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ORIGINAL STUDY

Epidemiology of acute haematogenous osteomyelitis in children – A single unit's experience over three different time-periods

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The epidemiology of paediatric osteomyelitis in a single health district in England from 2000 to 2005 was compared to that from two prior timeframes. Fifty-three children were diagnosed with acute haematological osteomyelitis (AHO) and were compared to 36 and 49 patients from 1982 to 1986 and 1947 to 1951 respectively.

The annual incidence of AHO in the most recent period was 0.4 patients per 100 000 of the total population. The mean age of presentation was 40 months (ranging between 0.5 and 179). This was statistically significantly less than the two earlier timeframes. Staphylococcus species was the commonest isolated organism. Plain radiography had a pickup rate of 32.7%. Second line investigation of nuclear medicine and magnetic resonance imaging had greater sensitivities of 78.8% and 75% respectively. The rate of surgical intervention was halved comparing 2000-05 to 1947-51.

We were unable to unequivocally demonstrate a decreased incidence AHO in our region. However the review does confirm that the clinical approach to diagnosing and treating AHO had changed over the years.

Keywords : acute haematological osteomyelitis ; children ; epidemiology ; diagnosis ; treatment.

INTRODUCTION

Acute haematogenous osteomyelitis (AHO) in children is considered to be a diminishing problem in the United Kingdom (*1,2*) and other developed countries. Early recognition of AHO is important as the associated morbidity and/or mortality can be significant unless prompt and appropriate treatment is instituted (*3-6*). Therefore, it is essential to understand the epidemiological trend in a geographical region so that the required early diagnosis and treatment can occur.

A recent epidemiological description of AHO by Blyth *et al* from Scotland (*1*) reported a decline in the incidence of AHO in the Glasgow health district. It is unclear whether or not this data can be extrapolated to other regions. There have not been any similar epidemiological studies in England over the last twenty years.

The aim of this paper is to describe the current epidemiological pattern of paediatric bone infections in a single health district in England between 2000 and 2005. It also compares the current

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epidemiology of AHO to that from two prior timeframes : 1947 to 1951 and 1982 to 1986.

PATIENTS & METHODS

We retrospectively reviewed all children (less than 16 years) with a diagnosis of AHO that were admitted to our department between January 2000 and December 2005. Patients were identified using the hospital electronic database – Meditech system. The clinical notes were retrieved and assessed to confirm the diagnosis.

Children presenting with bony pain or an unexplained limp were included for analysis if they presented acutely (less than 14 days) with any of the following clinical features : bacteriological and/or radiological confirmation of osteomyelitis or grossly elevated inflammatory markers in the absence of any other identifiable source of infection in the body *(6)*. The exclusion criteria were patients with symptoms for more than 14 days before presentation *(7,8)* and/or the presence of an open injury or previous surgery at the affected site.

A proforma was designed to collect data regarding demographic details, mode of clinical presentation, site of pathology, investigations done and their results and what treatment was required. The same proforma was used to collect similar data from a thesis by Harvey (*9*). The basis of the thesis was the assessment of the epidemiology of AHO in children between the years 1947 to 1951 and 1982 to 1986 from the same demographic region.

The hospital's Meditech system generated 55 patients with a diagnosis code for AHO. After examining the clinical records, 2 patients failed to satisfy the inclusion/exclusion criteria for the study. There were 49 patients with AHO in the period 1947-1951 and 36 patients between 1982 and 1986. Current population data for the health region was obtained from the Strategic Health Authority (SHA).

Statistical analysis

Descriptive statistics was used to evaluate the epidemiology of the presentation of the patients. Analytical statistical methods were used to compare the findings of the different timeframes.

RESULTS

Demographics

The number of children diagnosed with AHO over the three timeframes with reference to their mean age and the male to female ratio is as shown in table I. The variation in the mean age of presentation over the different time periods reached statistical significance ($p < 0.05$) when comparing 2000-05 to both 1947-51 and 1982-86. There was no statistical difference in the presentation age when patients from 1947-51 were compared to patients from 1982 to 1986. This is demonstrated graphically in figure 1. The incidence of AHO for the region during the 2000-05 period was 0.4 new cases per 100000 of the population per year. A similar incidence for the two other timeframes was not calculated because of uncertainty of the catchment area population size.

