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Hernia Mesh Repair of the Anterior Abdominal Wall and Antibiotic Chemoprophylaxis: Multiple Doses of Antibiotics Failed to Prevent or Reduce Wound Infection

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Rezumat

Protezarea herniilor de perete abdominal anterior și chemoprofilaxia cu antibiotice - dozele multiple de antibiotice au eșuat în prevenția sau reducerea numărului de infecții ale plăgilor chirurgicale

Principiu și scop: Protezarea herniilor de perete abdominal anterior este o tehnică populară și acceptată de majoritatea chirurgilor. Cea mai frecvent utilizată tehnică la ora actuală este procedeul fără tensiune (tension-free). Este încă incert dacă profilaxia antibiotică este necesară pentru a preveni infecția postoperatorie a plăgii chirurgicale, în special în cazul în care un corp străin de tipul plasei de polipropilenă este utilizat.
Materiale și metode: Am studiat retrospectiv pacienții care au primit tratament chirurgical în cadrul secției noastre pentru hernii de perete abdominal anterior în perioada Ianuarie 1995 – Decembrie 2004. Pacienții au fost împărțiți în 3 grupuri pe baza dozelor de antibiotice administrate.
Rezultate: În 780 din cele 1245 de cazuri a fost utilizată o plasă de polipropilenă. Am exclus din studiu 221 de pacienți din cauza bolilor ce necesitau asocierea unui tratament antibiotic. Am studiat frecvența infecțiilor superficiale și profunde în corelație cu utilizarea antibioticelor (cefalosporine de generația a doua sau o combinație de ampicilină și sulbactam).
Concluzii: Nu s-au observat diferențe vizând incidența infecțiilor post-chirurgicale legate de durata și numărul de doze de tratament antibiotic. Rata infecțiilor postchirurgicale în studiul curent nu susține utilizarea de doze multiple de antibiotice, și nu diferă de rata infecțiilor raportată în literatură. Mai multe studii sunt necesare pentru a clarifica necesitatea chemoprofilaxiei cu doză unică.

Cuvinte cheie: hernie, profilaxie antibiotică, proteză

Abstract

Background: Mesh repair of the anterior abdominal wall hernias is a popular technique and commonly accepted among the majority of surgeons. The technique used most frequently today is the free tension technique. It is uncertain whether antibiotic prophylaxis is necessary to prevent post-operative wound infection, especially when a foreign body like a polypropylene mesh is used.
Methods: We have studied retrospectively the patients who received surgical treatment in our department for anterior abdominal wall hernia during the period of January 1995 - December 2004. Patients were divided into 3 groups based on the doses of antibiotics administered.
Results: In 780 out of 1245 cases, a mesh of polypropylene was used. In our sample, we excluded 221 patients due to diseases that made the use of antibiotics necessary. We have studied the frequency of superficial and deep infections in correlation with

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the use of antibiotics (cephalosporin of second generation or a combination of ampicillin plus sulbactam).
Conclusion: No difference was observed in the incidence of surgical trauma infection in relation to the duration and the doses of antibiotic cover. The wound infection rate in the current study does not support the use of multiple doses of antibiotics, as this rate does not differ from the rates of infection reported in the literature. Further studies are needed to clarify if antibiotic chemoprophylaxis with one dose or no chemoprophylaxis should be recommended.

Key words: hernia, mesh repair, wound infection, chemoprophylaxia

Introduction

The mesh repair of the anterior abdominal wall hernias has been established as the technique of choice among the majority of surgeons. The technique used most frequently today is the free tension technique. This technique allows wound repair, better collagen restoration and prevents recurrence (1). Furthermore, the use of a polypropylene (PP) mesh has many advantages such as biocompatibility and comfort. This free tension technique is commonly accepted for recurrent, complicated and primary hernias because of the low risk of infection of the introduced foreign body, such as a non-absorbable mesh (2-7).

Surgical wounds may be classified as follows, based on perioperative bacterial contamination: clean, clean contaminated, contaminated and dirty (8-10). Wound infections are categorized as superficial or deep (8,9,11). Superficial incisional surgical site infection occurs within 30 days of surgery and involves only the skin and subcutaneous tissue. Deep incisional surgical site infection involves deep soft tissue and appears to be related to the operation. It occurs within 30 days if no implant was left in place and within one year if an implant was left in place (12).

