Doctor's Duty

This real risk of further and more serious injury means that not only must we recognize the syndrome for what it is, we must also report the cases to the police. We cannot return children to parents in whose care they may have a 10% chance of violent death. Doctors are reluctant to believe that such assaults on innocent babies are possible, and they are even more reluctant to become involved in the squalor of criminal proceedings, but in the interests of some of our most helpless patients we must realize that epiphysial trauma is due to violence and that not all parents, even if warned, are safe custodians.

Summary

Five cases of multiple epiphysial injuries in babies are described which illustrate the classical features of the condition—namely, (1) unexplained swelling in a baby's limb, (2) characteristic x-ray changes, (3) elevation of temperature, (4) leucocytosis.

Typical x-ray appearances are described, and it is emphasized that the diagnosis can be made from these rather than from the clinical history, from which a story of trauma is often conspicuously absent. The conditions must be differentiated from scurvy, osteomyelitis, and

congenital indifference to pain, and should not be confused with the other form of "Caffey's disease"—namely, infantile cortical hyperostosis. The mode of production of these injuries is described and a plea is made for recognition of this syndrome and the desirability of reporting such cases to the police in order to minimize the risk of further injuries being inflicted upon these children.

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SOME ASPECTS OF ACUTE HAEMATOGENOUS OSTEITIS IN CHILDREN

BY

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In the pre-antibiotic era acute haematogenous osteitis of childhood was a disease with a high risk to life and limb. When penicillin was introduced both mortality and morbidity rates dropped dramatically and it appeared that the *Staphylococcus aureus* had met its match. Dennison and Macpherson (1952) reported that osteitis of childhood had become "exceedingly rare" in Glasgow hospitals. This state of affairs no longer exists. Acute osteitis is now common in hospital practice and complications are frequent.

This paper is based upon a study of recent cases of the disease and is an attempt to form a rational approach to some of the problems.

Material

During the two-year period 1960–1 59 children in age-group 1–12 years were treated for acute osteitis in the Royal Hospital for Sick Children, Glasgow. The treatment of all patients included bed rest, splintage, and the exhibition of one or more antibiotics; 37 were subjected to operation, all within the first fortnight of the illness, and 13 were left with a chronic bone infection.

Patients can be placed into one of three groups (Table I). In assembling these groups the difficulty of confirming a purely clinical diagnosis of acute osteitis has been taken

into account, and doubtful cases have been omitted. In most patients the diagnosis was supported by radiological evidence of osteitis: in all others the bone involved was accessible to clinical examination—for example, the tibia. It is appreciated that this is a review of immediate results, and it is possible that complications may later develop in an apparently healed bone.

This paper is concerned with haematogenous osteitis in children aged 1 to 12 years. In younger children osteitis has a different pathology and prognosis (Trueta, 1959). Osteitis in association with septic arthritis also presents a different clinical picture and requires other methods of treatment. During the period of the review 19 infants under 1 year of age were treated for acute osteitis, and 22 children under 12 years of age were treated as cases of septic arthritis. These 41 patients have been excluded from this review.

Analysis of Results

Most studies of osteitis tend to be statistical and each proponent of a routine of treatment vies to produce "better" figures than the last. Clinical experience shows how invidious such comparisons can be. The relative balance between the seed and the soil—the virulence of the organism and the resistance of the patient—difference in age of the child or timing of treatment, all summate to make each case unique. In any hospital series selection of patients is inevitable, for some are treated satisfactorily at home. In this area some family doctors refer the child on suspicion, while others wait until a complication develops.

