

CALCANEAL CYSTS

A Radiological and Anatomico-Pathological Study

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A radiological and anatomico-pathological study of 17 cases of calcaneal cysts in young patients without other known affections is documented.

There are two essential histological characteristics of the fibrous wall lining the cysts: (1) hemosiderin deposits together with cholesterol and an associated giant cell reaction, which can be attributed to previous hemorrhages; (2) newly formed bone – similar to that observed in solitary cysts of the humerus and femur – applied to preexisting trabeculae which forms a bony wall explaining the typical radiological picture.

These uncommon cysts may be the evolution of purely local hemorrhages in the trigonum calcis.

Key words: bone cysts; calcaneum; intra-osseous hemorrhage; cholesterol granuloma

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Calcaneal cysts are quite uncommon and since Smith's observation (1930) only about 100 cases have been reported in the literature. Most of these were asymptomatic.

Seventeen surgically removed calcaneal cysts were studied and this report deals with their radiological and pathological appearances.

MATERIAL AND METHODS

Each of the 17 subjects (15 men and 2 women) with ages ranging between 10 and 37 years (average 23 years, s.d. 5.35) had a unilateral cyst of the anterior calcaneus. Five were situated on the right and seven on the left. In five cases the side was not mentioned.

Four patients complained of moderate heel pain. In the remaining cases the cyst was an accidental radiological finding (often after a minor trauma). A surgical curettage was performed in all cases.

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The material, fixed in 10 per cent formalin, was paraffin embedded, and sections were stained with hematoxylin-eosin (HE), van Gieson, Gomori's silver impregnation and Pearl's stain. In one case, lipids were looked for with the Oil red O stain in gelatin embedded tissue.

OBSERVATIONS

Radiology

The radiological picture in each case was that of an anterior calcaneal lacuna with an almost trapezoidal form, sometimes circumscribed by a thin border of condensed bone (Figure 1). On two occasions, axial views revealed a lateral position.

Pathology

Histologically, the material was made up essentially of a wall of fibrous scar tissue (Figure 2) containing varying quantities of hemosiderin (Figure 3a). In seven cases cholesterol was noted (directly with Oil red O or indirectly with HE or van Gieson) within histiocytes or in the form of crystals provoking a foreign body giant cell reaction

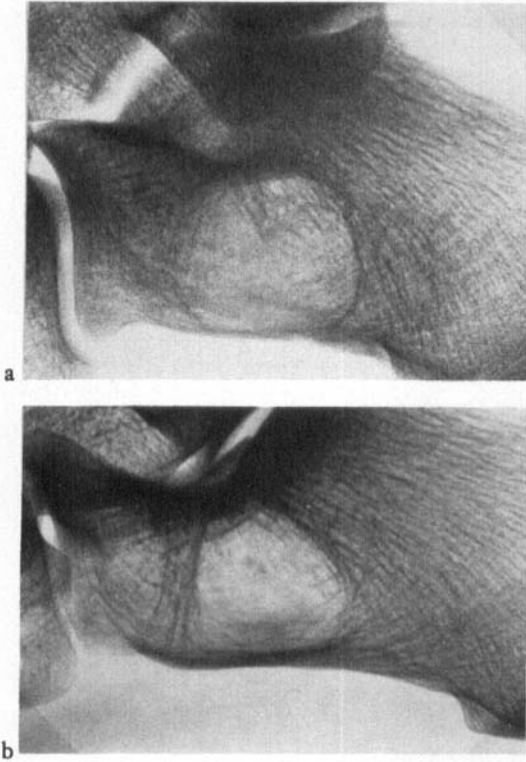


Figure 1. X-ray of anterior calcaneal cyst (lateral view - $0.9\times$). (a) Cyst surrounded by a well-defined bony border (T. 12634/67 - 22 year old male). (b) Cyst with a "leafy" wall (T. 5093/66 - 37 year old male).

