NON-INFECTION DISEASE OF THE DIABETIC FOOT

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Six different conditions of non-infective bone and joint pathology have been seen amongst 67 patients with diabetic neuropathy. The characteristics of each are described. Not all the conditions require treatment but they should be differentiated from osteomyelitis. Charcot osteoarthropathy is the most common condition seen but spontaneous fractures and dislocations generally present greater therapeutic problems. The aim of treatment should be to obtain a stable foot in which there is no undue pressure on the skin from a bony prominence.

Although osteomyelitis is the commonest form of bone and joint disease seen in association with diabetic neuropathy a number of non-infective conditions have also been described. In 1936, Jordan reported Charcot’s disease in a diabetic patient; this condition has since become increasingly well recognised. It was not until 1966 that the second non-infective condition was reported by Heiple and Cammarn who described a spontaneous peritalar fracture and one year later, Pogonowska, Collins and Dobson reported lytic changes of the bone in association with diabetic neuropathy. In 1972 Forgacs, Halmos and Salamon discussed two other entities, osteoporosis and excessive new bone formation. Spontaneous fractures occurring in neuropathic feet were reviewed by Johnson in 1967 and spontaneous dislocations were described by Newman in 1979. In the intervening period many other publications have referred to some of the changes of the bone seen in diabetic neuropathy and the terminology has become confusing.

An attempt is made here to classify the different forms of non-infective disease of bones and joints that can be seen in association with diabetic neuropathy and to discuss their management.

Some patients had a swollen foot whereas in others a radiograph of the foot was taken because of minor infection in the toe. Areas of bony abnormality were found which were totally unrelated to the clinical problem.

RESULTS

Reviewing the radiographic material available it became clear that the observed changes fell into six main categories (Table II).

Osteoporosis. Seven cases were seen in which there was generalised loss of bone in the feet without a preceding period of immobilisation. Two of the seven cases

<table>
<thead>
<tr>
<th>Diabetic status</th>
<th>Number of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulin dependent</td>
<td>49</td>
</tr>
<tr>
<td>Oral agents</td>
<td>5</td>
</tr>
<tr>
<td>Diet controlled</td>
<td>8</td>
</tr>
<tr>
<td>Unknown</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>67</td>
</tr>
</tbody>
</table>

Table II. Patterns of diabetic osteopathy

<table>
<thead>
<tr>
<th>Pattern</th>
<th>Number of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Osteoporosis</td>
<td>7</td>
</tr>
<tr>
<td>New bone formation</td>
<td>9</td>
</tr>
<tr>
<td>Bone loss</td>
<td>12</td>
</tr>
<tr>
<td>Osteoarthropathy</td>
<td>54</td>
</tr>
<tr>
<td>Pathological fracture</td>
<td>3</td>
</tr>
<tr>
<td>Spontaneous dislocation</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td>92</td>
</tr>
</tbody>
</table>

developed a spontaneous phalangeal fracture (Fig. 1). This condition did not give rise to any clinical problem and no treatment was required.

**New bone formation.** Excessive formation of new bone was frequently seen in association with Charcot's disease but in nine instances it occurred whilst the adjacent joints remained relatively normal (Fig. 2). Two patterns of excessive formation of new bone were seen. Firstly, new bone was formed in the region of a ligamentous attachment and secondly, it was seen in relation to a metatarsal shaft, probably after a spontaneous fracture (Figs 3 and 4). The importance of this entity lies in its recognition since treatment is seldom necessary. Excessive formation of new subperiosteal bone along the shaft of a metatarsal obviously suggests osteomyelitis, and differentiation on radiological grounds can be difficult. This condition should therefore be considered and the final diagnosis based on clinical and haematological assessment. In three of the nine patients, the nature of the excessive formation was not recognised with the result that unnecessary aspirations or biopsies of the lesions were done. Such intervention should obviously be avoided in the diabetic foot since any form of trauma can lead to problems with healing.

**Loss of bone.** Twelve cases were seen in which the pattern of involvement in the bone was predominantly destructive. Usually the shafts of the metatarsals or, less frequently, the phalanges were severely wasted (Fig. 5).

