Acute haematogenous osteitis

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SUMMARY During a 10-year period 217 cases of acute haematogenous osteitis were treated. In 131 patients the diagnosis was confirmed either radiologically or bacteriologically, but in the other 86 the diagnosis was based on clinical examination. Either cloxacillin or lincomycin proved to be effective if given before bacteriological diagnosis. Frequent clinical examination, assessing both local signs and the child's general state, will decide which child requires surgery (which should be reserved for the toxic child, the child with concomitant medical disorders lowering host resistance, and the child who does not respond to, or has a lesion which flares up after, initial conservative treatment). Constant vigilance is required by clinicians looking after children with this disease in order to reduce the disabling long-term sequelae.

Although antibiotics have virtually eliminated the mortality associated with acute haematogenous osteitis, there is still an unacceptably high incidence of chronic infection, deformity, and disability. The virulence of the causative organism, the host resistance, delay in diagnosis, and inadequate treatment are all factors that should be considered if failure of primary treatment leads to complications. Rest, splintage, and antibiotics are now accepted as essential to the successful treatment of a child with osteitis. The place of surgery in management remains controversial.

This paper reports the clinical features and management of 217 cases of acute haematogenous osteitis, and the experience gained in treatment is discussed.

Patients and methods

217 patients with acute haematogenous osteitis were seen at three Edinburgh hospitals during the 10-year period 1967-76. An analysis is made of factors that were relevant to success or failure in their management. We have included patients in whom a presumptive clinical diagnosis was made; the reasons for this are discussed later. The criteria accepted for the diagnosis of osteitis were: (1) a raised temperature, (2) localised bone tenderness, (3) localised swelling. In addition, one of the following had to be present too: (a) erythema, (b) localised temperature increase, or (c) decreased range of movement.

Patients in whom the diagnosis was established had either positive blood cultures or abnormal x-ray

appearances (periosteal new bone formation, cortical erosions, or metaphyseal cavities), or the diagnosis was confirmed at operation. The patients comprised 131 established cases, and 86 in whom the diagnosis was presumptive. All patients had histories of less than 14 days and they were all under the care of four general paediatric surgeons.

Results

154 of the 217 patients were boys, a male preponderance of 2.4:1 (2.1:1 in the established cases). The age and sex distribution is shown in Fig. 1.

The average length of history before admission was 3.5 (range 1-14) days. A history of trauma to the affected area was established in 79 (36%) patients,

Fig. 1 Age and sex distribution.

and the finding of a septic focus was present in 23 (11%). Sites of bone infection and the incidence for each site are shown (Table 1). In 3 patients more than one bone was affected: in 2 the tibia and fibula of the same leg, and in the third the tibia and contralateral fibula.

The initial white blood cell counts (WBC) and erythrocyte sedimentation rates (ESR) are shown in Fig. 2. All but 8 patients were pyrexial on admission. The initial temperature, WBC, and ESR, whether taken singly or in combination, did not help to determine which patients should have surgery.

Table 1 Incidence of bones affected and relationship to surgery

Site	No of patients*	No of operations
Tibia	74	25
Femur	62	19
Humerus	22	7
Calcaneum	18	5
Fibula	15	8
Ulna	5	1
Radius	5	0
Metatarsals	5	0
Clavicle	4	2
Metacarpals	3	1
Talus	1	1

*3 patients had 2 affected bones, see text.

Fig. 2 Initial WBC, ESR, and temperature, and relationship to surgery.

Blood cultures were obtained in 203 patients and were positive in 75. This represents 35% of all patients and 57% of the established group. The organisms are listed in Table 2. *Staphylococcus aureus* was isolated in 90% of positive blood cultures and was resistant to benzylpenicillin in 85% of them.

In 26 patients abnormalities were noted on the initial x-ray films, and 14 of them underwent surgery—10 within 48 hours and the other 4 within 4 days. Follow-up x-ray films showed evidence of osteitis in a further 67 patients. This finding was noted between 8 and 21 days after admission in 63 cases, and was found later in the remaining 4. A total of 94 patients therefore had x-ray evidence of infection, 43% of the whole group and 71% of the established group.

All patients received antibiotics after the first blood cultures had been taken. The initial doses were given parenterally and changed to the oral preparations if there was good evidence of clinical response. Lincomycin was used alone in 71 patients and in combination with other antibiotics in a further 24. Cloxacillin was used in combination (usually with ampicillin) in 94 patients, and as the sole antibiotic in 18. Fusidic acid was used in 9 patients and gentamicin was used in a child with *Escherichia coli* infection.

69 patients underwent surgery, 51 within 48 hours of admission. A further 15 cases were operated on between 2 and 4 days after admission, and the remaining three after 6, 8, and 12 days.