Hernia mesh repair of the anterior abdominal wall is regarded as a clean surgery and the incidence of postoperative mesh infection is considered to be around 1-2% (1,13,14). It is uncertain whether antibiotic prophylaxis is necessary to prevent postoperative wound infection, especially when a foreign body like a polypropylene mesh is used. There are no specific guidelines for antibiotic prophylaxis; the surgeon is responsible for determining whether a patient needs antibiotics or not. (10,15). The estimation of the value of the antibiotics seems to be empiric rather than evidence based (4) and that is why their value is a controversial issue. There are antibiotic supportive statements (16-18) that reported a decrease of the wound infection rate from 9% to 0.7% after antibiotic prophylaxis that are in contrast to other statements in which the antibiotic contribution is underestimated (6). There is no evidence that the advantages of antibiotic prophylaxis outweigh its disadvantages. The "triple E" (6) summarizes the equivocal nature of antibiotic prophylaxis: ecological impact on the patient's flora (resistance and mutations of the microorganisms), adverse effects such as anaphylaxis, hypersensitivity, blood dyscrasias and finally, economic impact. We present our experience with the use of multiple doses of antibiotics in hernia mesh repair.

Purpose of the study

The purpose of this study is to clarify the effectiveness of antibiotic prophylaxis in reducing postoperative wound infection rates in elective open anterior abdominal wall hernia mesh repair.

Materials and Methods

We have studied retrospectively the patients who have undergone surgical treatment in our clinic due to anterior abdomen wall hernia over the past 10 years, from January 1995 - December 2004. We have studied the frequency of superficial and deep infections, in conjunction with the use of antibiotics (cephalosporin of second generation or a combination of ampicillin plus sulbactam). There were 3 groups according to antibiotic prophylaxis duration:

Group 1 received antibiotic chemoprophylaxis for 4 days, Group 2 received antibiotic chemoprophylaxis for 2 days and Group 3 received 2 doses of antibiotic chemoprophylaxis. From January 2004 in hernia mesh repair of the anterior abdominal wall, we started administering one dose of antibiotic chemoprophylaxis. Comparisons of infection incidence between groups were made using binary logistic regression with group 3 used as a reference category. The confidence interval was 95%, and a difference was considered statistically significant at $p<0.05$. The statistical analyses were performed using SPSS (Statistical Package for Social Sciences, version 19.0).

Results

1245 patients had been operated in our clinic due to anterior abdomen wall hernia. In 780 out of 1245 patients, a mesh of polypropylene was used, while 465 patients were treated without mesh repair because of the demand of an urgent operation due to the presence of complications of their condition or because of the surgeon's choice. In our sample we excluded 221 patients due to diseases that made the use of antibiotics necessary, so a total of 559 patients have been included (*Table 1*). The types of hernia are presented in *Table 2*.

The patients were split into 3 groups according to antibiotic prophylaxis duration:

Group 1: Of 148 patients in the period 1995-1998 who received antibiotic chemoprophylaxis for 4 days, 4 presented with superficial infection and 1 with deep infection.

Group 2: Of 187 patients in the period 1999-2001 who received antibiotic chemoprophylaxis for 2 days, 3 presented with superficial infection and 1 with deep infection.

Group 3: Of 224 patients in the period 2002-2004 who

Table 1. *Number of patients per year*

Year	Number of patients
1995	24
1996	31
1997	42
1998	51
1999	52
2000	63
2001	72
2002	69
2003	72
2004	81
Total	559

Table 2. *Type of hernias*

Inguinal hernia	397
Postoperative abdominal hernia	61
Omphalocele	68
Femoral hernia	33
Total 559	

Table 3. *Infection in each group*

	Deep infections	Superficial infections	Total
Group 1	1(0.7%)	4 (2.7%)	5 (3.3%)
Group 2	1 (0.5%)	3 (1.6%)	4 (2.1%)
Group 3	0 (0%)	4 (1.7%)	4 (1.7%)

received 2 doses of antibiotic as chemoprophylaxis, 4 presented with superficial infection and 0 with deep infection.

