POSTOPERATIVE DEEP WOUND INFECTION IN INSTRUMENTED SPINAL SURGERY

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This study was designed to analyze the frequency, nature and risk factors of postoperative deep wound infection in instrumented spinal surgery. The infection rate of 174 instrumented spinal operations was documented. The patients were investigated in terms of risk factors. Infections occurring after 12 months were considered as late. Eight (4.6%) acute infections occurred and were treated by early surgical debridement. Three (1.7%) late reactions were noted ; they were treated by implant removal. These late reactions were not bacterial infections, but rather foreign body reactions around the implants. Metallic debris due to micromotion especially around the rod and the cross-link connections caused this inflammation. Metallic debris may cause a foreign body reaction mimicking late infection which resolves after debridement and implant removal.

Keywords : infection ; spine ; wound ; instrumentation ; risk factors.
Mots-clés : infection ; rachis ; plaie ; matériel de fixation ; facteurs de risque.

The development of new methods in spinal surgery has resulted in changes in the incidence and character of postoperative complications. Postoperative wound infection following spine surgery is one of the most devastating complications, and it increases with the complexity of the procedure. Diskectomy is associated with less than a 1% risk of infection ; spine fusion without instrumentation is associated with a risk between 1 and 5% , whereas fusion with instrumentation may be associated with a risk up to 13% (mean = 7%) (11, 13).

Wound infection is defined as purulence at the operative site and a microbiological culture positive for one or more microorganisms. Infections may be deep or superficial. Deep infection develops below the lumbodorsal fascia ; its presentation may be late, and the diagnosis is more difficult to establish than with superficial infection. Management of wound infection should be started immediately with aggressive surgical debridement (8, 12, 14). The aim of this study was to investigate our infections following spine fusion and instrumentation to determine their type and frequency.

MATERIALS AND METHODS

A retrospective chart review of 174 patients who underwent spinal fusion and instrumentation between 1992 and 1996 was done. Seventy-two patients had surgery for spinal trauma, 67 for spinal deformity, 23 for spondylolisthesis and 12 for other conditions. The average age at operation was 16 years, with a range of 7 to 74 years. The patients were also classified according to their host responses (systemic defense, metabolic capabilities, poorly controlled diabetes, smoking habits) (25). The complexity and extent of spinal

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instrumentation systems and the operating room conditions were analyzed. The operating room was not equipped with laminar air flow. Isola (Acromed), TSRH (Sofamor Danek), CD (Sofamor), Alycy (Hipokrat), and Kaneda (Acromed) instrumentation systems were used for spinal stabilization.A total of 174 operations were performed : 11 approaches were anterior, 110 were posterior and 53 were both anterior and posterior. All patients received prophylactic antibiotic therapy : second generation cephalosporins were administered intravenously 1 hour prior to surgery and were continued for 24 hours. Skin preparation was done just prior to surgery in the operating room after the patient was anesthetized. Tincture of dichlorhexidine was used for wound preparation ; after draping, iodophore adherent films were used. During the operation, double gloves were used and the outer gloves were changed every two hours. Suction drainage tubes were inserted before closure of the wound. Constant fever over 38.5°C after the second postoperative day, detection of a fluid collection by palpation or ultrasonography, or discharge or aspiration of pus from the wound with a positive Gram stain suggested postoperative infection. This was an indication for prompt exploration of the wound, which was performed in the operating room under general anesthesia. An immediate Gram stain and culture of the wound was taken. Aggressive debridement and irrigation of the entire wound was done. Implants were not removed unless the infection persisted despite 3 repeated debridements performed at 48 hour intervals. Unless grafted bone was not sequestrated, further bone grafting was performed after irrigation and debridement. Adjuvant antibiotic treatment with cefazolin 4 × 1 gr. and gentamycin 3 × 80 mg. was given intravenously after obtaining appropriate cultures during the operation. These antibiotics were modified, if necessary, after obtaining the results of culture and sensitivity. Following 3 weeks of intravenous antibiotic treatment, 3 weeks of oral treatment was given. If the erythrocyte sedimentation rate and blood C-reactive protein did not return to normal levels, oral antibiotic treatment was extended to 3 months. The minimum follow-up period was 18 months. All wound infections that occurred within 12 months postoperatively were considered as early infections.

RESULTS

For the infected cases, the average operation time was 7 hours (5-9 hours) and the average number of vertebrae instrumented was 12 (9-15 vertebrae). We observed 8 (4.6%) acute infections and 3 (1.7%) foreign body reactions out of 174 cases. According to the classification of Thalgott *et al.* (25) the 8 infected cases were class A. The infection rate changed over the years and peaked in 1994 (table I). The complexity of the procedure also correlated well with the rate of infection (table II). Two out of 8 infected cases had paralytic scoliosis, and 2 other patients were post traumatic paraplegia cases.

