The management of childhood osteomyelitis

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Summary

The management of seventy-six children admitted to Alder Hey Children's Hospital with osteomyelitis is discussed and the indications for surgical intervention are defined. The clinical and pathological course of the disease is examined and the term post-acute osteomyelitis is introduced. The importance of recognition of this stage of the disease and its relevance to the management is highlighted. The use of single antibiotic therapy (clindamycin) is shown to be at least as effective as combinational therapy. Complete resolution was achieved in 94.7% of children, surgical intervention was performed on 74.6%.

Introduction

The indications for conservative and surgical management of osteomyelitis have been greatly discussed but not clearly defined. The authors therefore propose to discuss the management of seventy-six cases of osteomyelitis treated at Alder Hey Children's Hospital, Liverpool, with reference to their indications for conservative and surgical treatment.

Since the introduction of antibiotics, the clinical management of osteomyelitis has been revolutionized with considerable reduction of morbidity and virtual total elimination of mortality from a figure of approximately 50%. Throughout this period there have been differing views on the relative merits of various individual antibiotics and, latterly, combinations of antibiotics.

The purpose of this paper is to discuss the management of seventy-six children admitted to this hospital with osteomyelitis over a 3-year period. The importance must be stressed of early surgical intervention when indicated and the selection of

appropriate antibiotic therapy. To help differentiate the group in whom surgery is considered mandatory for swift and complete resolution, the term 'post-acute osteomyelitis' has been introduced.

Method

Between September 1972 and September 1975 a total of seventy-six children with osteomyelitis were treated at Alder Hey Children's Hospital. Their ages ranged from 7 months to 14 years and the length of their follow-up from 6 months to 3 years. The osteomyelitis was of either haematogenous origin (seventy-three children) or followed trauma (three children). The diagnosis was made on classical clinical signs supported in the majority of cases by one or more of the following investigations: (a) positive bacteriology – either by blood culture or by direct swabbing of the infected area; (b) positive radiographic changes characteristic of osteomyelitis; (c) a blood picture, particularly an ESR, typical of infection; (d) presence of pus.

Excluded from the consideration are children with primary septic arthritis as there appears to be universal agreement of the need for early surgical decompression in these cases. Similarly excluded were all cases of neonatal osteomyelitis as it was felt that these form a distinct, separate group.

On admission, all children were fully examined and a detailed history obtained from the accompanying parent or guardian. Radiographs of the suspected area were taken and samples of venous blood were taken for blood culture, haemoglobin, white cell count and differential and erythrocyte sedimentation rate. Once diagnosed, the osteomyelitis was classified as being acute, post-acute, sub-acute or chronic.

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The term 'post-acute osteomyelitis' is defined at a stage of the disease with the following features:

1. A recent history of the acute stage, one to several weeks previously, with pyrexia and other systematic manifestations.

2. Radiographic changes typical of osteomyelitis, i.e. porosis, bone destruction or periosteal new bone formation.

3. Elevated temperature.

4. Localizing signs.

5. A sub-periosteal or sub-cutaneous abscess may be present.

6. The ESR is often elevated.

The indications for surgical intervention were assessed using the following criteria:

Absolute:

Sub-periosteal abscess formation.

Post-acute osteomyelitis.

Sub-acute osteomyelitis.

Chronic osteomyelitis.

Relative:

Diagnostic.

Incomplete or no response to conservative treatment.

When surgery was indicated the child was given intravenous lincomycin at a dose of 20 mg/kg/day in divided doses. When indications for surgery were not satisfied oral clindamycin was commenced. The dose recommended for severe infections was used, 24 mg/kg/day in divided doses for infants, 75 mg 6-hourly for toddlers, 150 mg 6-hourly for juveniles and 300 mg 6-hourly for adolescents. All the children who initially received parenteral lincomycin were transferred to clindamycin when they could accept oral medication. At the time of this study parenteral clindamycin was not available.

Results

Of the seventy-six children admitted, seventy-two were diagnosed as suffering from osteomyelitis on clinical assessment supported by at least one objective investigation; however, four children were included in the series who had classical clinical signs

with negative investigations; all responded rapidly to clindamycin, with no relapse. The osteomyelitis was classified as being acute in twenty children, post-acute in fifty, and sub-acute or chronic in the remaining six.

The osteomyelitis lesions involved more than one site in only one patient who had lesions in the lower ulna and lower femur. Their distribution in order of frequency is outlined in Table 1, predictably the lower limb was affected four times as often as the upper limb. As reported in other series, boys were affected 2.4 times more frequently than girls.

TABLE 1. Distribution of infected foci

Site of infection	Number of foci
Tibia	27
Femur	17
Fibula	9
Radius	4
Phalanges	4
Os calcis	3
Ulna	3
Metatarsus	2
Metarsus	2
Ilium	2
Humerus	1
Clavicle	1
Scapula	1
Navicular	1
Total:	77 foci in 76 patients

Altogether forty-six blood cultures were taken of which twenty-two (47.8%) were positive. A more reliable method of isolating the causative organism was to swab the infected area at surgery, in this way fifty positive cultures were obtained from the fifty-six children who underwent surgery (89.3%). The organisms isolated are shown in Table 2.

As expected, the most common pathogen isolated was *Staphylococcus* sp. which was found in 81.8% of positive blood cultures and 92% of positive swabs. Of these, only 10.8% were sensitive to penicillin and ampicillin, all were sensitive to both lincomycin and clindamycin.

