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The changing epidemiology of acute and subacute haematogenous osteomyelitis in children

M. J. G. Blyth, R. Kincaid, M. A. C. Craigen, G. C. Bennet

From the Royal Hospital for Sick Children, Glasgow, Scotland

We have reviewed the incidence of bacteriologically or radiologically confirmed acute haematogenous osteomyelitis in children under 13 years of age resident in the area of the Greater Glasgow Health Board between 1990 and 1997. In this period there was a fall of 44% in the incidence of both acute and subacute osteomyelitis, mainly involving the acute form ($p = 0.005$). This mirrors the decline of just over 50% previously reported in the same population between 1970 and 1990. Using multiple regression analysis a decline in incidence of 0.185 cases per 100 000 population per year was calculated for the 28-year period ($p < 0.001$).

***Staphylococcus* was the most commonly isolated pathogen (70%). Only 20% of patients required surgery and there was a low rate of complications (10%). In general, patients with a subacute presentation followed a benign course and there were no complications or long-term sequelae in this group.**

Haematogenous osteomyelitis in children in this area is becoming a rare disease with an annual incidence of 2.9 new cases per 100 000 population per year.

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Our aim was to assess the changing epidemiology of acute and subacute osteomyelitis in a single health district from 1990 to 1997, with particular reference to the incidence and the type (acute or subacute) and site of presentation. In addition, we assessed and compared the pathogens responsible, the routes and duration of antibiotic therapy, the need for surgery and the complications encountered with those of earlier series.[1-10]

The study repeated that of Craigen, Watters and Hackett[11] on the same reference population between 1970 and 1990. By using identical methods we were able to observe trends, particularly with regard to incidence, over a period of 28 years.

Patients and Methods

The Information and Statistics Division of the National Health Service in Scotland provided data based on the Scottish hospitals discharge system (SMR1) which identifies and codes all Scottish hospital inpatient and day-care admissions. The SMR1 was used to identify all those patients under the age of 13 years resident in the Greater Glasgow Health Board area who had a hospital admission code for osteomyelitis between 1990 and 1997.

The case notes were then examined to see if they satisfied the accepted criteria for the diagnosis of acute osteomyelitis, namely a clinical history and either bacteriological confirmation from blood culture or specimens obtained at surgery, or radiological confirmation from bone scan or radiographic changes.[4] We excluded patients with a history of penetrating injury and those with involvement of the spine or skull.

Information was collected from the case notes regarding the mode of presentation. An acute presentation implied a history of less than two weeks and subacute of more than two weeks. We recorded the patients' age, the site of infection, bacteriology and radiology, the duration and route of antibiotic therapy, the nature and timing of surgery and the complications encountered.

In addition, the SMR database produced a deprivation category score for each patient. This gives an assessment of the social status of the patient based on data from the 1991 census. Variables such as car ownership, male unemployment and overcrowding in the home are used to calculate a mean score for a given postcode sector with each sector assigned a score from 1 to 7. A deprivation category of 1 assumes a higher social class with 7 allotted to the most deprived areas.

The data collected were then subjected to statistical analysis using chi-squared and multiple regression analysis tests.

M. J. G. Blyth, FRCS Orth, Specialist Orthopaedic Registrar
R. Kincaid, FRCS, Specialist Orthopaedic Registrar
G. C. Bennet, FRCS, Consultant Orthopaedic Surgeon
Department of Orthopaedics and Trauma, Royal Hospital for Sick Children, Yorkhill, Glasgow G3 8SJ, UK.

M. A. C. Craigen, FRCS Orth, Consultant Orthopaedic Surgeon
The Royal Orthopaedic Hospital, Bristol Road, Northfield, Birmingham B31 2AP, UK.

Correspondence should be sent to Mr G. C. Bennet.

