

CHARACTERIZATION OF DERMATOLOGICAL LESIONS BY ULTRASOUND

Caracterización de lesiones dermatológicas por ecografía

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Key words (MeSH)

Ultrasonography
Epidermal cyst
Carcinoma, basal cell
Lipoma
Biopolymers
Pilonidal sinus
Silicone gels

Palabras clave (DeCS)

Ultrasonografía
Quiste epidérmico
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Seno pilonidal
Geles de silicona

Summary

Introduction: At the present day the use of high resolution transducers have allowed significant progress in characterizing skin lesions, providing anatomical information such as size, depth, vascularization, calcium deposits, cyst or solid contents and even hair. **Objective:** the objective of this article is to review the ultrasound characteristics of skin lesions, like: infections, tumors, and traumas. **Methodology:** for its methodology, we use ultrasound images of outpatients seen at our institution. **Conclusion:** we conclude that ultrasound is a useful tool that provides additional clinical information for the management of multiple skin lesions.

Resumen

Introducción: En la actualidad, el uso de transductores de alta resolución ha permitido avances muy importantes en la caracterización de lesiones dermatológicas, brindando información anatómica como tamaño, profundidad, patrón de vascularización, depósitos de calcio, contenido sólido o quístico e, incluso, elementos como cabello. **Objetivo:** Revisar las características ecográficas de lesiones cutáneas de diferentes etiologías, como infecciosas, tumorales y traumáticas. **Metodología:** Se utilizaron las imágenes ecográficas correspondientes a pacientes de consulta externa vistos en nuestra institución. **Conclusión:** Se concluye que la ecografía es una herramienta muy útil que aporta información adicional al clínico para el manejo de múltiples lesiones dermatológicas.

Introduction

Ultrasound is a very important diagnostic modality in the research of dermatological diseases (1-3), given that it enables to perform early diagnosis, determine the degree and activity and severity of the disease and provide precise anatomical information which enables to adequately plan the surgical procedures. Even when magnetic resonance is frequently recommended for pre-surgical evaluation, requires the use of endovenous contrast and has proven to be less effective in the detection of lesions under 3 mm (4).

Ultrasound is a non-invasive diagnostic method, without ionizing radiation which is adequate for diagnosis and follow-up.

This revision uses cases of external consultation patients in our institution, obtained with ultrasound GE logiq P5, with a 12-15 MHz high-resolution lineal transducer.

Technical considerations

The study must be performed with a 12-20 MHz high resolution multi-channel lineal transducer, which has the capacity to clearly define the superficial structures such as skin layers, as well as delimit lesions with a diameter of up to 1 mm, or perform a deeper exploration of subcutaneous or muscular lesions which can simulate superficial lesions (5,6). It is essential to have a trained radiologist, with precise knowledge of normal dermatological anatomy and pathology. Ultrasound tools must be found as a field of enlarged vision which enable to delimit the totality of the lesion and the commitment of adjacent structures. Doppler for the evaluation of a vascular pattern in real time and in 3D reconstruction (7,8).

Normal skin

It is made up of three layers: epidermis, dermis, and subcutaneous cellular tissue (9). The epidermis has a

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highly pleomorphic cellular content and it is not vascularized. Its nutrition is enhanced due to diffusion of the dermic circulation. The main cellular types of the epidermis are keratocytes, melanocytes and Langerhans cells (10,11). One can see a highly hyperechoic lineal layer, due to its high content of keratin and collagen (figure 1).

The dermis corresponds to the skin support structure. Histologically, it is dominated by packages of organized collagen, providing the mechanical function of the skin. It includes lymphatic vessels, nerves, the profound portion of the pilose follicles and the sweat glands. A hyperechoic band can be seen in the ultrasound, with variable width, depending on the area of the body; in older persons or with high solar exposure it can turn hypoechoic due to trophic changes (12).

The subcutaneous cellular tissue is made up of fatty lobes separated by partitions. A hypoechoic layer can be seen in the ultrasound, separated by hyperechoic lineal partitions (figure 2).

Tumor pathology

- Epidermal cyst
- Pilomatrixoma
- Lipomatous tumors
- Pilonidal cyst
- Endometrioma
- Dermoid
- Basal cell carcinomas

Epidermic cyst

Epidermic cysts are originated by the implantation of epidermic elements in the dermis and the subcutaneous cellular tissue, in the infundibular portion of the pilose follicle (their origin is not sebaceous and it must not be called that way) (13).

The causes of the cysts can be congenital, traumatic or previous surgeries. Clinically, it presents itself as an erythematous and painful node which drains whitish material.

Histologically, they contain keratin, cholesterol and calcifications.

In the ultrasound one can see a mass with an oval configuration, hyperechoic, with a duct which connects to the surface called punctum and posterior acoustic reinforcement (figures 3 and 4).

Pilomatrixomas

They are benign tumors derived from the hair matrix. They are also called pilomatrixomas or Melherbe calcified epitheliomas (14).

Clinically, they are more common in children and young adults, and they especially affect the head, the hand, the neck, and the limbs (15).

Usually, they appear as a single node, but occasionally they may present themselves as multiple nodes. The clinical diagnosis can be incorrect up to 56% of cases, given that they can be easily be mistaken for other benign tumors such as epidermal cysts (16).

