Treatment of aneurysmal bone cysts with percutaneous sclerotherapy using polidocanol
A REVIEW OF 72 CASES WITH LONG-TERM FOLLOW-UP

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Aneurysmal bone cyst is a rare tumour-like lesion which develops during growth. Our aim was to determine the efficacy of the administration of percutaneous intralesional 3% polidocanol (hydroxypolyaethoxydodecan) as sclerotherapy.

Between July 1997 and December 2004 we treated 72 patients (46 males, 26 females) with a histologically-proven diagnosis of aneurysmal bone cyst, at various skeletal sites using this method. The sclerotherapy was performed under fluoroscopic guidance and general anaesthesia or sedation and local anaesthesia. The mean follow-up period was 34 months (26.5 to 80). The patients were evaluated using the Enneking system for functional assessment and all the lesions were radiologically quantified into four grades.

The mean age of patients was 15.6 years (3 to 38) and the mean number of injections was three (1 to 5). Ten patients were cured by a single injection. The mean reduction in size of the lesion (radiological healing) was found to be 76.6% (61.9% to 93.2%) with a mean clinical response of 84.5% (73.4% to 100%). Recurrence was seen in two patients (2.8%) within two years of treatment and both were treated successfully by further sclerotherapy.

Percutaneous sclerotherapy with polidocanol is a safe alternative to conventional surgery for the treatment of an aneurysmal bone cyst. It can be used at surgically-inaccessible sites and treatment can be performed on an out-patient basis.

Since its first description by Jaffe and Lichtenstein1 in 1942, many cases of aneurysmal bone cyst have been reported.2 The origin of the lesion remains controversial.3-6 The radiological criteria of the lesion and its characterisation have also been extensively described and reviewed.7 An eccentrically located, lytic, expansile lesion in the metaphysis with cortical thinning and a subperiosteal thin shell of bone is considered to be typical of an aneurysmal bone cyst. Surgical and adjuvant treatment have a high rate of complications.8-12

In recent years percutaneous sclerotherapy has emerged as an excellent method of treatment for aneurysmal bone cyst, and obviates the potential functional disabilities such as joint stiffness and shortening which are commonly seen with other methods of treatment. We report our experience using a novel method of sclerotherapy using 3% polidocanol (hydroxypolyaethoxydodecan (Samarth Life-sciences Pvt. Ltd., Solan, India); available in 2 ml ampoules; 1 ml = 30 mg of polidocanol) and describe the clinical and radiological results.

| Table I. Site of distribution of the lesions |
|-----------------|-------------------|
| Bones affected  | Number of cases   |
| Clavicle        | 3                 |
| Humerus         | 30                |
| Radius          | 4                 |
| Ulna            | 2                 |
| Pelvis          | 3                 |
| Spine           | 1                 |
| Femur           | 14                |
| Tibia           | 6                 |
| Fibula          | 6                 |
| Foot            | 3                 |
| Total           | 72                |

Patients and Methods
Between July 1997 and December 2004, we treated 72 patients with an aneurysmal bone cyst. This study is a combined retrospective and prospective review of these patients.

There were 46 males and 26 females with a mean age of 15.6 years (3 to 38). There were 39 lesions in the upper limb, 29 in the lower limb and four in the axial skeleton (Table I). The mean follow-up was 34 months (26.5 to 80). No patient was lost to follow-up.
operative evaluation included clinical, radiological and histopathological assessment. Radiographs were obtained for all the patients and MR scans for patients with axially-distributed lesions. A histological diagnosis was obtained using a percutaneous trephine biopsy. When the tissue was inadequate for establishing a diagnosis, a repeat trephine biopsy was obtained. In two patients a definitive diagnosis was not possible on the trephine biopsy specimen and an open biopsy was performed. All cases of secondary aneurysmal bone cysts were excluded from the study.

Treatment started three months after the biopsy, to give enough time for spontaneous healing to occur following bone puncture as has been reported previously. The volume of the cyst was measured pre-operatively using plain radiography in two planes by multiplying the length and the width of the cyst on the anteroposterior view and the depth on the lateral view. A magnification factor of 10% was incorporated in the calculations. This calculation was found to be suitable only for small and spherical lesions less than 3 cm in diameter.

