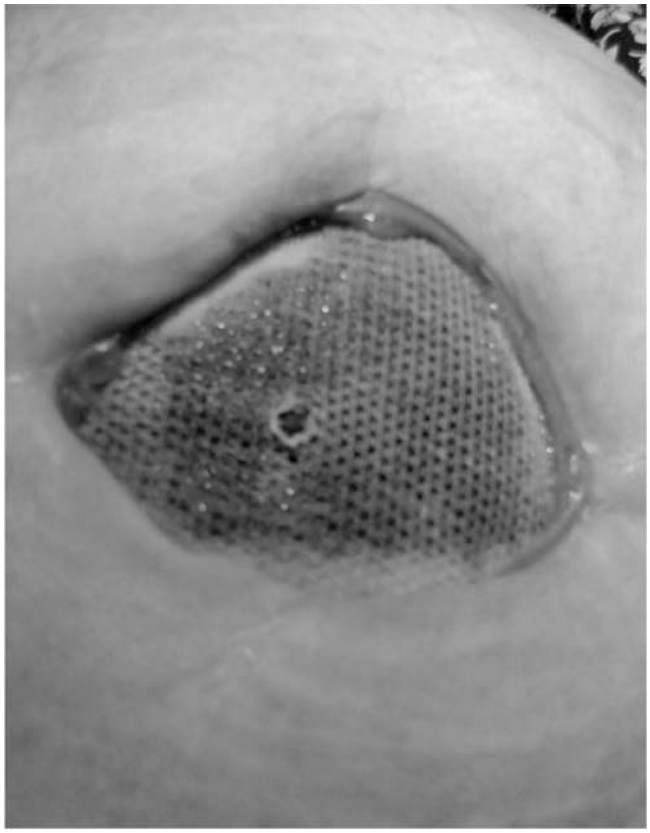

Figure 1 - Polypropylene prosthesis infection.

Results

Demographic characteristics of patients, types of repair, and risk factors analyzed are shown in Table 1. In general, the percentage of superficial wound infection was 6.1%: 2.2% in inguinocrural hernias (17 repairs) and 16.3% in abdominal eventrations (48 repairs).

Prosthesis infection occurred in 1.3% of cases: 2 cases of inguinocrural hernias and 14 cases of eventrations. Of these, we observed infection in 11 repairs with PPL prosthesis (1.1% of total repairs with this biomaterial; Figure 1), in 4 with PTFE-e prosthesis (22.1%; Figure 2), and 1 case with combined prosthesis. The biomaterial infection appeared more frequently in emergency operations (9 cases) compared with scheduled operations (7 patients). The average time of manifestation of the infection was 38.5 (31) days (Figure 3).

Risk factors related to biomaterial infection were: obesity (*P*=.002), diabetes (*P*=.020), type of repair (*P*=.047), surgery operation (*P*=.001), type and size of prosthesis (*P*=.003 and *P*=.007), and surgery time >180 min (*P*<.001) (Table 1).

The microbiological spectrum of isolated germs was: *Staphilococcus aureus* (9 cases), enterobacteria (3 cases), *Pseudomonas* (1 patient), and mixed flora (3 patients). The most frequently used antibiotic therapy after finding a wound infection was broad-spectrum coverage with amoxicillin-clavulanate or fluoroquinolone, and specific antibiotics were

