Treatment of aneurysmal bone cyst by curettage and hydrogen peroxide as an adjuvant without refilling of the resultant cavity

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Background
Aneurysmal bone cyst (ABC) is a rare tumor-like lesion with wide controversy as regards the perfect means of treatment and the way to manage the resulting bony cyst after curettage.
Patients and methods
The study included 24 patients: 13 were male and the mean age was 12.6 years (range: 6–26 years). Six cases were diagnosed as solid ABC, nine (37.5%) cases were in the proximal femur. All cases were treated by thorough curettage followed by washing the cyst with hydrogen peroxide for 5 min. No bone graft or substitute was used as a filler of the cysts, except strut fibular graft, which was used to stabilize weak cysts in nine cases. Plaster cast was used in 11 cases for external fixation. Follow-up ranged from 12 to 46 months (mean: 25 months).
Results
All cysts healed without pathological fracture. There was no local recurrence until the end of follow-up. All patients returned back to normal life.
Conclusion
Thorough curettage with lavage of the cyst with hydrogen peroxide could be an acceptable method of treatment of ABC without the need of refilling of the resulting cavity.

Keywords:
aneurysmal, bone cyst, cavity, hydrogen peroxide

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Introduction

Aneurysmal bone cyst (ABC) is an expansile cystic lesion that most often affects individuals during their second decade of life and may occur in any bone in the body. Although benign, the ABC can be locally aggressive and can cause extensive weakening of the bony structure [1–5].

The majority of ABCs arise *de novo* and are referred to as primary ABCs. Up to 30% of ABCs arise with a coexisting bone lesion and are referred to as secondary ABCs [1,2,6,7].

Pathogenesis of these tumors remains controversial and may be vascular, traumatic, or genetic [8–11].

Once the diagnosis is established, management generally consists of intralesional curettage with or without bone graft and with or without adjuvant therapy [12]. Recurrence is not uncommon [7,13]. Other surgical options include en-bloc resection or wide excision, selective arterial embolization, and curettage with locally applied adjuvants such as liquid nitrogen or phenol [14,15].

Adjuvant treatment is intended to treat microscopic disease contamination within the lesion bed in the reactive zone after curettage has removed the gross tumor to lower the incidence of local recurrence.

In the literature, the description of curettage ranges from creation of either a small fenestration or a large cortical window in the cyst to complete saucerization.

Saucerization is preferred when a strut of cortical bone may be preserved to allow maintenance of the structural integrity of the bone [1,2,16].

Many different adjuvant therapies have been suggested, ranging from mechanical, chemical, to thermal (both hypothermic and hyperthermic treatment), biologic, injection, and embolization treatments; also, irradiation was tried to control local recurrence [17–23].

Injectable materials include steroids (methylprednisolone acetate). Steroid injection is not recommended in ABC because of its more active nature than simple cysts [21]. In addition, autogenous bone marrow aspirate and demineralized bone matrix were used to stimulate cyst

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healing, as the graft provides a scaffold for osteoconduction, as well as using the osteoinductive and osteogenic properties intrinsic to the cyst to help healing of it [12,14,21].

Chemical adjuvants such as phenol, ethanol, hydrogen peroxide, and alcohol have been used to extend the margin of resection in benign aggressive bone lesions. The advantages of chemical adjuvant include lowering recurrence rates and necrosis [17–23]. The hypothesis behind the use of chemical adjuvant such as hydrogen peroxide is to create a balance between exclusive mechanical methods while limiting the higher toxicity of more aggressive adjuvants. Hydrogen peroxide has a direct cytotoxic effect on active cells through denaturation of protein, which controls the microscopic disease in the reactive zone after curettage has removed the gross tumor-like tissues [19,20,21].

Filling of the resulting cavity after removal of the pathological tissues and management of the microscopic disease by different means as mentioned is not necessary, and healing of the cavity can occur in a reasonable time [24].

Patients and methods

This study included 24 patients, 11 were male and 13 were female. Age ranged from 6 to 26 years with a mean age of 12.65 years. All were diagnosed radiologically as ABC. Eighteen cases were primary lesions and six were recurrent lesions. Five cases were diagnosed as solid variants of ABC and one was mixed pathology, whereas the others were ordinary ABCs. The anatomical sites affected were distal tibia in three cases, proximal tibia in three cases, and distal femur in one case, whereas proximal femur was the affected site in nine cases, pelvis in three cases, proximal humerus in three cases, and finally the scapula in two cases. The size of the lesion in relation to the original diameter was as follows: 14 lesions were expanding the bone (>100% of diameter), in six cases the lesion was less than the diameter of the affected bone, whereas in four cases the lesion was occupying the whole girth of the affected bone (Table 1).