Methicillin- resistant *Staphylococcus aureus* was the most common microorganism and was cultured from 6 cases. *Pseudomonas aeruginosa* was grown on one culture ; a mixed infection with both *Enterobacter cloacae* and *Acinetobacter baumanii* was noted in another case. We were not able to identify any microorganisms from the aspiration material in cases with late reactions. Histological examination of the granulation tissue obtained in late cases revealed a foreign body reaction with

Table I. — Surgical procedures on the spine and number of infections

	1992	1993	1994	1995	1996	Total
Anterior	—	—	3	4	4	11
Posterior	11	27(1)	21(1)	26(2)	26	110(4)
Ant-post*	—	5	6(1)	15	11(1)	37(2)
Ant-Post**	1	1	5(2)	3	5	15(2)
TOTAL	12	33	35	48	46	174
Infection (%)	0	3.3	11.4	4	2	4.6

* One session
** Two sessions
( ) : Number of infections.

Table II. — The complexity of the procedure correlated well with the infection rate

	1992	1993	1994	1995	1996	Total
Trauma	8	18(1)	11	17(1)	18(1)	72
Deformity	3	8	17(4)	19(1)	20	67
Low-back	—	4	4	9	6	23
Others	1	3	3	3	2	12
Total	12	33	35	48	46	174
Infection (%)	0	3.3	11.4	4	2	4.6

( ) : Number of infections.

foreign body type multinuclear giant cells and metallic debris which possibly caused this reaction. Following debridement the implants were removed in all late cases as there was sufficient bony union. Postoperative cultures were negative. We did not use further antibiotic treatment.

In only one of the cases with acute infection were the implants removed 3 months postoperatively, as debridements alone were not enough to eradicate the infection. In all cases with acute infection, the implants were removed within 3 to 5 years postoperatively either because of recurrence of infection or because of fistula formation.

DISCUSSION

The increased complexity and extent of spinal instrumentation systems has resulted in longer operating time. Additionally these more complex operations may be associated with greater blood loss, longer anesthesia time, and increased postoperative complications (10-13, 15, 16, 24). Certain host related factors are known to increase the risk of postoperative wound infections : advanced age, chronic malnutrition, poorly controlled diabetes, immunosuppression, steroid therapy, smoking and infection at remote sites (1,18,22). None of the 8 cases in which infection occurred had these risk factors, and all were class A according to the classification of Thalgott *et al.* (25).

The literature documents that operations lasting longer than five hours have increased infection rates (9,19,23). Robson *et al.* (21) documented that the bacterial colonization per gram of tissue in a wound is 10^2 after 2.2 hours and increases to 10^5 in 5.7 hours, which means a 90% risk for infection. In our series, the operation time for infected cases was 5 to 9 hours, with an average duration of 7 hours. The postoperative infection rate increases up to 25% especially in paralytic and myelomeningocele cases (3, 28). Two out of 8 infected cases in our study had paralytic scoliosis and 2 other patients were post traumatic paraplegia cases. The average number of vertebrae instrumented in the infected cases was 12 (9-17 vertebrae), and three of them underwent long instrumentations (two T2-S1 and one T4-L4).

The role of prophylactic antibiotics in spinal surgery is well established (9, 13). Lonstein and Akbarnia (13) reported a decreased infection rate from 9.3% to 2.8% with prophylactic antibiotic usage. We used second generation cephalosporins beginning 1 hour prior to surgery and continuing for 24 hours postoperatively. Second generation cephalosporins were selected as they are effective against both *Staphylococcus* species and Gram negative bacteria. Usage 12 hours apart saved nursing overload. As reported in most previous studies, *Staphylococcus aureus* was the most commonly isolated microorganism on culture in these cases (7, 14). Self-retaining retractors should be released periodically to allow tissue perfusion (17). We tried to limit the wound exposure to air by closing the inactive surgical field with sponges. Before closure of the wound, necrotic tissue due to compression by retractors, poor tissue handling and electrocautery was debrided. If possible the implants should be left in place to promote union (3, 10, 12, 16, 25, 27). We did so in all of our cases except one. All the implants in acute infections were removed within 3 to 5 years because of recurrence of infection or fistula formation. Maintenance of the implants resulted in bony union, but infection recurred in all cases, and it was only controlled once the hardware was removed. Operating conditions were also very important as it has been documented that the infection rate increases in crowded operating rooms (14, 26, 27). In our series there was a significant increase in the infection rate during an 8-month period between 1994 and 1995 and we correlated this with poor operating room conditions which were then improved. All the above mentioned preventive measures decreased the infection rate to more acceptable levels (2%) (table I).

