PRIMARY SUBACUTE PYOGENIC OSTEOMYELITIS

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It is common experience that pyogenic osteomyelitis varies in severity from an acute or fulminating illness to a comparatively mild one. Since 1944, when antibiotics, with or without surgical drainage, have been used successfully in treatment, the severely ill patient has been seen less often, and there has been a marked increase in the number of patients presenting with a mild or subacute illness.

The purpose of this paper is to draw attention to a primary subacute form of pyogenic osteomyelitis. In this type of disease there has been no acute attack and the patient has not received antibiotics before admission to hospital; the onset is insidious and as a rule the infection does not produce a general reaction. This condition has assumed more importance in recent years as it is becoming more common in Great Britain and it often gives rise to difficulty in diagnosis and delay in treatment. In East Africa it is seen more commonly than the acute form of the disease, and since 1949 it has been noted by one of us (W. H. K.-W.) that two-thirds of the patients with osteomyelitis presented with a subacute form. This paper is based on a study of seventy-five patients with accurate records. No attempt has been made to present a statistical review. The characteristic features of the disease are illustrated by examples which are typical of the whole group. Infantile and antibiotic-modified infections are not included, though they also may present in a subacute form.

HISTORICAL REVIEW

Sir Benjamin Brodie (1836) gave a graphic account of a localised abscess in the tibia which had originated without a previous acute illness in patients who appeared to have had a comparatively mild general reaction to the infection. It is now common practice to give Brodie’s name to a bone abscess which develops after a previous acute attack of osteomyelitis treated with antibiotics. Wiles (1951) referred to Brodie’s abscess as a special form of chronic osteomyelitis which follows an acute attack, when the virulence of the organism and the resistance of the patient are evenly balanced. Garré (1893) described a low grade, diffuse inflammation of bone which he called sclerosing non-suppurative osteomyelitis; this is generally thought to be a rare condition, and, as indicated by Aegerter and Kirkpatrick (1958), many clinicians have questioned its existence. It is, however, recognised as a relatively common form of osteomyelitis in East Africa. Melanotte and Marotti (1960) supported the view of Phemister (1929) in their description of primary chronic osteomyelitis, and they gave historical but no bacteriological evidence. Capener (1952) referred to a relatively benign illness with few symptoms and signs. Kessel (1956) described a type of disease with local but no general signs. Buchman (1959) discussed the various degrees of severity of osteomyelitis and correlated this with the invasiveness and toxigenicity of the organism. Winters and Cahen (1960), in a review of sixty-six patients with acute osteomyelitis, suggested that the clinical picture has become modified in the last ten years. They observed that the signs of severe toxicity and septicaemia are not now occurring so often as in the past. Thirty-three per cent of their patients were admitted with a temperature of less than 100 degrees Fahrenheit and had no significant systemic manifestations. Bryson (1962) asserted that osteomyelitis in Northern Nigeria is common but is only occasionally seen in its acute form.

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SITE AND DISTRIBUTION OF THE LESIONS

The distribution is like that of acute osteomyelitis, but the lower tibial metaphysis is a particularly common site. We have confirmed the observation of Garcia and Grantham (1960) that in the adult, vertebral body infection usually presents as a subacute illness.

In the long bones certain distinct patterns have been observed. The infection may start in the metaphysis and subsequently spread to the diaphysis; occasionally it crosses the epiphysial line. Less often, the diaphysis is involved at a later stage. About a quarter of the patients were over sixteen and in these patients the metaphysis and diaphysis were affected with the same frequency. In children, however, the metaphysis was a more common site than the diaphysis.

CLINICAL FEATURES

There was no significant variation from patient to patient (Table I). The onset is insidious. Pain, the commonest presenting symptom, has usually been present for months. Spontaneous remissions are common and may be prolonged. A significant feature is the absence of a general reaction. The temperature is often normal throughout the illness. Localised tenderness and swelling are the only physical signs, though one or both may be absent. In East Africa it is not uncommon for patients to present with one or more discharging sinuses, probably because they come to hospital at a much later stage than they do in Great Britain.

Fig. 1—Case 1. Small abscess in the tibia with a surrounding zone of sclerosis and periosteal reaction. Figure 2—Case 2. Large bone abscess in the distal tibial metaphysis. There is relatively little surrounding sclerosis and no significant periosteal reaction. Figure 3—Case 3. Large abscess cavity in the proximal humeral metaphysis; surrounding sclerosis but no significant periosteal reaction. Figure 4—Case 4. Showing a large abscess cavity in calcaneus but only slight bone and periosteal reaction.

