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# The role of high-frequency ultrasound in the evaluation of an acral subcutaneous nodule: a case report and literature review

*O papel da ultrassonografia de alta frequência na avaliação de um nódulo subcutâneo acral: relato de caso e revisão da literatura*

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**ABSTRACT**

Acral subcutaneous nodules pose a diagnostic challenge due to their broad differential diagnoses. We report a case of a foreign body granuloma presenting as a long-standing acral subcutaneous nodule on the thumb of a 64-year-old woman. High-frequency ultrasound revealed a homogeneous hypoechoic nodule with posterior acoustic enhancement, surrounding a central linear hyperechoic structure suggestive of a foreign body reaction. Excisional biopsy confirmed a granulomatous inflammatory process surrounding a vegetal fiber. This case highlights the value of high-frequency ultrasound as a noninvasive tool to support etiological diagnosis and guide surgical planning in chronic acral subcutaneous nodules.

**Keywords:** Ultrasonography; Granuloma, Foreign-Body; Epidermal Cyst

***RESUMO***

*Os nódulos subcutâneos acrais representam um desafio diagnóstico devido ao amplo diagnóstico diferencial. Relatamos um caso de granuloma por corpo estranho que se apresentou como um nódulo subcutâneo acral de longa duração no polegar de uma mulher de 64 anos. A ultrassonografia de alta frequência revelou um nódulo hipoecoico homogêneo com reforço acústico posterior, envolvendo uma estrutura linear hiperecogênica central, sugerindo reação a corpo estranho. A biopsia excisional confirmou um processo inflamatório granulomatoso ao redor de uma fibra vegetal. Este caso destaca o valor da ultrassonografia de alta frequência como ferramenta não invasiva para auxiliar no diagnóstico etiológico e orientar o planejamento cirúrgico em nódulos subcutâneos acrais crônicos.*

***Palavras-chave:*** *Ultrassonografia; Granuloma de Corpo Estranho; Cisto Epidérmico*

## Diagnostic Imaging

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Acral subcutaneous nodules (ASNs) pose a diagnostic challenge given the broad range of conditions that may present with this clinical appearance. In this context, complementary imaging techniques, such as high-frequency ultrasound (HFUS), can aid in establishing an etiological diagnosis,[1] since ASNs, although common in dermatological practice, may represent inflammatory, infectious, or neoplastic conditions that require distinct management strategies.

We report a case of a foreign body granuloma (FBG) presenting as an ASN on the thumb and discuss the clinical features and HFUS findings that helped elucidate the etiological diagnosis.

A 64-year-old White woman presented with a painless, slow-growing nodule that had progressively increased in size over 15 years. Physical examination revealed a 1.5 × 1.0 cm no¬dular lesion located on the lateral aspect of the proximal phalanx of the thumb, which was fibroelastic in consistency, mobile, and non-tender (Figure 1). The initial clinical differential diagnoses included giant cell tumor of the tendon sheath, epidermal inclusion cyst, lipoma, FBG, and low-grade fibromyxoid sarcoma. HFUS was performed using a 22 MHz transducer (LogicE GE®, GE Electronics®, Boston, MA, USA) and demonstrated a ho¬mogeneous hypoechoic nodule with posterior acoustic enhan¬cement, surrounding a central linear hyperechoic structure (Figure 2). No central vascular flow was detected on Doppler imaging. These findings were suggestive of an FBG.

An excisional biopsy was subsequently performed. Histopathological examination revealed granulation tissue composed of aggregates of epithelioid histiocytes surrounded by a lymphocytic rim, with a central suppurative area and no cellular atypia. A central foreign body compatible with a vegetal fiber was identified (Figure 3), confirming the diagnosis of FBG. Upon further questioning, the patient recalled a prior injury involving "broom fibers."

Foreign body granulomatous reaction is defined as a chronic inflammatory response to exogenous materials introdu-

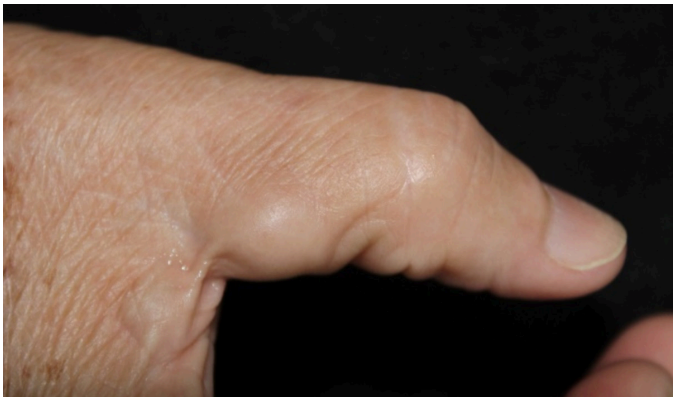

**Figure 1:** Subcutaneous nodule on the lateral aspect of the right thumb, becoming more prominent with flexion of the distal phalanx

