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An 18 year clinical review of septic arthritis from tropical Australia

D. S. MORGAN[1], D. FISHER[1], A. MERIANOS[2] AND B. J. CURRIE[1,2]*

[1] *Division of Medicine, Royal Darwin Hospital, Northern Territory*
[2] *Disease Control Centre and Menzies School of Health Research, Royal Darwin Hospital, Northern Territory*

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SUMMARY

A retrospective study of 191 cases of septic arthritis was undertaken at Royal Darwin Hospital in the tropical north of Australia. Incidence was 9·2 per 100000 overall and 29·1 per 100000 in Aboriginal Australians (RR 6·6; 95% CI 5·0–8·9). Males were affected more than females (RR 1·6; 95% CI 1·2–2·1). There was no previous joint disease or medical illness in 54%. The commonest joints involved were the knee (54%) and hip (13%). Significant age associations were infected hips in those under 15 years and infected knees in those over 45 years. Seventy-two percent of infections were haematogenous. Causative organisms included *Staphylococcus aureus* (37%), *Streptococcus pyogenes* (16%) and *Neisseria gonorrhoeae* (12%). Unusual infections included three melioidosis cases. Polyarthritis occurred in 17%, with *N. gonorrhoeae* (11/23) more likely to present as polyarthritis than other organisms (22/168) (OR 6·0; 95% CI 2·1–16·7). Univariate and multivariate analysis showed the hip to be at greater risk for *S. aureus* than other joints. Open arthrotomy was a more successful treatment procedure than arthroscopic washout or needle aspiration.

INTRODUCTION

Septic arthritis is the most serious cause of acute joint inflammation and if not diagnosed and treated promptly can be associated with severe morbidity [1–6]. The most common aetiological agents are *Staphylococcus aureus*, *Streptococcus pyogenes* and *Neisseria gonorrhoeae* [1–9]. The Royal Darwin Hospital is the referral centre for the tropical top end of the Northern Territory of Australia. The hospital services a population of around 130000, of whom 20% are Aboriginal Australians often living in remote communities under disadvantageous circumstances. Nearly all patients in the top end with septic arthritis require management at Royal Darwin Hospital for intravenous antibiotics and orthopaedic procedures. Previous studies have demonstrated a high incidence of infectious diseases in this region, particularly in Aboriginals [10–12]. This is the first study of joint sepsis in this region. We have reviewed the epidemiology, clinical aspects, microbiology and management of patients admitted to Royal Darwin Hospital with septic arthritis between 1976 and 1994.

* Correspondence and requests for reprints: Assoc. Prof. B. J. Currie, Menzies School of Health Research, P.O. Box 41096, Casuarina, NT 0811, Australia.

METHODS

The study involved a retrospective medical record review. Cases were identified via the medical records department and from records maintained by the orthopaedic unit. Cases were classified as definite, probable, or possible septic arthritis based on the following case definitions:

Definite cases

Patients with disease clinically consistent with septic arthritis and an aspirate organism demonstrated on culture or Gram stain.

Probable cases

Patients with disease clinically consistent with septic arthritis and:

1. Synovial fluid leucocyte count $\geqslant 50000/mm^3$ [1, 3] and no other cause of arthritis identified, but no organism identified on aspirate Gram stain or culture, or
2. Blood culture positive but the joint not aspirated and no other cause of bacteraemia evident, or
3. Pathogenic organism cultured from either a discharging wound sinus or in the case of *N. gonorrhoeae*, a genito-urinary swab.

Possible cases

Patients with a discharge diagnosis of septic arthritis but the available data did not fulfil the criteria for definite or probable cases. These represented cases where the discharge diagnosis was misclassified and obviously wrong as well as cases that may have been septic arthritis but were inadequately documented.

Only patients with definite and probable septic arthritis were included in the analysis. Cases were not included if an organism was cultured but was considered on clinical or laboratory grounds to be a contaminant.

Time to presentation was defined as the period in days from the onset of symptoms to the commencement of medical attention at either Royal Darwin Hospital or a community health centre. Patients were divided into age groups as follows: 14 years and under, 15–29 years, 30–44 years and 45 years and over. Where no direct route of joint infection was evident, it was considered to be 'haematogenous'.

The causative organism was defined as the organism isolated from a joint/tissue aspirate, blood culture or, in the case of *N. gonorrhoeae*, a urethral swab.

Statistical analysis

Incidence rates were calculated using population denominators extracted from the Australian Bureau of Statistics census data 1986–91. Epi Info Version 5 was used to generate simple descriptive statistics, odds ratios, relative risks and 95% confidence intervals (95% CI) [13]. Factors associated with septic arthritis in the univariate analysis were fitted to logistic regression models with Egret Software [14], using the presence of gonococcal and alternatively staphylococcal arthritis as the outcome factors.

