THE LOCALIZATION OF OSTEOMYELITIS, ESPECIALLY IN ADULTS.

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In bringing forward the following cases, it is possible that they belong to a well-recognized group, but I can find no mention of them in the text-books, and the importance of their recognition seems to be paramount.

Case 1.—Male, age 51, was admitted on Nov. 6, 1911; he had had pain in the right thigh for twelve days, and four days before admission it began to swell. There was no history of injury, or of any previous infection elsewhere in the body.

The temperature was 102·6°, the pulse 116, the general condition was good. The right thigh was nearly twice the size of the left, the swelling being most marked in front and on the outer side. The skin over it was a little blue, and below the knee there was thought to be some yellow staining. There was increased local heat. The swelling seemed to lie beneath the muscles; the skin on the outer side was tense, and seemed to be attached to the deeper structures. The swelling was elastic. There was some œdema behind and below, but the popliteal space was free. There was no fluid in the knee-joint.

An *x*-ray photograph showed no change in the bone.

It was thought that the case might be one of hæmorrhage into the muscles, so operation was delayed; but the continuance of pyrexia, with a high leucocytosis, determined an exploratory operation.

On Nov. 10 the swelling was aspirated, and dark, foul-smelling pus was found. Two incisions were made, one just below the great trochanter and another just above the knee on the outer side. The front of the shaft of the femur was found to be bare in the anterior aspect of its middle third.

On Nov. 11 the patient had a cough, with an offensive blood-stained frothy expectoration. The physical signs were those of bronchitis and emphysema.

The temperature fell to normal after the operation, but gradually rose again; the wound did not drain well, and five weeks later the thigh was again explored. At this operation, on Dec. 22, the sinuses were opened up and continued into one another. It was found that a large piece of the surface of the femur, where it had been found bare at the previous operation, had necrosed, and the upper part was separated; the separation was not complete below, and there was new bone formation outside it. In spite of this operation no improvement in the temperature occurred, and six weeks later it was again explored.

On Feb. 8, 1913, the femur was well exposed, and its shaft was found to be covered by a layer of new bone. The medullary canal was opened up and two large central sequestra were removed. The outer layer of the bone had not necrosed beyond the area from which the dead bone had been removed on Dec. 22. After this the patient recovered and the wound healed completely.

The pus obtained at the first operation contained *streptococcus brevis* and coliform and diphtheroid rods.

This case showed, therefore, a large collection of pus in the muscles of the thigh, with very little raising of the periosteum. It was not until after weeks of pyrexia that it was recognized that the bone infection was primarily a central one, and that the necrosed bone was removed from the medullary cavity. The primary source was never discovered, unless the bronchitis

with foul expectoration which occurred after the first operation was evidence of some focus in the lung.

Case 2.—Male, age 50, was admitted on Feb. 9, 1912. He had had a gnawing pain in the right knee for eight weeks. The pain commenced gradually, it was worse at night and on movement. For the last three weeks there had been swelling above the knee, and he had been confined to bed.

He was a well-nourished man. Temperature 101°. There was some cyanosis, and the fingers and toes were clubbed. There was a swelling of the right thigh extending from just above the knee-joint along nearly the whole length of the shaft; it was most marked in front. It corresponded in outline to the attachments of the quadriceps to the femur. It was tender on pressure, and fluctuated from end to end. On the outer side, above the middle of the thigh, there was a separate swelling, consisting of superficial œdema. There was free fluid in the knee-joint.

There was evidence of bronchiectasis in the chest, and he was coughing up a profuse and extensive sputum.

On Feb. 12 the thigh was explored under spinal anæsthesia. A large abscess was found beneath the periosteum of the shaft, but it did not extend to either end of the bone. The pus was very offensive. The bone appeared to be normal, but a small opening was made into the medulla; it seemed to be free from pus, so nothing more was done.

The patient died seven days later from broncho-pneumonia.

On opening the medullary canal of the femur post mortem, creamy pus was found in which were lying two well-separated central sequestra.

The above case showed very clearly the origin of the infection from the lungs. There was a large subperiosteal abscess. The opening made into the medulla was not large enough to have disclosed the condition of the bone within. At the time it was thought that a larger opening might increase the risk of infection of a previously normal medulla, but this idea is probably incorrect—apart from the question as to whether the medulla is not always infected in the presence of such an extent of suppuration beneath the periosteum.