Table I helps to concentrate interest upon the more serious cases. Osteitis of the vertebral body is well recog-

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TABLE I.—Osteitis in Children (1–12 Years). Outcome in 59 Patients

	Antibiotic and Cure	Antibiotics, Operation, and Cure	Antibiotics, Operation, and Chronic
Focus in a shorter bone ..	8	4	Nil
.. .. longer ..	14	20	13
Total ..	22	24	13

nized as being relatively benign (Garcia and Grantham, 1960; Pritchard and Thompson, 1960). Although a vertebra is anatomically a "long" bone, with a shaft and two ends, it is by linear measurement short. It has been included with the clavicle, scapula, and the innominate bone and with the anatomically short bones of the tarsus. In this series no case of chronic osteitis occurred outside the group of longer bones—femur, tibia, fibula, humerus, radius, ulna. This may be coincidental, for chronic osteitis of the os calcis, for example, is not unknown, but it does support the clinical impression that osteitis of the longer bones is more acute, more malignant, and more prone to complication.

Some factors which may determine outcome are shown in Tables II and III. In each case the first antibiotic used was judged "correct" or "incorrect" according to the bacteriologist's sensitivity report. Table II reveals that more than half of the patients developing chronic osteitis

TABLE II.—*Osteitis in the Long Bones of Children (47 Patients). The Wrong Antibiotic as a Cause of Chronic Osteitis*

	Antibiotic and Cure	Operation and Cure	Operation and Chronic
No. of patients	14	20	13
Initial antibiotic incorrect	Nil	4	7

TABLE III.—*Osteitis in the Long Bones of Children (47 Patients). Delay as a Cause of Chronic Osteitis*

	Antibiotic and Cure	Operation and Cure	Operation and Chronic
No. of patients	14	20	13
Day of presentation*			
Average	3	3	5
Range	1-10	1-7	2-10
Day of operation*			
Average	—	4	7
Range	—	1-9	2-11

* All figures refer to number of days after onset of illness.

were initially treated with an incorrect antibiotic. Table III analyses delay; in general, cases of chronic osteitis present later than those cured after operation or by antibiotics alone: operation tends to be delayed in this group. The range of figures is of some significance and is discussed later.

Extent of the Problem

The extent of the problem can best be illustrated by the story of a single patient, typical of many appearing at the present day.

Case 1.—A 6-year-old boy was attended by his own doctor for pain and swelling of the left knee of two days' duration. Oral penicillin was started, but his condition deteriorated and three days later he was admitted to hospital. A clinical diagnosis was made of acute osteitis of the upper end of the tibia. At operation pus was evacuated from a subperiosteal abscess stretching almost half-way down the bone and the cortex was drilled. The organism cultured was *Staph. aureus* resistant to penicillin but sensitive to other antibiotics. A chronic osteitis resulted, with a small sequestrum and discharging sinus. Fig. 1 shows the extent of periosteal stripping as revealed by new bone formation on the radiograph 14 days after operation. Fig. 2 demonstrates the size of the resultant sequestrum.

From a detailed study of this patient and of 46 others, aged 1 to 12 years, with acute osteitis in the metaphysis of a long bone it appears that there are three major problems: (1) early diagnosis, (2) using the correct antibiotic, and (3) the indications for operation.

Early Diagnosis

Although the symptoms and signs of acute osteitis are well known misdiagnosis is common. Harris (1960) has

emphasized the difficulties that arise in making a diagnosis from trauma, poliomyelitis, acute rheumatism, and transient synovitis. Of these, trauma is the most important, for children are prone to bumps and bruises, and if a leading question is asked a recent injury will usually be admitted. It has long been considered (Fraser, 1924) that trauma is a vital factor in determining localization of the lesion.

Many patients in this series were sent to hospital too late in the course of their disease (Table III). In some the correct diagnosis had been made and antibiotics had been administered at home: in others, wrongly diagnosed, the treatment was ineffective. One patient, thought to be suffering from acute rheumatism, had received antipyretic treatment while in hospital.

FIG. 1

FIG. 2

FIG. 1.—Case 1. Radiograph of tibia two weeks after drainage of a small subperiosteal abscess. The new bone formation reveals the extent of periosteal stripping that has occurred. FIG. 2.—Radiograph of the same tibia as in Fig. 1 one month later. The bone has healed except for a small sequestrum.

