INCOMPLETE HEALING OF SIMPLE BONE CYSTS AFTER STEROID INJECTIONS

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We reviewed 32 children after the treatment of simple bone cysts by intralesional injections of methylprednisolone acetate. The age of the child and the activity and size of the cyst did not significantly affect the radiological outcome. The earliest time at which the radiological response could be reliably determined was three months. After a median period of review of five years, four (13%) cysts had healed, 20 (62%) cysts were partially visible but sclerotic, four (12.5%) were still visible but opaque and four (12.5%) were clearly visible. The healed and partially visible but sclerotic cysts were classified as having satisfactory radiological healing. This was observed in 13 of 32 cysts (41%) after the first injection, in eight of 21 (38%) after the second injection, but in relatively few of the remaining cysts after subsequent injections.

A satisfactory symptomatic outcome was achieved in all of the 18 children with humeral cysts and in the one child with a fibular cyst irrespective of the radiological outcome, but only in nine (67%) of the 13 children with femoral or tibial lesions, in whom the cysts were healed or sclerotic. The remaining four children had exertional bone pain and repeated fractures of their femoral or tibial cysts which were incompletely healed with sclerosis in one and opacities in three.

We conclude that the healing response to intralesional corticosteroids is unpredictable and usually incomplete even after multiple injections. The failure rate in weight-bearing bones is too high.

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During childhood, about 15% of simple bone cysts heal without treatment, but most persist or enlarge.^{1,2} Treatment is recommended for persistent or enlarging cysts to reduce the frequency of fractures and to allow the children to return to normal activities.^{3,4} The injection into the cyst of a corticosteroid under general anaesthesia has been recommended as the treatment of choice.³ Multiple injections are often given but the indication for, and timing of repeat injections have not been clearly defined,^{3,5,6} and the radiological healing required for comfort and normal function is not clear.

We have investigated the radiological and symptomatic outcomes of simple bone cysts treated by aspiration, cystography and injection of corticosteroid in a series of 32 children.

PATIENTS AND METHODS

From January 1985 to December 1995, we treated 32 children with simple bone cysts by injections of corticosteroid. There were 19 boys and 13 girls; their median age was seven years (4 to 16). The median follow-up from the latest steroid injection was five years (1 to 10); a minimal follow-up of one year has been reported to be adequate for the assessment of the response to corticosteroid injections.³ Eighteen of the cysts were in the humerus, 11 in the femur, two in the tibia and one in the fibula. There were four diaphyseal cysts in the humerus; the rest were metaphyseal. All the children had presented with fractures, except one in whom the chance finding of a proximal femoral cyst was made on a pelvic radiograph taken for review of hip development.

At presentation, we classified a cyst that abutted the growth plate as active and the rest as inactive.⁴ Seventeen cysts were active and 15 were inactive. We used the dimensions of the cyst on the first radiographs to calculate its approximate volume.⁶ The median volume was 47 cm³ (4 to 256).

Fractures were treated initially by slings or casts for four to six weeks, and steroid injections were not given until the fractures had healed. The median interval between fracture and the first steroid injection was 2.5 months (1.5 to 3). At this stage, 13 of the cysts (41%) showed no radiological signs of healing; the others were still visible but had become more opaque.

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Under general anaesthesia, the diagnosis was confirmed by the needle aspiration of clear or greenish fluid and the demonstration of a single cavity by cystography.^{3,5,6} The fluid was then forcibly aspirated in an attempt to rupture the lining membrane,³ and 80 mg of methylprednisolone acetate (Depo-Medrol; Upjohn, Canada) instilled into the cavity.

Monthly radiographs were taken to assess the radiological response to injection which was repeated unless healing was seen. The median number of injections was three: 21 children had two, 11 had three, 8 had four, 6 had five and 2 had six separate injections, each under general anaesthesia. The median time between the first and the third injection was three months; each subsequent injection was

after a median of seven months. After several injections, cystography often showed several separate cavities, and in such cases the dose of methylprednisolone was divided for separate instillation into each cavity.

All 32 patients and all their radiographs were reviewed. Radiological healing was graded according to Neer et al⁴ and Chigira et al⁷ as follows: grade 1, cyst clearly visible; grade 2, cyst visible but multilocular and opaque; grade 3, sclerosis around or within a partially visible cyst; grade 4, complete healing with obliteration of the cyst. Typical examples of these healing grades are shown in Figures 1 to 3. Grade-1 and grade-2 results were recorded as unsatisfactory; grades 3 and 4 were considered to show a satisfactory radiological outcome.⁴

Fig. 1a

Fig. 1b

Fig. 1c

A simple bone cyst of the proximal femur with unsatisfactory healing. Figure 1a – Cyst clearly visible (grade-1 healing) two months after an undisplaced fracture of the medial cortex. Figure 1b – Two years later, after four steroid injections, the medial cortex has thickened but the cyst is multilocular and opaque (grade-2 healing). Figure 1c – At four years grade-2 healing persists despite six steroid injections. Pain persisted and five years later there was a displaced fracture through the cyst.

Fig. 2a

Fig. 2b

Fig. 2c

A simple cyst of the proximal femur with satisfactory healing. Figure 2a – At two months after a fracture of the medial wall of the cyst the fracture is healing but the cyst is still visible (grade-2 healing). Figure 2b – At five months after presentation and three months after the first steroid injection the cyst is still clearly visible (grade-1 healing). Figure 2c – At two years after presentation and one year after a second steroid injection the cyst is partially visible but sclerotic (grade-3 healing).