Clinical presentation

There was no statistically significant difference in the mean duration of symptoms prior to presentation over the years. In the years 2000-05, the mean duration of symptoms was 3.4 days. It was 3.0 days in 1982-86 and 3.9 days in the 1947-51. All of the patients from the period 2000-05 presented with pain at the affected site. Pyrexia (temperature > 38°C) was present in 47.1% of the patients (n = 25), a similar number of children had swelling of the affected site (n = 25). Twelve patients (22.6%) appeared systemically unwell at presentation. Three children had associated illnesses (meningitis in one child, chickenpox in one child and a neuropathic ulcer on the ipsilateral ankle of a child whose 5th metatarsal was affected).

Table I. — Age and sex distribution of patients over three time periods

	2000 – 2005	1982 – 1986	1947 – 1951
No. of patients	53	36	49
Mean Age (in months)	40 (0.5 – 179)	76 (6 – 170)	81 (12 – 160)
Male : Female	26 :27	21:15	35 :14

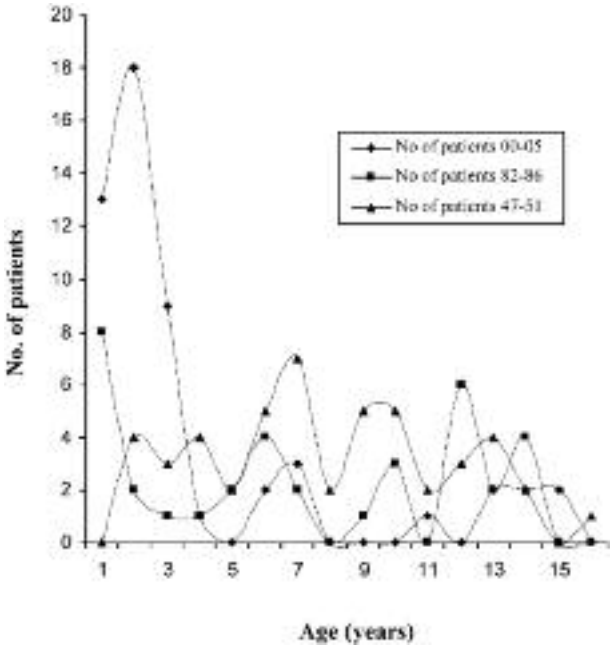

Fig. 1. — Comparison of age distribution of children over the three time periods.

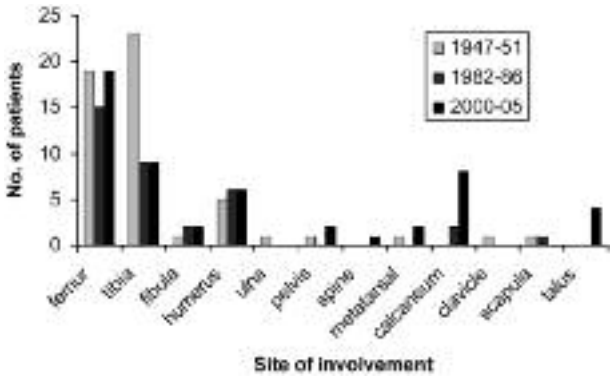

Fig. 2. — Bone affected by AHO in the 3 time periods

Sites involved

The sites affected with osteomyelitis have been depicted in figure 2. The most common bones affected were the metaphyses of long bones. However, the 2000-05 group had a high proportion of foot involvement (14 out of 53) (talus, calcaneum and metatarsals) compared to the other time frames.

Table II. — Blood markers in AHO (2000-05)

	Mean	Standard Deviation	Sensitivity
WCC	21.35 (X 10^9 cells/L)	3.48	44%
CRP	70.74 (mg/L)	68.25	84%
ESR	40.63 (mm/hr)	24.12	92.1%

(WCC = white cell count ; CRP = C-reactive protein ; ESR = erythrocyte sedimentation rate).

