THE EFFECTS OF METHYLPREDNISOLONE ACETATE IN THE TREATMENT OF BONE CYSTS
RESULTS OF THREE YEARS FOLLOW-UP

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The treatment of bone cysts by topical injection of methylprednisolone acetate was initiated at the end of 1973, and the late results are reported in this paper. In seventy-two cases followed up for one to three years favourable results have been obtained in about 90 per cent. The technique of local injection and the surgical equipment employed, in the case of focal recurrences, are considered. With this method, surgical treatment of bone cysts in youth is seldom necessary.

In investigating the physicochemical composition of the fluid contents of bone cysts, Scaglietti confirmed the findings of other authors (Villani 1956; Trifaud and Bureau 1959; Cohen 1960), that this fluid was a transudate. Although the pathogenesis of bone cysts could not be identified, it was felt that injection of a corticosteroid into the cavity would cause resorption of the cystic fluid, in the same manner as it causes resorption of transudates in synovitis in a joint.

Clinical trials of microcrystalline corticosteroid were begun in 1974. The results of the cases treated in 1974 and 1975 are reported here; that is, only those cases with a follow-up of at least eighteen months.

MATERIAL AND METHODS

In 1974 and 1975, eighty-two cases of bone cysts were treated, seventy-two of which were followed up for one to three years. No definite evaluation can be made of the other ten cases because, for various reasons, the follow-up has been too short. The seventy-two patients comprised forty-seven males and twenty-five females with an age range from sixteen months to twenty-seven years; thirty patients were aged between eight and eleven years.

The most frequent sites of the cysts were the upper metaphysis of the humerus, the middle third of the humeral diaphysis, the upper femoral metaphysis, and the middle third of femoral diaphysis (Fig. 1).

Six cysts had recurred after conventional surgical treatment; in sixteen cases the bone cysts persisted after an old pathological fracture, which had been treated by closed reduction and a cast; in twenty-six cases, methylprednisolone acetate was injected into cysts which had been diagnosed at the time of a recent pathological fracture and in these cases a cast was applied for forty-five to sixty days. In the remaining thirty-four cases the diagnosis resulted from a radiographic examination performed because of local pain or for various other reasons.

Technique. When the cyst wall is thin, a thin trocar provided with a co-axial mandrel with pointed, screw-shaped end is used manually.

With a thicker wall a cannulated needle is used, mounted on a drill.

The cyst is entered under radiographic control, using a television monitor.

Two fundamental rules should be followed. First, two needles must be introduced into the cavity, in order to obtain a spontaneous escape of the cystic fluid; a single perforation, with forced aspiration, is always followed by profuse venous haemorrhage, which impairs qualitative diagnosis of the cystic contents. Secondly, the injected liquid must run over the whole surface of the cyst, to give an even distribution of the corticosteroid crystals. It has been found that

Fig. 1
The sites of the seventy-two bone cysts treated in 1974 and 1975.

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200
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quicker repair occurs with a multilocular cyst than with a unilocular one.

Quantum of methylprednisolone acetate introduced. This has been established empirically from case to case, and depends upon the size of the cyst and the age of the patient: 40 to 80 milligrams for smaller cysts and younger patients, but up to 200 milligrams (5 millilitres of Depo-Medrol) for larger cysts. Doses of 40 to 80 milligrams were employed for local and tiny recurrences.

Stages of follow-up. Radiographs were taken approximately every sixty to ninety days. If the cavity persisted or there was only scanty osteogenic repair, local injection was repeated up to a maximum of six times (eight cases) at the same frequency. No abnormal biochemical findings due to excessive doses of corticosteroids were noted. We feel this must be due to the use of low-absorption crystalline steroids.

![Fig. 2](image)

Histological section of a bone cyst seen two months after treatment with methylprednisolone acetate. The upper half of the illustration shows the cavity full of richly vascularised fibroblastic tissue. Below, there is actively proliferating bone in the wall of the cyst with trabeculae partially lined by osteoid and covered by chains of osteoblasts. (Haematoxylin and eosin, ×120.)

RESULTS

Pathological findings. In one case the cystic cavity was examined two months after injection of 80 milligrams of methylprednisolone acetate and it was found to be filled with reddish-grey tissue, which on histological examination showed oedematous fibroblastic connective tissue (Fig. 2), and an active proliferation of trabeculae of reticular and osteoid bone on the wall of the cyst.

These findings are completely different from the usual histological findings in bone cysts of a thin fibrous, poorly vascularised lining, with little active proliferation and few giant cells (Fig. 3). The bony wall shows trabeculae undergoing resorption, with fibrous bone marrow and evidence of eccentric atrophy of cortical bone.

Clinical and radiographic changes. The first clinical occurrence after local injection of methylprednisolone acetate was the extremely swift relief of any pain. Radiographs taken two to three months after the first injection generally showed the reduction of eccentric atrophy and reconstruction of the cortical bone of the cystic wall both inside and outside, while the cystic cavity became radiographically opaque. In the case of multiloculated cysts, the trabeculae of cancellous bone were thickened, and new bone formation was evident. If a further injection was given at this stage the surgeon could clearly feel a striking increase in the hardness of the cystic wall and the resistance of the bone to the cannulated needle.