Fig. 3a

Fig. 3b

Fig. 3c

Complete healing of a simple bone cyst of the femur. Figure 3a – At two months after a fracture of the medial wall of the cyst the fracture has healed and the cyst is opaque (grade-2 healing). Figure 3b – A cystogram at three months shows a single cavity which was injected with steroid. Figure 3c – There is complete healing (grade 4) at three months after the single steroid injection.

The clinical outcome was determined using the validated Childhood Health Assessment Questionnaire⁸ to assess function, pain and satisfaction. Functional activities were recorded on a scale of 0 to 3, where 0 was no functional disability and 3 means unable to perform the activity.⁹ Visual pain scores were from 0 for none to 100 for severe pain. Patient satisfaction assessment was from 0 for no difficulties to 100 for severe problems. A satisfactory outcome had pain and functional scores of 0 and a satisfaction score of less than 10. All other outcomes were recorded as unsatisfactory.

We used binary logistical regression to determine whether the radiological outcome was significantly influenced by the age of the child or the volume or activity of the cyst.

RESULTS

At the latest review, four cysts had healed (grade 4), 20 were sclerotic (grade 3), four were opaque (grade 2) and four were unchanged (grade 1). On this grouping 24 cysts (75%) had a satisfactory radiological outcome and eight were unsatisfactory. A review of the monthly radiographs showed that a radiological response was not detectable until two months after an injection and that the films taken at three months were the most useful for determining such a response. Thirteen of the 32 cysts (41%) had a satisfactory radiological outcome after one injection, eight of 21 (38%) after the second, two of 11 (18%) after the third, none of eight after the fourth, one of six (17%) after the fifth and none of two after their sixth treatment. Binary logistical regression analysis showed that the radiological outcome

was not significantly associated with the volume of the cyst ($p = 0.113$), its activity ($p = 0.072$) or the age of the child ($p = 0.067$).

The four children with grade-4 healing had no complications. Five of those with sclerotic cysts (grade 3) had malunion of their fracture and one of these became infected. None of the malunions required surgical correction. Two of the four children with opaque cysts (grade 2) had refractures and were treated later with further corticosteroid injections. Two of the four unresponsive (grade 1) cysts showed enlargement and were therefore treated by curettage, bone grafting and internal fixation.

Of the 32 children, 28 (88%) had a satisfactory clinical outcome, and returned to full activities. Of the 24 children with a satisfactory radiological outcome, 23 (96%) had good clinical results, but one child had persistent exertional pain over a large sclerotic cyst in the proximal tibia. Five (63%) of the eight children with an unsatisfactory radiological outcome had a satisfactory clinical result for four cysts of the humerus and one of the fibula. The other three children all had cysts in the proximal femur causing pain on exertion and recurrent fractures, despite four or more corticosteroid injections. In the whole series four of the 13 children (33%) with cysts of the femur or tibia had unsatisfactory clinical results, but all 19 with cysts of the humerus or fibula were satisfactory.

DISCUSSION

Our radiological review showed that the response of simple bone cysts to injections of corticosteroids was unpredict-

able and usually incomplete. In contrast to previous reports we found no statistically significant effect for the age of the child, the activity of the cyst or its size on the radiological outcome.⁴⁻⁶

Our finding that the response of the cyst to an injection of corticosteroid could not be reliably determined for three months implies that further radiographs and treatment should be delayed for at least this period. Satisfactory radiological healing in 41% of cysts after the first injection agrees with the report of Oppenheim and Galleno,³ but is higher than the 24% found by Scaglietti et al.⁵ We also showed a satisfactory healing rate in 38% of cases after the second injection, but the radiological response to more injections was poor, and may not justify further attempts. Despite this, 75% of the cysts which we reviewed achieved satisfactory radiological healing after numerous injections.³

The clinical outcome was satisfactory for all children with humeral cysts and for one child with a fibular cyst regardless of the grade of radiological response. This indicates that cysts in non-weight-bearing bones are well tolerated during normal recreational and sporting activities in children. By contrast, only 67% of children with cysts of the femur or tibia had a satisfactory symptomatic outcome, although most with a satisfactory radiological outcome, complete healing or sclerosis could undertake normal activities without pain. An unsatisfactory radiological outcome in the femur was associated with exertional pain and further fractures.

The radiological results after corticosteroid injections are similar to those achieved by multiple drill holes,¹⁰ and it is doubtful therefore whether the corticosteroids which we used had any therapeutic value. Healing may have been stimulated by disruption of the membranous lining by forceful aspiration and by the irritant effect of the contrast medium used for cystography. It is clear that treatment by aspiration, cystography and intralesional corticosteroids is unreliable, particularly in weight-bearing bones. Moreau and Letts¹¹ have expressed similar views as regards simple bone cysts of the calcaneum in children, recommending curettage and bone grafting, although this has been reported to give recurrence rates of up to 40%.^{4,12} Subtotal resection and grafting give lower recurrence rates but more complications.¹³⁻¹⁵

There is a clear need for a simple percutaneous method of treatment with a high rate of complete healing. A preliminary report from Lokiec et al.¹⁶ indicates that the percutaneous injection of autologous bone marrow may be successful: ten simple bone cysts all showed rapid consolidation within three months and extensive remodelling within six months, with success even as early as two weeks after a fracture, when the cyst wall had probably been sealed by callus. The described technique was the disruption of the lining membrane by aspiration and multiple perforation followed by injection of autologous marrow

harvested from the ilium. The apparent success of this procedure was probably due to the differentiation of the osteoprogenitor cells, contained within the fresh autologous marrow, to osteoblasts.¹⁷ Other possible means of inducing bone formation within these cysts are injection of bone-graft substitutes or recombinant bone morphogenetic proteins.^{18,19}

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