The classic ultrasound appearance is a target-shaped lesion, characterized by a hyperechoic solid mass with a hypoechoic halo. They present point-like calcifications, with a posterior acoustic shadow as a diagnostic key, which can be single or multiple (17). They can present a degree of vascularization in the periphery (figure 5).

Lipomatous tumors

Lipomas are the most frequent soft tissue tumors which derive from mature fatty tissue. They may be single or multiple.

Clinically, they are non-painful soft masses, except if they compress a nervous structure (18).

They are called superficial when they are located in the subcutaneous cellular tissue and they are profound when they are under the muscular plane.

They are typical when their content is exclusively fatty and atypical when they are associated with mesenchymal tissue, of a connective type (fibrolipomas) or capillary (angiolipoma).

The typical lipomas in the ultrasound are present as markedly hyperechoic oval masses which follow the transverse axis of the skin layers, when their ultrasound presentation is typical, the diagnostic certainty is very high (19-22) (figure 6).

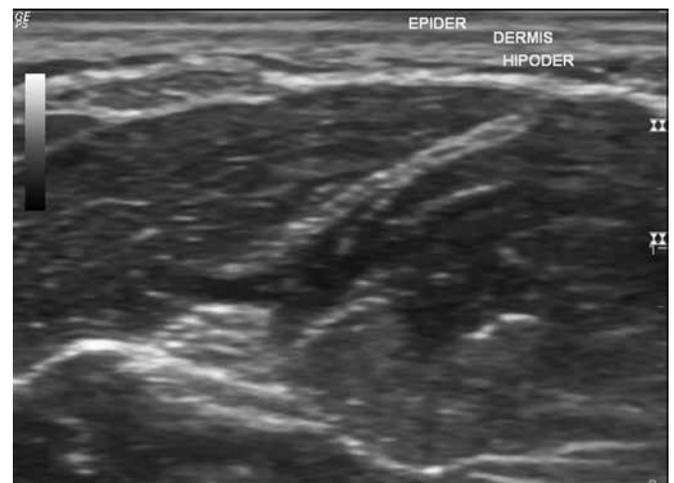


Figure 1. Ultrasound which shows the normal layers of the skin.

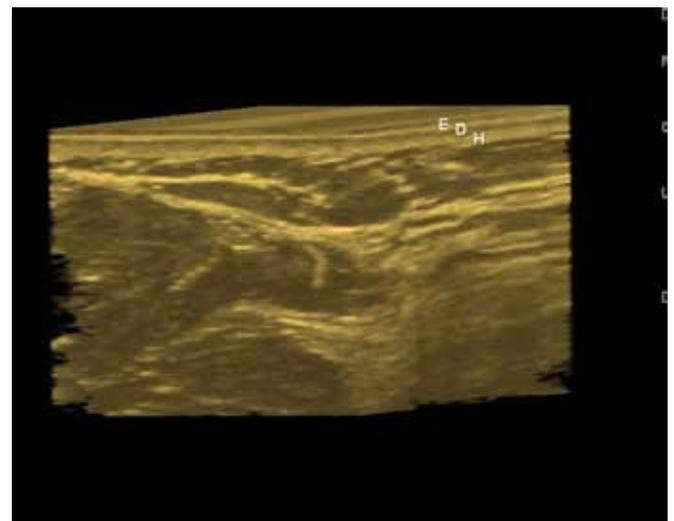


Figure 2. Normal ultrasound of the skin with 3D reconstruction which shows three layers. (E corresponds to epidermis, D corresponds to dermis and H corresponds to hypodermis).

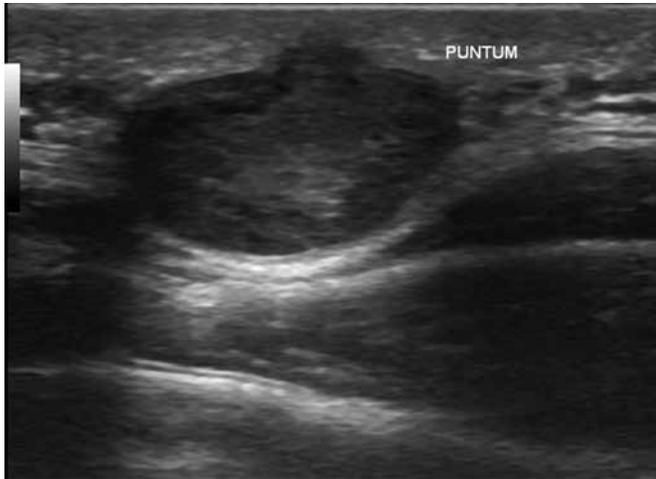


Figure 3. Ultrasound appearance of the epidermal cyst with an oval configuration, hypoechoic, and a marked posterior acoustic reinforcement. The typical punctum is highlighted.