Early diagnosis is essential for the proper treatment of osteitis. There are two main causes of delay. Firstly, a lack of awareness of the disease and a consequent inability to suspect its presence; secondly, a failure to recognize the two cardinal features (Platt, 1928) of fixed pain at the end of a long bone accompanied by metaphysal tenderness.

Using the Correct Antibiotic

"*Staphylococcus aureus* by Gram and Koch he swore
... To take a patient's life."

R. B. P. (1909).

The commonest causal organism in acute osteitis is the coagulase-positive *Staph. aureus*. A major problem to-day is the frequent occurrence of staphylococci insensitive to penicillin G.

Where infection is acquired in a hospital it is probable that the organism will be resistant to penicillin and perhaps

to other antibiotics. In neonatal osteitis the baby has almost always been born in hospital, and as long ago as 1951 it was the practice in Glasgow to assume that all infections in the newborn were due to penicillin-insensitive organisms (Dennison and Macpherson, 1952). In older children previous hospital admission is not usual; nevertheless about one-half of the strains of staphylococci isolated in this hospital from children with osteitis are resistant to penicillin.

Antibiotics are essential for the proper treatment of acute osteitis. The urgency of the condition is such that initial treatment must be empirical, for therapy must be started before the sensitivity of the organism is known. The patient's interests are best served by early and adequate treatment with the antibiotic which is most likely to be effective against the responsible organism. This can be determined only by studying recent experience (Blockey and Mann, 1962).

In the two years 1960-1 100 children aged 0 to 12 years were admitted to the Royal Hospital for Sick Children, Glasgow, suffering from acute haematogenous infection of bone or joint; from these, 75 organisms were cultured (Table IV). When the organisms are examined according to the age of the children three groups emerge:

1. *Neonates* (0-2 months).—Of 13 identified organisms, 11 were staphylococci, only one of which was sensitive to penicillin G.

2. *Infants* (2-24 months).—A variety of organisms were encountered: staphylococci and streptococci were commonest.

3. *Children* (2-12 years).—Almost all had a staphylococcal infection.

TABLE IV.—Organisms Isolated From 100 Cases of Acute Haematogenous Infection of Bone or Joint (1960-1)

	<i>Staph. aureus</i>	Haemolytic Streptococcus	Pneumococcus	Meningococcus	Para-typhoid B	<i>E. coli</i>	Coccal-negative Staphylococcus	No Organism Isolated	Total
Neonates (0-2 months) ..	11	1	1					5	18
Infants (2-24 months) ..	4	4	2	1	1	1	1	2	15
Children (2-12 years) ..	46	1			1			18	67
All groups (0-12 years) ..	61	6	3	1	2	1	1	25	100

Infection of bone or joint is most severe when it is caused by a staphylococcus or streptococcus. Other organisms are less common and give rise to a disease which is less acute. Almost any antimicrobacterial agent will prevent the growth of streptococci. The real therapeutic dilemma is presented by *Staph. aureus*—in this series all patients who developed sequestration had a staphylococcal infection. Table V shows the *in vitro* sensitivity of the 61 staphylococci isolated*: 34 (55%) were resistant to penicillin G. All the neonates were born in hospital, but the single baby with osteitis due to a penicillin-sensitive staphylococcus had been at home for three weeks before admission with acute osteitis.

Choice of an Antibiotic

It is apparent that penicillin G cannot be recommended for the treatment of acute osteitis unless the organism is known to be sensitive to it. If it had been used in this series of children more than half would have received

*All organisms were cultured and sensitivities reported by the Bacteriological Laboratory at the Royal Hospital for Sick Children. A staphylococcal strain was declared "penicillin resistant" when there was no inhibition of growth by a disk of 1.5 units of benzylpenicillin.

ineffective treatment during the early and most vital stage of their infection (34 of 61 staphylococci, 40 of 75 identified organisms were penicillin resistant).

Table VI summarizes the main arguments for and against the use of some alternative antibiotics. Table VII lists three antibiotic combinations which are sometimes recommended.

