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Case Report

Cholesterol granuloma presenting as a large calcaneal cyst: A case report

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Abstract

Cholesterol granuloma (CG) is a rare chronic inflammatory lesion that typically affects the temporal bone. Involvement of the appendicular skeleton is extremely rare, with only a limited number of cases described in the literature. We report a unique case of CG occurring in the calcaneus. We present a 23-year-old female amateur athlete with a 6-month history of pain and swelling of the left calcaneus following physical activity. Imaging indicated a large calcaneal cyst, and the patient underwent curettage and bone grafting. The histopathological examination revealed CG, making this the first reported case involving the calcaneus. This case highlights the need to include this rare disease in the differential diagnosis of cystic bone lesions.

Level of evidence IV; Case series; Therapeutic studies - investigating the results of treatment.

Keywords: Calcaneus; Cysts; Rare diseases; Granuloma.

Introduction

Calcaneal bone cysts are usually identified as incidental radiologic findings and rarely require surgical intervention[1]. Cholesterol granulomas (CG), although known as usual lesions of the petrous part of the temporal bone, have also been reported in the femur, the radius, and the humerus[2,3]. We report a unique case of CG in the calcaneus along with a review of this rare pathology.

Case description

A 23-year-old female amateur athlete presented with a 6-month history of pain and discomfort in her left calcaneus during sports activities. A lateral radiograph of the calcaneus revealed a well-defined cystic lesion within the calcaneal body, with benign radiographic features and a size greater than that typically seen in simple bone cysts (Figure 1). Computed tomography (CT) imaging revealed a large fluid-filled cystic lesion (46 × 29 × 22 mm) with sclerotic yet thin cortical margins (Figure 2). Magnetic resonance imaging (MRI) with gadolinium contrast demonstrated minimal peripheral enhancement and absence of fatty tissue, findings consistent with a benign lesion (Figure 3). To prevent a pathological fracture of the calcaneus, the patient was scheduled for surgery with a provisional diagnosis of an atypical aneurysmal bone cyst based on lesion size and expansile morphology. A standard lateral approach to the calcaneus was performed, and a cortical window of 20 × 20 mm was elevated and attached to the soft tissue flap (Figure 4). Following evacuation of chocolate-brown fluid from the cyst, a yellow-grey soft-tissue mass measuring 20 × 10 mm was identified, loosely attached to the cavity wall, and was sent for microbiological culture and histopathological examination. The cyst cavity was initially treated with

Study performed at the 251 Hellenic Air Force General Hospital, Athens, Greece.

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curettage and alcohol application and then filled with a mixture of packed autologous iliac crest bone and allograft bone. The cortical window was repositioned by suturing the full-thickness skin flap. Histopathological analysis identified the lesion as a CG (Figure 5). The patient's postoperative recovery was unremarkable, and she ambulated non-weight-bearing in a cast for six weeks, after which she progressed to a walking boot for another six weeks. At 12 weeks, the grafted area had healed sufficiently, both radiologically and clinically, to allow activities of daily living and initiation of physiotherapy for subtalar motion. A full return to sports was possible at six months, accompanied by notable radiological improvement (Figures 6 and 7). The study was approved by the Ethics and Research Commission of the Institution, and informed consent was obtained from the patient for publication of this case report and accompanying images.

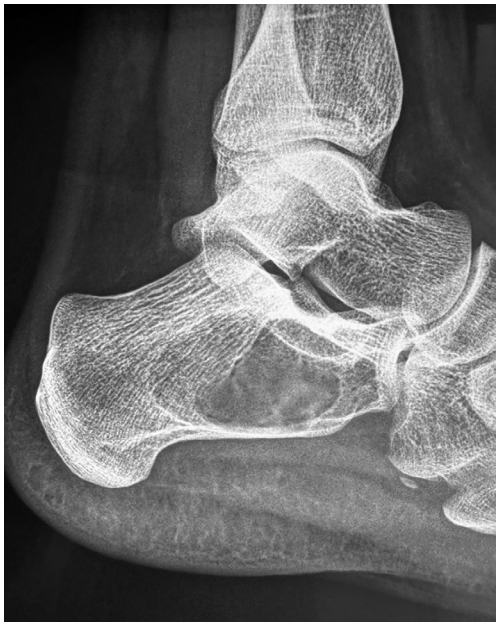

Figure 1. Lateral radiograph of the calcaneus demonstrating a well-defined cystic lesion within the body of the calcaneus.