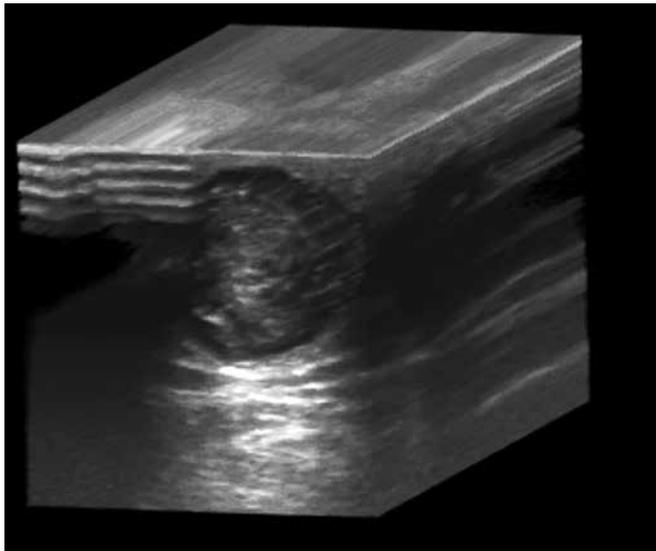


Figure 4. Ultrasound with 3D reconstruction with epidermal cyst. Observe the posterior acoustic reinforcement of the lesion.

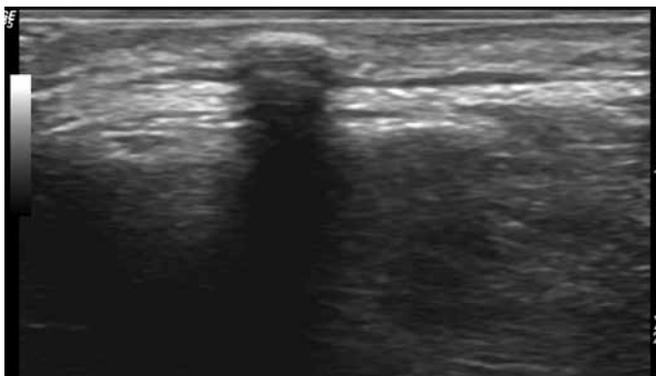


Figure 5. Pilomatricoma with single calcification which generates a marked posterior acoustic shadow.

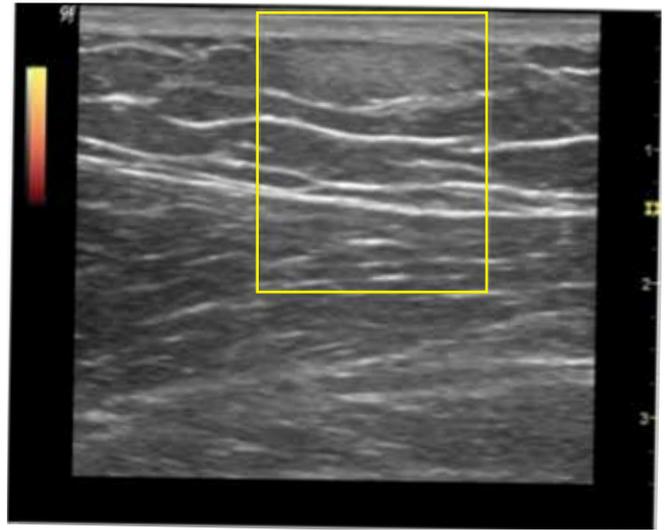


Figure 6. Typical lipoma: oval mass, homogenous texture, hyperechoic with defined shapes, avascular in the Doppler exploration.

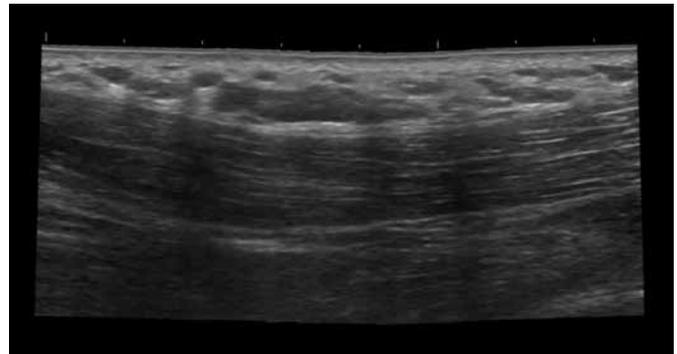


Figure 7. Ultrasound with an extended field of vision. A fusiform mass of well-defined edges with a hyperechoic predominance. The pathology evidenced an intramuscular lipoma.

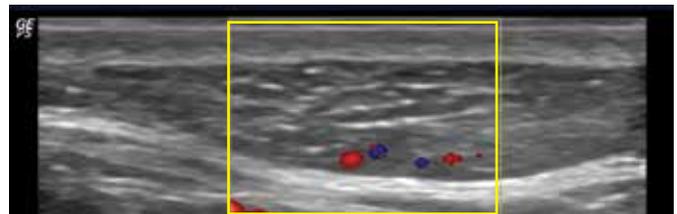


Figure 8. Mass with a heterogeneous texture, predominantly hyperechoic, with lineal tracts and discrete vascularization in the periphery, which rules out a typical lipoma. The pathology evidenced an angiolipoma.

Atypical lipomas in the ultrasound are solid masses, with predominantly hyperechoic heterogeneous texture with hyperechoic tracts, its edges can be well or badly defined (figure 7).

