

# Bacterial arthritis in an English health district: a 10 year review

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**SUMMARY** Bacterial arthritis continues to present a difficult clinical and therapeutic problem necessitating prompt diagnosis and intensive therapy. This study comprises a 10 year review of the condition in an English health district, with particular reference to aetiology, presentation, treatment, and outcome. Although the causative organisms remain qualitatively unchanged increasing numbers of patients are elderly, immunosuppressed, or have underlying arthropathy. Factors which influence outcome include age, causative organism, joint involved, and delay in diagnosis. Attention is drawn to the notably poor outcome of hip infections in the elderly.

**Key words:** septic arthritis, epidemiology, diagnosis, outcome.

Despite the widespread use of potent antibiotics, bacterial arthritis remains a diagnostic and therapeutic problem. Several studies over the last two decades, largely from North America, have suggested a change in the age of patients affected, with the disease becoming increasingly common in the elderly, and a change in the causative organism, with higher rates of gonococcal and gram negative bacillary infection.<sup>1-9</sup> We have reviewed all cases of bacterial arthritis presenting in the Southampton health district over the decade from 1973 to 1982 inclusive, with particular reference to the joints involved, aetiology, therapy, and outcome.

## Patients and methods

The case records of all patients with a final diagnosis of bacterial arthritis presenting to hospitals in the Southampton health district (population *c* 350 000) between 1973 and 1982 were identified with the International Classification of Disease coding on the district health authority returns. Diagnostic criteria for inclusion in the study were modified from those of Newman,<sup>7</sup> to restrict the number of patients in whom a causative organism could not be identified. Patients either had the clinical features of septic arthritis with the organism isolated from synovial fluid or blood, or they showed typical clinical features but had previously been treated with

antibiotics and on aspiration the joint fluid contained greater than  $10^5$  pus cells/ml. Joints previously treated surgically and infections due to *Mycobacterium tuberculosis* were excluded.

The information recorded in each case comprised: (i) age, (ii) sex, (iii) source of referral, (iv) clinical specialty undertaking management, (v) previous medical history, including pre-existing joint disease, (vi) presenting joint, (vii) delay between onset of symptoms and diagnosis, (viii) presenting symptoms and signs, (ix) toxaemia (pyrexia greater than  $39^\circ\text{C}$  or peripheral white cell count greater than  $14 \times 10^9/\text{l}$ ), (x) source of infection, (xi) immunosuppression, (xii) causative organism and source of diagnosis, (xiii) results of joint aspiration, haematological indices, and blood culture, (xiv) radiology, (xv) treatment, (xvi) outcome, quantified by the use of four measures: (a) the occurrence of complications, (b) recurrences (defined as recurrence of infection in the same joint despite treatment with antibiotics for a period of at least four weeks), (c) bed occupancy, and (d) duration of immobility (defined as the period of time from the onset of symptoms until the joint regained its previous level of mobility). Data about the nature, route, and suitability of antibiotic administration could not be reliably documented retrospectively.

## Results

### EPIDEMIOLOGY

Of the 137 cases coded for bacterial arthritis during the study period, 74 were considered suitable for

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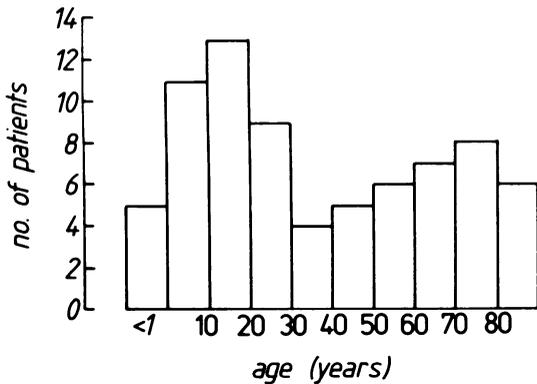


Fig. 1 Septic arthritis: age distribution of cases.

entry (27 followed surgery, 22 were miscoded or did not fulfil entry criteria, 10 were tuberculous, and four were not traceable).

