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ACUTE OSTEOMYELITIS *

BY

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I confess I have found it difficult to decide as to the best method of introducing the discussion of acute osteomyelitis. If I called it an "old friend" I would not be exaggerating, for certainly there is nothing of the parvenu about it, and yet its very familiarity is the subject of disconcerting thoughts, for we must confess that there are many problems relating to this condition which are still unsolved. We may therefore regard this choice of subject as suitable and appropriate.

I feel that it would not serve any purpose to present an outline of the subject on the basis of aetiology, pathology, etc.—these are already fully accepted and established—and I therefore prefer to treat the subject from what I might call a personal point of view, and to recall in what I am afraid may be a haphazard fashion certain of the more problematical, and therefore more interesting features of the disease. I do so in the hope that the discussion (which is, after all, the most fruitful source of enlightenment in a meeting of this kind) may throw some light upon points which to me are brimful of difficulty. Perhaps it is well that I should indicate that what I have to say applies to the acute staphylococcal infection of growing bone.

Incidence of Staphylococcal Osteomyelitis

In recent years it has been said that staphylococcal osteomyelitis is a disappearing disease—a statement with which most of us are in agreement. A statistical survey by Cecil Wakeley, based upon the analysis of hospital cases recorded in the decades 1900–10 and 1920–30, appears to bear out the truth of this statement, and it is held that the lessened incidence is explained by improvement in the general health conditions of the people, and by beneficial changes in the housing and sanitary arrangements. It has been our experience that, while this appreciation is in general correct, there has been, during the past year, a curious increase in the occurrence of the disease. This is borne out by a presentation of the numbers of osteomyelitis cases admitted year by year to one surgical charge in the Edinburgh Royal Infirmary. Over the decade May, 1924, to May, 1934, the figures are as follows:

3, 4, 2, 3, 3, 4, 5, 7, 5, 12 (48 cases).

I agree that it may be merely a coincidence, but I suspect that it may have a more stable explanation. Are the more susceptible individuals of the population entering on a phase of lessened immunity, or is the increase of staphylococcal infection a single example of a state of increased, and it may be increasing, coccal infection? I understand there has been, for example, in the autumn and early

winter a definite increase in the incidence of streptococcal infections, particularly of the haemolytic type, ascribable, in the opinion of some, to the unusually dry character of last summer. I wonder if the increase of staphylococcal incidence which we have experienced is attributable to the same influence.

Pathology

The conception of the pathology which is universally accepted is an infection of the marrow area of the bone metaphysis conveyed by the blood stream. No valid reason has ever been advanced in dispute of this view, and all experimental evidence supports its reasoning, but there is one aspect of the pathology which is not so frequently alluded to, and yet I believe that it may hold features of great significance. The haemic theory of staphylococcal osteomyelitis infection adumbrates of necessity a pre-existing staphylococcal septicaemia. I agree that the general infection may be difficult to demonstrate; I appreciate that attempts to exhibit the existence of the organism by blood culture are in the majority of cases without result; but none the less a haemic infection of a bone presupposes that staphylococcal organisms are already circulating in the blood stream, and that their localization in the bone is but a local manifestation of the general disturbance.

To the surgeon the local infection has been the important item in the clinical picture—it is upon this that he has concentrated his ingenuity and his skill; but is it right that we should regard the local focus as a most deplorable and regrettable manifestation? There is such a thing as a fixation abscess; when it appears it is regarded as a providential occurrence, for it is Nature's method of producing a defensive area from which the factors of immunity are organized and developed. From what I have seen of acute osteomyelitis the impression is growing that the focus in the bone, while it creates a difficult and regrettable situation so far as local infection and suppuration are concerned, has certain aspects which can only be regarded as defensive in their action and salutary in their effects. It is obvious that if this conception is accepted the decision will logically follow that we must reorient our attitude towards the treatment and, in fact, towards the clinical progress of the disease.