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Results

The SMR codes generated 83 patients in the eight-year period who had been treated in four hospitals with most attending the Royal Hospital for Sick Children, Glasgow. Seven sets of case notes had been either lost or destroyed. Of the remaining 76 there were 50 cases of proven osteomyelitis which met the rigid inclusion criteria. An additional 12 patients gave a history suggestive of infection but did not have the necessary bacteriological or radiological confirmation. Eleven patients met the specific exclusions of a history of penetrating injury or spinal involvement. Only three out of the 76 patients clearly did not have osteomyelitis and had been coded incorrectly, giving a coding error of 4%.

Age. The mean age of the patients was 5.4 years (1 month to 12 years). The distribution of ages is shown in Figure 1.

Incidence. The incidence of acute and subacute forms of the disease as well as the overall incidence is shown in Figure 2. The reduction in overall incidence was due to a reduction in the acute form of the disease, confirmed by regression analysis ($p < 0.005$). The same analysis confirmed that there was no significant change in the incidence of the subacute form of the disease ($p < 0.855$).

Site. There was a proportionate reduction in osteomyelitis in long bones compared with other sites during the period of the study (Fig. 3).

Bacteriology. *Staphylococcus aureus* was the most commonly isolated bacterium with a greater percentage of acute cases yielding a positive culture (Table I).

Treatment with antibiotics. The mean duration of treatment was one day for intravenous therapy (0 to 4) followed by a median of four weeks of oral therapy (1 to 32). In most children flucloxacillin was used initially on a 'best-guess' basis, followed by a change depending on the results of culture sensitivities when these were available.

In four patients there was a change of antibiotics. In these children *Streptococcus* had been isolated. In one the antibiotic was changed to ampicillin from flucloxacillin. In two penicillin and clindamycin were substituted for Augmentin in one and for Magnapen in the other. In the fourth child flucloxacillin was changed to ampicillin.

Of two other children in whom *Streptococcus* was isolated, one was a subacute case in which antibiotic therapy had not been started until the culture was available and the other had been treated initially with Magnapen, which it was felt appropriate to continue.

Surgery. Eleven patients (22%) had surgery, the indication for which was the clinical suspicion of a collection of pus. The median time to surgery was three days (1 to 60). A further seven had aspiration of bone or soft tissue for diagnostic purposes.

Complications. There were six complications in 50 patients (12%) (Table II). Age appeared to be the only factor influencing the rate of complications. Three of the six occurred in patients under the age of two years.

Deprivation did not appear to be associated with a higher rate of complications. There was none in the subacute group.

Hospital stay. The median hospital stay was nine days (1 to 42).

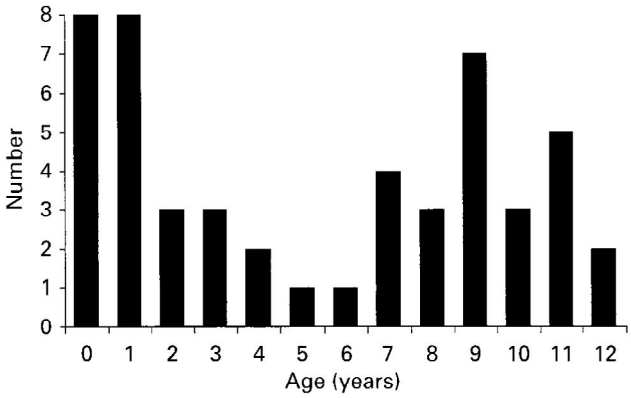


Fig. 1

Distribution of the ages of the 50 patients with osteomyelitis.

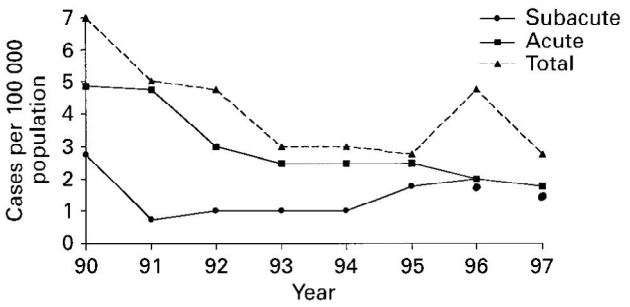


Fig. 2

Incidence of osteomyelitis between 1990 and 1997.