Of the 74 cases studied, 43 were male and 31 female; no relation was detected between the sex of patients and either the causative organism or outcome. Their ages ranged from 2 months to 85 years, and the age distribution is shown in Fig. 1. Although there was some preponderance of cases at the extremes of life, 33% of the patients were between the ages of 20 and 59 years. For the purposes of this study they were grouped into three age categories: less than 19 years, 20 to 59 years, and 60 years or over. Five cases were identified in infants.

Forty eight patients were referred to hospital by general practitioners and 26 were admitted via accident and emergency departments; several hospital specialties were concerned in their initial management (Table 1).

The organism was identified in 81% of cases overall (Table 2); in 43 cases (58%) it was grown from the joint aspirate, and in 16 of these blood culture was also positive. Blood cultures were the sole source of the diagnosis in 10 further cases (14%), and in seven cases (9%) the organism was cultured from other sources (skin—three, sputum—two, middle ear—one, and pharynx—one).

Table 1 Speciality of management

Speciality	No
Orthopaedic	33
Paediatric	13
Rheumatology	11
Medical	7
Geriatric	5
Genitourinary	5

Table 2 Source of organism

Source of organism	No	(%)
Blood and synovial fluid	16	22
Blood	10	14
Synovial fluid	27	36
Other	7	9
None*	14	19

\*Cloudy aspirate with  $10^5$ /ml pus cells, in a patient with typical clinical features, previously treated with antibiotics.

*Staphylococcus aureus* was the commonest infecting organism, comprising 44% of the total number of cases, of which the majority were penicillin resistant strains. Beta haemolytic streptococci and *Neisseria gonorrhoeae* were each isolated in 11% of cases; a number of other organisms were also encountered (Table 3). It should be emphasised that in the cases attributed to gonococcal infection the organism was cultured from synovial fluid. The causative organism was not identified in 14 patients (19%). In these patients with negative bacterial cultures admission to the study required documented exclusion of other causes of acute monoarticular synovial effusion. Thus synovial fluid had been examined for crystals. In the presence of chondrocalcinosis, positive bacterial culture from the joint was required for inclusion in the study.

When grouped by age it was found that almost all infections in middle life were caused by penicillin resistant staphylococci and gonococci. Penicillin sensitive staphylococcal arthritis and gram negative bacillary infections were confined to the young and elderly. Both cases due to *Haemophilus influenzae*

Table 3 Causative organism and relation to age

Organism	Age group			Total	
	0-19	20-59	60+	No	(%)
<i>Staph aureus</i> (pen. res.)	7	12	7	26	35
<i>Staph aureus</i> (pen. sens.)	5	—	2	7	9
<i>Streptococcus pyogenes</i>	5	1	2	8	11
<i>Str viridans</i>	1	—	1	2	3
<i>Haemophilus influenzae</i>	2	—	—	2	3
<i>Neisseria gonorrhoeae</i>	2	6	—	8	11
Pneumococcus	1	—	—	1	—
Meningococcus	—	1	—	1	—
<i>Escherichia coli</i>	—	—	1	1	—
<i>Proteus</i>	—	—	1	1	—
<i>Pseudomonas</i>	1	—	—	1	—
<i>Clostridium welchii</i>	—	—	1	1	—
Bacteroides	—	—	1	1	—
No organism detected	5	4	5	14	19

Table 4 Presenting joint and relation to age

Joint	Age group			Total	
	0-19	20-59	60+	No	(%)
Knee	14	15	10	39	53
Hip	9	2	8	19	26
Shoulder	1	1	1	3	4
Elbow	3	1	—	4	5
Foot	—	—	2	2	3
Ankle	1	1	—	2	3
Hand	—	3	—	3	4
Sternoclavicular	—	1	—	1	—
Spine	1	—	1	2	3
Total	29	24	22	75	100

were in infants. Polymicrobial infections were not encountered.

The most commonly affected joints were the knee (39 cases, 53%) and the hip (19 cases, 26%). The knee was the commonest site of infection in all age groups, but the hip was increasingly affected in youth and old age. Several other limb joints were involved less commonly (Table 4). There was only one case of polyarticular infection, and two cases of primary septic arthritis of the spine were encountered.