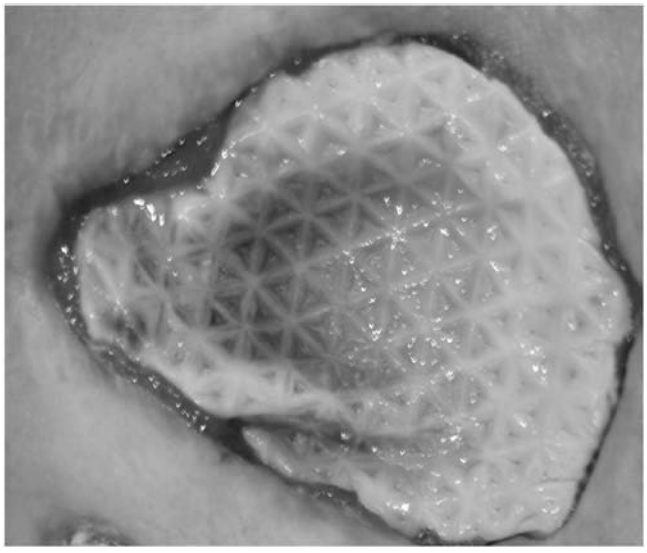

Figure 2 - PTFE-e prosthesis infection.

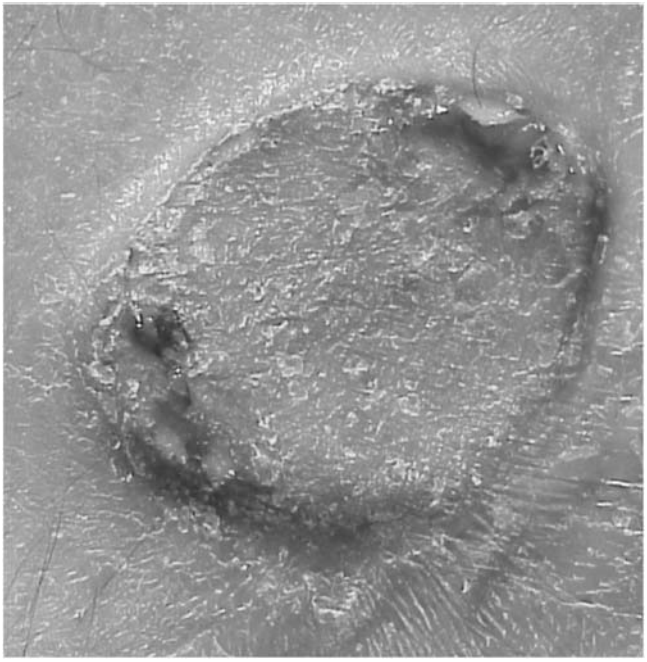

Figure 3 - Result after removal and insertion of skin graft.

used against gram positives (intravenous vancomicin) after the mesh infection was established in 96% of cases. In 2 patients, intravenous linezolid was used for 15 days, with good results.

Prosthesis removal was necessary in 9 cases, and in 2 more than 1 operation was needed because the first was incomplete. Whereas 7 of 11 patients with PPL prosthesis infection responded to treatment with local healing, all cases with PTFE-e infection or mixed material needed extirpation to resolve the problem of infection (Table 2). To speed up scar formation of the defect in patients with PPL prosthesis infection, we used vacuum assisted closure therapy (VAC). We observed hernia recurrence during the follow-up period in 5 out of 9 patients with prosthesis removal, and they needed another surgical intervention once the infectious process was conclusively resolved.

Discussion

The intensity of fibroblastic reaction and incidence of infection are related to porosity of the prosthetic material. Consequently, when mesh pores are <10 µm, the granulocytes and macrophages which pass these dimensions cannot neutralize and destroy bacteria while wider pores (>10 µm) prevent their growth and allow for a fast fibrosis and angiogenesis. Standard microporous meshes o >10 µm is PTFE-e, while for macroporous prosthesis it is PPL (pore >75 µm).

The influence of determining factors in the appearance and behaviour of prosthesis infection has been studied by altering the process of tissue integration of biomaterial.[1,5-8] Comorbidity of patients with conditions such as diabetes, chronic obstructive pulmonary disease, and immunodeficiency influences the possibility of postoperative deep infection. Some authors have speculated that preperitoneal repair, by localization of mesh and the existence of a fatty tissue and muscular "barrier," may have a protecting effect against the infection.[9,10] This would explain why the rate of infection in Stoppa technique repair is less than repair by the anterior supraaponeurotic tract.[11,12] However, there is disagreement over the theoretical defensive effect which it could provide to the obese patient, as a few series have observed a harmful effect in this protection and in others.[1,13] For the case in question, we have observed a higher risk of mesh infection in obese and diabetic patients, but we have not found differences in relation to preoperative ASA classification status.