TABLE 2. Bacteriological analysis. Numbers sensitive to clindamycin in parentheses

Sample	Number taken	Number positive	<i>Staph. aureus</i>	<i>Staph. albus</i>	<i>Strep. sp.</i>	<i>Bacteroides</i> sp.	<i>Strep. viridans</i>	<i>Pseudomonas</i> sp.	<i>Proteus</i> sp.	<i>Klebsiella</i> sp.
Blood	46	22	18 (18)	11 (11)	1 (1)	—	1 (1)	1 (0)	—	—
Swab	56	50	46 (46)	—	1 (1)	1 (1)	—	1 (0)	1 (0)	1 (0)

One blood culture grew both *Staph. albus* and *Strep. viridans*.

One swab culture grew both *Pseudomonas* sp. and *Proteus* sp.

Twenty children were treated conservatively, the other fifty-six children required surgical exploration, the procedures performed are described in Table 3.

TABLE 3. Surgical procedures

Incision and drainage of sub-periosteal abscess	22
Drainage of abscess and drilling of bone	18
De-roofing and guttering	9
Sequestrectomy	4
Arthrotomy	2
Aspiration	1
Total:	56

Twenty-one children were admitted already receiving antibiotics, this treatment was maintained until either poor response or bacteriological evidence suggested the drug to be ineffective. Thirteen children were thus transferred from their original antibiotic to clindamycin, no child with staphylococcal infection required changing from clindamycin to another antibiotic.

Complete resolution was achieved in seventy-two children (94.7%) there being no evidence of recurrence 6 months or more after cessation of treatment.

Clindamycin was used to treat sixty-eight children, either alone or in combination with surgery. Of these, fifty-five children were treated throughout with clindamycin whilst thirteen were switched from other antibiotics because of unsatisfactory response. Two of the eight children who responded to other antibiotics had infection due to organisms beyond the spectrum of clindamycin, namely *Klebsiella* sp., *Pseudomonas* sp., and *Proteus* sp.

Analysis of the four failures serves to emphasize the importance of adequate surgery coupled with a minimum 6-week course of the appropriate antibiotics. One child had a recurrence when the clindamycin was discontinued after only 3 weeks, prompt recommencement of the drug produced a satisfactory result. Two children were inadequately drained and despite clindamycin therapy, suffered a recurrence, the organism retained its full sensitivity to clindamycin and a satisfactory resolution was obtained following the radical drainage and a further course of clindamycin. The fourth child had a severe de-gloving injury which was initially infected with *Staph. aureus*. This infection settled rapidly on clindamycin but following skin grafting, infection with *Proteus* sp. and *Pseudomonas* sp. became evident and bone infection ensued; these organisms were resistant to clindamycin, and gentamicin was prescribed. Notwithstanding, resolution did not occur until formal surgical drainage was performed.

Although there have been reports of severe diarrhoea associated with clindamycin therapy, this complication has not been seen in any of the patients, at no time was it necessary to discontinue clindamycin therapy.

Discussion

Early acute osteomyelitis stems from infection of the sluggish venous lakes and capillary loops in the metaphysis (Trueta, 1959).

The ensuing oedema and thrombosis within the rigid confines of the cancellous bone produces a rapidly progressive ischaemic pressure necrosis which isolates the infection from the blood supply. Once established, the infection crosses the bony cortex and elevates the periosteum thereby increasing the ischaemia. Once these changes are visible radiologically it is felt that there is little chance of any antibiotic effectively reaching the infection. The clinical management of osteomyelitis is based upon this pathological sequence, because the formation of pus, with its surrounding ischaemia, inhibits recovery, increases the likelihood of relapse and threatens chronicity (Khazenifar, 1976).

It is reasonable to expect an antibiotic swiftly and permanently to eradicate infection in the very early stages of the disease, the true acute stage. Consequently clindamycin was administered at this stage. Clindamycin was chosen because it not only has excellent activity against the predominant pathogen *Staph. aureus* but it also has the important ability to penetrate both soft tissue and bone. Should there be a deterioration in the condition of the patient within 12 hr or if there is no improvement within 24 hr, surgical decompression of bone is performed. If the child presents with radiographic bone destruction and meets the criteria of the post-acute stage, decompression of the bone under antibiotic cover is performed immediately in order to diminish the ischaemia which would otherwise impede the antibiotic action. The distinction drawn between the early 'acute' and 'post-acute' is more than academic as it indicates a sensible modification in treatment. The child who presents with an abscess or who has responded partially to antibiotics with incomplete resolution will have progressed to the post-acute stage and requires decompressing surgically, in the sub-acute and chronic stages of the disease, surgical drainage is obligatory.

The primary healing rate of 94.7% in this series compares favourably with other series where combinations of antibiotics were used. Blockey and Watson (1970) achieved a success rate of 81.4% using penicillin and cloxacillin whilst Blockey and McAllister (1972) achieved a recovery rate of 89.5% using a combination of erythromycin and fusidic acid. Wharton and Beddow (1975) of Alder Hey

reported a primary healing rate of 94.2% but their operative rate was 89% as opposed to 50% in Blockey's 1972 series and 74.6% in this series. Wharton also used clindamycin and it is worthy of note, in view of McAllister's findings of emergence of resistant strains of *Staph. aureus*, that no evidence of resistance to clindamycin has been seen in this unit.

The results of this study show that the combination of clindamycin and appropriate surgery offers both patient and surgeon a most satisfactory result in what can be a devastating disease.

Conclusions

1. The management of osteomyelitis should be related to the stage of the disease.
2. The term 'post-acute' is introduced to define a stage of the disease in which the ischaemic element is such that surgical drainage is absolutely indicated.
3. Single antibiotic therapy (clindamycin) is at least as effective as combination therapy.

4. Single antibiotic therapy does not appear to encourage resistant strains to emerge.

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