Acute osteitis is a local manifestation of a blood-borne infection, and the organism must be attacked in the primary focus, in the blood-stream, and in the bone. Because of the nature of the disease and the mechanical barrier in the bone a prolonged course of treatment is usually necessary and the antibiotic should be suitable for administration over a period of three weeks without undue risk of toxicity to the patient and without likelihood of the organism developing resistance. For quick action and certainty of dosage parenteral administration is desirable. The antibiotic chosen will be more effective if its action is bactericidal rather than bacteriostatic.

TABLE V.—Antibiotic Sensitivity of 61 Strains of Staphylococci (1960-1)

Age-group	Strains Sensitive to P C T E	Strains Resistant to							Total
		P	P C	P C T	T	C	E	P T	
Neonates (0-2 months)	1	8		1				1	11
Infants (2-24 months)	2	2							4
Children (2-12 years)	20	19	3		1	2	1		46
All groups (0-12 years)	23	29	3	1	1	2	1	1	61

P=Penicillin. C=Chloramphenicol. T=Tetracycline. E=Erythromycin.

TABLE VI.—A Consideration of Antibiotics Used in Treatment of Acute Osteitis

	In Favour	Against
Penicillin G ..	Bactericidal. The most effective antibiotic if the staphylococcus is sensitive	50% of staphylococci are insensitive
Chloramphenicol	Broad spectrum	Bacteriostatic and has relatively poor action against staphylococci. Toxic, especially if treatment is prolonged
Tetracycline ..	" "	Bacteriostatic. Superinfection is a complication. Not advised in neonates because of danger of fixation to growing bone and tooth
Erythromycin ..	Bactericidal and has good action against staphylococci	Sensitive organisms become resistant very quickly (should be used in combination with another antibiotic). Inactive against many Gram-negative organisms
Methicillin/cloxacillin	In full dosage have effective bactericidal action against staphylococci and streptococci. Non-toxic with exception of occasional hypersensitivity reactions	Other organisms are not affected
Fusidic acid ..	Bactericidal to staphylococci	Relatively ineffective against streptococci. Cannot be given parenterally

TABLE VII.—Antibiotic Combinations in Empirical Treatment of Acute Osteitis

Penicillin and tetracycline	An attempt to utilize the strong action of penicillin against sensitive staphylococci yet covering the insensitive organisms by the broad spectrum of tetracycline. Unfortunately these antibiotics are often antagonistic and the bactericidal action of penicillin may be lost. Many staphylococci in hospitals are now resistant to both antibiotics, therefore it is likely that more osteitis cases will be caused by organisms having this pattern
Penicillin and erythromycin	If the osteitis is caused by a penicillin-sensitive staphylococcus this combination is no better than penicillin alone. If caused by a penicillin-resistant staphylococcus it is probable that resistance to erythromycin will develop within a few days
Penicillin and fusidic acid	Utilizes two antistaphylococcal antibiotics which may be synergistic against penicillin-sensitive staphylococci. Infections due to penicillin-resistant staphylococci receive treatment which depends upon the vagaries of oral administration

Because this condition is in the nature of a therapeutic emergency antibiotics must be started before the causative organism is known, though not before a suitable specimen has been secured for laboratory examination. The antibiotic used must be chosen on a best-guess basis, having regard to past experience of similar cases in similar age-groups from similar geographical areas. In retrospect, it appears that more patients of this series would have received earlier effective antibiotic treatment if penicillinase-resistant penicillins—that is, methicillin or cloxacillin—had been available and been given empirically when the child was first seen. If to-day the pattern of organisms has not greatly changed then these penicillins offer the best chance of aborting infection in its early stages before abscess formation can occur.

When the sensitivity of the organism is known treatment may be changed to a bactericidal agent which is more effective, more convenient, or less expensive.

Conclusion

The staphylococcus will no doubt continue to change its pattern, and as new and more active antibiotics are produced our present therapy will become outdated. Nevertheless it is considered that the principles stated above will remain valid.