RADIOLOGICAL CHANGES

Lesions of the long bones—A number of radiologically distinct types may be recognised. Sometimes more than one of these is present in a single bone. It is best to divide them into two groups depending upon whether an obvious abscess cavity is present or not. Lesions with abscess cavity—The one that is most familiar is the classical Brodie’s abscess; it occurs most often in the diaphysis, particularly in the tibia (Fig. 1). A much larger abscess is not uncommon, and this presents certain features which distinguish it from the former. It occurs in the metaphysis and seems to have a predilection for the lower tibia (Fig. 2). The upper limb bones are less commonly affected (Fig. 3). Sclerosis in the adjacent bone is often slight and the periosteal new bone formation negligible (Fig. 4). Contrary to the accepted view, the abscess cavity may cross the epiphysial line and confirmation of this has been obtained at operation.
(Fig. 5). It occurs as a single lesion and is not accompanied by sequestrum formation. In yet another variety, multiple abscess cavities are present as part of a more diffuse infection throughout the shaft, resembling chronic osteomyelitis that develops after a previously treated acute infection (Fig. 6).

Lesions without obvious abscess formation—In one variety the radiograph demonstrates a patchy necrosis of bone; cortical sequestration and a slight periosteal reaction may occur (Fig. 7). A few of these patients had operative treatment before receiving antibiotics and it was interesting that the lesion comprised infected granulation tissue only; pus was absent. In other instances the lesion resembles Garre’s sclerosing osteitis (Fig. 8). This diffuse inflammatory lesion usually occurs in patients under the age of twenty-five and affects the diaphysis. It is accompanied by thickening of both cortical and cancellous bone and the marrow space becomes obliterated by the new bone formation. Suppurative does not occur. It is not usually associated with sequestrum or sinus formation. In children a localized diaphysial lesion is sometimes seen which exhibits

“onion layering” and which may be confused with Ewing’s sarcoma (Fig. 9). Study of the changes seen in the radiographs leads to the conclusion that in children and adolescents the metaphysis is most commonly affected. The metaphysial branches of the nutrient artery carry a greater proportion of the blood supply to bone in a growing child and the end-loops of these arteries encourage the lodgement of clumps of bacteria in this region. Not infrequently the diaphysis of a long bone in children is affected as well as the metaphysis. In this instance it is reasonable to suppose that a massive infection has occurred and that clumps of bacteria have lodged in the finer branches of the nutrient artery that supply the diaphysis, as well as in the metaphysial loops. In adults the diaphysis is affected as often as the metaphysis. This is probably because the blood supply to the shaft and to the ends of a long bone is approximately equal. Therefore it is equally likely that a lesion will occur in the diaphysis or in the metaphysis.

Two further points are worth comment. Reactive new bone formation, as seen in the radiograph, occurs at the same time as destruction of bone from toxic necrosis or embolism
in the blood vessels. The apparent sclerosis often seen in a lesion of some duration is not due to an increase in density of the bone but only to the presence of a greater amount of new bone. Biopsy of such "sclerotic" bone shows that it is most often cancellous in type. The diameter of the shaft is increased and the bone producing this is in fact of less density than normal cortical bone.

**Spinal lesions in adults**—It has been noted that staphylococcal infections of vertebral bodies in adults often present as a subacute illness, which has a good prognosis even when the diagnosis is made late (Garcia and Grantham 1960, Harris 1962). Often the lesion is already showing signs of healing by the time the diagnosis is made, and the radiological appearance is then usually characteristic (Fig. 10). The principal features which help to distinguish it from tuberculosis are sclerosis of the vertebral body, with a variable degree of destruction of bone and disc space, associated with relatively early new bone formation; the latter often takes the form of bony bridging between adjacent vertebral bodies. A paravertebral abscess may be present but it is usually much smaller than in tuberculous infections. In East Africa it has sometimes been a matter of difficulty to determine whether a lesion is tuberculous or staphylococcal. On occasions a tuberculous lesion presents with anterior bridging and little bone destruction; staphylococcal infections sometimes cause considerable porosis and destruction of bone on either side of the disc space. Similarly, staphylococcal infections can lead to the formation of a large paravertebral abscess; in one such case two large abscesses were present, one above, the other below the diaphragm. Approximately 10 per cent of spinal lesions that formerly were considered tuberculous are in East Africa now found to be due to the staphylococcus aureus. In case of doubt as to the diagnosis or whether the abscess will resolve, it has been found wise to approach the lesion directly from the front, both to establish the diagnosis and to make certain that treatment is adequate.
TABLE I
PRINCIPAL CLINICAL DETAILS IN NINE PATIENTS