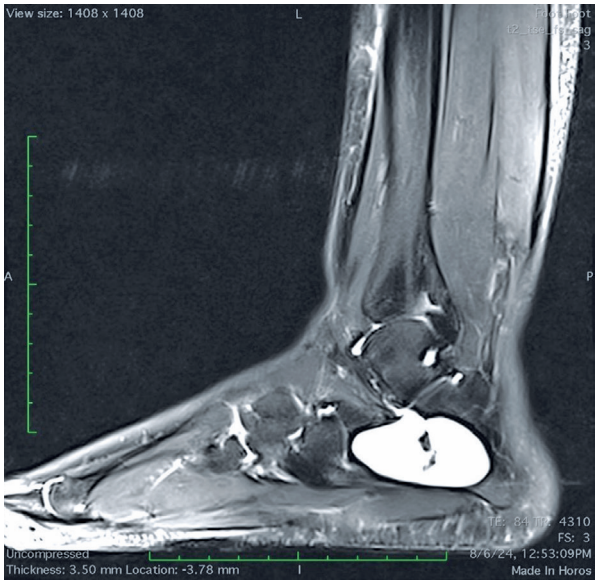

Figure 3. A magnetic resonance imaging with gadolinium contrast showing minimal marginal uptake and no fat tissue.

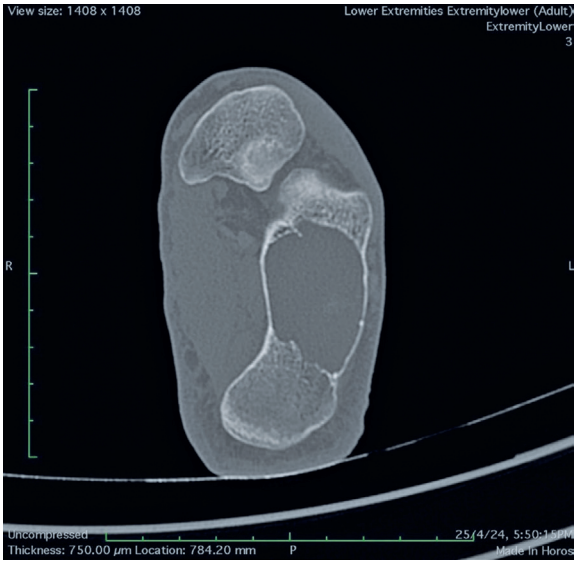

Figure 2. A computed tomography scan revealing a large fluid-filled cystic lesion (46x29x22mm) with a sclerotic but thin cortical margin.

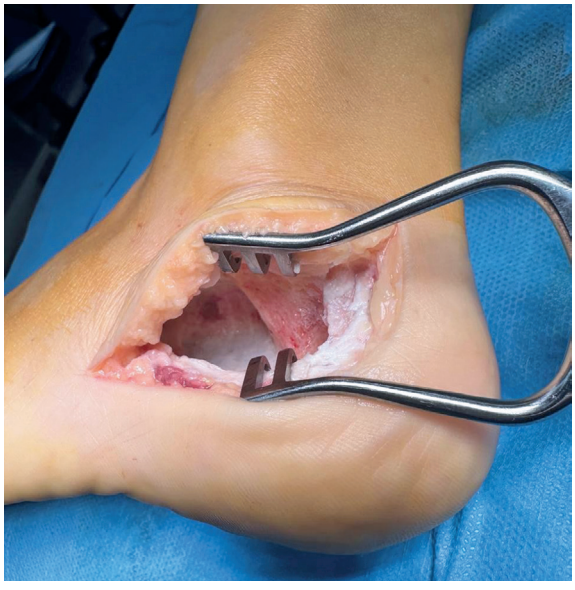

Figure 4. Image taken during the surgery that depicts the cavity after the cyst curettage and alcohol irrigation.