#### PREDISPOSING FACTORS

The major predisposing factors to infectious arthritis comprised pre-existing joint disease, minor trauma, immunosuppression, and diabetes mellitus. Pre-existing joint disease was found in 34 patients (46%); osteoarthritis and rheumatoid arthritis were the most prevalent (Table 5). Although the majority of cases of infectious arthritis arising in patients with underlying joint disease occurred in middle and late life, three juvenile skeletal disorders were identified: congenital dislocation of the hip, Perthes' disease, and a dysunited radial epiphysis.

A history of preceding trauma was recorded in 24

Table 5 Pre-existing joint disease

Joint disease	No	(%)
Osteoarthritis	15	20
Rheumatoid arthritis	10	14
Gout	3	4
Psoriatic arthritis	2	3
Ankylosing spondylitis	1	—
Congenital dislocation of the hip	1	—
Perthes' disease	1	—
Dysunited radial epiphysis	1	—
Total	34	46

Table 6 Complications

Complication	No
Osteomyelitis	12
Permanent immobility/ankylosis	7
Recurrent effusion (six months)	7
Osteoarthritis	4
Avascular necrosis	3
Others*	5

\*Loose body, instability, drop foot, quadriceps wasting (two).

cases (32%). Immunosuppression was identified in 12 cases (16%), eight in diseases associated with immunoparesis (three haematological malignancies, four with disseminated carcinoma, and one with a fibrosarcoma), and four due to cytotoxic drug therapy in non-immunosuppressive disease. Five patients (7%) had insulin dependent diabetes mellitus.

#### DIAGNOSIS

All patients presented with pain and some loss of joint function, but considerable variation was seen in constitutional features at presentation. A temperature of greater than 39°C was found in only 29 cases (39%), and a peripheral blood leucocytosis greater than  $14 \times 10^9/l$  in only 17 (23%). Blood cultures were positive in 36% of cases overall, and aspiration in 58% of the total number. The erythrocyte sedimentation rate was raised in the majority of cases, between 50 and 99 mm/1st h in 31 patients and to greater than 100 mm/1st h in 13.

The mean delay in establishing the diagnosis was 12 days; it was influenced by age (prolonged in the elderly), by the joint affected (prolonged in cases of hip infection), and by the presence of underlying joint disease.

#### TREATMENT AND OUTCOME

The conventional measures used in the treatment of infectious arthritis, namely joint immobilisation, aspiration, and the administration of systemic antibiotics, were employed in all cases. In addition, intra-articular antibiotics were instilled in 15 cases (11 knees and four hips), and surgical drainage was carried out in 25 cases, 13 affecting the hip. Multiple aspirations were necessary in 19 (26%), predominantly for the hip.

Overall outcome was assessed by the occurrence of complications, recurrences, duration of immobility, and bed occupancy. Data on these variables were obtained in all cases except for the duration of immobility, which could only be assessed in 90% of the patients. Complications occurred in 35% of the

total number of cases and were often multiple (Table 6). Osteomyelitis, not detectable radiologically at presentation but subsequently evident, occurred in 12 cases, all staphylococcal. Seven patients died during their inpatient stay; all were over the age of 60 years, and in five cases the cause of death was a fulminating septicaemic illness following the episode of infectious arthritis. The overall recurrence rate was 14%, and the mean bed occupancy (excluding the seven deaths) was 27 days. Fifteen of the 74 cases (20%) never regained the level of joint mobility possessed before their infectious episode; in the remainder the mean duration of immobility was 9.7 weeks. The average follow up period was 20 months, ranging from two months in uncomplicated infections to several years in those with severe disability.

A number of factors were found to influence the four measures of outcome, including the infecting organism, joint affected, age, delay in diagnosis, pre-existing joint disease, and immunosuppression (Table 7). These are now considered individually.