<table>
<thead>
<tr>
<th>Case number</th>
<th>Sex</th>
<th>Age (years)</th>
<th>Length of history</th>
<th>Temperature</th>
<th>Erythrocyte sedimentation rate</th>
<th>White blood count</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Male</td>
<td>36</td>
<td>5 months</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
</tr>
<tr>
<td>2</td>
<td>Male</td>
<td>15</td>
<td>2½ months</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
</tr>
<tr>
<td>3</td>
<td>Male</td>
<td>17</td>
<td>5 months</td>
<td>Normal</td>
<td>68 millimetres</td>
<td>Normal</td>
</tr>
<tr>
<td>4</td>
<td>Female</td>
<td>17</td>
<td>1 year</td>
<td>Normal</td>
<td>40 millimetres</td>
<td>Normal</td>
</tr>
<tr>
<td>5</td>
<td>Male</td>
<td>13</td>
<td>3 months</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
</tr>
<tr>
<td>6</td>
<td>Male</td>
<td>25</td>
<td>3½ years</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
</tr>
<tr>
<td>7</td>
<td>Male</td>
<td>17</td>
<td>1 month</td>
<td>Slightly raised</td>
<td>76 millimetres</td>
<td>Normal</td>
</tr>
<tr>
<td>8</td>
<td>Male</td>
<td>12</td>
<td>6 months</td>
<td>Slightly raised</td>
<td>Normal</td>
<td>Normal</td>
</tr>
<tr>
<td>9</td>
<td>Male</td>
<td>14</td>
<td>1 month</td>
<td>Slightly raised</td>
<td>36 millimetres</td>
<td>Normal</td>
</tr>
</tbody>
</table>

PATHOLOGICAL INVESTIGATIONS

More reliance has to be placed on these investigations than in acute osteomyelitis because physical signs are so often absent.

**Bacteriology**—The nature of these lesions is such that it is not usually possible to isolate the organism by aspiration, and for this purpose surgical exploration is generally necessary. The patients do not have septicaemia and so it is not surprising that the blood culture is invariably negative. The organism is usually a coagulase positive staphylococcus, but in a few instances it has proved to be coagulase negative. This supports the view that these lesions are caused by staphylococci of reduced virulence. Occasionally we have seen similar subacute lesions due to Escherichia coli, Salmonella typhi, treponema pallidum, framboesia, actinomyces, histoplasma and haemolytic streptococci.

**Staphylococcal antibody titres**—The method of estimation and diagnostic value of these titres has been described by Lack and Towers (1962). A rise in the anti-alpha haemolysin or anti-Panton-Valentine leudocidin titre, or both, is of diagnostic significance. A negative result does not exclude infection, and "false" negatives form about 8 per cent of the total when all grades of osteomyelitis are included (three out of forty consecutive patients examined by one of us—N. H. H.). It should be stressed that the diagnostic value of titres is increased if both tests are done, and they have been found to be particularly helpful in distinguishing a staphylococcal from a tuberculous vertebral body infection.

**White blood count and erythrocyte sedimentation rate**—The diagnostic value of these investigations has been reported (Harris 1960). In subacute disease the total white blood count is usually normal and the differential count is only slightly more reliable. The erythrocyte sedimentation rate, though it is often normal, is more reliable than the white blood count. It is particularly helpful in the differentiation of spinal tuberculosis from a staphylococcal infection; a very high reading (over 50 millimetres in one hour) is the usual finding in staphylococcal infections, and a much lower value favours a tuberculous infection.

PATHOGENESIS

It is not known why the staphylococcus produces an acute or fulminating illness in some patients and in others an illness that is comparatively mild. It is an obvious assumption that the organism causing subacute infections is of reduced virulence. Elek (1959) has stated that
the nature and role of the agents enabling the staphylococcus to survive and multiply in human tissues are ill understood. The available evidence, which he discusses in some detail, suggests that the virulence of staphylococci is due to a combination of factors, but their relative importance cannot be assessed until more is known about the tissue reactions that overcome a sub-clinical infection. A further factor is the patient's resistance to the infection. Bryson (1962) considers that the frequency of subacute osteomyelitis in Northern Nigeria is due to the population's having developed a resistance to the staphylococcus from an early age. The fact that many Africans do not wear shoes explains the frequency with which they suffer from foot infections (mainly staphylococcal) and it may be that as a result they acquire some degree of resistance to the organism.