Discussion

Cholesterol granulomas are benign, expansile cystic lesions characterized by chocolate-brown fluid content and a surrounding granulation tissue reaction to cholesterol crystals[3]. Initially described by Manasse in 1894, the nomenclature of these lesions has evolved to use the term "cholesterol granuloma," although alternative labels such as cholesteatoma and xanthomatosis have also been used[4]. Cholesterol granuloma is more common in males, and although predominantly associated with the mastoid process, middle ear, and the temporal bone, it has also been reported in various locations, including the central nervous system, the orbital cavity, the paranasal sinuses, the thyroid gland, the mediastinum, the ovaries, the peritoneum, and the breast[5,6]. Macroscopically, the lesion presents as yellowish-brown, soft, or sandy-textured, well-demarcated masses, in which vascular structures are frequently observed[5,6]. The hallmark histological finding is cholesterol crystals encased within fibrous granulation tissue and surrounded by foreign-body multinucleated giant cells[5,7]. Immunohistochemistry has demonstrated increased expression of angiogenic markers, such as VEGF and CD34, reflecting active vascular proliferation within these lesions[6]. There is no clear correlation between CG and elevated serum cholesterol levels[3,8]. The pathogenesis of CG remains poorly understood, with various hypotheses proposed[2,5]. The obstruction vacuum theory attributes lesion formation to negative-pressure-induced hemorrhage following impaired ventilation[3]. Alternatively, the exposed marrow theory suggests that trauma releases marrow lipids, initiating cholesterol crystal accumulation and a granulomatous immune response, which may be perpetuated by neovascularization and a self-sustaining hemorrhage-inflammation cycle[6,8]. In the present case, the patient's young age and athletic profile imply repetitive calcaneal loading and possible microtrauma, leading to intraosseous hemorrhage, subsequent cholesterol crystal deposition, and foreign body granulomatous reaction. In addition, contributions from perlecan-mediated trapping of oxidized

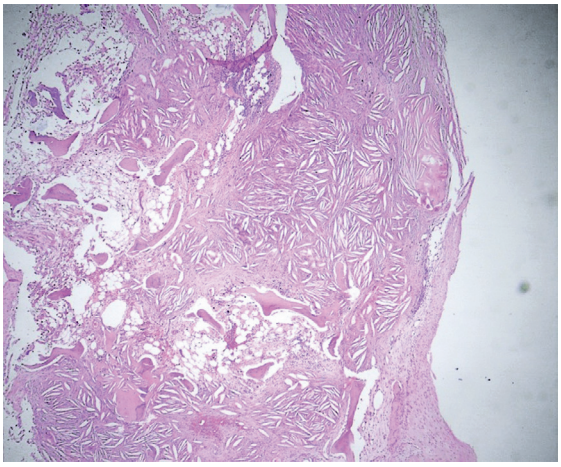

Figure 5. Histological image stained with hematoxylin and eosin showing numerous needle-shaped cholesterol clefts surrounded by inflammatory cells and bone pieces.

