

Hematogenous osteomyelitis in children

In a 10-year period, 31 children, including 9 infants, were treated for hematogenous osteomyelitis. Fifteen children were treated closed and 16 open. Thirteen of 14 positive cultures were *Staphylococcus aureus*. Three recurrences could possibly have been prevented by a more aggressive primary approach.

At follow-up after 5 (1-12) years, 3 neonates had developed severe growth disturbances despite optimal initial treatment. Acceptable results were obtained with antibiotic therapy for 6 weeks or more. We recommend ampicillin and a penicillinase-resistant penicillin, unless bacterial resistance patterns indicate a different antibiotic. We operate if pus has formed and if a child with severe symptoms does not improve during adequate antibiotic treatment and immobilization.

Bjarne Rud
Susanne Halcken¹
Vilhelm Damholt

Department of Orthopedics
and ¹Pediatrics, Odense Uni-
versity Hospital, DK-5000
Odense C, Denmark

Osteomyelitis has always been a serious disease, which was often fatal prior to the antibiotic era. It is important that the diagnosis be made early and proper treatment be instituted in order to prevent permanent deformity and functional disability.

We have analyzed a 10-year material of hematogenous osteomyelitis in children.

Patients and methods

The records of 31 children aged 0 to 15 years treated for hematogenous osteomyelitis from 1973 through 1982 were studied. Criteria for inclusion were clinical signs of osteomyelitis confirmed by blood culture, abnormal radiographs, bone scans, and/or operative findings.

Thirty patients were reexamined after 5 (1-12) years. Twenty-one of them still lived in the county and were reexamined by one of the us. Nine other patients were reexamined by an orthopedic surgeon or family physician according to our instructions. One patient filled out a questionnaire. Unless they had complaints, those who had normal radiographs at the last out-patient examination did not undergo a radiographic examination at the follow-up.

Results

Our 31 patients (Table 1) were hospitalized 38 times for an average of 30 days. The mean age was 4 years, and upon dividing the material ac-

ording to Trueta (1959), 9 were infants and 22 were children. Seven patients were less than 1 month old, and most of them were being treated for various neonatal conditions (ileus, respiratory distress syndrome, prematurity) when the diagnosis osteomyelitis was made.

A possible entry of bacteria was demonstrable in only 9 patients, 5 of whom were less than 1 month old. Twenty-five children demonstrated local signs of infection, while in 6 the only sign of osteomyelitis was impaired function of the affected part—in 3 cases the column and in 3 the femur. In 4 patients (Cases 19, 26, 28, 29), primary radiographs demonstrated typical Brodie's abscesses. Case 12 had osteomyelitis of the femoral head with septic coxitis, which was openly drained the day after the diagnosis was made. Antibiotics were administered for 8 (0-36) weeks.

Seven patients had two admissions. Case 11 was readmitted because of pain, whereas Cases 13 and 15 were diagnostic failures; they were misinterpreted as having innocent conditions and had inadequate treatment. Case 24 did not improve convincingly; nevertheless, she was discharged. However, because of lack of response to lincomycin, she was readmitted for an operation 1 month later.

The last three readmissions represented recurrences. In Case 9, symptoms subsided after treatment with one antibiotic drug for 10 weeks; bacteriologic diagnosis was not obtained, and the arm was not immobilized. He

returned 7 weeks after discharge and *Staphylococcus aureus* was isolated by aspiration; antibiotic therapy was instituted and after 6 months healing was confirmed. Case 20 received appropriate antibiotic therapy, but despite radiographically confirmed osteomyelitis, only soft-tissue revision was performed. Recurrent drainage finally made a costal resection necessary. The third recurrence, Case 27, occurred after aspiration and antibiotic treatment for 5 weeks; 2 months after discharge, she was readmitted and a sequestrum was removed.