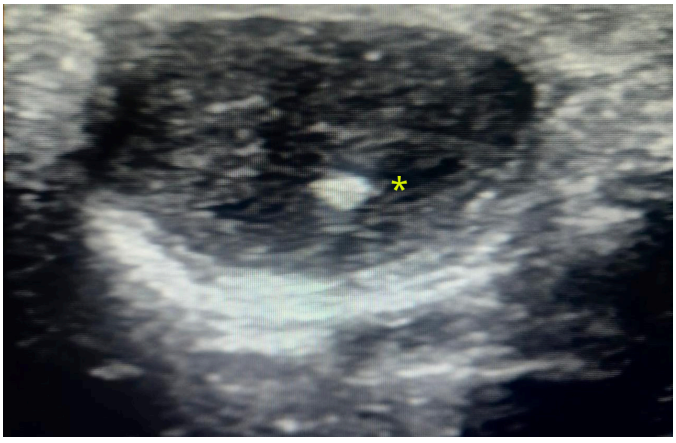

**Figure 2:** Homogeneous hypoechoic nodule with posterior acoustic enhancement, surrounding a central linear hyperechoic structure (yellow asterisk)

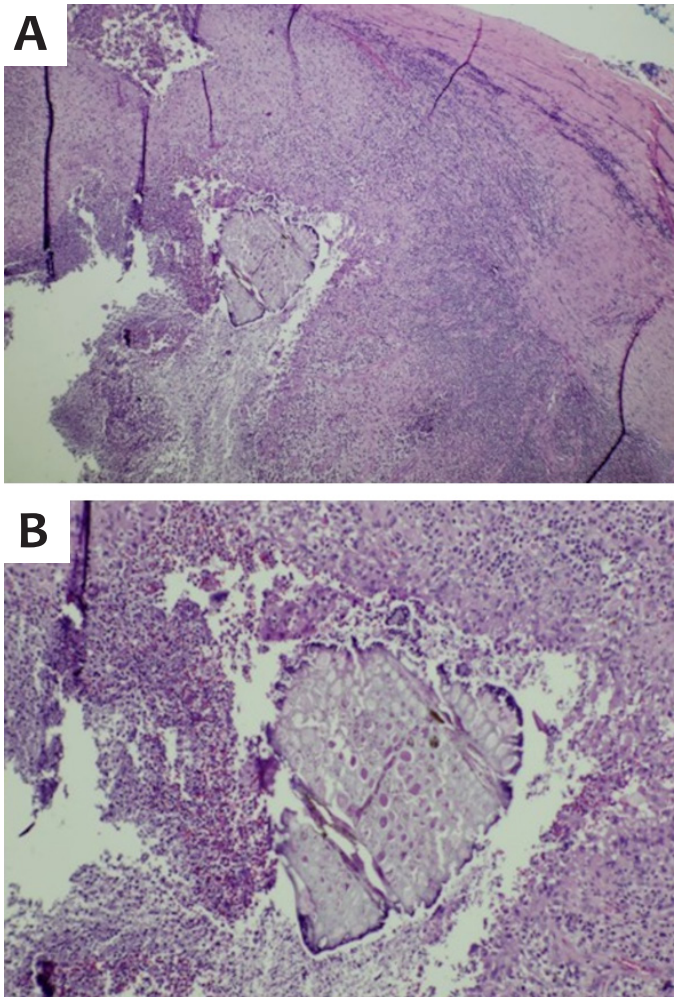


**Figure 3: A -** Mixed granulomatous infiltrate, rich in histiocytes and lymphocytes, with a central non-human cellular structure (H&E, 400×); **B -** presence of a non- human cellular structure with visible cell walls, consistent with plant-derived material, forming a foreign body granuloma (H&E, 1000×)