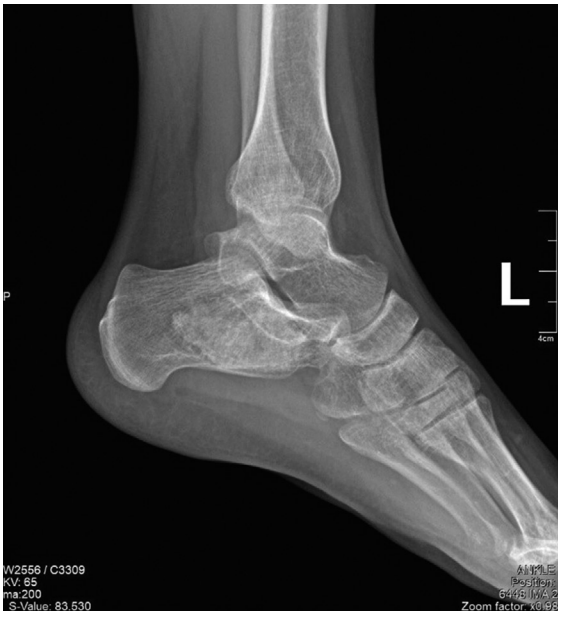

Figure 6. Six-month postoperative lateral radiograph demonstrating significant radiological improvement.

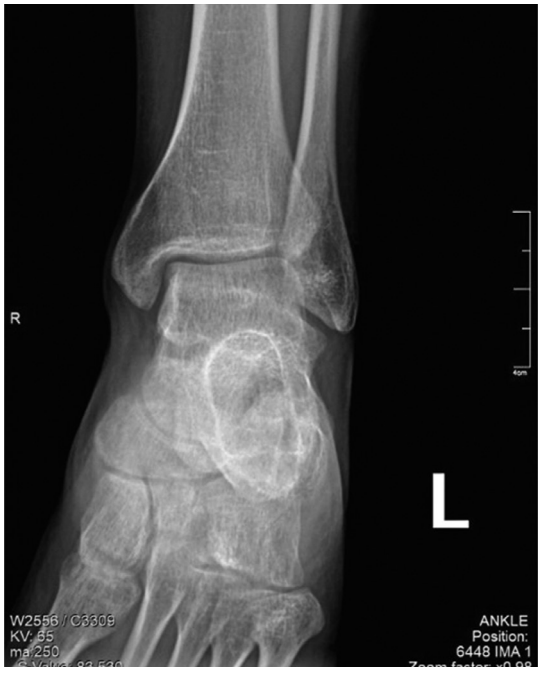

Figure 7. Six-month postoperative anteroposterior radiograph demonstrating significant radiological improvement.

low-density lipoproteins within granulation tissue may further amplify cholesterol crystal formation[4]. Due to the subtle progression and mild symptoms, differential diagnosis can be challenging[1]. Simple bone cysts typically present as centrally located, well-defined lucent lesions in younger patients, usually without cortical expansion or internal septations[1]. Aneurysmal bone cysts are more aggressive, characterized by expansile remodeling, cortical thinning, internal septations, and fluid-fluid levels on MRI[1,3]. Giant cell-rich lesions, including giant cell tumors, often demonstrate locally aggressive bone destruction and occasional soft-tissue extension[3]. Xanthomatous lesions, histologically, may resemble CGs but are commonly associated with lipid metabolism disorders and show more diffuse marrow infiltration[5]. Malignant tumors of the calcaneus are uncommon and typically present with ill-defined margins, cortical destruction, and periosteal reaction, features not characteristic of CG[1,3]. Radiographically, CG are typically described as well-demarcated lytic lesions with regular margins and minimal reactive sclerosis[1]. In the present case, lateral radiographs demonstrated a benign appearing calcaneal cyst that was notably larger than expected for a simple bone cyst. Computed tomography imaging revealed a large fluid-filled lesion with thin but sclerotic cortical margins, smooth erosion, and no aggressive features, consistent with the reported CG morphology[4]. Magnetic resonance imaging findings further supported this diagnosis, showing minimal peripheral enhancement after gadolinium administration and the absence of fatty components, consistent with the characteristic high-signal cystic nature of CG and with the limited enhancement patterns described in the literature[2,4]. Although not performed in this case, conventional angiography has been described as a useful adjunct for evaluating lesion vascularity and guiding preoperative embolization when significant intraoperative bleeding is anticipated[9]. In conclusion, the imaging profile favored CG over alternative cystic or aggressive lytic lesions. In small lesions, bone grafting has been effective, whereas in more extensive lesions, bone cement implantation and internal fixation have been used[3]. Overall, the goal of surgical management is complete excision with minimal invasiveness, along with improvement in symptoms[10]. Postoperative outcomes for CG are generally favorable, with minimal recurrence reported in the literature[2,3].