On two occasions punctate lesions were seen. No specific treatment is required but the condition must be distinguished from osteomyelitis since antibiotic therapy is unnecessary.

**Charcot osteoarthropathy.** This condition is characterised by involvement of both bone and joint. Such changes involving the ankle, subtalar, midtarsal or tarsometatarsal joints were observed on 54 occasions. In other instances similar changes were seen in the toes, but these were not included because of the difficulty of excluding previous osteomyelitis. It was noticeable that when the midfoot was involved the changes were generally of a hypertrophic nature (Fig. 6) whilst in the hindfoot it was more frequent for an atrophic form of Charcot joint to occur (Fig. 7).

It was noticeable that in this group many of the patients who developed a Charcot osteoarthropathy had a precipitating cause. This was generally an operation or an injury to the forefoot. It seems probable that either of these occurrences would have altered the mechanics of walking, throwing an abnormal strain on the joints with sensory impairment, thus precipitating the classical neuropathic changes.

Although Charcot's disease is usually painless, this was not invariably the case and a number of patients presented with either pain or swelling in the foot. When the condition is in an active phase it is frequently necessary to protect the foot in order to prevent deformity occurring. Provided this is done a stable
situation will eventually be reached. Unfortunately, 15 cases were seen in which this did not happen and these patients developed an ulcer overlying a prominent bony lump in a deformed foot. These proved impossible to heal with conservative treatment and the lumps were

well-padded cast for a number of weeks proved adequate.

**Spontaneous subluxations and dislocations.** Most of these cases have previously been reported (Newman 1979) and form the final group of radiological abnormalities. Two cases of marked joint subluxation were observed and in five instances there was spontaneous dislocation. In all patients the most striking aspect was the normal architecture of the bone; the abnormality was related purely to the soft tissues (Fig. 10).

The patients with this condition present with a grossly deformed swollen foot and some treatment is always required. In one patient the dislocation was reduced, but no attempt was made to arthrodese the joint. This redislocated once the fixation was removed.

**Pathological fractures.** Small peri-articular fractures are frequently seen in the early stages of development of a Charcot osteoarthropathy. However, three cases were observed in which a spontaneous major fracture occurred. None of these patients developed pain and although the fractures were slow to heal the neighbouring joints did not undergo typical neuropathic changes (Figs 8 and 9). Patients with this condition presented with a swollen foot and once the nature of the underlying bony abnormality had been recognised, treatment in a

Figure 6—Radiograph showing characteristic endstage of Charcot's disease in the midfoot. There is intermetatarsal widening, excessive bone formation and loss of normal joint space. Figure 7—Radiograph demonstrating atrophic Charcot joint. There is gross destruction of the subtalar joint with loss of bone affecting both talus and calcaneum.
Since the underlying pathology had not been corrected it could be anticipated that such a recurrence would occur. It therefore seems that reduction followed by primary arthrodesis is necessary to obtain stability.

DISCUSSION

There is much confusion in the literature concerning the terminology of the various patterns of non-infective disease of bones and joints in diabetic neuropathy. The changes described in this review fall into six main groups. Whether the conditions represent separate disease entities or whether they form a continuous spectrum of diabetic osteopathy is not resolved. Unfortunately there is insufficient pathological material available to settle this issue.

The importance of most of these conditions lies in recognising them and in distinguishing them from osteomyelitis. Most do not require treatment, but because of the similarity of the radiological changes to osteomyelitis, a careful follow-up of the clinical state of the foot is mandatory. Cases of Charcot osteoarthropathy, spontaneous fracture, and dislocation generally require treatment. This must follow the general principles for treatment of any diabetic foot. In this series it was found that there was always an adequate blood supply present to allow simple operations to be undertaken when necessary. The aims of treatment in these conditions should be to provide a stable foot of satisfactory shape. In general this can be achieved by prolonged immobilisation of the part during the active phase of the disease process or, once deformity has occurred, by removing the lump and thus ensuring there is no excessive pressure on the overlying skin. Once stability and correct alignment have been achieved the wearing of properly fitting footwear is essential (Mooney and Wagner 1977).

I am grateful to the surgeons who have allowed me to study their cases and particularly to Dr F. W. Wagner who stimulated my interest as well as caring for many of the patients reported.

REFERENCES