Place of Operation

"... Bone can live and have its peripheral circulation restored, even after the destruction of the periosteum" (Macewen, 1912).

There is no general agreement upon the place of operation in the treatment of acute osteitis. One school of thought denies that operation is ever required; Pappworth (1962) argues that antibiotics can control the infection and sterilize the abscess, and that pus and sequestra will be absorbed in time. At the other extreme, operation is advised in all patients when infection has been present for 48 hours (Harris, 1962). This is advocated to forestall stripping of the periosteum by the abscess, which it is argued is the main cause of death of bone. A more moderate approach is the suggestion that the surgeon should observe each patient for 24 hours to permit resolution to occur and operate only when the condition appears to deteriorate (Trueta and Morgan, 1954). Needle aspiration is used by Higgins, Browne, and Bodian (1947) as a method of removing subperiosteal pus and avoiding an unsightly scar or the danger of secondary infection.

There are several advantages of early operation in acute osteitis. The surgeon requires no great skill, he can never be accused of operating too late, and when pus escapes he feels that he has done something for his patient. But this approach oversimplifies the problem, a patient whose bone heals after an operation is not necessarily cured by it. Procedures which were required in the days before chemotherapy may be superfluous when an effective antibiotic is used. The liberation of a few millilitres of pus is not always sufficient justification for the infliction of a permanent scar.

In this series 33 children underwent operation, all during the first 10 days of the infection; 13 failed to heal in spite of or perhaps because of the operative treatment. These children were under the care of several different surgeons and there were no standard indica-

tions for operation. This provides an opportunity of comparing individual patients operated upon at different stages of the disease.

Reference to Table III may lead to the assumption that complications develop because operation is delayed: closer inspection reveals that early operation does not necessarily forestall chronic osteitis and delay in decompression does not always result in sequestration. In several instances uneventful recovery was achieved when drainage of a large periosteal abscess was carried out a week or more after the onset of the infection. Nine patients were operated upon before subperiosteal pus could collect: three resulted in chronic osteitis.

Case 2.—A 5-year-old boy was admitted to hospital with a clinical osteitis of lower end of ulna of 48 hours' duration. Operation was performed immediately, but no frank pus was found under the periosteum or on drilling the bone. Treatment with penicillin was begun, but the staphylococcus obtained by culture of the marrow and blood was insensitive to the antibiotic. Chronic osteitis with sequestration of the lower end of the ulna resulted (Fig. 3).

What Does Operation Achieve?

There are three reasons for operating during the acute phase of osteitis—to culture an organism, to protect the blood supply of the bone, or to improve the patient's general condition by draining an abscess.

To Identify the Organism.—It has been shown that awareness of the trend of infection and administration of appropriate antibiotics enable most patients to be given effective treatment in the earliest stages of the disease. No patient can afford to wait 24 hours for laboratory identification of an organism and its sensitivity, but this does not justify operation and the risk of secondary infection and sinus formation.

To Drain an Abscess.—Pappworth (1962) claims that drainage of an abscess is never indicated and that pus and sequestra will eventually absorb if secondary infection can be prevented. No patient in this series with the clinical signs of abscess formation has been managed in this fully conservative manner, for most surgeons agree that the patient's general condition will improve after drainage of a subperiosteal abscess and will advise operation or aspiration in the fully developed case, at least.

To Protect the Blood Supply of the Bone.—The shaft of a long bone in a child derives its circulation from two sources, the nutrient artery and the periosteal vessels. Sequestration of bone follows loss of blood supply. Macewen (1912) thought that nutrient artery thrombosis was the chief cause of bone death and that periosteal stripping was unimportant if the medullary vessels survived. Trueta (1962) believes that metaphyseal sinusoids always infarct before the periosteum is stripped and that the fate of the bone is determined by the integrity of the periosteal vessels; he states that early incision of periosteum allows reattachment and revascularization.