Angiolipomas show a degree of vascularization to the Doppler exploration (figure 8). They present a surgical indication due to the possibility of angiomatous or sarcomatous changes.

Pilonidal cyst

They are the most common lesions in the inter-gluteous region. They are made up of a pseudocystic structure which contains a network of hairs and keratin.

It usually affects young male patients. Some risk factors are obesity, excess hair and occupations which require seating for a long time (23).

Clinically they are present as acute or chronic abscesses with intermittent secretion or bleeding.

Post-surgical recurrence is frequent given that they are usually larger than clinically suspected. (24) (figure 9).

Scar endometriosis

Scar endometriosis is the implantation of the endometrial tissue, in post-surgical scars of caesarian or gynecological surgeries. The tissue is implemented in the layers of the skin and the subcutaneous cellular tissue. Even through it is infrequent, it is a cause of pelvic pain.

Clinically, they are manifested as masses of skin, in the subcutaneous cellular mass or in the abdominal wall, which can classically have variable size according to the menstrual cycle.

The most frequent cause is the implantation of endometrial tissue cells at the moment of surgery.

The typical ultrasound presentation is a solid mass, hypoechoic, in the area of the post-surgical pathway, with detectable flow in the Doppler exploration (25) (figure 10).

Dermoid cyst

They are masses which contain remnants of cutaneous tissue, such as keratin, hair and stratified epithelium with thick capsule which originate throughout the embryonic closure (26).

Usually, they are observed in the superior external quadrant of the orbit in children and young adults. Other areas of less frequent location are the middle line of the neck, the nasal dorsum, the forehead, the mastoid area and the torso (27-29).

It is observed as an anechoic round mass in the ultrasound, well defined with thick capsule (figure 11). It must not present calcifications or vascularization, given that the absence of bone or cartilage differentiates it from cystic teratomas (30).

Basal cell carcinoma

In the tumor pathology of the skin, malignancies are classified in two large groups; the first one, known as melanoma type cancer and the second one, known as cancer without a pigmented component. This last one is represented by basal cell and squamous cell carcinoma, which constitutes 95% of skin malignancies (31).

Basal cellular carcinoma mainly involves the thin skin in solar exposure areas, such as eyelids, the nose, lips, and ears.

Basal cellular carcinoma or epithelioma is rarely fatal, but it causes a high degree of disfigurement (32).

Clinically, it is presented as a node or a slow growth papule, not painful, which can easily bleed with minor traumas.

In the ultrasound, they are observed as masses of the epidermis, the dermis and the subcutaneous cellular tissue, hypoechoic with irregular edges, with increased vascularization which can have an arterial and a venous pattern (figure 12 a and b). The ultrasound report must include the deepest diameter of the mass (33,34).

Infectious pathology

Includes surface and profound cellulite, as well as abscesses.

Cellulite

It is an inflammatory acute condition of the skin which is characterized by pain, erythema and heat in the affected area (35). Generally speaking, it is secondary to the bacterial infection and its main agents are golden staphylococcus and pyogenic staphylococcus.

Even when the diagnosis is clinical, the ultrasound is used to differentiate between superficial and deep cellulite. In superficial cellulite, the infectious process involves the epidermis, the dermis and the subcutaneous cellular tissue, without extending to the muscular fascia. There is an increase in the thickness and echogenicity of the three layers of the skin in the cellular tissue, in an irregular type. One can see an increase in vascularization in the subcutaneous cellular tissue. When an associated edema is present, one can see foci of hypoechoic liquid which dissect the subcutaneous cellular tissue (figure 13).

In deep cellulite, there is an extension of the inflammatory process in the deep tissues, such as muscular fascia or muscles, called fasciitis, myositis with or without necrosis according to the affected area.

In addition to superficial changes, the ultrasound must define the extension to the profound plane (figure 14). Necrosis is observed as a badly defined irregular cystic area, and there is an increase in the vascularization in the Doppler exploration.

Abscesses

Abscesses correspond to the presence of infection and pus in a liquid collection. The most frequent etiological agent is golden staphylococcus (36). Among the causes of organized collections which can originate abscesses are hematomas, broken epidermal cysts and swollen pilonidal cysts.

Cellulite and abscesses are the first cause of hospitalization in drug addicts (37).

Abscesses may or may not be organized. In an ultrasound, non-organized abscesses can be seen as hypo and hyperechoic collections, irregular, with a variable degree of vascularization in the periphery (38) (figure 15).

The organized abscesses show a well-defined hypoechoic collection with peripheral pseudo capsule; there can be hyperechoic points with "comet-tail" artifact corresponding to air in its interior. Likewise, they can present anechoic lineal fistulous pathways which communicate the collection with the skin (figure 16).

Drainage guided by ultrasound is very useful, both for defining the etiological agent as well as for performing its treatment (39).