**Table 1: Differential diagnoses of chronic digital subcutaneous nodules and their clinical, ultrasonographic, and histopathological findings**

| Differential diagnosis | Ultrasonographic findings | Histopathological findings | Clinical (semiological) findings |
|---|---|---|---|
| Foreign body granuloma | Isoechoic nodular lesion with posterior acoustic enhancement, surrounding a central linear hyperechoic structure. | Epithelioid histiocytes surrounded by a lymphocytic rim and a central suppurative area. | Indurated nodule, erythematous or hyperpigmented, variably painful, typically located at sites of prior trauma or inoculation. |
| Lipoma | Isoechoic lesion, generally homogeneous. | Adipocytes without atypia, increased in size, occasionally with focal necrosis. | Soft, mobile, painless subcutaneous mass with slow growth. |
| GCTTS | Generally heterogeneous lesion with increased vascularity on Doppler imaging. | Multinucleated giant cells, villonodular architecture, collagenized stroma, and inflammatory infiltrate. | Firm, painless, slow-growing nodule adjacent to tendons, most commonly in the hands. |
| LGFMS | Generally hyperechoic, hypoechoic, or homogeneous lesion, with increased vascularity on Doppler imaging. | Alternating myxoid and fibrous areas, low to moderate cellularity, mild pleomorphism, and absence of mitotic figures or necrosis. | Deep mass with insidious growth, generally painless and located in proximal extremities. |
| Epidermoid inclusion cyst | Well-defined hypoechoic or anechoic lesion, possibly with echogenic lamellar content (keratin). | Cyst lined by stratified squamous epithelium containing laminated keratin. | Firm, mobile, painless subcutaneous nodule, sometimes with a central punctum (pore). |
| Synovial cyst | Anechoic, well- defined lesion with fine internal echoes, adjacent to joints or tendon sheaths. | Fibrous wall without epithelial lining, containing mucinous material. | Rounded, fluctuating, usually painless mass, which may become painful due to local compression. |
| Vascular tumors (hemangioma) | Hypoechoic lesion with visible internal vessels on Doppler imaging; may contain anechoic spaces. | Proliferation of vascular channels (capillary, cavernous, or mixed types). | Bluish or purplish lesion, compressible, with enlargement during Valsalva maneuver. |
| Traumatic neuroma | Hypoechoic solid mass contiguous with a nerve, poorly defined. | Disorganized proliferation of axons, Schwann cells, and fibrous tissue. | Painful nodule along a nerve pathway after trauma or surgery, with paresthesia on palpation. |
| Deep granuloma annulare | Well-defined hypoechoic dermo-hypodermal nodule. | Central collagen degeneration with palisading histiocytes. | Firm, painless, asymptomatic nodule, generally located in the extremities (mainly the dorsum of the hands or feet). |

*GCTTS: giant cell tumor of the tendon sheath; LGFMS: low-grade fibromyxoid sarcoma.*

ced into the skin, such as sand, plant fibers, glass, or injectable substances (e.g., polymethyl methacrylate [PMMA]).[2] In the present case, HFUS suggested the diagnosis of FBG through the visualization of a central hyperechoic structure corresponding to the retained foreign material.

The use of HFUS has expanded across all areas of dermatology. Owing to its high spatial resolution (0.1–0.2 mm), HFUS enables the assessment of small structures, improving diagnostic accuracy and facilitating the evaluation of the activity of several inflammatory, infectious, neoplastic, and degenerative skin disorders.[1]

A previous study compared the ultrasound findings of patients with FBG secondary to injectable fillers (e.g., PMMA) with those of patients with hyaluronic acid deposits.[3] In FBG,

lesions are characteristically oval with irregular, poorly defined margins and contain hyperechoic foci representing accumulated material surrounded by granulomatous inflammation — features consistent with those observed in the present case.[4]

HFUS may also aid in differentiating ASNs of various etiologies. Lesions with heterogeneous central areas and increased Doppler flow may suggest a neoplastic etiology, whereas inflammatory lesions or benign tumors tend to be more homogeneous and avascular on HFUS. Cystic lesions, in turn, typically demonstrate posterior acoustic enhancement.[5] Table 1 summa¬rizes the main HFUS and histopathological features of chronic ASN differential diagnoses.

In patients with chronic ASNs, obtaining an accurate clinical history may be challenging due to the often prolonged period between exposure and lesion development, hindering clinical characterization and diagnosis. In this setting, HFUS — a noninvasive, painless, rapid, and increasingly common procedure in dermatological practice — emerges as an important tool in the management of ASNs.

In conclusion, we report a case of ASN whose etiology was FBG, which could be anticipated by HFUS findings. Dermatologists should consider HFUS as part of the diagnostic workup of ASNs, thereby aiding surgical planning. ●

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