A total of 13 patients presented with superficial infections and 2 patients with deep infections and were re-operated in order to remove the mesh (*Table 3*). In both cases, Staphylococcus aureus was isolated.

The difference in possibility of superficial and deep infection in group 1 compared with group 3 was not statistically significant (p=0.553 and 0.995, respectively) as was the case between groups 2 and 3 (p=0.887 and 0.995, respectively).

Discussion

In our study we did not observe a difference in the infection of the trauma in relation to the duration and the doses of antibiotic cover. Many studies were undertaken to determine the role of antibiotic prophylaxis in mesh hernia repair. An incidence of approximately 10% of the patients submitted to surgical hernia repair presented with infection (4,6,19). The incidence ranges from 3.3% to 14% (18), and this rate has remained at the same unacceptable level for the past 60 years (14,19-22). Haley et al. demonstrated a rate of abdominal wall abscess varying from 1.1% to 15.8% (23). In inguinal herniorrhaphy, surgical site infection is the most frequent complication (24). It is certain that abdominal wall implant infection increases morbidity. Impaired wound healing and functional loss of the abdominal wall are some of the consequences of implant infection. Also, secondary operations and extended hospital stay are required.

A bacterial colonization has been detected in more than 40% of implants (25). It was demonstrated that bacteria invade the wounds at the time of closure, coming from the body, the air or the surgical instruments (20). Staphylococcus aureus, Staphylococcus epidermidis and Escherichia coli are usually responsible for mesh infection. Colonies of Staphylococcus epidermidis are not vulnerable in prophylactic systemic antibiotics because of a biofilm at the surface of the mesh fibres (25). Furthermore, the presence of multiple bacterial strains per patient has also been reported (4,16,18,19,26-29). It has been estimated that 72% of patients are diagnosed during a 4-6 week follow-up period after the surgery, but colonization might occur even after years of implantation and without clinical signs of infection (30).

According to several clinical studies, the occurrence of infection depends on surgical technique and on mesh type. Infection rates, when a polypropylene mesh is used, range from 2-4.2% (31,32). This infection rate does not differ from the rate observed in the current study. Aufenacker et al. (26) reported a low rate (1.7%) of wound infection after Lichtenstein open mesh inguinal (primary) hernia repair. There was no difference between the antibiotic prophylaxis and the placebo group. Perez et al. (6) also found no difference in the outcome of infection. However, the infection rates are perhaps underestimated due to the unclear definition of infection and the method of follow up.

On the other hand, there are several studies that show a significant reduction in infection after antibiotic prophylaxis. Yerdel et al. (18) found that the wound infection rate was 0.7% in the prophylaxis group, and 9% in the placebo group, in addition to the Turkish trial in which the reported infection rates between the group receiving a single dose of ampicillin plus sulbactam and the placebo group was considerably different. Celdran et al. (7) also reported a reduction in wound infection. However, the sample sizes in those studies were small. Furthermore, a subgroup analysis suggested that in mesh hernia repair, a protective effect could exist and be undetectable because of the small sample size. Furthermore, it has been recently reported that the wound infection rate dropped from 4.2% to 2.3% with the use of prophylaxis (6) and, according to Lazorthes et al. (16), a single-dose of cefandole of 750 mg added to local anesthetic reduced the wound infection rate from 4.5% to 0% compared to anesthesia with no antibiotics (16,18,25). Troy et al. warranted that a reduction of the growth of bacteria in wounds implanted with mesh was observed after the administration of preoperative single-dose intravenous cefazolin or the topical bacitracin (18). Gentamycin is reported to be one additional choice for its antimicrobial action. It kills bacteria by diffusing passively across the outer membrane through bacterial pores

and, after entering into the cytoplasm, causing the production of a faulty reading of mRNA codons (20). Gentamycin, in combination with B-Lactams (3), results in an antimicrobial synergy and furthermore, at high serum concentrations it can produce auditory and renal damage. There is research that reported the wound infection rate was at 9% in the placebo group, whereas in the group treated with a monodose of ampicillin plus Sulbactam, the infection rate was 0%. Moreover, a single-dose of preoperative intravenous Cefazoline decreases the wound infection rate from 8% to 0%, in comparison to the placebo group (7).