Differences associated with using certain sutures for anchoring the mesh have not been described either, in the case of staples, absorbable, and non-absorbable sutures.[14] Furthermore, even though various series have shown less risk of infectious complications in laparoscopic repair, the influence of such a technique remains unclear regarding possible prosthesis infection compared to open technique.[15-17] There is also no common consensus as to which type of biomaterial presents a higher predisposition of infection. Some series determine higher probability with PTFE-e prosthesis, as in our case, but there are not broad comparative series which conclude such an assertion.[7]

In the late nineties, Costerton defined the concept of biofilm as the group of bacteria with a high adhesive capacity used to strongly connect to a solid support which provides them with stability, nutrients, and protection, therefore making the formation of microcolonies possible.[18] This author explains biofilm's high resistance to antimicrobial treatment for 3 reasons: its poor diffusion across the polymeric material

Table 2 – Characteristics of patients who presented with prosthesis infection after hernial repair

Patient	Gender	Diagnosis	Technique	Scope	Material	Therapy	Reintervention
1	Male	HI	Lichtenstein	Emergency	Prolene	Cure	No
2	Female	HI	Repair	Scheduled	Prolene	Withdrawal	Yes
3	Female	SEV	Repair	Scheduled	PTFE-e	Withdrawal	Yes
4	Female	SEV	ACS	Scheduled	Prolene	Withdrawal	Yes
5	Female	SEV	ACS	Scheduled	Prolene	Cure/VAC	No
6	Male	SEV	Repair	Scheduled	PTFE-e	Withdrawal	Yes
7	Female	SEV	Repair	Emergency	Prolene	Withdrawal	Yes
8	Male	IEV	Repair	Emergency	Prolene	Withdrawal	Yes
9	Female	SEV	Repair	Emergency	PTFE-e	Withdrawal	Yes
10	Male	SEV	Repair	Emergency	PTFE-e	Withdrawal	Yes
11	Female	IEV	Repair	Emergency	Mixed	Withdrawal	Yes
12	Female	SEV	Repair	Emergency	Prolene	Cure/VAC	No
13	Female	SEV	Repair	Scheduled	Prolene	Cure/VAC	No
14	Male	SEV	ACS	Scheduled	Prolene	Cure/VAC	No
15	Female	SEV	Repair	Emergency	Prolene	Cure	No
16	Female	SEV	Repair	Emergency	Prolene	Cure/VAC	No

ACS indicates anatomical component separation technique; HID, inguinal hernia; IEV, infra-umbilical eventration; SEV, supra-umbilical eventration.

surrounding it; the bacterial heterogeneity present in biofilm, due to slow-growing bacterium, and high metabolic variability, which ensures its survival in a semi-latent state, and by mechanisms reduced from susceptibility, conferred by phenotypes adopted by the bacterium inside of biofilm. All of this would lead to an exchange of extrachromosomal DNA through a transfer of plasmids which would explain its resistance to conventional antimicrobial therapy. The existence of such "persistent bacterium" would make the infection become chronic during immunodeficiency circumstances of the host, and later a biomaterial infection would be produced. This would explain the finding of cutaneous sinus and fistulas with seropurulent secretion after a prolonged time after operation.

It is important to emphasize prevention of the infection. Adequate use of preoperative and postoperative antimicrobials, decreased surgery time, elimination of dead tissue, minimized contact of the biomaterial with the skin, efficient use of outlets for preventing haematoma formation, and suturing the wall by aseptic technique have been analyzed as effective measures, to a greater or lesser degree.[6,19] In the case in question, we have verified the existence of a greater number of cases of infection in emergency repair, and in operations where large prosthesis or those which exceeded 180 min. were used. These parameters are related to intraoperative factors which are difficult to prevent, especially due to the increased morbidity currently in emergency surgeries related to the patient's lack of preparation, the need for broad dissections, and the increased possibility of infection involved in this type of surgery.