### Organism

When categorised bacteriologically into staphylococcal (penicillin sensitive and resistant), streptococcal, gonococcal, and gram negative bacillary infections clear differences were seen in outcome. Gonococcal arthritis had a notably favourable outlook, with no complications, recurrences, or permanent loss of joint function, and low rates of bed occupancy. Infections due to streptococci (both *Str pyogenes* and *Str viridans*) also had a relatively benign course, but staphylococci and gram negative bacilli were associated with a poor outcome. Penicillin resistant *Staph aureus* had a worse prognosis than the penicillin sensitive variety, with a high rate of complications, recurrences, and permanent disability. Of the other less frequently encountered pathogens, it is noteworthy that both cases due to *H influenzae* had long term complications.

### Joint affected

Of the two most commonly affected joints, the hip had a far worse outcome than the knee, with a

Table 7 Outcome

	No	C(%) <sup>*</sup>	R(%) <sup>*</sup>	P(%) <sup>*</sup>	I <sup>m</sup> (weeks) <sup>*</sup>	B(days) <sup>*</sup>
<i>Organism</i>						
<i>Staph aureus</i> (pen. res.)	26	58	23	31	16	34
<i>Staph aureus</i> (pen. sens.)	7	28	14	28	7	25
Streptococcus	10	30	10	20	7	16
<i>N gonorrhoeae</i>	8	—	—	—	4	5
Gram neg. bacilli	4	25	—	25	12	28
<i>Joint</i>						
Knee	39	31	8	13	9	23
Hip	19	53	21	47	11	43
Shoulder	3	33	—	33	5	17
Elbow	4	—	25	—	2	10
Hand	3	33	—	—	2	25
Foot/ankle	4	25	50	—	4	32
<i>Age (years)</i>						
0-19	29	21	7	3	7	24
20-59	24	33	8	13	15	34
60+	21	62	29	52	18	43
<i>Delay in diagnosis</i>						
Less than 10 days	42	33	12	11	8	25
Greater than 10 days	31	41	16	32	12	31
<i>Pre-existing joint disease</i>						
Present	34	57	19	35	10	37
Absent	40	24	10	8	9	23
<i>Immunosuppression</i>						
Present	12	67	17	33	13	29
Absent	62	32	15	19	9	28

<sup>\*</sup>C(%)=occurrence of complications (% in each category); R(%)=recurrences (% in each category); P(%)=patients with permanent loss of some joint function (% in each category). I<sup>m</sup>(weeks)=mean duration of immobility; B(days)=mean bed occupancy.

complication rate of 53% and permanent loss of function in 47% of cases. Among the other joints, infections of the elbow had a better outcome than those of the shoulder, ankle, foot, and hand.

#### Age

Complication and recurrence rates, duration of immobility, and bed occupancy were all related to age, with the worst outcome in the elderly and a considerably better prognosis in those aged less than 20 years.

#### Delay in diagnosis, underlying joint disease, immunosuppression

These three factors influenced outcome as shown (Table 7). A delay in diagnosis of less than 10 days appeared to confer a substantial reduction in bed occupancy and duration of immobility, and the mean delay in patients who developed complications was three times longer (21.5 days) than in those who did not (7.5 days).

No difference was detected between outcome and the use of either intra-articular antibiotics or surgical drainage; the latter was in fact associated with higher rates of complications and permanent immobility. This is possibly a reflection of the use of these therapeutic manoeuvres in the more severe infections, and in particular for those affecting the hip, a joint with a considerably poorer prognosis.

#### Discussion

This study confirms certain trends in the pattern of infectious arthritis in the United Kingdom. The incidence rate found in this district is comparable with that in previous studies from this country and from North America.<sup>7-9</sup> Although initially ascribed as a disease of children,<sup>1 10</sup> subsequent workers have shown a rising incidence among the elderly;<sup>7 8</sup> this pattern of age distribution is borne out in our results, with 28% of patients above the age of 60 years. *Staph aureus* (particularly the penicillin resistant strains) remains the most common infecting organism in this country, in accord with the findings of other European studies.<sup>5 7 11 12</sup> American reviews, however, suggest a higher prevalence of gonococcal and gram negative bacillary infections.<sup>1-4 6 8 9</sup> The varying distribution of gonococcal arthritis is partly accounted for by differences in diagnostic criteria, such as the inclusion of patients with reactive arthropathy after gonococcal infection, but may also reflect the varying pathogenicity of different auxotypes of the organism.<sup>13</sup> The reasons for the higher rate of gram negative bacillary arthritis in the USA is not known, but the finding is in accord with the higher American prevalence of gram negative bacteraemia.<sup>14</sup>