The degree of severity of the general disturbance in cases of acute osteomyelitis shows considerable variation. In a certain percentage of cases the general infection is so acute that the individual is overwhelmed in the early stages of the disease with the signs and symptoms of an intense general infection, and, as a rule, succumbs before the local evidences are manifest or confirmed. In others the general disturbance is less intense, while the picture is that of a pronounced local inflammatory reaction which quickly passes on to suppuration. If we express this

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variation in terms of pathology we may argue that in the first instance the intensity of the general infection has been in large measure dependent upon a deficient local reaction, while in the second instance the antibacterial influences released from the local focus have been efficient in counteracting the more general sepsis. If I may put the matter in a more personal way, I feel infinitely less anxious about the future of the osteomyelitis case when there is a pronounced local bone focus with early suppuration than I am when the local reaction is indefinite and suppuration absent or delayed.

Localization of the Infection

I wonder how many of us have asked ourselves why it should be that the infection of acute osteomyelitis is localized with such a remarkable degree of constancy to the metaphyseal areas of long bones? When the question is raised we are told that the localizing influences are a profuse but rather stagnant blood supply, the tissue activities of rapid growth, and the possibilities of trauma. I do not know that there is much to support any of these arguments, and in regard to the last the bulk of clinical and experimental evidence appears to negative its importance.

I venture to suggest another possible reason. The marrow of all bones, and of long bones in particular, contains a large amount of reticulo-endothelial tissue. During the period of growth, and more especially in those years when the epiphyses are being ossified and the epiphyseal plates are putting forth their greatest effort, there is an immense concentration of reticulo-endothelial cells in the metaphyseal area, where, under the demands of health, they are concerned with various phagocytic functions and the requirements of calcium metabolism. Now there is a growing volume of evidence that in the presence of general body infection the reticulo-endothelial arrangements form one of the most important defensive mechanisms of the body. We find indications of its response in septicaemia, and there are those who believe that when local suppuration appears in relation to the general infection its localization in joints or in the pleurae is an evidence of the reactive activities of reticulo-endothelial tissues.

I know that the argument is difficult to prove, but for myself I have a suspicion that in acute osteomyelitis the bone disturbance is but a local evidence of a general infection, and that the reason why the local infection is so constantly localized to the metaphysis is conceivably because we there encounter a concentration of reticulo-endothelial tissue, and that the local suppuration which results from the defensive activities of the area is in some measure protective against the general disturbance. I anticipate that this thesis will give rise to criticism, and I hope it may stimulate discussion. If space and time allowed, I would elaborate the argument to a fuller degree, but for the present it is sufficient to say that as time goes on I feel that there may be a considerable measure of truth in the theory.

Operative Treatment

It is obvious that, if one believes what I have attempted to define, one's plans of treatment must be considerably influenced by one's views, and so it has been with me. I confess that I am conservative in the matter of operation, and by that I mean that I am an advocate of what has come to be known as the Starr technique in a form which is perhaps even less extensive than that recommended by the one whose name is associated with the method. I confess I am disappointed with the results of the gutter operation, and I regard any attempt at diaphysectomy as utterly wrong in principle and ideal.

Let me describe the procedure as it is actually practised. When the diagnosis is established the infected area is exposed through a suitable incision, and, if the situation permits it, a tourniquet is used. Having exposed the affected metaphysis, the periosteum is separated, and any pus which lies in the subperiosteal area is mopped away. By means of a drill one-eighth of an inch in diameter the cortex of the metaphysis is perforated in a number of places, beginning at a point central to the epiphyseal cartilage and extending along the shaft until healthy marrow is reached. In order to lessen the risk of infecting healthy marrow, a series of drills should be available, and each should be sterilized before each successive use. The ideal is to render the cortex as porous as possible without inflicting undue disturbance upon the parts, and to attain the ideal it may be necessary to drill the cortex at intervals of a quarter of an inch over the entire area related to the infection. Through the puncture points pus and blood exude as the tension of the underlying infection is released.