All patients after been diagnosed with ABC, clinically and radiologically or after biopsy that was needed in five cases using incisional biopsy, were treated surgically by thorough curettage and normal saline lavage. In all cases, hydrogen peroxide (20%) was used routinely as an adjuvant lavage that was used as a continuous lavage for 3–5 min without interrupting this by saline wash. Care was taken to protect the surrounding important soft tissues from being thermally and chemically injured by the reacting hydrogen peroxide. No fillers were used to refill the resultant cavity, especially if the bone is mechanically stable. In nine cases, autogenous nonvascularized fibula was used as a strut graft to stabilize the weak cystic wall after curettage. The fibular graft was used as a complete part without shuttering it and is applied in a way that it is rigidly impacted inside the cavity. If it was difficult to impact it, minimal fixation methods were used to stabilize it, such as Kirschner wires. Immobilization by plaster cast was used in 11 cases, internal fixation was used in two cases,

Table 1 Statistical description of the case series

Variables	Mean (range) or *n* (%)
Age (years)	12.65 (6–26)
Sex	
Male	11 (45.8)
Female	13 (54.2)
Previous treatment	
Primary	18 (75)
Recurrent	6 (25)
Type	
Usual	18 (75)
Solid	5 (20.8)
Mixed	1 (4.2)
Anatomical site	
Proximal tibia	3 (12.5)
Distal tibia	3 (12.5)
Proximal femur	9 (37.5)
Distal femur	1 (4.2)
Proximal humerus	3 (12.5)
Pelvis	3 (12.5)
Scapula	2 (8.3)
Size in relation to affected bone	
Expanding	14 (58.3)
?Diameter	6 (25)
Whole girth	4 (16.7)
Follow-up period (months)	25.1 (12–46)

Table 2 Operative data of the studied patients

	n (%)
Use of BG	
None	15 (62.5)
Fibular strut graft	9 (37.5)
Method of fixation	
Cast	11 (45.8)
KW	1 (4.2)
Locked plate	1 (4.2)
None	11 (45.8)
Time to weight bearing	
Immediate	9 (37.5)
<3 months	9 (37.5)
>3 months	6 (25.0)
Pathological fracture	
No	24 (100.0)

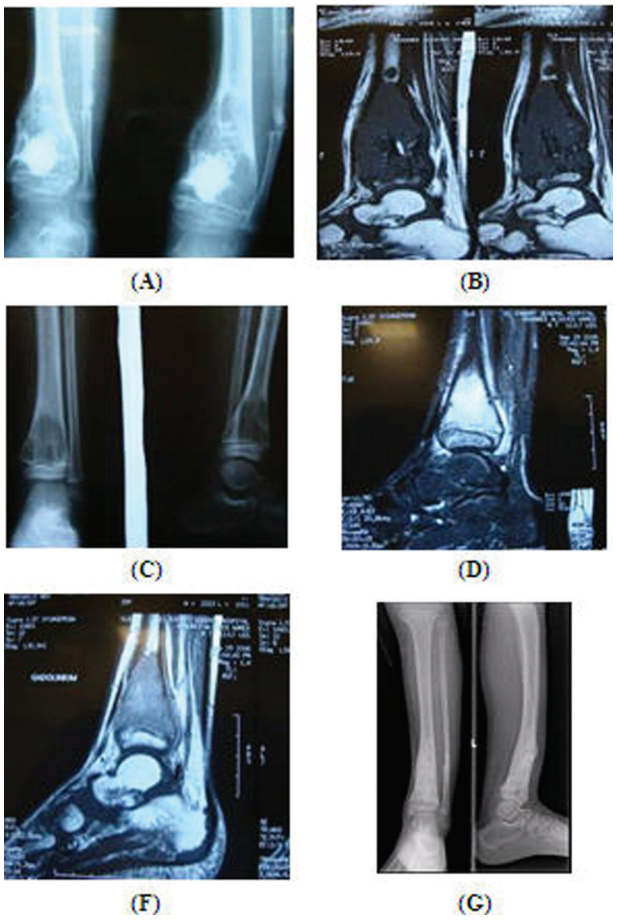
BG, bone graft; KW, Kirschner wires.

one by Kirshner wire and the other by proximal femoral locked plate in a case presented as a pathological fracture on top of a recurrent lesion. All patients were followed up regularly by radiological assessment depending mainly on radiography, but in some cases follow-up computed tomography scan was performed to asses refilling of cavity. Cast was removed when a radiological healing was noticed, which took an average time of 8–10 weeks, being longer in lesions affecting the proximal femur (Table 2).