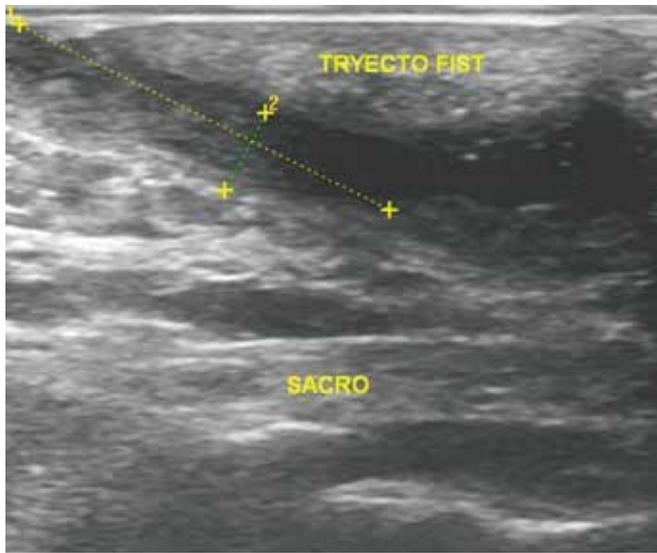


Figure 9. Typical ultrasound image in the inter-gluteal region which correspond to a pilonidal cyst. Lines 1 and 2 demarcate the fistulous pathway which comes in contact with the surface of the skin.

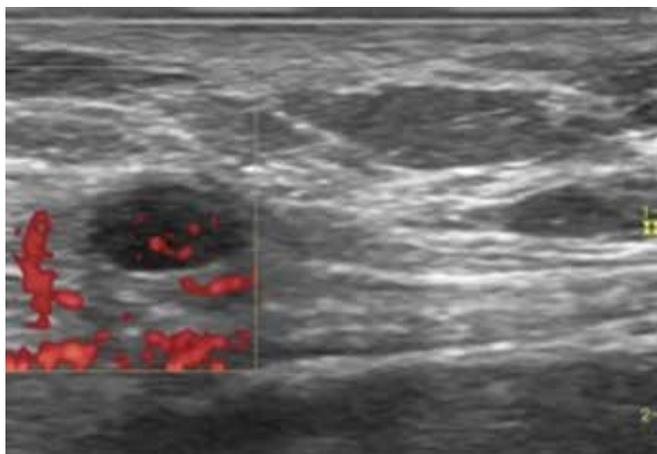


Figure 10. Patient with a background of caesarian section, with a mass in subcutaneous cellular tissue in a scar pathway, with vascularization in the Doppler exploration.

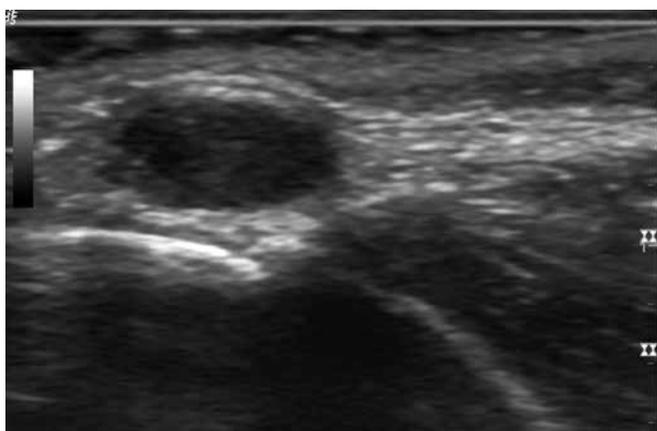


Figure 11. Three-month old patient with subdermic mass, in the external quadrant of the orbit, with typical dermoid presentation.

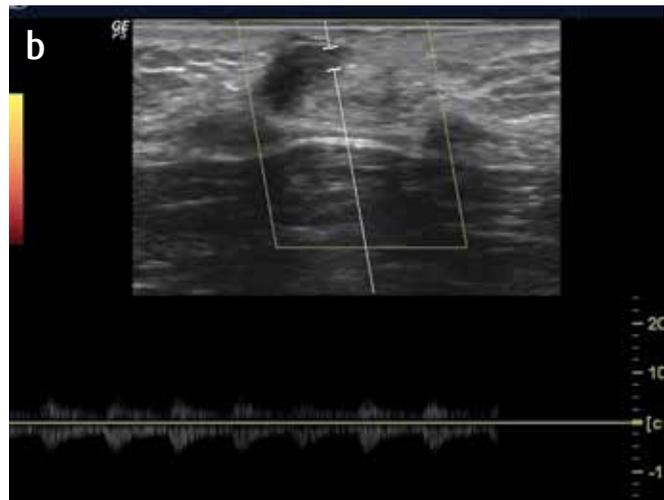
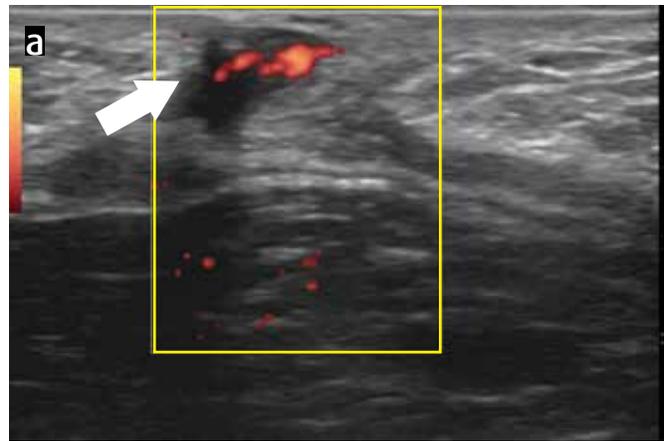


Figure 12. a) Patient with markedly hypoechoic subdermic mass, with edges and spicules, with an increased vascular pattern. The arrow shows an increase in vascularization. b) The mass presents low-resistance arterial pattern. The pathology evidenced basal cell carcinoma.