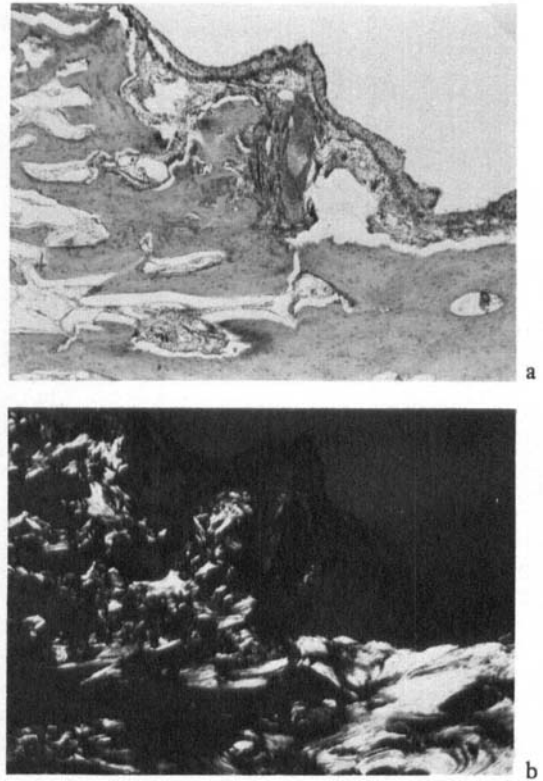


Figure 2. Histological appearance of the cyst wall (T. 4081/76 - HE stain - $6\times$). Lower right: compact lamellated bone. To the left: mostly lamellated remodelled bone (and in places woven bone). Superior border of this bony wall is covered by a layer of connective tissue which lines the cyst cavity. (a) Normal light. (b) Polarized light.

(Figure 3b). In three cases the fibrous material was intermingled with newly formed coarse fibrillar osteoid tissue. This was either typically "reparative" (Figure 4) or composed of flakes with a peculiar woven appearance (Figure 5). In two of these cases the fibrous osteoid tissue was connected to partially remodelled preexisting trabeculae (Figures 2 and 4). The 14 remaining cases presented non-specific osteogenic and fibrous tissue, which could be due to variations in the quantity of the excised material.

Infectious or tumoral lesions as well as bone infarction were excluded on histological examination.

DISCUSSION

Our findings were compared to those described in the literature and from these comparisons a number of interesting points have arisen.

The average age in both series is comparable [20 years in the literature but with a greater variation ranging from 4 years (Kingsbery 1957) to 65 years (Denis 1965)]. There is definitely a male predominance, which was also present in our series. The cysts may be seen on either side with about equal frequency but bilateral cysts are rarely observed (Bachiocco & Leonessa 1968, Christman & Kopell 1961, Kingsbery 1957, Lentini 1967).

A history of trauma is found in approximately one out of ten cases. Only two reports from the literature mentioned the presence of fractured cysts (Aegerter & Kirkpatrick 1968, Malcapi & Turrini 1963).

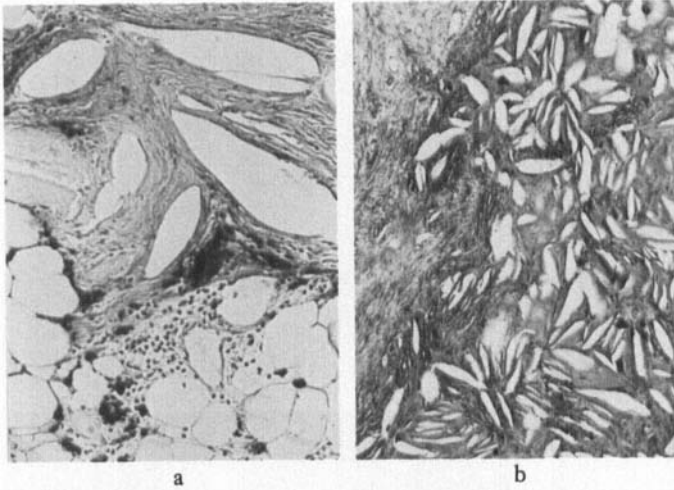


Figure 3. Detail of connective tissue portion of cyst wall (T. 12634/67). (a) Fibrous tissue with clefts of cholesterol crystals (upper half) near adipose tissue containing hemosiderin deposits (lower part). Pearl's iron stain (no counter stain of the nuclei) – 36 \times . (b) Granulation tissue with clefts of cholesterol crystals and giant cells (right side) joined to fibrous tissue (left border). van Gieson – 8 \times .