A meta-analysis by Sanabria et al. (33) reported a 50% protective effect of antibiotic prophylaxis on the reduction of wound infection in patients submitted to mesh inguinal hernioplasty. A meta-analysis by Sanchez-Manuel and Seco-Gil (3) for the Cochrane Collaboration reported no statistical difference in SSI rates between antibiotic prophylaxis and no antibiotic prophylaxis groups. The absence of this difference between the teams above was corroborated in the Dutch trial (4,6,18,26).

Moreover, there are studies that examine what antibiotics should be administered and how: intravenously, orally or locally. Terzi et al. (11) reported that a single dose of oral ciprofloxacin is as effective as the administration of intravenous cefazolin in patients undergoing inguinal hernia repair with mesh. Musella et al. (34) reported an infection rate of 0.3% when local antibiotics were used. Several studies reported a remarkable benefit of the intravenous monodose, prophylactic 1.5 gr ampicillin and sulbactam, which resulted in a 3X decrease of the deep incisional surgical site infection and a 10X decrease in overall wound infection. Furthermore, it is certain that proper surgical technique, hemostasis and postoperative surveillance play an important role as far as prevention of wound infection is concerned (8,10). As for the type of antibiotic, it seems that it is not responsible for the different outcomes of the trials and their use appears to be more important in prosthetic hernia rather than in non-implant repair (6,20). On the other hand, in recent reviews Sanchez Manuel et al. (3) concluded that the incidence of superficial wound infection is not altered by the use of a foreign body.

According to recent studies, the drug of choice is ampicillin-clavulanic, which seems to be as effective as cephalosporins. However, this combination has been challenged by a multi-center study (19,23,35), which also supports that there is no difference between oral antibiotic prophylaxis and parenteral drug reception, despite a higher dose of amoxicillin-clavulanic acid being used in the oral-treatment group. Furthermore, this combination is twice as expensive as parenteral treatment compared to oral antibiotic prophylaxis.

In summary, the role of antibiotic prophylaxis is still a matter of debate. It is difficult to compare studies due to different antibiotics, surgical techniques, synthetic materials, type of anaesthesia and methods of follow up. Sanabria et al. (33) suggest that wound infection rates must be estimated in each hospital to define if antibiotics should be administered in all patients. In case of low rates of wound infection, selective use of antibiotic prophylaxis based on patients' risk factors might be a good option. In addition, cost-effectiveness should be assessed and it should be determined if the benefits of the antibiotic prophylaxis outweigh the drawbacks. Only carefully designed studies are able to answer these questions. Until strong evidence about antibiotics becomes available, surgeons must follow the current guidelines (antibiotics are recommended when there is a high risk of infection or when the occurrence of an infection is associated with severe consequences)(19). One important step for minimizing infection could be the improvement of the materials (25,36). A mesh material that uses acrylic acid grafting and gentamicin binding is the antibiotic polyvinylidenfluoride (PVDF), which was found to have antimicrobial effect with no signs of cell cytotoxicity. A decrease of infiltrating macrophages and apoptotic cells plus physiologic cell proliferation rates are detected by the use of PVDF. It is well understood that the decrease of the infection rate has many benefits in the confinement of the postoperative costs (2) and the complication rate. Regarding the insertion of drains, in general it has been reportedthat drains acts as a foreign body and may increase the incidence ofinfection, but the use of drain use in selected patients seems to not increase infection risk (37).

We did not observe a difference in the infection of the trauma site in conjunction with the duration and the doses of antibiotic cover in our 10-year, retrospective study. The wound infection rate in the current study fails to support the use of multiple doses of antibiotics, as the infection rate does not differ from the rates of infection reported in the literature. Today, prosthetic repair of inguinal hernias has low recurrence and infection rates in practice. However, surgical site infection is still a potential complication (38). Further studies are needed to clarify if antibiotic chemo-prophylaxis with one dose or no chemoprophylaxis should be recommended.

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