Outcome of the infected hip arthroplasty

A retrospective study of 36 patients

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We report the outcome after revision for deep infection in 34 total and two hemiarthroplasties of the hip. Excision arthroplasty was carried out in 26 cases a median of 1 (0–8) years after the infection was diagnosed. Thirteen of these cases later underwent rearthroplasty, and in 3 of them the infection recurred. In 3 cases, revision in one stage with exchange of both components was successfully performed. In 2 cases only one of the components was exchanged; both of these procedures failed to eradicate the infection. Five patients died, two deaths being related to the infection. Altogether, the infection was eradicated in 30/36 cases, 34 of whom first underwent nonradical treatment. This contributed to 1 (0–7) years' delay of removal of the prosthesis. Clearly, revision should be performed early if the infection fails to respond rapidly to antibiotic treatment.

The incidence of infection after hip replacement is now below 1 percent (Editorial 1987, Lidwell et al. 1987), but may still threaten life and limb (Calandruccio 1987).

We have analyzed the records of 36 patients with infected hip arthroplasties revised at the Orthopedic Hospital of the Invalid Foundation between 1976 and 1985.

Patients and methods

There were 36 hip replacements with deep infection (34 total and two hemiarthroplasties) in as many patients; 23 replacements were performed at the Orthopedic Hospital of the Invalid Foundation and 13 in other hospitals. The median age of the patients at the time of arthroplasty was 57 (33–76) years. Twenty-two patients were women and 14 were men (Table 1). The indication for arthroplasty was primary arthrosis (19), arthrosis secondary to trauma (10) congenital dysplasia (4), previous hip infection (2), or rheumatoid arthritis (1).

Previous hip surgery had been performed up to six times in 10 patients, with a previous arthroplasty in 7. A history of focal infective disease or complications was elicited in 4 patients: 1 infectious coxitis of unknown cause, 1 coxitis caused by *Mycobacterium tuberculosis*, and 2 cured or quiescent deep infections after previous hip surgery (Table 2).

Short-term prophylactic antibiotic treatment was always used. There were three cementless prostheses (Cases 22, 31, 32); all the others were cemented. Six peroperative complications occurred in 5 patients: heavy bleeding (2), perforation of the posterior femoral cortex by the femoral component (1), acetabular fracture (1), and femoral fracture (2).

In 24 patients a discharging sinus was identified over the operated-on hip. Within 1 month postoperatively, 5 patients had typical local and systemic signs of purulent infection without sinus formation. In 7 patients either 2 or 3 infective organisms were cultured (Table 1). All the *Staphylococcus aureus* (Tables 1 and 3) were initially only beta lactamase-producing bacteria and susceptible to methicillin. Later, strains of methicillin-resistant staphylococci were cultured in 2 patients (Cases 27 and 31).

Manifestation of infection after the arthroplasty was early (3 months), delayed (3–12 months), or late (> 1 year), with 12 cases in each category. The me-

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Table 1. Observations in 36 patients with endoprosthetic infection. In Cases 1–13, late rearthroplasty was performed after resection

A	B	C	D	E	F	G	H	I	J	K	L	M
1	70	M	1	84	1	4	12	1	3/2	2	3.6	1
2	67	M	1	72	3	0	5	–	5/7	4	6.5	1
3	60	F	1	71	2	5	18	2, 4	5/7	4	15	1
4	71	M	2	83	3	5	18	3	1/2	2	3.8	1
5	49	M	1	75	3	0	12	–	1/11	2	7.7	1
6	74	F	1	85	1	5	18	2, 4, 5	3/2 6/14 4/14	3	2.2	1
7	57	M	3	83	1	28	14	6	1/2	4	3.8	1
8	75	F	1	79	1	12	15	–	1/2 2/2	1	4	1
9	65	F	1	77	2	27	50	4, 7	3/3	3	9	1
10	69	F	1	72	3	21	18	4, 8, 9	5/7	3	12	1
11	49	M	1	77	1	13	6	8	5/7	2	9.7	1
12	71	F	3	81	1	1	33	6	3/3	3	2.8	1
13	62	F	5	78	3	24	110	9	5/7	2	3.2	1
14	63	M	1	77	1	6	6	6			2.6	1
15	72	M	3	77	1	80	ND	2, 3			10.5	1
16	76	F	1	82	2	43	ND	9			4.3	1
17	56	F	1	79	2	20	21	7			6.3	1
18	53	F	1	80	3	65	ND	–			7	1
19	57	F	1	79	2	25	25	8			5.8	1
20	35	F	3	80	2	5	ND	8			1	1
21	60	F	3	82	3	36	ND	4			5	2a
22	50	M	1	77	2	12	6	8, 9			11.3	1
23	70	F	3	84	3	22	ND	2			2.7	1
24	36	M	3	85	1	22	10	4			2.8	1
25	53	F	4	71	3	ND	ND	4			10	2b
26	43	F	3	80	1	6	ND	4			6.5	1
27	59	M	5	71	2	44	ND	4			8.8	2b
28	52	F	1	79	3	83	ND	–			7.3	1
29	46	F	3	74	2	59	ND	2, 4, 5			11.8	1
30	54	M	5	78	2	ND	ND	4			3.6	1c
31	67	M	1	77	3	11	31	4			2.6	2
32	44	F	2	85	2	16	16	4			1.3	1
33	57	F	5	85	2	11	20	9			1.6	1
34	67	F	1	82	1	ND	ND	4			2	2a
35	52	F	1	82	3	58	64	–			5.3	1
36	33	M	3	78	1	30	58	8			4.8	2a