In all but 4 patients medullary drilling was undertaken, as was drainage of any subperiosteal abscess. In these 4 subperiosteal drainage only was undertaken. Pus was found in 58 patients, and in 5 of the remaining 11, swabs from the drill holes and medullary cavity grew pathogenic organisms. In 3 patients the pus found at operation failed to yield organisms. *S. aureus* was isolated in 93% of positive cases and was resistant to benzylpenicillin in 90% of them (Table 2). Pus was found subperiosteally in 28 patients, within the medullary cavity in 16, and in both sites in 14. Of the 51 patients operated on within 48

Table 2 Organisms isolated from culture of blood and pus found at operation

Organism	Bacteria isolated from		
	Both sites	Blood only	Bone only*
<i>Staphylococcus aureus</i>			
Penicillin-resistant	26	32	25
Penicillin-sensitive	2†	8	4
<i>Streptococcus pyogenes</i>	1‡	3	0
<i>Streptococcus pneumoniae</i>	1	1†	1‡
<i>Haemophilus influenzae</i>	0	1	0
<i>Escherichia coli</i>	1	0	0

*In 9 patients pus found at operation and bone swabs were sterile.

† ‡ Both organisms grown in one patient.

hours, bacteriological proof of the diagnosis was made only from the pus found at operation in 18 cases, all the blood cultures being sterile. In 3 patients the bone culture was sterile but blood cultures grew pathogenic organisms. In a further 3 cases neither source yielded bacteria. In the remaining 27 cases both sites grew the same pathogenic organism.

In 8 patients the temperature on admission was normal and remained so. In 6 patients the initial recorded temperature was raised but no further information was recorded. 91% of patients with pyrexia had a normal temperature within 6 days of admission. No relationship between failure of treatment and the day the temperature became normal could be found.

Seven patients developed septic arthritis, 6 after surgery. Four of these followed operations on the neck of the femur and the hip joint became affected. The other 3 affected the knee, the elbow, and the talocalcaneo-navicular joint. A further 23 patients developed sympathetic joint effusions which were sterile.

Two patients had delayed wound healing but in neither was this a major problem and no sinuses developed. One patient developed septic shock after surgery, another an acute toxic psychosis, and one child developed a serious staphylococcal pneumonia from which she made a good recovery. Long-term temporary complications (that is, noninfective complications arising 3–9 months after admission which had resolved by 3 years) were noted in 4 patients. In 2 this was limb lengthening and in 2 limb shortening, but within 3 years these abnormalities had resolved.

In this series, 9 patients failed to respond to initial management and the reasons for this are listed (Table 3). Five developed chronic osteitis and one has required limb lengthening surgery. The other 4 eventually recovered fully cured, but one of these children developed a Brodie's abscess 5 years after her initial treatment. Two further patients each developed a Brodie's abscess 3 years after his initial admission. Another child developed an acute flare-up 8 weeks after stopping treatment, and the final patient developed an intramedullary abscess one month after starting treatment.

It was noted that in 3 of the failures who developed chronic osteitis, the ESR 3–4 weeks after presenta-

tion had risen compared with the rate at admission, but had fallen in the other 6 patients. 121 patients had the ESR repeated between 3 and 4 weeks, and in 98 of these the level had fallen to below half the admission figure or had returned to normal. In the other 23 cases there were 7 of the 9 failures (the remaining 2 were the patients who each developed a Brodie's abscess after 3 years), 6 of the 7 patients who developed septic arthritis, 4 of the patients with sympathetic joint effusions (18 of the 23 cases had repeat ESRs), and 6 patients who had a successful outcome and in whom there was no obvious cause for the increased ESR.

Discussion

Recent reports of childhood osteitis have included only patients where the diagnosis has been confirmed either bacteriologically or radiologically.^{1–3} We have deliberately included a number of patients in whom the diagnosis was made clinically because the initial management of this disease depends almost solely on clinical judgement. The diagnosis was established radiologically in only 26 (12%) patients on admission. The minimum time taken to establish a bacteriological diagnosis from blood cultures is 24 hours. 51 of the 69 patients who underwent surgery did so within 48 hours of admission. In only 10 of these was the diagnosis established radiologically and therefore the decision to operate on the other 41 was made on clinical grounds alone. The main indications for operation were a toxic child and increasing local tenderness. In a few patients a rising pulse and temperature despite antibiotics led to exploration. Six of the 10 children operated on with radiological abnormalities showed metaphyseal cavities and, in all, pus was found within the medullary cavity.

S. aureus remains the predominant organism, with a high rate of resistance to benzylpenicillin. During the 10-year period under review no case due to tuberculosis was seen. In the series reported, 90% of the proved infections were caused by staphylococci with 85% of organisms isolated from blood resistant to penicillin. These figures are similar to those presented by Blockey and McAllister.³ Because of the time delay between taking cultures and obtaining results, treatment with antibiotics should be aimed primarily at this organism.

Modification of any antibiotic regimen can be instituted when the causative organism and its sensitivities are known. There were no significant side effects with any of the antibiotics.