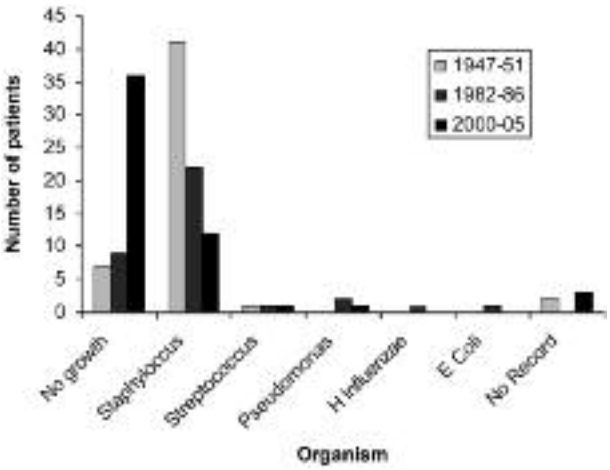

Fig. 3. — Bacteriology of AHO in the three groups

Investigations

The results of blood investigations and the sensitivities of the baseline investigation are demonstrated in table II. Staphylococcus species remains the most commonly isolated pathogen over the years. There has been an increase in the incidence of negative cultures compared to earlier years (fig 3). No case of MRSA osteomyelitis was seen in our series. Blood cultures were positive in 9 out of 31 cases. Cultures from local aspirate and intra-operative tissue samples were positive for 6 out of 21 cases.

Plain radiographs demonstrated signs of osteomyelitis (including soft tissue swelling as earliest sign) in 17 out of 53 cases (32.7%). Bone scan revealed increased uptake in 26 out of 33 cases

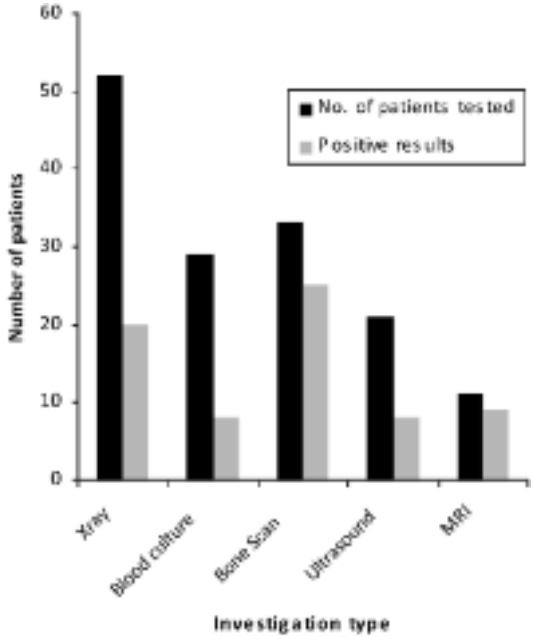

Fig. 4. — Investigations performed and numl positive results 2000 – 05.

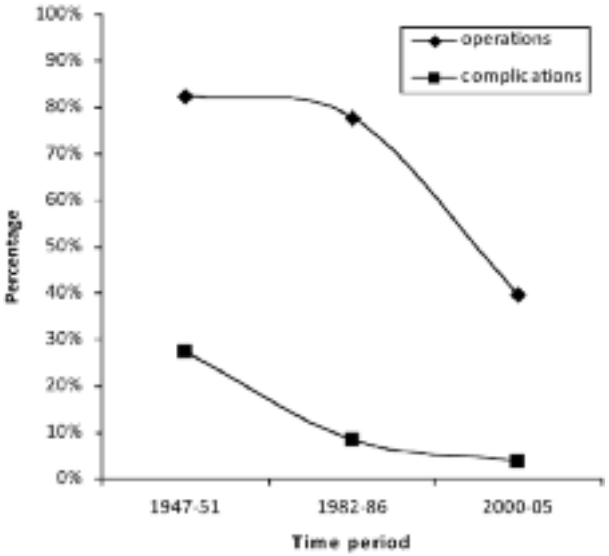

Fig. 5. — Surgical intervention and complication following AHO.