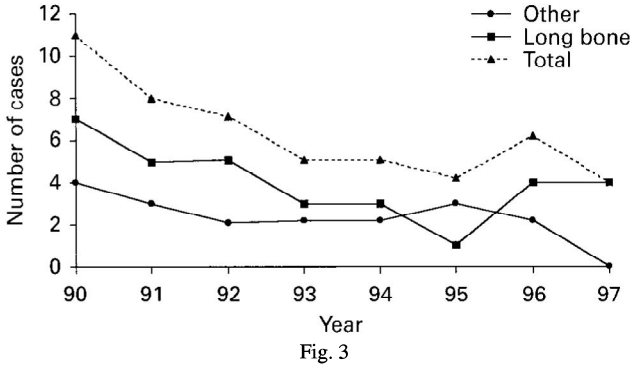


Fig. 3

Sites affected with osteomyelitis.

Table I. Bacteria isolated from 20 of the 50 children with osteomyelitis

Organism	Total	Acute	Subacute
Staph. aureus	13 (65%)	11	2
Streptococcus	6	5	1
Staph. epidermidis	1	0	1

Table II. Complications in the 50 patients with osteomyelitis

Complication	Number
Recurrence	1
Growth disturbance	1
Pathological fracture	2
Chronic osteomyelitis	2

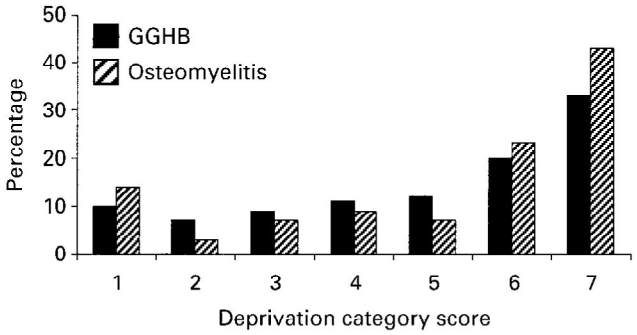


Fig. 4

Deprivation category score for patients with osteomyelitis *versus* that for the population in the Greater Glasgow Health Board (GGHB).

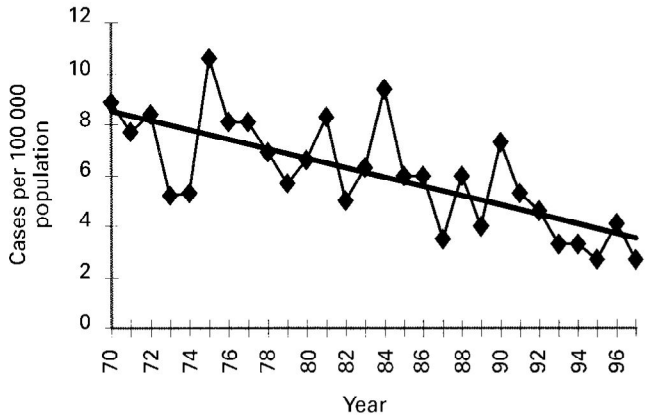


Fig. 5

Total incidence of osteomyelitis between 1970 and 1997.

Deprivation category. The deprivation category scores are shown in Figure 4 as percentages of the osteomyelitis group as a whole. The data for osteomyelitis have been plotted beside those provided by the Information and Statistics Division for the distribution of scores among the age-matched population of the Greater Glasgow Health Board as a whole. It would appear from this that osteomyelitis is evenly distributed throughout the social spectrum with no significant difference between the groups. Chi-squared analysis confirmed this ($p = 0.49$).