At particular risk from joint infection are the elderly, the immunosuppressed, and those with underlying joint disease. The clinical features of bacterial arthritis in the elderly are discussed in greater detail elsewhere.<sup>14a</sup> The prevalence of underlying arthropathy in our study is higher than that in other reviews,<sup>6-8</sup> partly due to the inclusion of patients with osteoarthritis, a condition which becomes increasingly common in an elderly population. Although suppurative arthritis is now a well recognised and dangerous complication of rheumatoid arthritis,<sup>15-17</sup> it is noteworthy that inflammatory joint diseases other than rheumatoid arthritis (namely psoriatic arthritis, ankylosing spondylitis, and gout) and juvenile skeletal disorders, may predispose to infection, and also that underlying joint disease causes difficulty in diagnosis and adversely affects outcome. The association of infectious arthritis with both penetrating and non-penetrating trauma has been previously reported,<sup>9</sup> though its significance is not clear. A history of non-penetrating trauma was recorded in a large proportion (29%) of our cases and was a particularly common antecedent of infection in patients with underlying joint disease.

Patients are often not toxaemic at presentation. The constitutional features used to define a toxic state (temperature greater than 39°C and peripheral blood leucocytosis greater than  $14 \times 10^9/l$ ) were adopted from previous studies.<sup>7 8</sup> Non-toxaemic presentation was most likely to occur in elderly and immunocompromised patients. The mean delay of 12 days between the onset of symptoms and diagnosis is disappointingly similar to that quoted previously.<sup>7</sup> Although a variety of biochemical, radiological, and immunological investigations, such as synovial fluid lactate level,<sup>18</sup> the nitroblue tetrazolium test,<sup>19</sup> radionuclide joint imaging,<sup>20</sup> and microbial antigen detection,<sup>21</sup> have been suggested as valuable in the diagnosis of septic arthritis, these had not been used in most of the cases included in this study. If more comprehensive investigation had been employed whenever the possibility of bacterial arthritis arose it is possible that other cases would have been diagnosed.

The measurement of outcome has been a major problem in studies of infectious arthritis, and a number of previous workers have classified this as being either good or bad, using a variety of criteria.<sup>6-8</sup> We attempted to quantify outcome retrospectively by recording the occurrence of complications and recurrences, duration of immobility, and bed occupancy. Although a number of factors, both social and medical, influence these measures, their collective use provides an indication of the

severity of infection and response to treatment. The following six inter-related factors were found to influence the four measures of outcome: increasing age, the causative organism, the joint affected, delay in diagnosis, pre-existing joint disease, and immunosuppression. Infections due to gonococci and streptococci were notably benign, whereas penicillin resistant *Staph aureus* and the gram negative bacilli were associated with a poorer outcome. Hip infections, particularly those in the elderly, carry a poor prognosis, with two of the eight cases occurring in elderly patients resulting in death and permanent disability ensuing in the remaining six. This is partly due to delay in diagnosis, but almost certainly involves other factors associated with the aging process, and emphasises the need for a high index of suspicion in the geriatric age group.

It is difficult to assess the various modalities of treatment of infectious arthritis in a retrospective manner. Our results suggest that early aspiration and administration of systemic antibiotics influence outcome favourably. As we have discussed elsewhere bactericidal antibiotic concentrations should be achieved in the synovial fluid and in the serum.<sup>22</sup> The use of intra-articular antibiotics and surgical drainage did not confer any benefit, though these measures were often employed in patients with hip infections (a group biased for other reasons towards a poor prognosis).

Finally, it is salutary that despite the widespread use of antibiotics, chronic morbidity occurs in nearly a third of patients, and a significant mortality is still attributable to the condition. It seems likely that this morbidity could be reduced by earlier diagnosis and treatment.

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