The wound in the periosteum and the soft tissues is left entirely open, the part being lightly packed with sterile gauze soaked in a solution of liquid paraffin, acraflavine, and potassium citrate.* Each of these substances is understood to fulfil a special purpose—the citrate keeps the discharge in solution and so prevents the bone punctures from becoming blocked, the flavine is of course an antiseptic, which lessens the likelihood of infection spreading into the soft tissues, while the liquid paraffin facilitates subsequent removal of the gauze. Over the packing a copious gauze and wool dressing is applied, and complete immobilization is thereafter secured by encasing the limb in plaster so as to include the related joints above and below the site of the lesion.

The original dressing is kept in place for a fortnight, at the end of which time it becomes uncomfortable, and so it is our practice to remove it under light anaesthesia, to examine the wound, remove any obvious sepsis, and pack the wound afresh. A new plaster casing is applied, and in this instance it may remain *in situ* for a period of a month or six weeks. At the end of that time the wound is again examined, any sequestration which may have occurred is removed, and an attempt is made to close a section of the wound by secondary suture.

Treatment of General Condition

In a favourable case the temperature begins to fall about forty-eight hours after the operation. If on the third day it does not show signs of improvement an antistaphylococcal immuno-blood-transfusion is given, the donor having been prepared by a vaccine injection estimated on a basis of 500 million to 750 million organisms. It is my experience that an ordinary blood transfusion is of virtually no value in correcting the general sepsis, although in late cases when anaemia exists it may be of value. We have given sera what we regard as a very fair trial, using a staphylococcal serum of a polyvalent type, but we have never been satisfied that this had a beneficial effect upon the disease, and, when put to what must be regarded as the acid test—its employment in the most severe cases—it had no appreciable influence upon the progress of the disease. In so far, therefore, as the treatment of the general condition is concerned we rely upon such principles as an abundant supply of fluid, a high vitamin intake in the form of orange juice, and the use of immuno-transfusion in a certain number of cases.

Acute staphylococcal osteomyelitis must always be a serious disease, because it implies a general blood infection and the development of local sepsis in a tissue which

* The solution is acraflavine emulsion 1 in 1,000 with potassium citrate 2 per cent.

for many reasons is intolerant of such disturbance, but we have found that, if we employ a local interference which ensures relief of tension without unduly disturbing the local reaction, the results are often surprisingly good. I have therefore gone upon the principle of regarding acute osteomyelitis as a local infection which is a reaction to a septicaemia. I have viewed the local error as having a certain potential value by increasing resistance to the general infection, and on this assumption we have been satisfied with an operative procedure which ensures relief of tension and as free drainage as is possible without unduly disturbing the local tissue reactions.

Other Operative Procedures

I have abandoned the gutter operation because it did not appear to afford any more efficient drainage than that provided by the method of multiple punctures, while the trauma necessitated by the operation lessened the degree of reaction and encouraged sequestrum formation. In the same way any attempt at curetting the infected marrow encourages an embolic spread of the disease and removes the tissue segments upon which an efficient reaction depends. It has been suggested that, instead of guttering the bone, more efficient drainage might be obtained by removing $3/4$ in. of the bone circumference.

As a matter of fact this was attempted in one case, but the result was a sequestration of the remaining segment, with a state of affairs which amounted to an extensive pathological fracture.

The suggestion which has been mooted and in some cases practised, that a metaphysectomy or partial diaphysectomy should be carried out, is to my mind a wrong procedure, and the high mortality which is associated with the operation is probably due to the fact that by this means we remove the actual segment of tissue upon which the patient's resistance to the general infection may well depend. This procedure, if considered at all, should be restricted to late cases in which the entire diaphysis has become necrotic and is lying in a large subperiosteal abscess. In this event the dead shaft is already detached at each metaphyseal extremity, and the operation amounts to nothing more or less than a sequestrectomy.