Robertson and Taylor (20) reported 2 late deep wound infections following Dwyer anterior spinal instrumentation but they were not able to grow any microorganisms in one of the cases. Heggeness *et al.* (7) reported 6 late deep wound infections. They were able to grow microorganisms in all of them ; they stated that they may have resulted from hematogenous seeding. Wimmer *et al.* (28) reported 10 (2%) late infections in 499 instrumented spinal procedures. In our series, there was granulation tissue and a bursa-like cystic formation surrounding the cross-links in cases with late inflammatory reactions. No microorganisms grew in the cultures taken from this region. Histological examination demonstrated that there was metallic debris which possibly caused a foreign body reaction. In our cases with late reactions, it was possible to solve the problem by just removing the implants without using any antibiotics, and no problems were observed subsequently, with a minimum 2-year follow up. Our opinion is that these late tissue reactions may not be true bacterial infections but foreign body reaction caused by metallic debris due to micromotion around the rod and the cross-link connections. Such late reactions may however also result from infection by hematogenous seeding : late infections after implantation of biomaterials have indeed been reported. The presence of a glycocalyx around the implants may result in microbial adherence (5, 6), which could also explain the late recurrence of infection in all our acute cases. This is different from a foreign body reaction as in our late cases the reaction was limited to cross — link rod connections around which micromotion caused metallic debris. Dubousset *et al.* (2) reported 18 (1%) late inflammatory reactions with the CD instrumentation ; they could not identify any microorganism in 17, and histological analysis revealed inflammation with granuloma formation. All healed with complete hardware removal and without extended antibiotic treatment. Dubousset *et al.* (2) thought this inflammatory reaction was due to implant corrosion.

CONCLUSIONS

Infection is a serious complication which may cause a very poor outcome in spinal surgery with instrumentation. Long segmental instrumentation, long operation time, poor operating room conditions, poor surgical technique, and paralysis cases are risk factors for postoperative infections. Recognition and management of risk factors, and prophylactic antibiotic usage may help to reduce the postoperative infection rate in instrumented spinal surgery. Micromotion around the rod and cross-links can generate metallic debris which may cause a foreign body reaction and pus formation. When infection is suspected, aggressive debridement should be performed without delay.

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SAMENVATTING

U. AYDINLI, O. KARAEMINOĞULLARY, K. TIŞKAYA. Postoperatief diepe wond infecties in de toegepaste spinale chirurgie.

De infectie snelheid van 174 gevallen van spinale chirurgie is gedocumenteerd. De patiënten zijn onderzocht in termen van risico factoren. Infecties die 12 maanden later hebben plaats gevonden zijn als te laat verondersteld. Acht (4,6%) acute infecties van de 174 toegepaste spinale chirurgie zijn geobserveerd en behandeld door een vroege chirurgische ingreep. Drie (1,7%) te late reacties zijn geobserveerd en behandeld door middel van „implant removal". Deze te late reacties zijn geen bacteriële infecties, maar vooral een vreemd lichaam reactie rond de implant. Metallic debris speciaal veroorzaakt door microbeweging rond de staaf en de kruisverbinding is de oorzaak van de opflakkering en wordt opgelost na „debridement" en verwijderen van de implant.

RÉSUMÉ

U. AYDINLI, O. KARAEMINOĞULLARY, K. TIŞKAYA. Les infections postopératoires profondes dans la chirurgie du rachis comportant une ostéosynthèse.

La proportion d'infections a été documentée pour 174 interventions chirurgicales sur le rachis comportant une fixation métallique. Les facteurs de risque ont été étudiés. Les infections apparues au delà de 12 mois

ont été considérés comme des infections tardives. Huit cas d'infection aiguë (4,6%) ont été traités par débridement chirurgical immédiat. Trois réactions tardives (1,7%) ont été traitées par l'ablation ultérieure du matériel métallique. Les réactions tardives ne résultaient pas d'une infection bactérienne ; il s'agissait plutôt de réactions contre corps étrangers autour des implants. Les débris métalliques dûs la mobilité entre la tige et les connexions transversales peuvent être à l'origine d'une réaction contre corps étranger, qui en impose pour une infection retardée mais qui évolue vers la résolution après débridement et ablation du matériel métallique.