Informed consent has been taken from the parents of the patients included in this study.

The protocol of this study has been approved by the Ethical Committee of the Faculty of Medicine, University of Alexandria, Egypt.

Figure 1

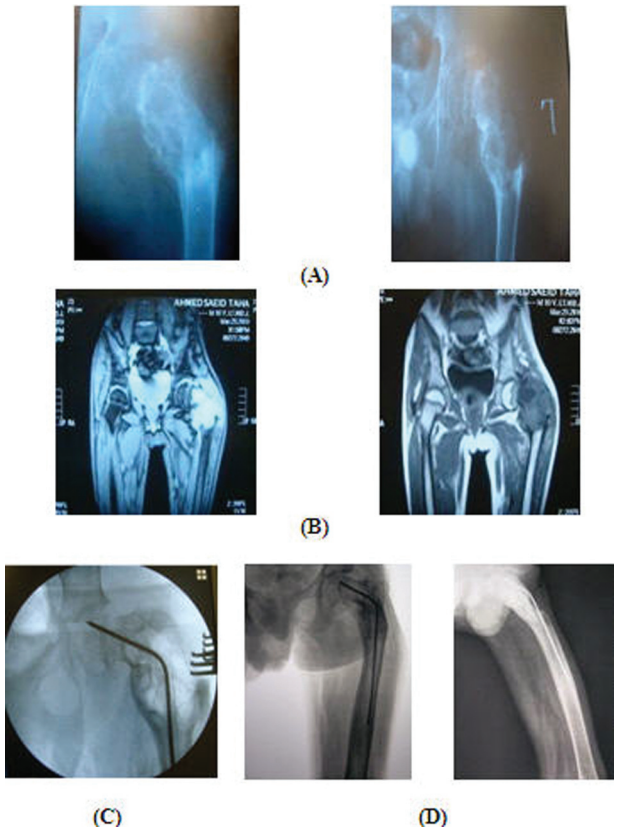


Radiological presentation of a case of recurrent solid aneurysmal bone cyst (ABC) of the distal tibia in a 9-year-old boy. Radiography of distal tibial recurrent cystic lesion that recurred 6 months after being surgically treated by curettage and mixed bone grafting (a). MRI of the same lesion shows skip like-lesion, so biopsy was taken to exclude malignancy and showed solid ABC (b). Radiography and MRI of the same case before any surgical interference the lesion shows marked edema in T_2 sequence of the MRI (c, d, f). Radiography after 18 months of follow-up, after second surgery where thorough curettage and hydrogen peroxide lavage were done, shows almost complete healing and consolidation of the lesion (g).

Results

The mean clinical follow-up was 25.1 months (range: 12–46 months). Functional assessment was performed at the most recent follow-up visit including surgical-related complaints and physical examination. All lesions were completely healed radiologically with full functional recovery, except in one case that was a recurrent proximal femur case for the third time before presentation who suffered from Trendelenburg gait because of coxa vara deformity of the proximal femur (Figs 1 and 2). Time to full weight bearing in cases of lower-limb lesions was 3 months in nine cases and more than 3 months in six cases. Time to full weight bearing was longer in cases of big cysts, especially in cases with proximal femur affection. Autogenous fibular grafts were used in nine cases; in these cases, the fibula was completely incorporated in the recipient site within 6 months after the surgery, but it took longer times to disappear completely. At the end of the follow-up period, we could not notice any evidence of local recurrence in any of the cases. Knowing that this study included different types of aneurismal bone cystic lesions, primary classic lesions, primary solid

Figure 2



Radiography and MRI of a recurrent aneurismal bone cyst of proximal femur for the third time (a, b). Intraoperative picture while the strut fibular graft is fixed by Kirschner wires (c). Radiography at 2 years of follow-up with complete healing of the cyst and complete incorporation of the fibular graft (d).

variants, and recurrent lesions of both subtypes and that all those lesions were treated by thorough curettage and hydrogen peroxide lavage as an adjuvant, there was no local recurrence in any of the cases until the last follow-up. In addition, all lesions healed without pathological fracture until the end of the follow-up period.