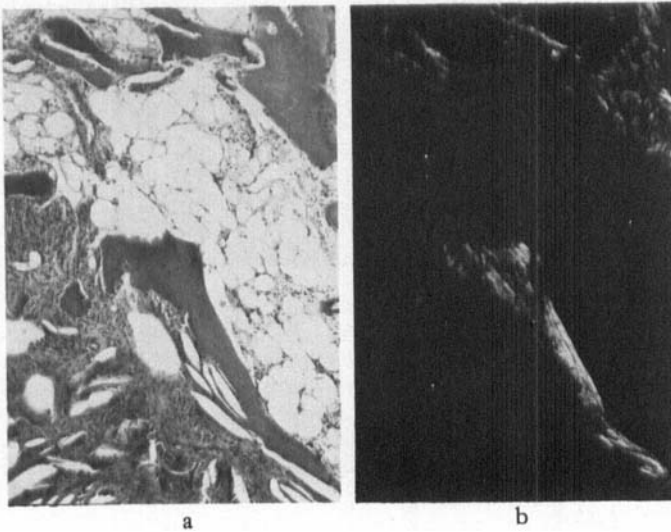


Figure 4. Detail of connective tissue external area of cyst wall (T. 12634/67 – HE – 13.5 \times). Lower left: granulation tissue with clefts of cholesterol crystals. Lower center: preexisting lamellated bony trabeculae. Top: newly formed woven bone. (a) Normal light. (b) Polarized light.

Pain is only present in one fourth of the cases and this correlates well with our series. Frequently the pain is accentuated by pressure and especially when walking. Swelling which has been noted by various authors was not noted in the present series. Radiologically, one case was considered as having healed spontaneously 21 years after diagnosis (Smith & Smith 1974).

In the literature, there are about 40 histologically proven cases described including one in a specimen from an amputated limb (Calcagni 1963). All of these cases showed fibrosis frequently accompanied by hemosiderin deposits, foam cells,

cholesterol crystals and a hemorrhagic, serous fluid in the cavity (Aegerter & Kirkpatrick 1968, Ayres & Cameron 1957, Bachiocco & Leonessa 1968, Palma & Venturini 1969).

Differential diagnosis

Evidence accumulated from the literature and from our own observations is sufficient for the recognition of an entity to be referred to as the "anterior calcaneal cyst", based on the characteristic radiological picture associated with the finding of cyst at surgery. Osteogenic scar tissue, hemosiderin pigment as well as cholesterol deposits seem to be the main histological characteristics.