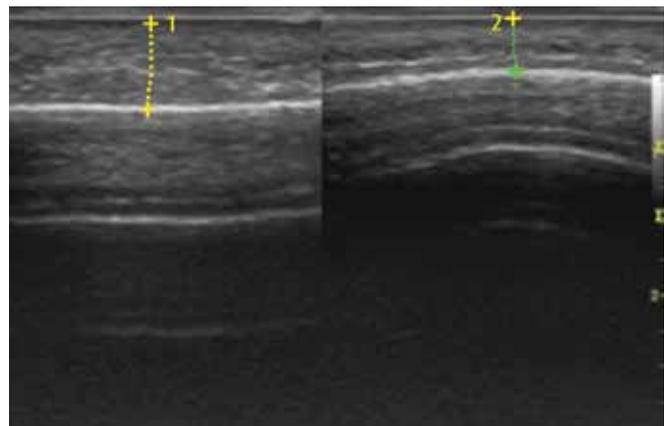


Figure 13. Patient with incipient frontal right cellulite. The image on the left shows an increase in the thickness and echogenicity of the subcutaneous cellular tissue, measuring 0.59 cm. The image at the right shows a thickness of 0.35 cm of the normal skin for comparison.

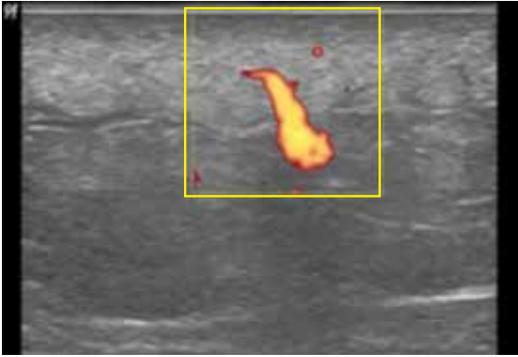


Figure 14. Patient with deep cellulite of the abdominal wall with extension of the inflammatory process of the profound fascia. There is a marked increase in vascularization.



Figure 15. Patient with a caesarian section, with an irregular collection in the abdominal wall which corresponds to an abscess which involves subcutaneous cellular tissue. ABS corresponds to the collection and the dotted line measures the diameter of the fistulous pathway.

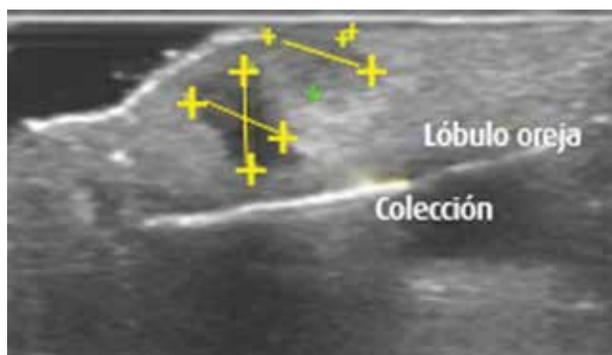


Figure 16. Patient with an extensive inflammatory process in the lobe of the ear. The ultrasound shows an increase in the thickness and in the echogenicity of the soft tissues of the lobe of the ear; the dotted lines define the organized collections.

Exogenous elements

The exogenous elements which are visualized in an ultrasound may correspond to foreign bodies or material injected with cosmetic purposes.

Foreign bodies

Depending on its nature, foreign bodies can be classified as inert (glass, metal, post-surgical material) or organic (wood, bone fishes) (40,41).

Clinically, an induration is observed, as well as an edema and an erythema in the affected area. In an ultrasound, one can observe a hyperechoic bi-laminar band, which is generally associated with a surrounding hypoechoic mass due to the development of granuloma in the periphery (figure 17). Elements such as glass or metal can present artefact due to reverberation.

Post-surgical granulomas can be developed by remnants of non-absorbable surgical material. In an ultrasound, the typical appearance is a markedly hypoechoic node with a defined hyperechoic lineal center (figures 18 and 19). The ultrasound enables to confirm the presence of a foreign body, the type of element and its exact location, which helps to extract the foreign body.

Cosmetic material

Filling cosmetic material corresponds to nanoparticles which are used to reduce the effects of skin aging: this procedure has currently become relevant. The most commonly used innocuous substances correspond to hyaluronic acid and to autologous fat (42,43). However, other non-absorbable materials which are not approved or are disputed, such as silicone or biopolymers, are used for cosmetic means and might cause reactions, complications or cosmetic deformities (44).

The ultrasound enables to clarify what the injected substance corresponds to, given that its ultrasound appearance is quite distinctive.

Regarding liquid silicone, there are two types of presentation used for cosmetic means: pure form and oily form (45).

The appearance of adverse reactions can take approximately 2-10 years and may clinically simulate entities such as morphea, atopic dermatitis, angioedema, among others. Histologically, there are inflammatory changes with a lymphocytic reaction, with abundant extracellular vacuoles of different sizes and an exuberant granulomatous reaction to a foreign body.