Discussion

The mean age of the affected patients in this study was12.65 years, which means that ABC was common in adolescents. In addition, there was slight predilection toward females (54% of cases). These findings match with those of some other studies [17,25,26]. This study included six cases who presented with recurrent lesions, two of whom had two previous recurrences before presentation. In addition, a rare type of ABC was diagnosed in five cases: two of them were recurrent, which is solid variant of ABC. All the five cases were treated the same way as other lesions, but the significance of those lesions was in their diagnosis and differential diagnosis, as two of them were diagnosed as osteosarcoma [27]. Because of unclear pathoetiology and the unexpected biological behavior of these lesions, several methods of treatment have been tried to control local recurrence ranging from just scratching of the lesion to en-bloc resection passing through curettage with or without refilling the resultant cavities; some of these methods succeeded in lowering the recurrence rate but not preventing it [17–22]. In a review of the literature of some series, the recurrence rate of the 690 ABCs treated with curettage ±bone graft was 31% [14]. On account of the high risk of recurrence after curettage alone, several authors used various forms of adjunctive therapy, with curettage to limit local recurrence such as phenol, and cryotherapy using liquid nitrogen and alcohol [17,21], with variable results and reports about their effect. Sclerotherapy and selective arterial embolization also was tried to control the hemodynamics of the disease either as a curative sole line of treatment or as an adjuvant to surgery [18,22].

In this study, hydrogen peroxide with a concentration of 20% in a continuous lavage for 3–5 min was routinely used as an adjuvant after curettage. It is believed that hydrogen peroxide has both local thermal effect and also chemical effect on the microscopic base. The use of hydrogen peroxide as an adjuvant treatment of nonmalignant active and aggressive bone tumors was rarely discussed in the literature [21]. To our knowledge, there are no reports in the literature on its use alone as an adjuvant after curettage of ABCs. Hydrogen peroxide has the advantages of being cheap and available at any hospital; also, it has no harmful effect on the skin or the local healthy tissues as reported with cryotherapy; besides, we claimed better results than similar studies using other adjuvants, as we have achieved excellent results with the use of hydrogen peroxide with no evidence of local recurrence in any case in this series that included recurrent cases and different subtypes of the disease until the end of follow-up (Table 3) [17,23,25,28–33].

In addition, we believe that there is no need to refill the cavity after curettage, as these cavities will heal in reasonable time as stated by Martti *et al.* [24]. Therefore, no refillers were used neither autogenous bone graft nor bone substitues to pack the resultant cavities. In huge lesions that affected 100% of the affected bone or more, strut nonvascularised autogenous fibular graft was used aiming at internal stabilization of the bone [34]. This was done in nine cases; in these cases, the autogenous nonvascularized fibula was impacted inside the cavity in a stable position, and if it this could not be done minimal fixation was used to stabilize it. Osteosynthesis was used only in one case that presented with pathological fracture.

To conclude, in this prospective study, we treated primary ABC by thorough curettage and hydrogen peroxide lavage, and in some cases nonvascularized strut fibular graft was used. The follow-up proved no local recurrence until the last visit. Compared with similar studies, we claim better results [17,25,26,28–33]. However, longer follow-up may be needed to prove the success of the treatment without recurrence. Therefore, we believe that thorough curettage with (hydrogen peroxide 20%) lavage could be an effective method to control local recurrence after treatment of ABC.

Table 3 Percentage of local recurrence compared with similar studies that used different adjuvants and methods to control local recurrence

References	Total number	*n* (%)
Campanacci *et al.* [25]	161	24 (14.9)
Cole [28]	25	7 (28.0)
Farcetti *et al.* [29]	20	2 (10.0)
Freiberg *et al.* [30]	7	5 (71.4)
van Loon *et al.* [23]	10	3 (30.0)
Marcove *et al.* [31]	106	36 (34.0)
Nobler *et al.* [32]	33	9 (27.3)
Ruiter *et al.* [26]	105	32 (30.5)
Slowick *et al.* [33]	13	1 (7.7)
Schreuder *et al.* [17]	27	1 (3.7)
This study	24	0 (0.0)

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Conflicts of interest
There are no conflicts of interest.

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