Results of Operation

I conclude this somewhat disjointed discussion of the disease with a summary of the operation results. In a total of fifty-six cases observed over the last twelve years there have been thirteen deaths, a mortality of 23.2 per cent. In those who succumbed, death was due to a progressive septicaemia which ultimately passed into a pyaemia with secondary abscesses in such varied situations as voluntary muscle and subcutaneous tissue, the heart muscle, the lungs, and the brain.

S. Bueno (*Thèse de Paris*, 1934, No. 606) states that two bodies were responsible for the prophylaxis of malaria in Cuba—the State, which supervises the towns and suburbs, and the sugar companies, which are concerned with the regions in which the sugar cane is cultivated. The areas occupied by small proprietors have hardly any prophylaxis. The campaign undertaken in the towns has caused a complete disappearance of yellow fever and the almost complete eradication of malaria, especially in Havana. Considerable improvement has taken place in the country districts as the result of the measures undertaken by the American sugar companies. The apparent increase in the incidence of malaria during the season in which the sugar is produced is due to the movements of the workmen, a large proportion of whom are infected. The selection of workmen therefore appears to be desirable, only those being taken on who are free from malaria.

FUNGUS INFECTION OF THE FEET: PROPHYLAXIS AND TREATMENT*

BY

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Fungus infection of the feet has loomed large in the practice of dermatologists during the last twenty years or so, and in no subject in this branch of medicine has investigation been more insistently pursued and more fruitful results obtained. At the same time there are many lines of investigation which remain to be followed, and, until certain further problems are solved, many difficulties as to prophylaxis and treatment will continue.

It is not necessary for me to enter into a description of the fungi which attack the skin of the feet: suffice it to say that a considerable number of different fungi of the hyphomycetes group have been found present in these cases, and also that yeast-like organisms, generally classed under the name "monilia," including the organism of thrush *Monilia albicans*, have also been incriminated. Inflammations of the skin by fungi can take place in two ways: first, by the growth of the fungus in the horny layer and on the horny appendages (the hair and nails), the fungus having been implanted from without on the affected area; or secondly, by transmission of the fungus or its toxins from a local site of infection by way of the blood stream to a distant site. In this latter case some sensitization of the epidermal cells appears to be a necessary preliminary to the production of the inflammatory reactions. Reactions of this type are spoken of as "dermatophytids."

Clinical Types

Clinically, fungus disease of the feet may occur in several forms. For the sake of convenience they may be divided into three types, though some dermatologists prefer a more elaborate classification: C. J. White (*Arch. Derm. and Syph.*, April, 1927, xv, 387), for example, describes eleven types.

The types most commonly seen are: (1) the intertriginous, (2) the vesicular, and (3) the hyperkeratotic. It may be noted, however, that various combinations of these types may occur.

Intertriginous Type.—This is by far the most common, and is found between the toes, often only in the fourth interdigital space, and nearly always bilaterally. In more advanced cases other interdigital spaces are involved, as is also the fold beneath the toes. In the mildest cases perhaps only slight scaling is visible in the fourth interdigital spaces; in more chronic cases the skin of the sides of the toes becomes much thickened, appearing as a dirty white layer, owing to a great thickening of the horny layer. This thickening may occasionally become much more marked at one spot, and a so-called "soft corn" may develop. Generally the skin in the web between the toes cracks, and this crack may extend beneath the toes. In the more active cases an eczematous eruption, of either a dry or a moist character, may spread over the dorsum of the toes and anterior part of the foot, and on to the anterior part of the sole. In the most acute cases the lesions may be vesicular or bullous from the start; in fact, Whitfield states that most cases commence in this way, though on this point I am not in entire agreement with him. In this type of case secondary pyogenic infection is liable to occur, and lymphangitis may be an occasional complication. In the intertriginous

* Read in opening a discussion in the Section of Dermatology, at the Annual Meeting of the British Medical Association, Bournemouth, 1934.