Some studies on animal models indicate that applying antibiotic solutions during operation offer advantages against possible biomaterial infection, as these theoretically produce inhibition of bacterial adhesion on the surface.[20] Some authors irrigate a gentamicin sulfate solution or cover tissue with gases saturated by this antibiotic, where the prosthesis is maintained before insertion.[21] However, the effectiveness of irrigation or the application of these solutions is controversial due to the short duration of the antibiotic's contact with the pathogen. Topical antiseptics such as povidone-iodine applied inside the wound are recommended by some series, although experimental evidence indicates that its use produces additional benefits with antibiotic prophylaxis but only in massive bacterial inoculation.[1]

The use of antibiotic prophylaxis in hernia surgery continues to be a point of controversy in various prospective studies, both nationally and internationally.[22-25] A recent Cochrane review concludes that no criteria exists for systematically recommending prophylaxis in the initial repair of inguinal hernia.[26] He concludes that in general it could be useful, but it would not implicate indiscriminate administration, rather its use should be based on local wound infection rates and on analysis of the patient's risk factors. In our series, we have applied the given prophylaxis protocol in all cases.

The microorganisms associated with the cases of prosthesis infection are *Staphylococcus* spp (up to 75%), especially *S aureus, Streptococcus* spp included in group B, gram negative bacterium (principally enterobacteria), and anaerobes.[27]

With suspicion of superficial infection of the surgical wound, a broad-spectrum coverage antibiotic should be used, and if there is no improvement, the wound should be examined and purulent collections should be drained. Likewise, the microbiological culture of the exudate for suitable antibiotherapy is mandatory. This therapy is effective in the majority of cases, obtaining good results. If intravenous antimicrobials are needed during slow evolution of the infection, antibiotics according to the antibiogram are recommended, above all those effective against gram-positives, such as vancomicin or teicoplanin.

Some study groups have achieved excellent results by applying new antimicrobial therapies against strains resistant to meticillin, such as linezolid (Zyvoxid®). This has to do with a bacteriostat against gram-positives, although in some hospitals its use is restricted. According to our experience, this antimicrobial was highly useful for us in 2 prosthesis infection cases after an eventroplasty with a PPL mesh, where they responded well to local therapy with local healing and with no need for withdrawing the biomaterial.

As we have previously mentioned, there are differences regarding the prosthesis' response to infection. In general terms, when the macroporous prosthesis is infected, sometimes only a small area of the biomaterial is affected. Therefore, the second attempt possibility of cicatrisation and partial exeresis represent an effective treatment option. However, in microporous prosthesis, the germs can remain inside the biomaterial, making prosthesis withdrawal necessary for complete resolution of symptoms. Our experience coincides with these statements; we have been forced to withdrawal 100% of the PTFE meshes used, while in 7 of 11 repair cases with PPL (63.6%), removal was not necessary.

With prosthesis withdrawal, the patient continues with exposure to hernial recurrence, which is frequently greater than the initial lesion. It is not uncommon that after initial removal of the material, there are prosthesis remains in a residual area, which can perpetuate or relapse suppuration, in the form of relapsing chronic sinus, therefore requiring complete extirpation for a definitive cure.[4] As a result, it is necessary to wait for the wound to be completely healed and free of infection before the new repair, because it is recommended to dilate the final repair until the wound has cicatrised.

To conclude, according to our experience, there are numerous risk factors. Some are certainly preventable and directly influence rates of prosthetic infection. Once the infection has been verified, conservative measures and proper drainage of collection could be sufficient for PPL meshes, while PTFE or mixed prosthesis should be removed early to stop the infectious process.

Acknowledgments

To other colleagues who have participated in one way or another in the completion of this study: Drs José Luis Ibáñez, José Iserte, José Miguel Martínez, Raquel Blasco, Soledad Carceller, and Gemma Bellver.

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