Antibiotic therapy was continued for 4 weeks in the mild cases but was continued for 6 or 8 weeks in all others. One child of 4 years presented with

Table 3 *Analysis of failures*

Reasons for failure	No of cases
Delay in diagnosis and inadequate antibiotics	2
Inadequate antibiotics and inadequate immobilisation	1
Inadequate surgery	1
Inadequate antibiotics	1
No obvious reason	4

osteitis of the upper tibia (proved radiologically) and was given antibiotics for only 3 weeks. He returned after a further 5 weeks with a flare-up in the same site. He was then given a full 8-week course and has remained well since. We disagree with Blockey and Watson³ that antibiotics can generally be stopped after 3 weeks; we feel they should be continued for a full 6 weeks, as recommended by Mollan and Piggot.¹

There is currently a great range of anti-staphylococcal drugs available. Success in the treatment of acute haematogenous osteitis has been documented using fusidic acid,² cloxacillin,⁴ lincomycin,⁵ co-trimoxazole,⁶ and the cephalosporins.⁷ In the series reported none of the staphylococci was resistant to cloxacillin. Whichever antibiotic or combination of antibiotics is used in the treatment of osteitis, we believe that there are 3 main principles to be taken into consideration: (1) the initial doses should be high, (2) the initial doses should always be parenteral, and (3) they should be continued for an average of 6 weeks.

A careful watch should be kept on organism sensitivities with reappraisal of any antibiotic policy periodically. From these data we have no reason to change our policy regarding lincomycin or cloxacillin as good 'best-guess' antibiotics. The incidence of *Haemophilus influenzae* osteitis in this series was low, and the routine use of ampicillin has now been dropped in favour of cloxacillin alone or in combination with fusidic acid.

There were 4 failures in which inadequate antibiotics were considered to be part of the reason for failure (2 were given lincomycin and 2 cloxacillin). In 2 of these there was delay in diagnosis, in one child 7 days' delay and in the other 26 days. The child with the 7-day delay probably had an inadequate dose of cloxacillin and developed a sequestrum after 4 months. The other child was admitted to a non-surgical ward as a case of pyrexia of unknown origin and was given antibiotics (including lincomycin) without a diagnosis having been arrived at. After 26 days she was noted to have a tender left femur and x-ray films showed gross destruction with a sequestrum. This was removed, and she slowly responded with new bone growth. She developed a pathological fracture after 6 months, necessitating further immobilisation and after 4 years was found to have 6 cm of shortening. She underwent leg lengthening with an excellent functional result. The child who had a short course of antibiotics has already been mentioned. The fourth child was given antibiotics sporadically by his mother after discharge and returned after 3 months with a sequestrum; after removal he made an uneventful recovery.

The place of surgery and even the extent of surgery

remain unresolved. Needle aspiration of subperiosteal abscesses as advocated by Neligan and Elderkin⁸ is inadequate. Weissberg *et al.*⁹ advocate needle aspiration followed by drainage if pus is found. In their series of 17 neonates, drilling of bone was not necessary, but most authors stress the need for medullary drilling whether or not subperiosteal pus is found.¹⁰ We would support this statement.

Blockey and Watson³ stated that operation needs to be performed only if an abscess is present. In our experience it is almost impossible to detect an abscess without submitting the child to a general anaesthetic. 16 of the cases operated on had pus within the medullary cavity only, and in this position an abscess will not be detected clinically. Nine children showed metaphyseal cavities on initial x-ray films and 6 underwent exploration, pus being found in the medullary cavity in all. The remaining 3 cases were treated conservatively and 1 developed a Brodie's abscess after 3 years, having been well in the intervening period. The other 2 responded well to conservative treatment without any complication. We would advocate exploration with antibiotic cover, as a metaphyseal cavity almost certainly implies intramedullary pus.

Harris¹¹ stated that operation should be undertaken without delay in patients admitted with a history of longer than 48 hours. To adhere to such a strict timetable when the exact onset of symptoms can only vaguely be determined is wrong. Adherence to such a timetable also ignores two factors mentioned earlier—namely organism virulence and host resistance. In a child with a concomitant serious medical disorder with poor host resistance an operation should be undertaken shortly after admission with antibiotic cover, irrespective of the length of history.

Mollan and Piggot,¹ in their review, favour early surgery in all but the mildest cases, but we disagree with this. Urgent early surgery should be reserved for the severely ill child, or the child who has a metaphyseal cavity on initial x-ray film. All other children should be treated conservatively with rest, splintage, and antibiotics. They must be reassessed at regular intervals during the first few days in hospital, and if local tenderness increases or if the child becomes toxic, exploration should be undertaken without delay.

Only one child had failure of primary treatment due to inadequate surgery. This was a 5-year-old girl who underwent drainage of a subperiosteal abscess without medullary drilling. She developed chronic osteitis requiring further surgery and responded well. After 5 years she returned with a Brodie's abscess. There was one other failure which might have been

avoided had early surgery been undertaken. This was the child who developed a Brodie's abscess 3 years later, but who had a metaphyseal cavity on initial x-ray film. In the other 3 children, no obvious cause for their failures could be found: 2 developed chronic osteitis, one having had surgery and the other having been treated conservatively. The other child developed a Brodie's abscess 3 years after primary treatment. We have not been able to note any relationship between failure and initial temperature, ESR or WBC, and the day on which temperature became normal. If, after 3–4 weeks, the ESR is greater than half the rate at admission, in our experience, about one-third of these cases will progress to chronic osteitis.

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