RESULTS

Epidemiology

Between 1976 and 1994, 541 patients had a discharge diagnosis of septic arthritis. Of these, 191 satisfied the criteria for either 'definite' ($n = 133$) or 'probable' ($n = 58$) disease. Three hundred and fifty 'possible' cases were excluded. The mean age at presentation was 30·2 years (range: 6 months–86 years). Twenty-seven patients (14%) were under the age of 10 years.

The average annual incidence of septic arthritis was 9·2 cases per 100000. Septic arthritis was more common in Aboriginals ($n = 118$) than in non-Aboriginals ($n = 73$) (RR = 6·6; 95% CI 5·0–8·9, $P < 0·0001$), with the annual incidence in Aboriginals being 29·1 per 100000 population. Males ($n = 120$) were affected more often overall than females ($n = 71$) (RR = 1·6; 95% CI 1·2–2·1, $P = 0·004$). However, there was no significant difference in the incidence of septic arthritis between Aboriginal males ($n = 64$) and females ($n = 54$) (RR = 1·2; 95% CI 0·9–1·8, $P = 0·3$), but non-Aboriginal males ($n = 56$) were over-represented compared with non-Aboriginal females ($n = 17$) (RR = 2·9; 95% CI 1·7–5·1, $P = 0·0001$).

Patients came from all regions of the top end of the Northern Territory, with a median duration of illness before presentation of 3·0 days (range 0·5–33). Duration of illness before presentation was not significantly different between Aboriginals and non-Aboriginals overall, nor between different age groups. However male Aboriginals presented significantly later than male non-Aboriginals (median 4·0 and 2·0 days respectively; $P = 0·01$). People living in remote communities took longer to seek medical attention (median 4·0 days) than their urban counterparts (median 2·0 days, $P = 0·006$). There was no difference in presentation time with respect to the causative organisms *S. aureus* (median 4·0 days), *S. pyogenes* (median 2·5 days) and *N. gonorrhoeae* (median 3·0 days). Although trauma to the involved joint was reported by 46% (87/191) of patients, a history of

Table 1. *Risk factors*

	No.	%
Alcohol abuse	30	16
Diabetes	21	11
Past septic arthritis	7	4
Corticosteroid use	6	3
Osteoarthritis	5	3
Rheumatoid arthritis	4	2
Malignancy	4	2
Prosthetic joints	3	2
Other past infection*	47	25
None	104	54
Total	191	100

* Significant infection requiring hospitalization.

Table 2. *Site of infection**

	No.	%
Knee	104	54
Hip	25	13
Ankle	16	8
Wrist	10	5
Metacarpo-phalangeal	9	5
Elbow	9	5
Shoulder	9	5
Proximal interphalangeal	7	4
Distal interphalangeal	1	1
Sterno-clavicular	1	1
Total	191	100

* Polyarthropathy was recorded in 34 cases. The most symptomatic joint is listed.

trauma did not affect the duration of illness before presentation.

Most patients (54%) were previously well. Alcohol abuse, diabetes, corticosteroid administration and pre-existing joint disease were the most common risk factors (Table 1).

The knee was the most commonly affected joint (54%), followed by the hip (13%) (Table 2). On univariate analysis infected hip joints were more common in those aged 0–14 years (19/47) than those aged 15 years and over (6/144) (OR = 15·6; 95% CI 5·3–51·1, $P < 0·0001$). Infected knee joints were more common in those over 45 years (29/40) than those under 45 (75/151) (OR = 2·7; 95% CI 1·2–6·2, $P = 0·016$).

Gonococcal arthritis was more common in Aboriginals (20/118) than in non-Aboriginals (3/73) (OR = 4·8; 95% CI 1·3–25·8, $P = 0·0016$) and in females (15/71) than in males (8/120) (OR = 3·8; 95% CI 1·4–10·8, $P = 0·006$). *S. aureus* was more common when compared with other organisms in the hip (18/25) than in other joints (52/166) (OR = 5·6; 95% CI 2·1–16·1, $P = 0·0002$). Neither *N. gonorrhoeae* nor *S. pyogenes* showed any joint predilection when compared to the other organisms.

Polyarthritis was seen in 34 cases. The most common organism identified in these patients were *N. gonorrhoeae* ($n = 11$) and *S. aureus* ($n = 10$), with *N. gonorrhoeae* more likely to present as a polyarthritis (11/23) than other organisms found in these patients (22/168) (OR = 6·0; 95% CI 2·1–16·7, $P = 0·0003$).

In the logistic regression model female sex remained a significant risk factor for gonococcal arthritis (OR = 3·4; 95% CI 1·3–9·1, $P = 0·016$), while age 15–29 and Aboriginality approached significance ($P = 0·078$ and $P = 0·064$ respectively).