(78.8%). Ultrasound scan was employed to demonstrate subperiosteal swelling in 8 out of 19 cases. MR scan was positive in 9 out of 12 cases (fig 4).

Treatment

The mainstay of treatment in the 2000-05 group was intravenous third generation cephalosporins. This was converted to oral antibiotics when a clinical improvement and decrease in the inflammatory markers had occurred (after an average of 5.8 days). All children were treated with third generation cephalosporins for a period of 4-6 weeks. Surgery was necessary in 21 (39.6%) patients during this period (fig 5). The indication for surgery was either clinical or radiological evidence of pus collection. In the 1947-51 group, most children were treated with penicillin. Surgical debridement was carried out in 82.4% of the cases, whilst in the 1982-86 group, surgical intervention was required in 77.8% of the cases. There were 2 (3.77%) complications of chronic osteomyelitis in the 2000-05 group compared to 8.33% and 27.5% in the 1982-86 group and 1947-51 group respectively.

DISCUSSION

This review suggests that there has been a decrease in the average age of patients presenting with AHO. The causes of this can be multifactorial and have not been assessed by this review. Possibilities include the coexisting increase in the absolute number of children in the health region and better diagnostic tools available to the clinician. However, the effects of these factors can be countered by the beneficial effect of immunisation and the easy accessibility of antibiotics. The calculated annual incidence of AHO for the region was 0.4 patients per 100 000 of the population. This figure is lower than that found by Blyth *et al* (*1*) which revealed 2.9 new cases per 100 000 of the population per year. This may represent a true reduction in the incidence of AHO. Alternatively, it may be related to the fact that some cases of AHO may have been treated at other institutions in the region. As such, the true incidence of the condition would have been underestimated.

It is reassuring to know that the clinical presentation of children with AHO has remained largely unchanged. It includes pain, swelling, reluctance to use the limb and fever as being the commonest

symptoms. Similarly, the metaphyses of long bones have remained the regions most prone to infection. However, interestingly there has been an increased detection of AHO in the small bones of the foot. The reasons for this is unknown but possibly related to newer more sensitive imaging methods. Isotope bone scans identified infection in 78.8% of patients it was used in. Its high yield (*12,13*) makes it a second line diagnostic tool in many units. Magnetic resonance imaging had 9 out of 12 positive yields and is also another sensitive imaging modality (*14*). Ultrasound scanning was used as an adjunct to identify co-existent septic arthritis or subperiosteal collections. However, plain radiographs were obtained in all patients and functioned effectively as a first line investigation that identified pathology in a third of our patients.

An elevated CRP and ESR was characteristic in most patients with sensitivities of 84% and 92.1% respectively. This is in keeping with what has been described in the literature (*15,16*). The yield of positive microbiology in the 21st century was less than the other two time periods in the 20th century but this did not reach statistical significance. This finding may be related to the commencement of antibiotic treatment prior to definitive diagnosis of AHO. In cases where an organism was identified, Staphylococcus species remained the most commonly isolated organism (*17-19*).

We treated all our patients from the 2000-05 cohort empirically with third generation cephalosporins. Clinical improvement and decreasing CRP were used to determine the timing for conversion of initial intravenous antibiotic to the oral route. The need for surgical intervention in the management of AHO has trended downwards over the years. Currently only 2 in 5 children require debridement compared to 4 in 5 children from the period 1947-51. It is likely that early diagnosis facilitated by current imaging techniques and easy access to appropriate antibiotics has played a major role in reducing the need for surgical intervention.

We recognise the limitations of this retrospective review of the epidemiology of AHO in a single district. The catchment area for the institution is very ill defined and does not fully take into consideration the changing population dynamics for the area over the years. We were unable to unequivocally demonstrate a decreased incidence of AHO in our region.

CONCLUSION

The review does confirm that the clinical approach to diagnosing and treating AHO has changed over the years. Current second line imaging modalities have a high pick up rate. Elevated inflammatory markers are common in the condition. Microbiology screening tends to be negative but, if positive, Staphylococcus species is likely to be isolated and be sensitive to a third generation cephalosporin. Also, the need for surgery has more than halved over the last 50 years.

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