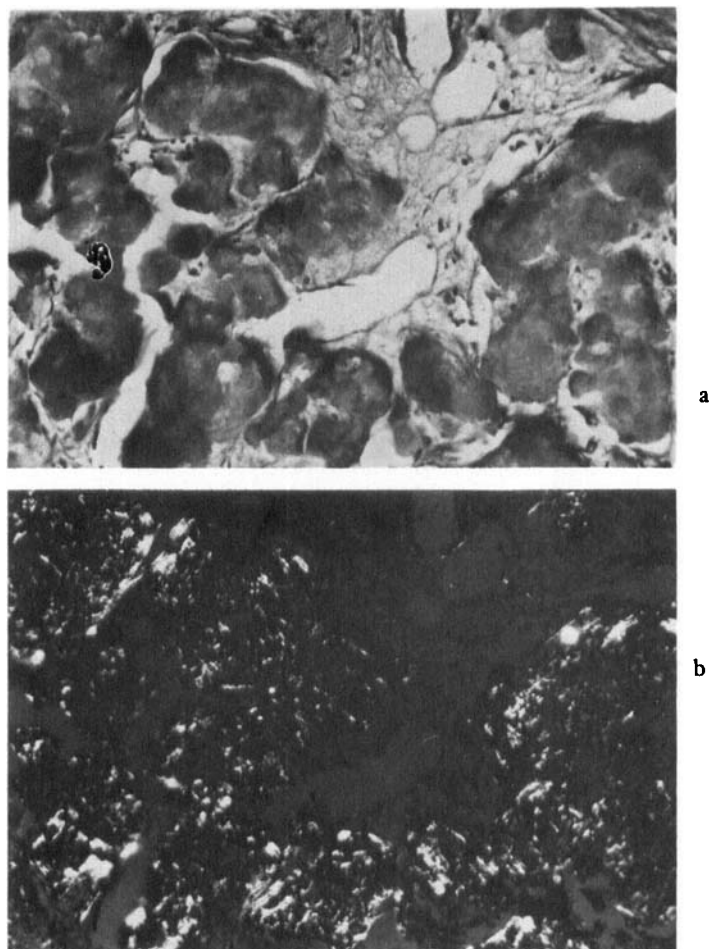


Figure 5. Osteoid flakes with a special woven appearance. Dilated capillaries in the intertrabecular spaces (T. 5278/74 - HE - 47 \times). (a) Normal light. (b) Polarized light.

These cysts should be differentiated from other calcaneal cysts and especially those in the posterior superior calcaneus which have been documented twice in the literature (Barbieri 1969, Christman & Kopell 1961). They should obviously be differentiated from erosive conditions of the calcaneus described in relation to xanthomatosis of the Achilles tendon (Sneider 1963).

Furthermore, they should not be confused with infectious and tumoral lesions which have different radiological appearances and can be found in any area of the calcaneus (Bonnet et al. 1968, Denis 1965). In fact, all infectious and tumoral (benign or malignant) lesions that may affect the skeleton have been

observed in this bone.

A calcaneal cyst related to an arthropathy such as described in a case of rheumatoid arthritis (Copeman 1955) is exceptional and must be integrated into the overall radiological findings. A radiological and anatomic study of a calcaneus, modified by an old Sudeck's dystrophy, has shown that this does not resemble a case of calcaneal cyst (Lagier & Van Linthoudt, in press).

It is also necessary to eliminate all of those cases presenting similar radiological pictures which do not have the anatomico-pathological criteria of a cyst, such as bone lipomas (Appenzeller & Weitzner 1974, Poussa & Holmstrom 1976).