At follow-up, 15 patients were completely normal including their radiographs. Ten patients had radiographic abnormalities, but no symptoms; among these were all 4 with affection of the spine. Severe sequelae were found in 3 patients. Case 1 had visible and radiographic deformity of the calcaneus and had problems with footwear. Case 2, with an affection of the proximal femur, had pain and a limp after physical exertion, visible atrophy of the gluteal muscles, reduced hip motion, and 1.5 cm shortening of the leg; radiographs revealed a slight deformity of the femoral neck and the greater trochanter, but the hip joint was normal. Case 3, with affection of the head of the humerus, had developed a shortening of 10 cm of the arm; radiographs showed a short, deformed proximal humerus. The last 3 patients had insignificant symptoms.

Discussion

From 1973 through 1982, we have treated 31 children with osteomyelitis. Like others (Blockey & Watson 1970, Anderson et al. 1980), we found that two thirds were boys. One fourth were neonates, a figure comparable with the 17 per cent of Petersen et al. (1979). Our series revealed the usual distribution of foci, with a concentration in the long bones of the extremities.

On admission, two thirds had fever, whereas Anderson et al. (1980) and Mollan & Piggot (1977) reported fever in more than 90 per cent of their subjects. This discrepancy may in part be due to the fact, that we did not exclude patients with a long period of symptoms, among these 4 with a Brodie abscess.

We isolated bacteria from half of our patients with *Staphylococcus aureus* in all but one. Anderson et al. (1980), Cole et al. (1982), Nade (1978), Mollan & Piggot (1977), and Petersen et al. (1979) observed the same preponderance of staphylococci and incidence of positive cultures. Our isolation rate might have been greater if blood culture had been performed consistently. Nine of the isolated staphylococci produced B-lactamase, whereas 4 were sensitive to penicillin. In 2 patients no bacterial diagnosis was made and lincomycin was the only treatment. Both patients had a poor response, 1 being readmitted for operation.

Blockey & Watson (1970) and Nade (1983) recommend that penicillin be given together with cloxacillin, because they regularly isolated streptococci from patients with osteomyelitis. We did not find streptococci, but in 17 patients the bacterium was unknown. When a bacterial diagnosis is not obtained, we prefer to administer two antibiotics concurrently. If bacteria are isolated, drugs, of course, are selected according to bacterial resistance patterns.

Blockey & Watson (1970) administered antibiotics for 3 weeks with a recurrence rate of 18 per cent. In our material, one recurrence occurred after operation and antibiotic treatment for 5 weeks. Like Anderson et al. (1981), Mollan & Piggot (1977) and Cole et al. (1982), we believe that antibiotics should be administered for at least 6 weeks. Our second recurrence might have been prevented by immobilization and simultaneous administration of two antibiotics, and the third recurrence by aspiration. Our recurrence rate agrees with the results of Petersen et al. (1979); a more rigorous primary approach could possibly have prevented our recurrences.

Trueta (1959) suggested that patients suffering from acute hematogenous osteomyelitis should be separated in three groups according to the vascular arrangement in bone at various ages. During the first year of life, the growth plate does not represent a barrier to infection, for it is traversed by vessels from the metaphysis; growth may become inhibited. We observed this in 3 infants. Upon scrutinizing their case histories, we did not find any information, objective findings, or laboratory tests that could have helped in predicting the unfor-