A Case
B Age at primary arthroplasty
C Sex
D Disease
  1 primary arthrosis
  2 postinfectious arthrosis
  3 posttraumatic arthrosis
  4 rheumatoid arthritis
  5 secondary arthrosis after congenitally dysplastic hip
E Year of primary arthroplasty
F Manifestation of infection
  1 early, 2 delayed, 3 late
G First resection arthroplasty after manifestation of infection (months); ND not done
H Rearthroplasty after removal of infected endoprosthesis (months); ND not done
I Infective organism:
  1 *Proteus mirabilis*
  2 *Pseudomonas aeroginosa*
  3 *Escherichia coli*
  4 *Staphylococcus aureus*
  5 *Klebsiella pneumoniae*
  6 *Staphylococcus epidermidis*
  7 *Acinetobacter*
  8 *Streptococcus beta haemolyticus*
  9 *Enterococcus*
J Prophylactic antibiotic/duration of treatment (days) at rearthroplasty
  1 fluoxacillin
  2 gentamicin
  3 clindamycin
  4 kephalosporin
  5 dicloxacillin
  6 rifampicin.
K Mayo scoring after rearthroplasty
  1 excellent, 2 good, 3 fair, 4 poor
L Follow-up from the manifestation of infection (years)
M Outcome of infection
  1 infection eradicated
  2 infection recurred or continued
  a persistent antibiotic therapy
  b death due to infection
  c infection was eradicated without removal of prosthesis

Table 2. Infections preceding hip arthroplasties

Infections	n
Hip infections	
Mycobacterium tuberculosis	1
Postoperative	2
—after osteosynthesis of femoral head fracture (n 1)	
—after previous THR (n 1)	
Unknown	1
Other	
Bacteriuria/urinary infection	7
Cholecystitis followed by *E. coli* sepsis	1
Osteomyelitis and femur amputation of the contralateral leg 7 months before THR	1
Pneumonia 1 month before THR	1
Spondylitis (*E. coli*) of Th 10–11	1
Chronic bronchitis	1
Erysipelas of the operated on leg	1
Ulcer of the leg	1
Total	19

THR total hip replacement.

dian interval between the arthroplasty and diagnosis of the infection was 5 months (14 days to 10 years), and from manifestation of the infection and removal of the infected material 16 months (0–7 years).

From 1976 to 1981, the antibiotic treatment was chosen individually from case to case. When sinus revisions were performed, Septopal® beads were used when feasible. Systemic antibiotic treatment was usually adjusted by culture results. This policy was changed in 1981. We discontinued using local antibiotics after soft-tissue revisions and began to favor radical revisions, usually in two stages, together with prolonged systemic antibiotics based on the cultures.

Two cases were excluded from analysis (Cases 13 and 18): 1 patient underwent an immediate excision arthroplasty with good results without any preceding minor revisions; and for the other, primarily treated elsewhere, insufficient data were available concerning the initial treatment. The remaining 34 patients at first underwent nonradical (Figure 1) treatment with antibiotics, revisions of sinuses, and applications of lavage and suction drainage. After this primary stage, the cases were divided according to the mode of treatment into three groups:

Group I: Excision arthroplasty was carried out in 26 cases in Stage II. Thirteen of them were left without further surgery, and 13 (Cases 1–13) underwent reathroplasty a median of 17 months (5 months–9 years) after removal of the infected prosthesis. The latter patients were reexamined, and the Mayo hip score (Kavanagh and Fitzgerald 1985) was used to assess the final result.