Case 3.—Male, age 9, admitted on Feb. 17, 1913. Had had pain and swelling in the right thigh for three weeks. The temperature was 101°. The right thigh was much swollen. The skin was hot and slightly red. The swelling was limited to the middle two-thirds of the thigh, and was more marked on the anterior and outer aspects. Fluctuation could be obtained. Pressure over the swelling caused a great deal of pain, but over the upper and lower ends of the femur in the neighbourhood of the epiphyses it did not cause pain.

An operation was performed under ether on the day of admission, and an incision made on the outer side of the thigh. Pus was found beneath the muscles. The opening in the muscles was enlarged, and an abscess found which surrounded the femur almost entirely. The periosteum was hyperæmic but not raised off the bone. A hole which admitted a probe was found on the outer side of the middle of the shaft of the bone. This led into the medulla. The medullary cavity was exposed in its middle two-thirds; there was a layer of newly-formed bone beneath the periosteum, about a twelfth of an inch thick and extending the whole length of the exposed bone. The medulla was infected, but not to a great degree, and there was no obvious necrosis of bone.

The pus contained *staphylococcus aureus*.

Eventually a sequestrum separated from the bone which had been left on the internal aspect of the medullary cavity.

This case is striking in that the infection occurred in the middle of the length of the shaft in a boy of nine years, and also in that the periosteum was not raised, the pus perforating it and forming an intramuscular abscess.

Case 4.—Male, age 32, was admitted on Feb. 12, 1912. Had had pain in the right arm for six weeks and swelling for three weeks. Six months before, he had a series of injections for boils.

There was no pyrexia. There was a swelling in the middle third of the right upper arm; it was fusiform, and surrounded the bone on all sides, but spread inwards and outwards in the position of the intermuscular septa. The spread on the outer side formed almost a separate tumour, which was movable on the bone. The upper and lower edges of the swelling were fairly well-defined. It did not involve the biceps or supinator longus, while its relation to the triceps was not quite clear. It was hard, except for the superficial portion on the outer side.

The radiogram showed a marked deposit of new bone beneath the periosteum over the middle third of the shaft; in the centre of the bone there were two small irregular cavities with smaller dense shadows in the middle of them, suggesting sequestra (*Fig.* 69).

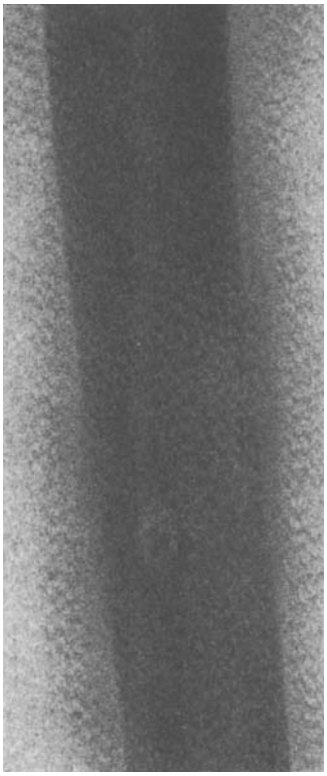

FIG. 69.

On Feb. 16 an incision was made over the outer side. On exposing the periosteum, it was found to be thickened, being about one-third of an inch thick; beneath it was some viscid pus. On raising the periosteum the bone was found to be thick and irregular, due to the deposit of new bone, and there was a small opening leading into the centre of the shaft, through which some pus was found. It was opened up, and a cavity containing two small sequestra was laid bare. The limits of the cavity above and below were ill-marked, since it lay close to the medulla of the bone.

The pus contained *staphylococcus aureus*.

This case shows exactly the same features as *Case* 3, only in a more chronic form, and clinically it was difficult to diagnose from a sarcoma. The *x* rays, however, settled the diagnosis.

Case 5.—Male, age 19, admitted Aug. 1, 1912. Three months before he had had a boil on the right buttock, which healed with poulticing, etc. He had several more, but a month ago he had noticed a severe pain over the right knee. The pain became gradually worse, and three weeks ago he had noticed some swelling of the thigh.

The general condition was fair. Temperature 100·8°.

There was a fusiform swelling on the anterior surface of the right femur. The skin was hot, but not reddened, and was tender.