If periosteal stripping is to be regarded as the most important factor in causing chronic osteitis, then operation is indicated as soon as pus is present under the periosteum.

FIG. 3.—Case 2. Radiograph showing chronic osteitis of ulna. This bone was "decompressed" 48 hours after infection began.

If thrombosed medullary vessels determine the fate of the bone neither decompression of the periosteum nor drilling of the cortex will avert sequestration.

In an attempt to answer the question, What does operation do for the bone? the operated patients of this review have been studied for evidence in favour of one or other of these theories. Three distinct groups emerge:

1. Of nine patients operated upon before a subperiosteal abscess could collect, three developed sequestration of bone. One of these three, Case 2 (described above), was operated upon before pus formed in the bone, and in the other two a little pus was obtained when the cortex was drilled. During the operative procedures the periosteum was incised but not stripped. Penicillin was administered to all three—but no patient had a "correct" antibiotic until the fourth day of his infection. In contrast, the six patients cured after similar operations all received a correct antibiotic on the second and third days of the disease. It is difficult to see how early operation benefited this group. The six patients cured received prophylactic treatment in exchange for a scar. In the other three the sensitivity of the organism was not discovered in time to use an effective antibiotic: sequestration supervened despite decompression of the periosteum.

2. One patient was treated by aspiration of a subperiosteal abscess (included in the tables as a patient cured after operation).

Case 3.—A 5-year-old girl with late osteitis was treated by chemotherapy and aspiration of 23 ml. of pus. The extent of the periosteal stripping is revealed by the new bone formation seen in a radiograph two weeks after aspiration (Fig. 4); perfect bone-healing resulted without evidence of sequestration.

FIG. 4.—Case 3. Left, lateral radiograph. Right, antero-posterior radiograph. These radiographs show new bone formation, demonstrating the extent of periosteal stripping two weeks after 23 ml. of pus had been aspirated. The periosteum has been stripped from all aspects of the lower half of the femur, yet perfect bone-healing took place. The arrow shows the position of the raised periosteum.

In this patient the nutrient vessels presumably remained patent.

3. A subperiosteal abscess was drained in 22 patients. In 12 the bone healed satisfactorily after operation, but 10 of these had received an effective antibiotic from the time of presentation. In the remaining 10 patients a sequestrum developed, but only five received the correct antibiotic. In general the patients with chronic osteitis presented later, received the correct antibiotic later, and had larger abscesses to evacuate. No one patient is representative of this group; in some cases large quantities of subperiosteal pus were present on the third day, in others only a few millilitres had collected at the end of a week. Chronic osteitis occurred after adequate drainage of a small abscess within 48 hours, and healing resulted when a large abscess was opened on the ninth day. It is apparent that acute osteitis does not conform to a time-table.

A detailed study of Case 1 is instructive. At operation the abscess stretched almost halfway down the bone, but the periosteum was firmly attached at this level. The radiograph taken two weeks later shows periosteal new bone formation along almost the entire length of the tibial shaft. Despite this, only a small sequestrum resulted. Thus periosteal stripping progressed after the abscess had been drained. The size of the sequestrum bears no direct relation to this loss of periosteal blood supply. It is concluded that the medullary vessels generally remained intact, except for localized metaphyseal thrombosis at the site of the sequestrum.

(One further patient presented late in the course of his illness with a septicaemia of some days' duration. On clinical and radiological grounds it is likely that sequestration was present before treatment of any kind was given.)

Conclusion

When the place of operative treatment is being considered, argument on a *post hoc ergo propter hoc* basis must be excluded: a patient whose bone heals after an operation is not necessarily cured because of the procedure. Comparisons are not easy in this group of patients; they may be invalid and misleading when several different factors are taken into account.