Group II: In 2 patients (Cases 24 and 31), only one of the infected components was revised (Figure 1).

Group III: One-stage exchange arthroplasty of both components was performed in Cases 14, 17, and 19 at 6–22 months after the manifestation of infection.

The median follow-up time for the patients with infection was 6 (1–15) years and after rearthroplasty in Cases 1–13, 3 (1–8) years.

Table 3. Infective organisms (N 40) cultured from 30 infected hip arthroplasties

Microorganism	Manifestation of infection after the arthroplasty (n)			
	< 3 months	3–12 months	> 1 year	Total
Gram-positive				
Staphylococcus aureus	4	6	4	14
Staphylococus epidermidis	3			3
Streptococcus, group A	2	3	1	6
Streptococcus, group D				
Enterococcus	0	3	2	5
Gram-negative				
E. coli	1		1	2
Psudomonas aeruginosa	2	2	1	5
Proteus mirabilis	1			1
Klebsiella pneumoniae	1	1		2
Acinetobacter		2		2
Unidentified	1		5	6

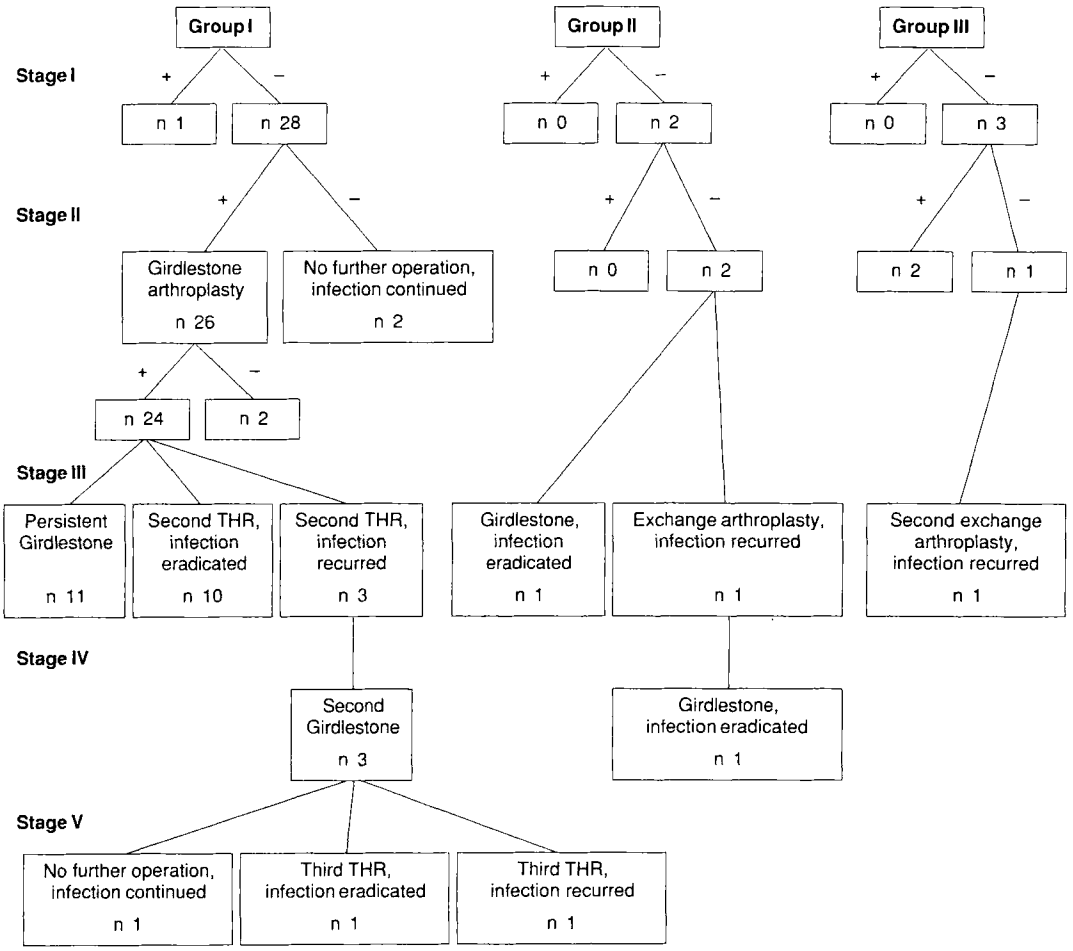

Figure 1. Treatment modes in 34 infected hip arthroplasties. Initial (Stage I) treatment with antibiotics, soft-tissue revision, lavage, and suction drainage was the same in each, and the patients were divided into three groups based on the treatment mode used from Stage II onward.