**TREATMENT**

A lesion that presents with a single localised bone abscess or several abscesses is best treated by careful and thorough curettage. Unless there is a subcutaneous collection of pus or a sinus it is often not possible to decide before operation what organism is present, or its antibiotic sensitivity. It is therefore wise to give penicillin and streptomycin for two weeks before operation whenever possible, and the appropriate antibiotic after operation as soon as the sensitivity has been determined. Often chemotherapy before operation results in apparent sterilisation of the abscess. If antibiotics alone are used the symptoms may be relieved but a relapse usually occurs, often weeks or months later.

The other type of lesion, without obvious abscess formation, is in the early stages best treated by antibiotics alone. Pus is seldom found, though the bone is extensively involved. The causative organism is in most cases unknown before antibiotics are started, but the disadvantage of empirical treatment may be overcome by a limited exposure in order to isolate the organism. At a later stage one or two large sequestra or a series of small sequestra are often present. When this is the case it is essential to expose the area of the lesion so that all the sequestra can be removed. Whenever it is thought advisable to operate in order to expose the lesion, to evacuate abscesses, or to remove sequestra, it is essential that the exposure be adequate and that it be made through a planned incision. On occasion it is tempting to expose the lesion by enlarging the sinus track. Any attempt to do this, in the presence of marked fibrosis, may endanger important structures such as the femoral artery or the lateral popliteal nerve.

The operation described by Bryson and Mandell (1964) aims at exposure of the whole length of the lesion through a planned incision; a window is made in the bone of sufficient width, depth and length to ensure that all abscess cavities and all sequestra can be evacuated or removed. Primary suture of the wound is carried out. One mega-unit of penicillin and one gramme of streptomycin are run into the cavity in the bone at the end of the operation. This is repeated every three to four days for two weeks. In 90 per cent of cases this procedure leads to primary healing within three to four weeks. The writers are of the opinion that this method of treatment is greatly superior to any other.

**SUMMARY AND CONCLUSIONS**

1. A primary subacute type of staphylococcal osteomyelitis has been described. It is the commonest form of osteomyelitis seen in East Africa, and the incidence appears to be increasing in Great Britain.
2. A review of the literature indicates that this is not a new disease but that in the past there has been some confusion in terminology.
3. The causative organism is a coagulase positive staphylococcus, but in a few instances a coagulase negative one has been isolated. The staphylococcus is thought to be of reduced virulence and in East Africa it is likely that the population has acquired an increased resistance to the staphylococcus.
4. Two radiologically distinct groups are recognised, depending on whether a bone abscess is present or not. In the first group there are two types of localised abscesses: the familiar Brodie's lesion and the less well recognised large bone abscess that occurs in the metaphysis of a long bone. While the pathology of the two types is similar, the radiological features are quite distinct. The lesions in the second group are characterised by extensive diaphysial changes, with or without metaphysial involvement, and an obvious abscess cannot usually be demonstrated.

5. The main clinical features are the long history, often weeks or months, before diagnosis; insignificant or absent general reaction to the infection and minimum physical signs.

6. Vertebral body osteomyelitis in adults is included because it generally presents as a subacute infection; the difficulties in distinguishing it from a tuberculous infection are outlined.

7. The most useful diagnostic aids are the staphylococcal antibody titres (especially in vertebral infections) and the erythrocyte sedimentation rate. A limited surgical exposure is usually required if the causative organism is to be isolated and empirical antibiotic therapy is to be avoided. The total and differential white blood count are so often normal in these patients that they are considered to be of no diagnostic value.

8. Curettage and local antibiotics together will cure the localised bone abscess. Other lesions may be effectively treated by systemic antibiotics alone, but in the later stages removal of sequestra and infected granulation tissue may be necessary. In this instance it is essential to make a planned incision and to cut a window in the bone large enough to expose the whole of the lesion; primary suture of the wound is advocated.

We wish to express our thanks to the surgeons at the Royal National Orthopaedic Hospital for allowing us to include their patients in this review. We are especially grateful to Dr R. S. K. Rajpal who had the difficult task of collecting data from the records of the patients seen at the Orthopaedic Centre, Nairobi. The illustrations have been prepared by Mr R. Whitley and his staff of the Medical Photographic Department, Institute of Orthopaedics, and by Mr A. Winters; we are most grateful to them for their assistance.

REFERENCES