The outcome in osteitis is likely to be affected by: (1) The time of presentation—that is, early or late application of the essential principle of *rest*. (2) The stage of the infection when an effective antibiotic is first administered. (3) The age of the patient. It has been shown (Trueta, 1959) that the pathology, the manifestations, and the outcome in osteitis vary with the age of the patient. (4) The bone affected. The prognosis in osteitis is less favourable when a longer bone is involved (Table I). (It may be equally invalid to compare infection in a femur with that in a fibula.) (5) The intensity of the infection. It is probable that overwhelming infections are admitted to hospital at an early stage. In subacute infections diagnosis is often more difficult, and parents or doctors may be content with incomplete treatment.

If these factors are not taken into account it is difficult to compare the outcome in individual patients, and since no group of cases of osteitis is homogeneous, comparisons of methods of treatment are often equally incompetent.

Discussion

The treatment of acute haematogenous osteitis must be based upon a concept of the pathology of the disease which is in accord with clinical experience. In this series

the thesis that periosteal stripping is the cause of sequestration has been found invalid in the three cases described above, and is not essential to the understanding of the outcome in any other patient.

It is suggested that the viability of bone in osteitis depends upon the presence of a medullary blood supply rather than the integrity of the periosteal vessels. In some patients the medullary vessels are thrombosed at an early stage and the outcome may be determined before the patient is seen by a doctor. This complication is not likely to be averted by decompression of the periosteum or drilling of the bone. A study of the patients of this series supports this conclusion.

In particular, the view that operation should be performed when the disease has been present for 48 hours (Harris, 1962) has been considered and some fallacies have been mentioned. It is difficult to see how operation helped the patients in groups 1 and 2, or influenced the degree of bone necrosis in 10 patients of group 3—a total of 20 patients out of 33 operated upon.

Drainage of a subperiosteal abscess is indicated to improve the general condition of the patient. This decision requires considerable clinical experience, since it is possible to operate too early. Premature operation may be performed at the wrong site or in the wrong bone; it obscures the development of further signs and may lead to sinus formation. Each patient should be treated as an individual problem and operative treatment should not be based upon a strict time-table.

Chronic osteitis will continue to be common so long as operation is regarded as a mainstay of treatment. Acute osteitis results from infection by a pyogenic organism, and complete resolution is to be expected if adequate doses of an efficient antibiotic, based upon recent experience of organism sensitivities, are given at a sufficiently early stage. In many patients the fate of the bone is determined early in the infection and antibiotic therapy cannot be delayed until a bacteriological report is received; operation at this stage will not prevent bone necrosis.

Antibiotics will not prevent complications if the infection has reached an advanced stage before treatment is begun. The most important factor in the development of chronic osteitis is late initiation of adequate treatment, which includes rest and splintage. Inadequate treatment occurs when a wrong or unsuitable antibiotic is chosen, or when the drug is given orally or parenterally in a dose which will not maintain a therapeutic blood level.

The key to the treatment of acute osteitis is prompt diagnosis, which depends upon awareness of the disease and a readiness to suspect its presence. If the diagnosis is uncertain it is preferable to treat the case as one of acute

osteitis until the clinical picture or laboratory investigations prove that this diagnosis is no longer tenable.

Summary

This paper reports the outcome of acute haematogenous osteitis in 59 children aged 1 to 12 years treated during the two years 1960–1 in a children's hospital: 47 had infection in the metaphysis of a long bone, 33 underwent operation in the acute stage of the disease, and 13 developed complications.

The factors leading to the development of chronic osteitis are analysed and discussed. It is considered that the proper treatment of acute osteitis depends upon early diagnosis and prompt initiation of full treatment, including rest, splintage, and correct antibiotic therapy. Principles are discussed whereby the best antibiotic may be selected before the organism has been cultured.

Some evidence is produced to suggest that medullary thrombosis is the chief cause of death of bone and that stripping of periosteal vessels is less important. It is suggested that sequestration of bone is predetermined, perhaps early in the infection and depending upon the virulence of the organism. It is argued that early operation in osteitis does not alter the fate of the bone. The place of operation is to improve the patient's general condition by removing a quantity of pus from an abscess.

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