This case contributes to the limited literature on cholesterol granuloma of the calcaneus and emphasizes the importance of considering this rare benign entity in the differential diagnosis of calcaneal cystic lesions, particularly in young and active patients. Accurate recognition relies on histopathological confirmation, as imaging findings may mimic those of other benign cystic lesions. Curettage with bone grafting was an effective approach, supporting its use as a reliable management option for cholesterol granuloma.

Authors' contributions: Each author contributed individually and significantly to the development of this article: AB *(https://orcid.org/0009-0001-1279-0818) Conceived and planned the activities that led to the study, interpreted the results of the study, participated in the review process, performed the surgeries, data collection, performed the bibliographic review, formatting of the article, survey of the medical records, and performed the clinical examination; SK *(https://orcid.org/0009-0007-2379-0745), MR *(https://orcid.org/0009-0009-7452-7861), and EC *(https://orcid.org/0009-0009-4550-2024) Interpreted the results of the study, participated in the review process, performed the bibliographic review, and formatting of the article; ZA *(https://orcid.org/0009-0006-8723-8071) Performed the surgeries, data collection, survey of the medical records, and performed the clinical examination; OP *(https://orcid.org/0000-0001-5449-7436) Conceived and planned the activities that led to the study, interpreted the results of the study, participated in the review process, performed the surgeries, data collection, survey of the medical records, and performed the clinical examination. All authors read and approved the final manuscript. *ORCID (Open Researcher and Contributor ID)

References

1. Hughes JD, Jacob JT, Garrity JA, Salomao DR, Link MJ. Orbitofrontal Cholesterol Granuloma: Four Case Reports and a Systematic Review of the English Literature. World Neurosurgery. 2016 Mar;87:355–61.
2. Jin M, Wu Q, Miao B, Jin J, Gao C, Xu X, et al. Multiple cholesterol granulomas of the breast: A case report and review of the literature. Medicine. 2023 Feb 22;102(8):e33084.
3. Shrirao N, Mukherjee B, Krishnakumar S, Biswas J. Cholesterol granuloma: a case series & review of literature. Graefe's Archive for Clinical and Experimental Ophthalmology. 2016 Jan 6;254(1):185–8.
4. Aoki T, Watanabe H, Aoki J, Fukuda T, Shinozaki T, Sano K, et al. Intraosseous cholesterol granuloma of radius showing a lamellar structure on MR images: a case report. Radiation medicine. 2001;19(4):203–8.
5. Hao S, Dong S, Li H, Liu S, Chen H, Zhang Z. Case report: Cholesterol granuloma of femur. Frontiers in Surgery. 2022 Dec 7;9.
6. Iannella G, di Gioia C, Carletti R, Magliulo G. Tympanomastoid cholesterol granulomas: Immunohistochemical evaluation of angiogenesis. The Laryngoscope. 2017 Aug 3;127(8).
7. Eisenberg MB, Haddad G, Al-Mefty O. Petrous apex cholesterol granulomas: evolution and management. Journal of Neurosurgery. 1997 May;86(5):822–9.
8. Isaacson B, Kutz JW, Roland PS. Lesions of the Petrous Apex: Diagnosis and Management. Otolaryngologic Clinics of North America. 2007 Jun;40(3):479–519.
9. Nam G, Singer TM, Lourenco AP, Wang Y. Cholesteroloma of the breast: A 10 year retrospective review of 79 cases with radiology correlation. The Breast Journal. 2019 Nov 6;25(6):1177–81.
10. Friedmann I, Graham MD. The ultrastructure of cholesterol granuloma of the middle ear: an electron microscope study. The Journal of Laryngology & Otology. 2002 Nov 8;116(11):877–81.