In the logistic regression model the hip joint was at greater risk for *S. aureus* infection than were other joints (OR = 3·8; 95% CI 1·3–10·7, $P = 0·012$). Ages 15–44 years had a reduced risk of *S. aureus* infection compared to children under 15 years (OR = 0·3; 95% CI 0·1–0·8, $P = 0·018$), but there was no significant difference between the 0–14 years and the 45 years and over groups. There was no effect modification between age and the hip joint with regards to *S. aureus* infection.

The route of infection was haematogenous in 138 cases (72%), due to penetrating injury of the joint in 42 cases (22%) and from local spread of infection in 10 cases (5%). Penetration was most commonly due to injuries sustained to the finger joints during assaults, such as blows to the mouth ($n = 10$). Foreign bodies and modes of trauma included fish spines, knives, star pickets, horse bites, pieces of wood and one part of a trampoline. Penetrating laceration occurred in five cases.

The mean peripheral white blood cell count was $14·1 \times 10^9$/L (S.D. 6·3), with 60/167 (36%) being normal. The ESR was $\geqslant 20$ mm/h in 119 (89%) of the 133 samples tested on admission. HIV infection was not diagnosed in any of the cases.

Microbiology

The joint was aspirated in 167 cases (87%). The other 24 cases were not aspirated, usually due to the inability to obtain aspirates from finger joints, with diagnoses usually based on positive blood culture. One hundred and twenty-three joint aspirates yielded

Table 3. *Causative organisms*

	Total	%	Joint		Blood culture positive
			Gram stain positive	Culture positive	
Staphylococcus aureus	70	37	37	56	32
Streptococcus pyogenes	31	16	21	30	5
Neisseria gonorrhoeae	23	12	7	12	0
Mixed growth*	20	10	11	13	1
Group G β-haemolytic streptococcus	4	2	2	4	1
Burkholderia pseudomallei	3	2	0	1	3
Other streptococci	3	2	1	2	0
Streptococcus pneumoniae	2	1	1	2	1
Haemophilus influenzae	2	1	1	1	2
Group B β-haemolytic streptococcus	2	1	0	2	0
Staphylococcus epidermidis	1	1	1	1	0
Pseudomonas aeruginosa	1	1	0	0	0
Citrobacter freundii	1	1	0	1	0
Bacillus sp.	1	1	0	1	0
Acremonium sp.	1	1	0	1	0
Enterobacter aerogenes	1	1	0	1	0
Gram positive cocci, unidentified	3	2	3	0	0
WCC ⩾ 50000†	22	12	0	0	0
Total	191	100	85/167	123/167	45/120

* Includes eight with a combination of *S. aureus* and *S. pyogenes* and one each of group C, group G and group F streptococcus.

† Probable cases where no organism was identified.

a pathogenic organism (Table 3). Seven definite cases had organisms seen on Gram stain of synovial fluid but culture was unsuccessful. Three of these were consistent with *N. gonorrhoeae*. The mean aspirate white cell count was 79000/mm^3, with 32% of those tested giving counts below 50000/mm^3.

Pathogenic organisms were identified in 166 patients (87%) (Table 3). The most common organism was *S. aureus*, followed by *S. pyogenes* and *N. gonorrhoeae*. Unusual isolates included three of *Burkholderia pseudomallei* and one *Acremonium* sp. Blood cultures were taken in 120 cases and were positive in 45 (38%). The most common organism was *S. aureus* (32 cases) (Table 3). Five of the cases with staphylococcal septicaemia had more than one joint involved and 22 had *S. aureus* also isolated from synovial fluid.

Treatment and outcome

One hundred and thirty-five patients (71%) received surgical intervention. Arthrotomy was the most common initial procedure (86 cases), with 4 cases (5%) requiring a repeat procedure. Arthroscopy was performed on 49 patients, with a subsequent repeat procedure rate of 16% (8 cases). Needle aspiration was performed in 16 cases, with 9 (56%) needing a further procedure. The mean time taken after admission for a patient to receive surgery was 43 h (range 2 h–19 days). Inpatients received intravenous antibiotics for a mean of 8 days and subsequent oral antibiotics for a mean of 12 days (range 0–90 days).

The mean length of hospital stay was 20·1 days (S.D. 16.6), with an average of 22·4 days for Aboriginal patients and 18·0 for non-Aboriginal patients (P = 0·13). There was no difference in length of stay between sexes. Those with septic arthritis of the hip joint were hospitalized significantly longer than others (mean = 30 days, P = 0·0001). Those in the youngest and oldest age groups stayed longer in hospital (mean 23 and 26 days respectively). There was no difference in length of stay when comparing the three most common causative organisms. The mean length of stay was longer in the 'needle aspiration' group (32 days) than in patients undergoing arthrotomy (23 days) or arthroscopy (18 days) (P = 0·06).