+ Infection was eradicated.
– Infection continued or recurred.

Results

All except Case 30, whose infection healed after nonradical treatment, needed further surgery (Figure 1).

In Group I, the infection was eradicated in 24 and continued in 2. For rearthroplasty cases, the result was excellent in 1, good in 5, fair in 4, and poor in 3. Three patients died during follow-up.

Both infections in Group II recurred, and the infection was eradicated after subsequent excision arthroplasty.

In Group 3, all three exchange arthroplasties were successful. Five years later, however, hematogenous spread of beta hemolytic *Streptococcus* originating from erysipelas on the operated on leg caused reinfection of the prosthesis in Case 19. This infection was eradicated after excision arthroplasty.

In 6 cases the infection was not eradicated. Two had a chronic infection with draining sinuses despite removal of the prosthesis; 4 had their prostheses left in place despite symptoms of infection treated by continuous antibiotic administration. In 3 of these 4 cases the infection was silent during the antibiotic treatment, and no loosening of the components was observed.

Ten major postoperative complications occurred in as many cases: five deep endoprosthesis infections manifested within 1 month postoperatively; two dislocations, one fracture of the proximal femur,

and one femoral nerve palsy. Two early reoperations were done: one for postoperative hematoma and the other for inadequate position of the the femoral component with fracture of the proximal femur.

Five patients died during the follow-up. Three deaths were unrelated to infection, but in Cases 25 and 27 the deaths were a direct complication of the infection.

The median time of hospitalization for treatment of the infection was 6 (2–23) months. A long hospital stay seemed to be due to a delay in radical revision and inadequate treatment.

Discussion

Often the endoprosthesis infection is caused by more than 1 pathogen (Gristina and Kolkin 1983, Gristina and Costerton 1985), as in 7 of our cases. In 6 cases the cultures were negative, which is more than reported (Inman et al. 1984, Fitzgerald 1986). The difference may be due to the antibiotic treatment the patients had received at the time when the specimen was obtained for culture. In addition, in the early years of the study, anaerobes and tissue biopsies were not cultured routinely. The diagnosis for deep infection in antibiotic-treated patients may in the future be facilitated by an immunocytologic analysis of the sterile synovial-fluid aspirate (Santavirta et al. 1989).

The development of two methicillin-resistant strains of *Staphylococcus aureus* in our patients can be concluded to be a direct consequence of inadequate treatment of the infection. Enterococcal infections (three unifocal and two in combination with other microbes in our series) are known to be highly resistant to most antibiotics and are found in both primary and secondary infections (Kaye 1982).

In chronic infections the rare possibility of *Mycobacterium tuberculosis* has to be kept in mind (Eskola et al. 1988, Santavirta et al. 1989): the 1 patient with a *M. tuberculosis* hip infection and fatal dissemination of the disease in this series is a warning example. The two deaths related to infections serve as a reminder that an endoprosthesis infection must be regarded as a potentially life-threatening complication.

Surgical debridement without excision of the endoprosthesis can only occasionally salvage the prosthesis (Amstutz and Kass 1977, Fitzgerald et al. 1977). Budding understanding of infections in relation to the biomaterials used in total hip replacements (Gristina and Costerton 1985) explains the need of a more radical treatment.

Minor revision procedures and systemic antibiotics have proved inadequate, with a few unpredictable exceptions, and seem mainly to contribute to long hospitalization, secondary complications, and increased suffering or even death of the patients. Our analysis reveals that the treatment of several patients was questionable in many ways. There is also no support for the exchange of only one of the infected components.

The primary results in 3 patients treated with one-stage exchange arthroplasty were good, but in general the results reported have been inconsistent (Carlsson et al. 1978, Buchholz et al. 1981, Hedström and Lidgren 1988, Sanzén et al. 1988). A two-stage revision is not totally without risk of recurrence of the infection. The opinion about the optimal interval between the two stages still varies. Our 25 (5–110) months' interval was probably too long (Hovelius and Josefsson 1979). At this point, our policy is to perform the rearthroplasty with a cementless prosthesis 3 to 6 months after removal of the infected components.

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