About five to six months after beginning the treatment, progressive formation of bone was observed, with the radiographic appearance of reticular bone distributed more or less uniformly throughout the cyst. Repair did not progress evenly: tiny local cavities could be left, which would spread and become the focus of recurrent osteolytic activity. These spots were reduced and eliminated by further local injections of methylprednisolone acetate. Bone with reticular structure, with no tendency to form new cavities, evolved a lamellar structure increasingly like normal bone, but with a complex radiographic appearance of "bone scar". The final outcome has yet to be shown.

"Healing", with complete disappearance of the cystic cavity, was only observed, after three years, in cysts in the diaphysis of the humerus. In metaphyseal cysts, complete filling of the cyst with a "bone scar" was considered as clinical and radiographic healing. Growth at the epiphysial cartilage plate, usually delayed by the presence of the cysts, became normal as soon as the first signs of bone repair shifted the lesion towards the diaphysis, thus showing progressive loss of activity and a tendency to heal.

It must be pointed out that no damage to the epiphysial cartilage plate is caused by injection of corticosteroid into the cystic cavity: healing may therefore be considered as spontaneous. In contrast, the use of bone grafts to fill the cyst is often followed by slackening of growth and secondary deformity, as, for example, the occurrence of coxa vara after treatment of a cyst of the femoral neck.
Results at follow-up. Of the seventy-two cases followed for more than eighteen months, sixty-nine (96 per cent) gave clearly positive results, with healing (60 per cent), or more or less complete bone repair (36 per cent) over a period that depended upon the frequency of tiny local recurrences (Figs. 4 to 7). In all cases with a positive response, any risk of pathological fracture was eliminated from the time of the first local injection of corticosteroid. In three cases (4 per cent) no response was observed after at least two local injections of methylprednisolone acetate.

A boy aged eleven years. Large cystic formation in the upper third of the femur, the arrow showing the site of infiltration with 120 milligrams of methylprednisolone acetate. Four months after the injection the cavity had filled with bony tissue. There was complete obliteration of the cavity after fifteen months and no recurrence after two years.

A boy aged nine years. Cystic formation of the left humeral diaphysis, which was injected with 80 milligrams of methylprednisolone acetate. Radiographs at three, seven, and eighteen months showed the remodelling of the bony structure. There was no evidence of partial recurrence.
A boy aged eight years. Fracture at the upper third of the left humerus through a bone cyst which was first referred to us eight months later. The initial radiograph taken in plaster showed a wide cystic cavity with a pathological fracture. After three months there was healing of the fracture but persistence of the bone lesion. At eight months the lesion was injected with 120 milligrams of methylprednisolone acetate. Twenty months after the fracture and a year after the injection only a bone “scar” can be noticed at the level of previous lesion.

A girl aged thirteen years. A wide, multiloculated cyst affecting the proximal metaphysis and part of the diaphysis of the left humerus. An injection of 120 milligrams of methylprednisolone acetate was given at the level of the arrow. Three months later, a radiograph showed a relative increase in the density of the cavity, with thickening of spongy bone in the upper half. An injection of 80 milligrams was given at the distal end of the cavity. At six months, relapse was evident in the proximal half, and 80 milligrams were injected at that level. Osteolytic gaps were left at eleven months, so 80 milligrams were injected at the level of the arrow. At twenty-nine months (eighteen months after the last local injection) there was good reconstruction of spongy bone. There was no evidence of recurrence at thirty-three months.
corticosteroid: this was attributed to the fact that these patients were all over sixteen years of age.

Our results showed that healing of bone cysts, with recovery of normal bone structure, could be obtained with simple injections of microcrystalline corticosteroid into the cyst. The shortest healing times were observed in the first, second and third quinquennia of life when osteogenic repair was most active.

We cannot explain the mode of action of corticosteroids on bone on the ground of our observations. The hypothesis upon which we based our experimental work was that microcrystals caused destruction of the connective tissue coat of the cystic wall, thus allowing secondary osteogenic repair.

Cases that had recurred after surgical treatment did not respond initially, but after repeated local injections of corticosteroid healing took place.

DISCUSSION

Our first observations suggested a possible osteogenic action of corticosteroid. Further experience did not confirm this hypothesis, although an osteogenic action was clearly shown in the radiographs and was demonstrated in the only case where a biopsy was taken.

Our experience showed that bone cysts could heal with complete bone repair, particularly at the age when osteogenesis was more active: the first, second and third quinquennia of life. In older patients (fourth quinquennium), bone repair could be achieved provided local injections of corticosteroid were repeated several times; bone repair was slower at this age. Any cyst diagnosed during the growth spurt would heal more or less rapidly provided control radiographs were taken every two to three months and local injection of corticosteroid was persistently repeated into those spots where bone repair was slow or residual cavities were observed.

We can affirm that there is no need to curette the cyst or to transplant bone: we never operated on any patient. Healing was always attained provided repeated injections of corticosteroid were persistently made for as long as was necessary.

Aspiration of cystic fluid may be a helpful diagnostic test in doubtful cases; but the injection of corticosteroid into the cystic cavity may provoke positive or negative reactions which will provide an exact diagnosis.

In each of the three cases where treatment with corticosteroid failed the patient was over sixteen years of age and the cyst was "exhausted", with no liquid contents.

Our results are confirmed by other authors (Campanacci, De Sessa and Bellando Randone 1975; Corrado and Passaretti 1976; Gualtieri, Gualtieri and Montefusco 1976; Campanacci, De Sessa and Trentani 1977).

REFERENCES