Treatment was undertaken under general anaesthesia for patients less than 15 years of age and using 2% xylocaine local anaesthetic with sedation in older patients. Polidocanol was injected into the lesion under fluoroscopic guidance using a bone-marrow aspiration needle (Gallini Medical Devices, Mirandula, Italy) or a 16G needle (Gallini Medical Devices). Approximately 1 ml of 3% polidocanol was injected per 1 cm$^3$ volume of the lesion. Back flow of the sclerosant was prevented by locking the needle for one minute and subsequently flushing it with 0.5 ml of normal saline. No more than 10 ml of sclerosant was injected into any lesion.

Larger and irregular cysts may be measured using ultrasoundography and complex mathematical calculations, but this was not considered to be necessary in view of the limitation of the amount of drug that could be injected into these lesions. Subsequent assessment was undertaken at six and 12 weeks and six-monthly intervals thereafter for up to approximately seven years. The end-point of treatment was defined as the time at which the pain had resolved, the cortical thickness of the wall of the cyst had started reforming and the lesion had stopped growing in size. A second injection of sclerosant was given if any one or a combination of the above three parameters was not observed in the first three months after treatment. Patients were advised to avoid contact sports and strenuous activity until the lesion healed. One patient with a lesion in the neck of femur remained non-weight-bearing for six weeks. Two patients with an extensive humeral lesion used removable splints until the completion of treatment.

At each follow-up visit, the lesions were graded radiologically, by our own system, as grade I (residual lesion < 25% of the initial lesion), grade II (residual lesion 25% to 49%), grade III (residual lesion 50% to 74%), and grade IV (residual lesion 75% or more). The acceptability of treatment, the occurrence of complications and a functional assessment were also recorded at each follow-up visit according to the method of Enneking et al.

**Statistical analysis.** We used the Fisher’s exact test, the chi-square test and Student’s $t$-test to analyse our results. A $p$ value < 0.05 was considered significant.

**Results**

The results are summarised in Table II.

The mean number of injections was 3 (1 to 5) per patient, only one being required in ten patients. The mean length of treatment was 11.9 months (6 to 18). The overall mean residual size of the lesion at final follow-up was 23.3% (6.8% to 39.1%). Grade-I healing was found in 48 patients (66.7%), grade-II in 22 (30.5%) and grade-III in two patients (2.8%) (Figs 1a to 3). The mean overall rating was
Radiographs showing an aneurysmal bone cyst of the lower end of the fibula a) before treatment and b) 26 months after sclerotherapy.

Radiographs showing an aneurysmal bone cyst of the right side of the pubic ramus a) before treatment and b) 29 months after sclerotherapy, and CT scans c) before treatment and d) 29 months after sclerotherapy showing complete healing of the lesion as well as new bone formation.
75% (60% to 86.7%) at the end of treatment and 84.5% (73.4% to 100%) at the final follow-up as assessed by the system of Enneking et al. Improvement in the functional score correlated positively with the reduction in size of the lesion.

The functional scores at the end of treatment and at the last follow-up were compared with a valid \( n = 72 \). Using the comparison for the paired samples (t-test) the result was found to be highly significant \( (p = 0.002) \). The functional score at the end of the final follow-up (34 months; 26.5 to 80) was significantly better than that at the end of the initial treatment (11.9 months; 6 to 18).

There was no correlation between the site treated and the length of treatment, indicating that the outcome is not influenced by the site of the lesion.

**Complications**

Local recurrence was seen in two patients (2.8%), at the end of treatment (mean 11.92 months, 6 to 18). However, both were successfully treated with a further single injection of sclerosant. Other complications included induration at the site of injection (18 cases), hypopigmentation (3), local inflammatory reaction (1), and an episode of dizziness (1).

**Discussion**

An aneurysmal bone cyst is a tumour which attracts controversy principally regarding its characterisation and management. It has been classically considered as an arteriovenous fistula, but some consider it to be post-traumatic in origin and others a de-novo lesion. A venous impedance aetiology has also been proposed. However, most consider it to be some type of vascular malformation, justifying the term ‘benign vascular tumour of bone’.

It may be a primary lesion or superimposed upon another lesion.

Many forms of treatment have been described including intralesional procedures, radiation therapy, subtotal or total excision with or without reconstruction, sclerotherapy and selective/super-selective embolisation. It has also been reported to regress spontaneously after biopsy and fracture healing. Curettage with or without bone grafting is considered to be the treatment of choice for these lesions.