Table 1. Data from 31 patients with hematogenous osteomyelitis

Case	Sex	Age ^a	Days of symptoms at diagnosis	Fever (>37.5°C)	ESR	Leucocytosis	Blood culture ^b	Location
1	F	0d	9	+	-	-	S	calcaneus
2	M	1d	5	+	-	-	S	femur
3	F	2d	6	-	+	+	N	humerus
4	M	11d	9	+	-	-	N	calcaneus
5	M	21d	7	-	+	-	N	femur
6	F	1m	2	+	-	-	S	humerus
7	M	1m	5	-	+	+	N	tibia + columna
8	F	5m	21	+	+	+	N	tibia
9	M	9m	60	-	+	-	-	ulna
10	M	13m	4	+	+	+	N	ulna
11	M	14m	30	+	-	-	-	columna
12	M	15m	5	+	-	-	N	femur
13	M	16m	3	+	-	-	-	femur
14	M	16m	1	+	+	-	N	calcaneus
15	M	19m	10	-	-	-	-	columna
16	M	4y	4	+	+	+	S	femur
17	M	4y	4	-	+	-	N	fibula
18	M	5y	2	+	+	-	N	columna
19	F	7y	30	-	+	-	-	tibia
20	M	8y	21	-	+	-	-	costa
21	M	9y	1	+	-	-	N	femur
22	F	9y	7	+	+	+	N	tibia
23	M	10y	7	+	+	-	N	fibula
24	F	10y	45	+	+	-	N	mandibula
25	M	10y	3	+	+	+	N	femur
26	M	12y	90	-	-	-	-	tibia
27	F	13y	5	+	+	-	S	tibia
28	M	13y	30	+	+	-	-	femur
29	F	13y	90	-	-	-	-	femur
30	M	14y	3	+	+	-	-	tibia
31	F	15y	90	-	+	-	-	femur

a. d days, m months, y years.

b. M *Micrococcus*, S *Staphylococcus aureus*, N Negative.

c. P Positive, N negative, * positive at some time during hospitalization.

d. A Abscess incision, T Trepanation, D Drainage of concurrent arthritis.

e. A Ampicillin, Li Lincomycin, P Penicillin, PR Penicillinase-resistant penicillin.

fortunate outcome; they were all treated adequately and cured after primary management. Two of them were premature. Trueta & Morgan (1954) and Trueta (1968) made similar observations.

We failed to establish any correlation between duration of symptoms before treatment or clinical status on admission and the final outcome. Apart from the patients with spinal lesions, only unimportant radiographic abnormalities were found at follow-up. Thus, we confirmed the observation of Trueta & Morgan (1954) that serious sequelae are not common in juveniles, especially if they are young at onset, leaving the bone several years to remodel.

Mollan & Piggot (1977) claimed that all but the mildest cases should be operated on. In our departments, we administer two antibiotics, ampicillin and methicillin, until bacterial diagnosis is obtained, initial therapy being given parenterally for 1 week. In all cases, antibiotic therapy is continued for at least 6 weeks. From our experience and in accordance with others (Nade 1983, Anderson et al. 1980), we find surgery indicated when a collection of pus is suspected in soft tissue or bone, or the response to antibiotic therapy is not rapid.

Primary		Operation ^d	Bacterium isolated at operation ^b	Antibiotics ^e + duration of treatment (wk)		Recurrence (mo)	Follow-up (yr)	Severe sequelae
Radio-graphs ^c	^{99m} Tc-MDP scans ^c							
P	P	A	N	PR	6		5	+
P		—		PR	9		10	+
P		A	S	A+PR	11		12	+
P		—		PR	8		6	
N*		—		P+PR	3		8	
N*	N	—		P	8		5	
P		A	M	Li	20		10	
P	P	—		A+PR	6		5	
P		—		PR	10	2 ^f	5	
P		—		Li	16		10	
P		—		—	—		4	
N*	P	D	S	PR	6		5	
N*		—		A+PR	6		6	
N	P	—		A+PR	3		3	
N*	N	—		A+PR	8		4	
N*	N	—		P	6		3	
P	P	T	N	A+PR	12		6	
P		—		P	5		10	
P		T	N	PR	5		1	
P		A	S	PR	7	24 ^g	11	
N	P	—		—	—		4	
N*	P	T	N	A+PR	8		3	
P		—		P	8		6	
P		T	N	Li	14		5	
N	P	T	S	PR	13		2	
P		T	S	P	12		4	
N*	P	T	S	PR	5	2 ^h	1	
P		T	S	P	14		8	
P		T	N	—	—		8	
N*		—		PR	3		8	
P	P	T	S	PR	9		2	

f. Treated by trepanation.

g. Treated by costal resection.

h. Treated by sequestrectomy.

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