SIMPLE BONE CYSTS TREATED BY PERCUTANEOUS AUTOLOGOUS MARROW GRAFTING

A PRELIMINARY REPORT

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We prospectively evaluated the percutaneous injection of autogenous bone marrow for the treatment of active simple bone cysts in ten consecutive children with cysts in the proximal humerus, proximal femur or tibia. The treatment included percutaneous biopsy, aspiration of fluid and the injection of autogenous bone marrow aspirated from the iliac crest.

All the patients became painfree after a mean of two weeks and resumed full activities within six weeks. All ten cysts consolidated radiologically and showed remarkable remodelling within four months. Review at 12 to 48 months showed satisfactory healing without complications. Percutaneous injection of autologous bone marrow appears to be an effective treatment for active simple bone cysts.

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Simple bone cysts are benign, fluid-containing and usually expanding lesions, seen in children before skeletal maturity. They form 3% of all bone lesions in this group (Goel et al 1994) and are most common in long bones (Campanacci, Capanna and Picci 1986). Uncomplicated lesions are painless and are diagnosed when there is a pathological fracture or as an incidental finding on a radiograph. The radiological appearance of simple bone cysts is characteristic.

Despite their benign nature and their tendency to disappear after skeletal maturation, their known presence may cause reduction in physical activities because of the danger of a fracture. Cysts close to the growth plate show biological activity, are usually expansile and recur more often than those which move away from the growth plate (Neer et al 1973; Oppenheim and Galleno 1984). An active cyst near the physis may cause retardation of longitudinal growth in up to 14% of patients (Campanacci et al 1986).

The pathogenesis of simple bone cysts is uncertain and most treatments are based on the clinical and radiological evaluation of partial successes or recurrences. Bone grafting has been disappointing, with reported recurrence rates of up to 40% after autogenous grafting (Neer et al 1966) and of 12% to 45% after allografting (Spence, Sell and Brown 1969; Spence et al 1976). Lower recurrence rates have been achieved only after subtotal resection (Fahey and O’Brien 1973; Gartland and Cole 1975; McKay and Nason 1977), but aggressive operations have a high rate of complications.

Percutaneous injection of steroid without curettage was initially stated to give favourable results in 90% of cases (Scaglietti, Marchetti and Bartolozzi 1979) with no growth arrest or secondary deformity, but Campanacci et al (1986) reported a 15% recurrence rate, with only 50% of cysts showing complete healing. The low morbidity and simplicity of steroid injection made it popular, although 50% of the patients required more than one injection (Oppenheim and Galleno 1984). The need for multiple steroid injections has led to interest in other methods of treatment (Altermatt, Schwobel and Pochon 1992; Adamsbaum et al 1993; Inoue et al 1993; Whiteman et al 1993). We have reported excellent clinical results using autologous marrow aspirate to improve the osteogenic potential of bone grafts in children (Wientroub et al 1989).

We now report a preliminary clinical trial of the use of percutaneous autologous marrow grafting alone for the treatment of simple bone cysts.

PATIENTS AND METHODS

We treated ten consecutive children in our prospective study. There were seven boys and three girls with a mean age at treatment of 10 years 3 months (7 to 15 years). All ten had active lesions of a metaphysis which were in direct contact with the growth plate. Six cysts were in the proximal humerus, two in the proximal femur, one in the proximal tibia and one in the distal tibia.
All the patients had sustained at least one pathological fracture and still had occasional pain, usually after physical activity. Two patients treated soon after their fracture were tender, but the other eight had no limitation of movement or tenderness after the healing of 12 fractures. Three patients had been referred with continuing radiological enlargement of cysts after the failure of previous treatments. One proximal humeral cyst had persisted after two open grafting operations using autogenous and allogeneic bone. The other two had failure of repeated steroid injections for proximal femoral and humeral cysts.

**Operative technique.** With the child under general anaesthesia, an image intensifier is used to locate the cyst and the physis and to guide a cannulated needle. After full skin preparation and draping, a thin trocar with a pointed coaxial mandrel is used to perforate the bone cortex. The cyst cavity is evacuated by aspiration of fluid which is sent for histological examination. The needle is used to disrupt the lining membrane and make multiple perforations through the cyst wall into the medullary cavity. For multicameral cysts, great care is taken to break all the intralossional septa to create a single cystic space.

Autologous bone marrow is then aspirated from the iliac crest, using a wide-bore sternal puncture needle and a syringe. To ensure the greatest possible proportion of marrow to blood and to avoid premature clotting, only 6 to 8 ml are aspirated from one site, but more can be obtained by multiple punctures 1 to 2 cm apart. Clotted marrow should not be used.

The mean volume of marrow injected was 25 ml (15 to 50) and there were no perioperative complications. Patients with cysts in the lower limb were kept non-weight-bearing on crutches for six weeks and then gradually returned to full weight-bearing.

All patients were reviewed clinically and radiologically at two and six weeks and at three months in the first year,
at six months in the second year and then annually. Radiographs were evaluated by the criteria of Campanacci et al (1986). Follow-up was for at least 12 months (12 to 48; mean 20).

RESULTS

The patients were free from pain within a mean of one week for humeral, two weeks for femoral and three weeks for tibial cysts, respectively. The two patients, with femoral and tibial lesions respectively, who were injected within two weeks of the diagnosis of long spiral pathological fractures, had the same course after injection as the other patients. Full activity including weight-bearing was resumed within six weeks in both children.

Review radiographs showed that all ten cysts had consolidated within three months, with remarkable narrowing, disappearance of the expansile pattern, and thickening of the cortex within six months (Figs 1 to 4). These radiological findings suggest that the healing of the cysts was accompanied by a remodelling process. No cyst increased in size after the injection (Figs 1 to 4), and all healed completely in 6 to 12 months.

DISCUSSION

The osteogenic potential of bone marrow has been shown, when marrow fragments were grafted under the kidney capsule, to derive from the marrow stroma (Owen and Friedenstein 1988). Such a cell line expresses an osteoblastic phenotype in vitro and produces bone in vivo (Benayahu et al 1989, 1991). Red marrow has been shown to have a beneficial effect on osteogenesis in both experimental models and in man (Burwell 1985). Combined xenografts of bone and autologous marrow in clinical practice were first described by Salama and Weissman (1978), and excellent results in 110 operations on 98 patients were reported by Salama in 1983. We have obtained similar results in children and adolescents (Wientroub et al 1989).

We report our preliminary results in a small group of patients, but believe that neither age nor the activity or site...
of the cyst affected the outcome. All our patients healed after one injection, the cyst was obliterated, and there was active remodelling. In the past, we have used aspiration and the disruption of the wall membranes and intrallesional septa into the marrow cavity and then injected steroids. Our results with steroids did not differ from those reported by others (Oppenheim and Galleno 1984; Campanacci et al. 1986), but they were much improved by the new method.

Injection of bone marrow is almost atraumatic and obviates the need for operations to procure autografts. It is safe and can be done on an outpatient basis. Our clinical results seem to confirm the experimental findings for bone-marrow injection: this places the appropriate cells in the right area and triggers early bone formation (Healey et al. 1990; Connolly et al. 1991; Garg, Gaur and Sharma 1993). Our results tend to confirm that the combination of fresh autologous red marrow with biological or synthetic biocompatible material that favours the induction of new bone may provide improved methods for autogenous bone-grafting procedures for other conditions (Piez and Wientroub, US Patent No. 4774227).

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

REFERENCES