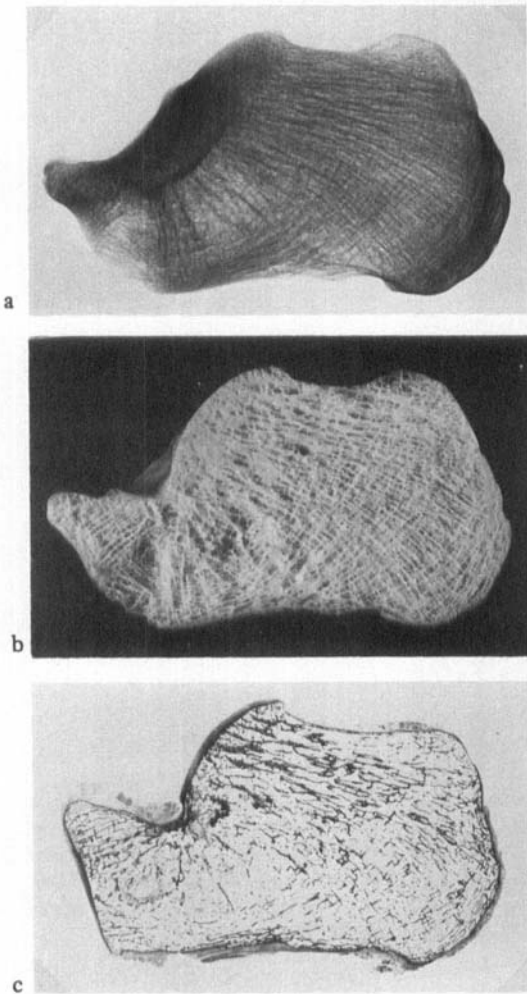


Figure 6. Normal calcaneus (A. 609/71 - 63 year old male - right side - 0.7 \times). (a) X-ray of the lateral half. (b) Macerated specimen corresponding to the preceding X-ray. (c) Medial parasagittal section (embedded in celloidin - HE stain). Bone marrow consists mostly of fatty tissue particularly in the trigonum calcis.

Pathogenesis and characteristics

From our observations three main characteristics explaining the pathogenesis of these cysts can be formulated.

(1) These cysts, because of their location, could be considered as a "deviation" of the normal anatomical pattern. It is known that the trabecular architecture of the calcaneus forms at this level the trigonum calcis

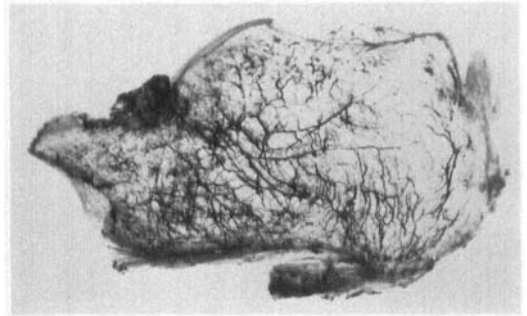


Figure 7. Arterial supply of normal calcaneus (T. 1369/77 - 60 year old male - left side - $\times 0.7$). Lateral parasagittal section. Arterial blood vessels are injected with Indian ink. Transparency of bone obtained by the Spalteholz technique.

delimited above by an arch of trabeculae whose structure is influenced by the stress of body weight and below by concave trabeculae situated against the corticalis which are affected by traction. Photo-elastic studies on models (Milch 1940; cited in Lentini 1967) have shown that this zone remains free from the mechanical strains affecting the neighboring areas. The interior of the trigonum contains fatty bone marrow; thus under normal conditions an anterior radiolucent area appears on the X-ray of a calcaneus and this may at times be accentuated, causing the pseudo-cystic images described by Sirry (1951) in 7.1 per cent of his series (Figure 6). These areas can be differentiated from true cysts by the fact that they are triangular in form and do not have a limiting bony wall.

(2) The histology showed that the bony wall of the cysts developed by an osteogenic metaplasia against the preexisting lamellated bone trabeculae and on the exterior surface of thin scarred connective tissue containing deposits of hemosiderin and cholesterol. It is well documented that this type of scarred connective tissue is due to the organization of hemorrhages such as that observed in the case of cholesterol granulomas of the ear or in certain experimental models (Dota et al. 1963, Friedmann 1959, Main et al. 1970).

(3) We therefore consider these cysts of the anterior calcaneus to be the result of

organizing hemorrhages in the region of the trigonum calcis. This could be related to the rather rich vascularization of this area (Chanzy et al. 1973, Crock 1967) (Figure 7).

It suggests a pathogenesis already proposed by Pommer for bone cysts, one which was also discussed for the formation of humeral and femoral cysts (Jaffé & Lichtenstein 1942, Lang 1954, Pommer 1919). In fact, we have observed that the newly formed bone in the wall of humeral or femoral cysts – which also develop under an arch of trabeculae – may be represented by the same peculiar woven osteoid material seen in Figure 5. Their great rarity (even after trauma) and the lack of any relation with hemorrhagic conditions [the hemophilic cysts of the calcaneus have a different appearance (Bonnet et al. 1968, Giambelli & Lanzetta 1964)] implies that an exceptional combination of various mechanical and vascular factors must be necessary for their formation. Among other things there may even be a relationship with the venous pressure of the lower leg. When this is increased, the pressure within the calcaneus also increases (Arnoldi & Linderholm 1971).

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