

The Effect of Steroid in the Treatment of Simple Bone Cysts in Comparison with Autogenous Bone Marrow Injection

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ABSTRACT


Background: Simple bone cysts (SBC) are well-known lesions; however, there is currently no cure for them. Studies using a common treatment technique – steroid injection – reported results that were quite diverse from one another. The outcomes of patients with pathological fractures who were not on any treatment were evaluated in comparison to the steroid injection method. **Materials and Methods:** A total of 44 patients had steroid injection therapy (Group – I) and 38 were treated with autogenous bone marrow injection (ABMI). For comparisons, Capanna’s plain radiographic evaluation criteria were applied, and magnetic resonance imaging (MRI) was utilized. The outcomes were graded in accordance with MRI and X-ray findings. **Results:** The first and most important finding was that the majority of ABMI patients responded well following their initial injection. We discovered that the majority of patients fell within the range of 5 months–1 year, taking into consideration the time between the start of conservative treatment and the mechanical repair of the cyst (CI lower than 3 and cortical width lower than 2 mm). **Conclusion:** Failure after a steroid injection is possible, and healing before the third injection only rarely happens, ABMI is a straightforward, cost-free procedure that works on both active and dormant cysts, and in the majority of cases, after the initial injection, certain symptoms of healing appear.

Key words: Autogenous bone marrow injection, simple bone cyst, steroid injection

INTRODUCTION

The proximal femur and proximal humerus are the most frequently affected bones by the simple bone cyst (SBC), which is the most frequent benign lytic bone lesion in children. A tumor-like lesion of unclear origin, the SBC, also known as unicameral bone cyst, is linked to a local disruption of bone development. The lesion seems to be reactive or developing rather than a real tumor, while the pathophysiology is yet uncertain.^[1] The single cavity that makes up the SBC is lined with a membrane that varies in thickness and is filled with a clear, yellow fluid. About 3% of all primary bone lesions are this one. Only two SBCs have been cytogenetically studied thus far, and they revealed intricate clonal rearrangements involving chromosomes.

Males are more likely than females to develop SBC, which is often discovered in the first two decades of life. Teenagers account for about 65% of these cysts, with another 20% developing during the first 10 years of life. SBC is almost always found in the proximal diaphysis of the humerus and femur, particularly in children under the age of 17.^[2] The adjacent joint may experience discomfort, swelling, or stiffness as a symptom. A pathologic fracture is frequently the lesion’s first symptom. In fact, this is the SBC consequence that affects 66% of patients the most frequently. The frequency of involvement in unusual places, such as the talus, calcaneus, and ilium, rises dramatically in older patients. Although there may be cortical expansion and frequent cortical thinning, the SBC’s breadth does not surpass that of the adjacent plate. Unless there has been a pathologic fracture, there is no periosteal reaction. Conventional radiographs

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work well for making diagnoses; conventional tomography and computed tomography are only occasionally employed in circumstances when the diagnosis is unclear.^[3] The goal of treating SBC is to avert any complications that could arise and to shorten any time that physical activity is restricted. A wide range of therapeutic techniques, from observation to subtotal resection, have been suggested, but the best course of action is still unknown.^[4]

MATERIALS AND METHODS

Eighty-two consecutive SBC patients were treated from 2012 to 2019 using percutaneous autogenous bone marrow injection (ABMI) and steroid injections (methylprednisolone). Based on the aspiration specimen's histological analysis and typical radiographic appearance, the diagnosis was confirmed. There were 38 girls and 44 boys. At the beginning of treatment, the average age was 10.6 ± 1.4 years (range 5–15). The humerus had 48 cases, the radius had 7, the Vth metacarpal had 2, the femur had 11, the peroneus had 7, the tibia had 6, and the calcaneus had 1. Twenty-five multiloculated and 57 uninoculated cysts were present. Cyst size is determined by dividing the length of the cyst by the width of the neighboring physis. This definition enables direct comparisons between sizes without the need for age-related correction factors. All cysts in this investigation had a mean size of $1.65 \text{ cm} \pm 0.35$. By assessing the cortical thickness and the Kaelin and McEwan cyst index, the fracture risk was assessed. The cyst index is calculated by dividing the cyst area by the diaphyseal diameter squared. When the index and cortical width are both <3 , a cyst is mechanically thought to be less likely to fracture. The treatment for SBC patients who suffered a pathologic fracture without fragment displacement was a straightforward cast immobilization. When cysts remained intact or when a fracture healed, ABMI and steroid injections were administered. The sole difference between the ABMI and steroid injection techniques is the substance used for the injection. In our institution, we used the ABMI technique described below:

- While the patient is completely asleep, we use fluoroscopic guidance to visualize the cystic cavity
- Into the proximal and distal poles of the cystic chamber, numerous bone needles are inserted
- Without using force, the cyst cavity was removed, and the fluid was sent for histological analysis
- Normal saline was used to properly rinse out the cavity
- To identify whether the cyst was uninoculated or multiloculated cystogram with contrast material was done
- Bone marrow aspiration needle was used to remove the bone marrow from the iliac crest.