Three patients (1·6%) died in the study group, two from complications of staphylococcal septicaemia and one from systemic melioidosis (*B. pseudomallei*).

DISCUSSION

In this study we used strict case definitions and it is certain that some patients with septic arthritis were excluded. The crude incidence of septic arthritis is therefore at least 10 cases per 100000 per year. The authors are unaware of similar studies which estimate the incidence of septic arthritis in other Australian populations. Septic arthritis is likely to be more common in the Northern Territory where infectious diseases overall are more frequent than in the rest of Australia, especially in the Aboriginal population [10, 11]. Mild cases of septic arthritis may be misdiagnosed as rheumatic fever or arboviral polyarthritis (Ross River virus and Barmah Forest virus), which are very common in this region [10]. Underdiagnosis is particularly relevant for gonococcal arthritis where, at best, synovial fluid cultures are positive in only 50% and blood cultures in only 20% of cases [1, 3]. In contrast to other studies over 50% of our cases of septic arthritis had no previous joint disease or underlying medical illness [2–5].

Aboriginals were seven times more likely to have septic arthritis than non-Aboriginals, which is consistent with their generally higher rates of infectious diseases [10, 11]. The reasons for this are multifactorial, in particular reflecting socioeconomic disadvantage and poor living conditions in a harsh tropical environment [12]. Skin sores with *S. pyogenes* infections are especially common in remote Aboriginal communities, as seen in similar tropical situations [15].

In non-Aboriginals the predominance of males with septic arthritis probably reflects an increased exposure both socially and occupationally to trauma. Of concern is the delay in presentation of people from remote areas and of Aboriginal males. Such delays have been shown to have a significantly adverse effect on outcomes [1–6].

This study supports previous studies in that the knee, followed by the hip are the most frequently involved joints and that the mechanism of infection is usually by haematogenous spread to the joint [1–7, 9, 16, 17]. *S. aureus* was isolated in 37% of cases followed by *S. pyogenes* and *N. gonorrhoeae*. Infection with mixed organisms occurred in 10% of cases. Most of these were secondary to penetrating injuries and involved common saprophytic organisms. As documented by others, *N. gonorrhoeae* was more likely to cause a polyarthritis than other organisms [1, 6].

The annual incidence of gonorrhoea in Northern Territory Aboriginals is around 1% [18]. This is 8 times the incidence in non-Aboriginals in the Northern Territory and over 60 times the national incidence. This is reflected in the higher rates of gonococcal arthritis in Aboriginals in this study. Female sex was associated with an increased risk of gonococcal arthritis in the multivariate analysis independent of Aboriginality and age, but failure of these other factors to reach statistical significance may reflect small sample size. Age 15–29 is the group at highest risk of genital gonorrhoea in the Northern Territory [18].

The three cases of melioidosis septic arthritis reflect the presence of the soil saprophyte *B. pseudomallei* (formerly *Pseudomonas pseudomallei*) in northern Australia. Melioidosis is the commonest cause of fatal community-acquired bacteraemic pneumonia at Royal Darwin Hospital [10]. Haematogenous spread following skin inoculation leads to pneumonia, visceral abscesses and occasionally osteomyelitis or septic arthritis. Diabetics and alcoholics are especially at risk of melioidosis [19].

This study supports the apparent predilection for abnormal joints to become a focus for group G streptococcal arthritis, with only 1 of the 4 cases occurring in a previously normal joint; 2 patients had osteoarthritis and 1 had received a recent penetrating joint injury [20].

There is no large prospective study examining orthopaedic procedures in septic arthritis [1, 3, 5, 21]. This review suggests that a preference for arthrotomy and arthroscopy over needle aspiration is justified by earlier patient discharge, presumably reflecting good clinical response. Needle aspiration or irrigation is associated with a prolonged hospital stay, with over half of the cases aspirated subsequently requiring alternative procedures. These results may be subject to some selection bias as the young and the old and infirm may have been treated with less invasive procedures.

Infectious diseases are amongst the leading causes of morbidity and mortality in northern Australian Aboriginals. This study shows that joints are another important site of infection. Local health workers need to have an increased awareness of this condition, as other diseases common in the north of Australia such as acute rheumatic fever and arboviral infections can

present in similar ways. Early diagnosis, good microbiology with consideration of unusual organisms and early initiation of treatment are essential if long term sequelae are to be avoided. Support is needed in Aboriginal communities to improve socioeconomic conditions and for better community health services. In addition to the benefits from these changes, programs for control of streptococcal skin sepsis and sexually transmitted diseases should help directly lower the incidence of septic arthritis.

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