A radiogram showed new bone formation beneath the periosteum over the outer side of the femur in its middle third; beneath it was a rarefied area with a central shadow suggesting a sequestrum. The rarefaction did not extend into the medullary cavity.

An incision was made on the outer side of the thigh. The muscles were very œdematous. Thick viscid pus was found beneath the periosteum, and leading into the bone was a small sinus. The new bone outside this was cut away, and a sequestrum found lying in a cavity in the bone. The medullary cavity was not exposed, since the radiogram showed that the rarefaction did not extend into this part of the shaft.

The wound healed without further necrosis.

Case 5 is the only one which did not show invasion of the medulla; it is possible that the infection had started in the latter position, and by the time of the operation the sequestrum had been walled off from it by new bone formation. Again the site of the infection was in the middle of the length of the shaft.

There are several striking features about these cases. The infection in every instance affected the shaft of the bone, and had apparently started in the middle and not at either end; this is in marked contrast to the acute infective osteomyelitis occurring in children, which is almost invariably in connection with the epiphysial end of the diaphysis (metaphysis).

At first sight it might have been thought that this was associated with the age of the patient, but the occurrence of the same condition in a boy of nine years negatived this as an absolute fact. However, the average age of the patients suggests that infection of the long bones in the adult is prone to take place in the middle rather than at the ends of the bones.

In four of the cases the infection was certainly primarily a central one, and not subperiosteal. It was of so subacute a nature in some of them as to have fixed the periosteum to the shaft by new bone formation, so that the abscess perforated that membrane rather than raised it; as a result, the main collection was in the muscles. From a practical point of view this is perhaps the most important feature; in *Case* 3 it would have been quite easy to have missed the bone disease, since there was not any exposure of bare bone, and the hole into the medulla only admitted a probe. *Case* 5 is the only possible exception, and might have been of subperiosteal origin.

Kocher, in his work on staphylomycosis, mentions a case which is very similar to these. The patient was a man of 24, he had had several boils, and there was a history of pain in the thigh for eight weeks. The femur was thickened in its middle third. At the operation the periosteum was found to be thickened, and there was an opening in the bone leading to a collection of pus in the medullary cavity. He lays considerable stress on the difficulty of making a diagnosis from a periosteal sarcoma; and in those cases without pyrexia, as in *Case* 4, the clinical resemblance is rather close. As a rule, sarcoma tends to be nearer the ends of the bone; while at the present day a radiogram should solve the difficulty.

In three of the cases there was a recognizable primary source of the infection. In two cases this was a boil, and the *staphylococcus* was recovered from the bone lesion. The third showed a mixed infection from a bronchiectatic lesion. One of the remaining cases showed a *staphylococcus aureus*; so that this organism predominates, as in the metaphysial affections of childhood. There was no history of injury which could have determined the site of the infection in any of the cases.

As above mentioned, I can find no special reference, beyond that of Kocher and Tavel,[1] to this class of case; and it is questionable whether so few cases are of value in making any generalization as to the factors which determine the site of the infection. They bear out the idea that it is nearly always the medulla which is first affected, and in this they do not differ from infective osteomyelitis of children; but it is not clear why the middle

of the length of the shaft should be affected rather than the ends. It is known that organisms entering the blood tend to be segregated in the marrow, so that the primary medullary infection would be expected. The localization of the lesion has been asserted to be due to injury, but it is improbable that trauma will affect a different part of the bone in the child and the adult. Lexer[2] has attempted to explain the position of the infection by the anatomical conditions of the blood-supply, but has not succeeded in demonstrating it satisfactorily. In the child the most active part of the bone is the metaphysis, while in the adult the medullary canal is probably most active; it may be that this is a possible explanation.

CONCLUSIONS.

1. These cases bear out the general idea that infection of bone is primarily one of the marrow; and therefore the medullary canal should be explored in all cases in which *x* rays do not give evidence to the contrary.

2. In adults the localization of the infection is in the middle of the length of the shaft rather than at either end.

3. In adults the infective osteomyelitis may be so subacute in character as to suggest a sarcoma rather than an infection in its clinical features.

I have to thank the surgical staff of University College Hospital for permission to publish these cases.

REFERENCES.

[1] KOCHER U. TAVEL, *Vorlesungen über chirurgische Infektionskrankheiten Staphylomycosis*, 1897.

[2] LEXER, *Archiv. f. klin. Chir.*, Bd. lxxi, 73.