Overall incidence. Using the data collected by Craigen et al[11] Figure 5 shows the pattern of the incidence of osteomyelitis in the under 13-year age group over a 28-year period. Regression analysis showed a mean reduction in the number of new cases of osteomyelitis annually of 0.185 per 100 000 population ($p < 0.001$; 95% confidence levels 0.113 to 0.257 per 100 000).

Discussion

Our study confirms the continued decline in the incidence of acute and subacute haematogenous osteomyelitis to 2.9 new cases per 100 000 population per year. In the area studied osteomyelitis is becoming a rare disease. In a population under 13 years of age of around 150 000, only four cases are expected in the coming year.

This decline is accounted for by a fall in the number of acute cases, consistent with the findings of Craigen et al[11] on the same population from 1970 to 1990. It would appear that osteomyelitis is now just as likely to present insidiously in its subacute form as in the classic form.

We accept that there are inherent inaccuracies in using the SMR coding for the retrieval of cases. Although there are now alternative methods for assessing the numbers treated, we were obliged to use this method in order to produce a series comparable to the earlier one. We were, however, surprised by the accuracy of the system.

Another potential area of inaccuracy is the population figures. The last census was taken in 1991. Because of the introduction of the poll tax at that time, it is thought that many forms were not completed and as a result the figure produced is likely to be an underestimate. Each year, however, a mid-year estimate is produced by the census department based on such factors as births, deaths, registration with family doctors, estimates of immigration and emigration, etc. These estimates are likely to be reasonably accurate. The methods used are unchanged over the period of the study.

There has been a steady reduction in the relative proportion of classic infection in long bones since 1970, although more recently this decline has been matched by a fall in the incidence at other sites. Despite these changes osteomyelitis is not becoming more difficult to treat. In cases of subacute infection, despite the delay in presentation and lack of positive bacterial cultures, treatment was without complication. This contrasts with previous series from this hospital.[1] From 1936 to 1940, before the availability of any treatment other than surgery, there were 75 cases of acute osteomyelitis with 27 deaths (36%). From 1941 to 1945 there were 55 cases. Sulphathiazole was then available for treatment and, as a result, the death rate fell to 12.7%. Finally, between 1946 and 1950, 82 cases were reported and after the introduction of penicillin the mortality fell to 1.2%. Between 1961 and 1968 Blockey and Watson[4] treated 113 cases at the same hospital without any deaths.

In most cases the primary antibiotic of choice was flucloxacillin. This satisfactorily covered the 70% of cases in which *Staphylococcus* was the infecting agent. It has some effect against *Streptococcus* but it is not the drug of choice. We accept that it may be better to add a second drug

such as amoxicillin to the primary drug regime until the nature and sensitivity of the infecting organism are determined. Before the introduction of vaccination against *Haemophilus influenzae* type B some cases of osteomyelitis in children under two years of age were caused by this organism. After vaccination had been introduced the incidence dropped to zero and there is no need now to cover this organism.[12] The improved results of treatment may reflect reduced virulence of the responsible pathogens or increased host resistance.

Contrary to a widespread and long-standing belief[1] we failed to show any link between deprivation and osteomyelitis in the 1990s. Despite this, the fall in the incidence over the last 30 years could still be linked to improved standards of living and hygiene. White and Dennison[1] found unsatisfactory home conditions in 70% of their patients with this disease. In the same population more than 50 years later this figure is almost identical. It can only be hoped that the definition of 'unsatisfactory' has changed.

The incidence of infection with *Staph. aureus* in hospitals has not changed significantly over the years. There is evidence, however, that the incidence of many of the community-acquired bacterial infections such as scarlatina is decreasing and this may reflect improved host resistance or improved efficacy of antimicrobial therapy in the community.

The increasing effectiveness of community-administered antibiotics may also explain the reduced incidence of osteomyelitis as determined by SMR1 inpatient data. It is possible that many patients are treated successfully in the community by oral therapy and that the uncomplicated course experienced by most militates against a change in policy by the prescribing practitioner.

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