In an ultrasound, pure silicone is observed as a round anechoic structure, pseudocystic in the subcutaneous cellular tissue, which in echogenicity can be similar to mammary prostheses. Silicone in oil diffusely infiltrates the subcutaneous cellular tissue and causes a typical “snow storm” appearance, similar to the one seen in extra-capsular ruptures in mammary prostheses (46) (figure 20).

Biopolymers can be of several types, such as poly methyl-methacrylate (PMMA) or polyacrylamide (PAAG); PAAG is a synthetic

hydrogel which was initially used in the facial reconstruction of HIV patients with lipodystrophy (47). Pseudocystic structures, round or oval, can be seen in an ultrasound. These are markedly hypoechoic, which infiltrate the subcutaneous cellular tissue. They can also be seen as irregular diffused images, markedly hypoechoic, which diffusely infiltrate the subcutaneous cellular tissue and do not enable the ultrasound transmission (48) (figure 21).

Traumatic pathology and consequences

The usefulness of an ultrasound in musculoskeletal traumatic lesions is well known. In dermatological lesions, it may clarify complications and its consequences such as the presence of hematomas, seromas, post-traumatic fbrosis, the development of fistulous pathways and hypertrophic scars.

Hematomas-seromas

The appearance of post-trauma collections is one of the most frequent practices in ultrasonography testing, given that hematomas or seromas may develop. Hematomas have red blood cells, blood clots and inflammatory cells in the acute phase, and granulation tissue and fibrin in the latter phases. Patients with hemophilia, Ehler Danlos, develop hematomas in soft tissues very easily (49). In an ultrasound, its appearance varies according to the evolutionary phase and the presence of liquefaction changes. Usually, they are present as well-delimited anechoic collections which, in time, can turn hypoechoic and hyperechoic (figure 22). During the initial stages, they can show hyper-vascularization in the periphery in the Doppler exploration, and hypo-vascularization in the latter phases (50).

Seromas or lymphoceles are mainly made up of lymphatic clear fluid, caused by a tear of the lymphatic network. They are seen more frequently after some surgical procedures such as abdominoplastias.

Fistulous pathways

A fistula is a pathological communication pathway between two anatomical spaces or a pathway which leads to the internal cavity of an organ to the surface of the skin. It generally originates in an infectious process of the profound layers which try to drain towards the surface.

Clinically, it is present as an erythematous or ulcerated node or point, with discharge of material which can be serous, purulent or hematic.

A hypoechoic tract can be seen in an ultrasound, usually lineal and with a variable diameter (figure 23). In its interior, one can see echoes and they may present vascularization in the periphery in the Doppler exploration.

Points to remember

All dermatological ultrasound reports must include:

- Whether the lesion is a skin lesion.
- The precise anatomical location (epidermis, dermis, subcutaneous cellular tissue).

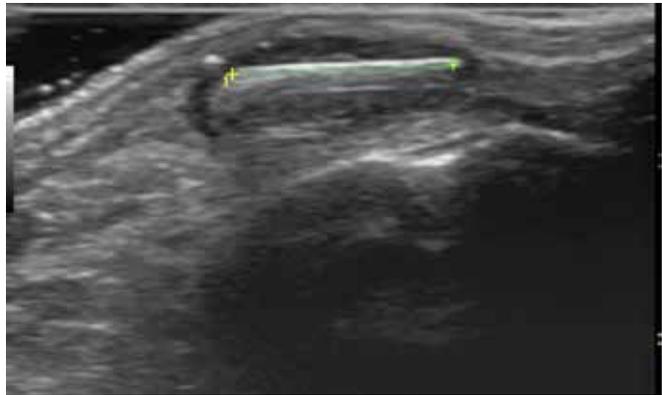


Figure 17. Patient with foot trauma with branches. Two months after, it presents soft tissue mass. The ultrasound confirms the presence of a hyperechoic lineal image which corresponds to a woodchip type foreign body, and hypoechoic in the periphery due to the formation of a granuloma.



Figure 18. Patient with post-surgical mass as a scar. The ultrasound shows a typical granuloma image, with a markedly irregular node with a hyperechoic center.

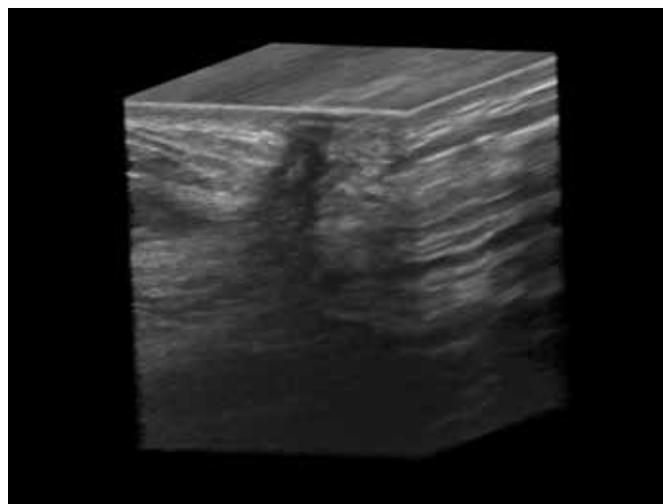


Figure 19. 3D ultrasound shows a typical granuloma image.