There is, however, a high recurrence rate and the potential of disturbance of growth when the lesion is near a physeal plate. Marcove et al. and Cole reported recurrence rates of more than 50% after curettage with or without bone grafting. Schreuder et al. reviewed the literature and found a recurrence rate of 30.8% after curettage and bone grafting. High-speed burring and cryotherapy have been used as adjuvants in an attempt to reduce the recurrence rate, to as low as 4% according to Schreuder et al. However, these procedures are associated with haemorrhage, particularly in large lesions, incomplete excision and physeal injury. Moreover, surgery is not feasible at all sites due to anatomical constraints. Endoscopic curettage has also been described in a small series of patients but long-term results are awaited.

Although extralesional excision removes the lesion in toto, it may involve extensive surgery with prolonged immobilisation, and may be complicated by the need for bone grafts and associated, growth plate injury morbidity. Sauceration of the lesion has similar complications although complete healing has been reported.

Radiotherapy has now been abandoned in view of the large number of complications including malignant change. Marcove et al. reported uncontrolled lesions in 9% of their patients and the development of a secondary tumour in one patient after radiotherapy.

Embolisation was used to reduce the intra-operative blood loss and proved to be an effective method of treatment. A recurrence rate of 10.5% was reported by De Cristofaro et al. Super selective embolisation of the feeding vessels widened the application of this method to surgically-inaccessible regions. Although the procedure is very effective, not all aneurysmal bone cysts have a major feeding vessel which can be satisfactorily embolised. Also ischaemia of vital neural and visceral structures remains a major concern.

Sclerosants, in general, act by direct damage to the endothelial lining, triggering a coagulation cascade and thrombotic occlusion of blood vessels. Several sclerosing agents have been used, but an alcoholic solution of Zein is the most popular. Polidocanol has been used safely in the treatment of varicose veins, telangiectases, venous malformations of the head, neck and limbs, gastro-oesophageal varices, endoscopic injection of intestinal vascular malformations and hydrocele of the testis. Methylprednisolone acetate, calcitonin and radionuclides have also been used sporadically.

To our knowledge, the use of polidocanol for the treatment of aneurysmal bone cysts has been described in only one previous study. We used polidocanol because of its proven efficacy in the treatment of vascular malformations at various sites with relatively few complications. The result was satisfactory in more than 97% (70) of our patients. The residual lesion was on average only 23.3% of the initial lesion. The rating of the clinical response was 75% at the end of treatment which improved to 84.5% at the final follow-up. This is comparable to the value of 90% (63% to 100%) observed by Marcove et al. who used curettage and cryotherapy. A mean of three injections (1 to 5) was required. Clinical and radiological improvement continued after the completion of treatment suggesting an ongoing healing process. A recurrence occurred in only two patients (2.8%), both occurring within two years of the end of treatment. Both were successfully treated by further sclerotherapy.

We found the method to be safe and effective with minimal complications. The response to therapy is graded, easily observed and followed. Patients with grade-II healing do
not require long follow-up as most are healed by one year after treatment. Patient acceptance is very good as the procedure respects cosmesis and can be done on an out-patient basis.

Potential complications with the use of polidocanol include hypopigmentation, necrosis at the site of injection in the case of extravasation, pulmonary embolism, osteomyelitis, allergic reactions and anaesthetic complications. However, none of these apart from hypopigmentation, which subsided spontaneously, was encountered in our study.

Polidocanol is relatively contraindicated for patients with skin conditions at the site of injection, heart disease, asthma and pregnancy, especially in the first trimester. It should not be injected intra-arterially because severe necrosis can occur, and it should not be used if the lesion causes neurovascular compression requiring surgical treatment. We did not use it in any intracranial site.

We recommend that sclerotherapy should be carried out only after an appropriate assessment of the patient under aseptic conditions and fluoroscopic guidance. Prevention of extravasation is the key to avoiding complications. Follow-up of at least two years is recommended. Recurrences may take place within two years.

Sclerotherapy using polidocanol for the treatment of primary aneurysmal bone cyst could prove to be a highly effective and acceptable alternative to conventional surgical techniques in view of its safety and efficacy.

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References