The presence of LDH, which was 2–3 times higher than the typical values observed in blood, was emphasized in the liquid that was recovered from the cystic cavity. In addition,

the alkaline phosphatase level was elevated by more than 10 times the typical serum level.

RESULTS

To quantify the outcomes, we took into account the frequency of recidivated cysts, the amount of time needed for complete healing, and the number of injections required for steroid injection and ABMI. Precocious healing (occurring before the age of one from the start of the treatment) was noted in cases with latent cysts, and multiple surgical treatments were required in situations where healing took a lengthy time.

From a conservative stance, the measurement of the outcomes in the case of steroid injection was also based on the quantity of injections required to achieve healing. Patients were allocated as follows: One injection resulted in 0 instances, two injections resulted in 11 cases, three injections resulted in nine cases, and four injections resulted in 24 cases. Five individuals underwent surgery since they showed absolutely no response to the treatment. The majority of the patients with ABMI had a positive response since their first injection, which was the first and most crucial conclusion. According to case division and accounting for the gap between the introduction of conservative treatment and the mechanical healing of the cyst (CI lower than 3 and cortical width lower than 2 mm), we found that the majority of patients fell within the range of 5 months to 1 year. Most of the instances that took longer to recover belonged to the cast immobility group.

DISCUSSION

Only when conservative care fails and there is a displaced pathological fracture do we advise such therapies. The

Table 1: Comparison of the baseline parameter between the two groups

Variable	Steroid group (Group – I)		ABMI (Group – II)	
	Success: n=24	Failure: n=20	Success: n=29	Failure: n=9
Mean age	10.2±1.3	9.2±1.7	11.8±1.4	19.6±1.2
Add fractures	17	19	12	8
Activity				
Active	5	9	2	5
Latent	8	3	4	8
X-ray				
Healed	5	0	20	0
With residual	19	0	9	0
Recurrent	0	9	0	3
Persistent	0	11	0	6

ABMI: Autogenous bone marrow injection

Table 2: Success rates comparison based on MRI findings

Rades	Steroid group		ABMI group		P-value
	Success: n=24	Failure: n=20	Success: n=29	Failure: n=9	
	Number	Percent	Number	Percent	
Healed	6	0	23	0	0.03
With residual	18	0	6	0	0.04
Recurrent	0	10	0	5	0.06
Persistent	0	10	0	4	0.06

ABMI: Autogenous bone marrow injection, MRI: Magnetic resonance imaging

conservative approach was immobilizing the pathological fracture in the upper limb simply with a cast, without ABMI or steroid injections, or fragment displacement. Only in cases where a cyst developed without a pathological fracture or following the healing of a prior pathological fracture that did not result in cyst healing were the last two treatment options used. Cases with a pathological fracture that was localized at the level of the upper limb were successfully treated with conservative measures, which led to the cyst and fracture both healing. Comparatively to ABMI, which had a 100% incidence of lesion healing even after the first injection, we found seven cases with the steroid injection that had no reaction.^[5-7]

There is still no agreement on the best way to treat SBCs, because their etiopathogenesis is yet hypothetical. The idea of venous drainage deficiency developed by Cohen *et al.* is one of the widely recognized theories, despite the fact that various causes are attributed to its origin.^[8] According to this view, there is a fluid discharge that is particularly transudate in character as well as a venous return blockage with an unexplained cause. Interleukin-1, prostoglandin-E2, and gelatinase, among other chemicals that increase osteoclastic activity, are present in this fluid. There are two critical components to pathogenesis. The first are substances contained in cyst contents that promote bone absorption, and the second is a rise in intracystic pressure brought on by persistent fluid secretion. There are many things that can influence how cysts recover.^[9-11]

Numerous characteristics were identified and in-depth research were conducted on them, including the patient's age, the cyst's volume, its location, how far it was from the epiphyseal line, the patient's gender, and even the type of treatment used. On any component or factors that might have an impact on the outcomes, nevertheless, no agreement could be obtained. In our investigation, no statistically significant difference between the healed and unhealed groups in terms of age, gender, volume, proximity to the physical line, or type of therapy was discovered in either group.^[2,12]

Important elements that play a role in the pathophysiology of this lesion include the existence of fluid secretion, the

increase in pressure brought on by the increased fluid, and the cytokines that the fluid carries. In addition to venous obstruction, we think that when the amount of fluid that is continuously released reaches a particular level, the arterial circulation is also impacted, and both of these factors are crucial in the pathophysiology of this disease. The condition becomes "intraosseous compartment syndrome" in the end. The pathological fracture and the lesion perform a spontaneous "faciotomy" surgery. By reducing the intrusive process, it will complete the first step in the therapeutic process. The cortical hole that is opened and the fluid withdrawn after the steroid injection procedure result in a reduction in intracystic pressure.^[13-15]

CONCLUSION

Failure after a steroid injection is possible, and healing before the third injection only rarely happens, ABMI is a straightforward, cost-free procedure that works on both active and dormant cysts, and in the majority of cases, after the initial injection, certain symptoms of healing appear.

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