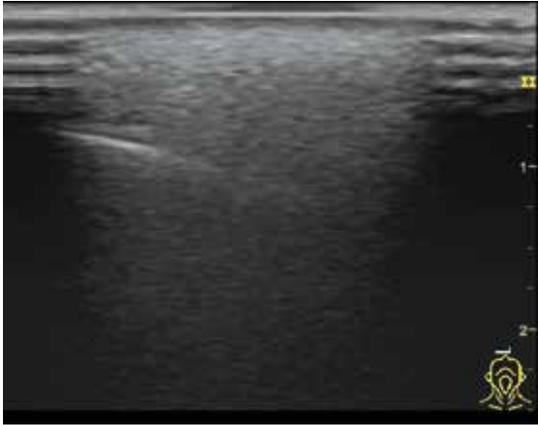


Figure 20. Patient with a mass in a cosmetic post-treatment inter-orbital region with an unknown substance. The ultrasound shows a markedly hyperechoic and irregular image, which infiltrates all the layers of the skin, as well as the subcutaneous cellular tissue and the muscular plane. Characteristic of the presence of liquid silicone, located in the frontal inter-orbital region. <https://www.youtube.com/watch?v=tQ-n61o-6EA>

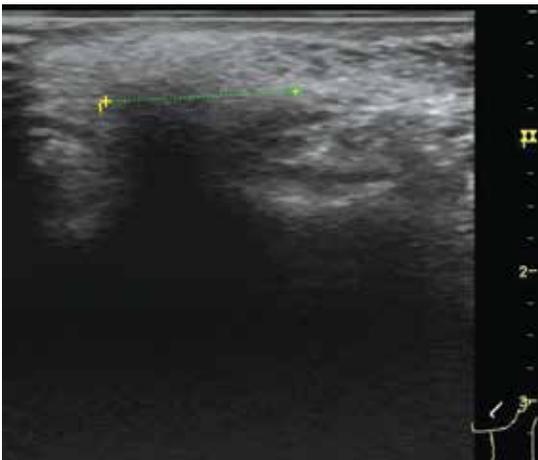


Figure 21. Patient who apparently had an injection of hyaluronic acid in the cheek, 4 years prior. It currently presents a mass and a deformity. The ultrasound shows an image which is typical of biopolymers with a markedly hypoechoic irregular mass, delimited by the dotted line.

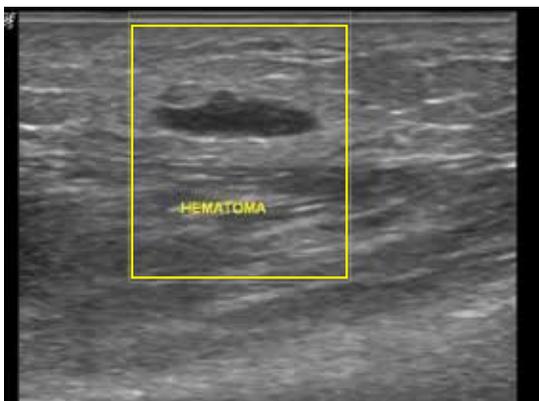


Figure 22. Patient with a background of trauma in the thigh, with an evolution of two weeks. Clinically, a superficial mass is palpated. The ultrasound shows a well-defined hypoechoic mass in the subcutaneous cellular tissue which corresponds to a hematoma.

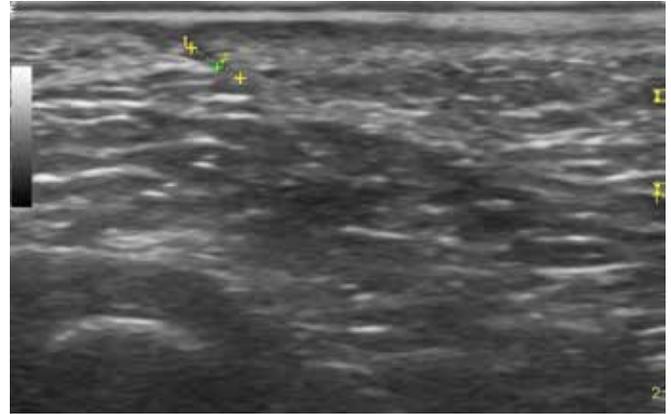


Figure 23. Breastfeeding patient with a background of abscess medically treated in the perineum. The control ultrasound shows a small residual fistulous pathway in the subcutaneous cellular tissue without residual collection.

- The extension of the lesions to the profound planes (such as fascia, muscles) and its distance with them.
- Whether the content of the lesion is solid, cystic, or mixed.
- The presence of accessory elements (calcification, hair, air).
- The dimension of the lesion in three axes.
- Whether there is vascularization, and what type it is.
- If the ultrasound aspect is typical of the suggested diagnosis. If it is not, the report must define the possibilities of a differential diagnosis.

Conclusion

High-resolution ultrasound is a useful tool which enables to make a precise diagnosis of many dermatological lesions, as well as contribute additional information to the doctor for the management of these lesions.

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