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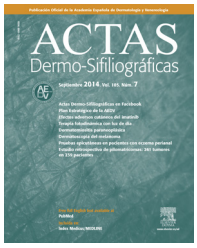

REVIEW

Ultrasound Skin Imaging☆

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Abstract The interaction of high-frequency ultrasound waves with the skin provides the basis for noninvasive, fast, and accessible diagnostic imaging. This tool is increasingly used in skin cancer and inflammatory conditions as well as in cosmetic dermatology. This article reviews the basic principles of skin ultrasound and its applications in the different areas of dermatology.

PALABRAS CLAVE
Ecografía;
Ultrasonido;
Ecografía cutánea

Ecografía cutánea

Resumen La ecografía cutánea es una técnica dermatológica de diagnóstico por imagen basada en la interacción de los ultrasonidos de alta frecuencia con la piel. Su carácter no invasivo, rápido y accesible hace que sus aplicaciones en la clínica sean cada vez más amplias, tanto en oncología cutánea como en afección inflamatoria o dermatología estética. En este artículo se revisan los principios de la técnica y las aplicaciones en los distintos ámbitos de la dermatología.

Introduction

Ultrasound skin imaging is a noninvasive diagnostic technique in which the physical properties of ultrasound are used to examine the skin and skin appendages.[1]

Both high-frequency (> 7 MHz) and very-high-frequency ultrasound (> 20 MHz) can provide a detailed diagnostic analysis of the skin, as they offer sufficient resolution and depth to clearly identify skin structures.[2]

Application of the Doppler effect in ultrasound enables the visualization of physiological and pathological processes involving increased local blood flow, such as inflammation and neoangiogenesis.[3]

Ultrasound is a relatively new imaging modality in dermatology, and while more studies are needed to support its

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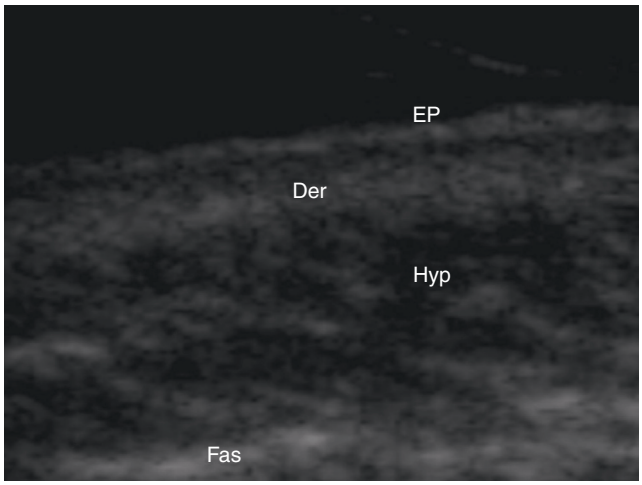

Figure 1 Structure of normal skin as seen on ultrasound. EP indicates epidermis; Der, dermis; Hyp, subcutaneous tissue; Fas, fascia.

integration into routine clinical practice, there is evidence of its usefulness in different fields of dermatology.[4]

Normal Skin and Skin Appendages

In B-mode (bright mode) ultrasound imaging, the skin is seen as a series of lines and bands in varying shades of gray, black, and white that correspond to the different layers of the skin[5] (Fig. 1).

The epidermis appears as a hyperechoic line, or in certain locations, such as acral sites, as a bilaminar hyperechoic line.[6]

The dermis also appears as a hyperechoic line but it is not quite as echogenic as the epidermis. A more superficial hypoechoic area, corresponding to the papillary dermis, may also be seen.

Subcutaneous tissue appears under the dermal band as a network of hyperechoic lines that correspond to the septa. Inside are hypoechoic areas that represent the fatty lobules.[1]

The nail is identified by the presence of a bilaminar hyperechoic structure (the nail plate) above a hypoechoic structure (the nail bed). The nail is closely related to the distal phalanx, which is seen as a continuous hyperechoic line on ultrasound[7] (Fig. 2).

The hair shaft appears as a bilaminar hyperechoic structure, similar to the nail plate, that penetrates the epidermis and dermis at an oblique angle. It is then seen as oblique hypoechoic lines in the dermis and as poorly defined oval hypoechoic areas at the dermal-subcutaneous junction[8] (Fig. 3).

Skin Cancer

Benign Skin Tumors

Subcutaneous tumors can occasionally pose a diagnostic challenge. Because ultrasound enables visualization of deep skin structures, it should theoretically offer better diagnostic information than clinical examination only (inspection and palpation).

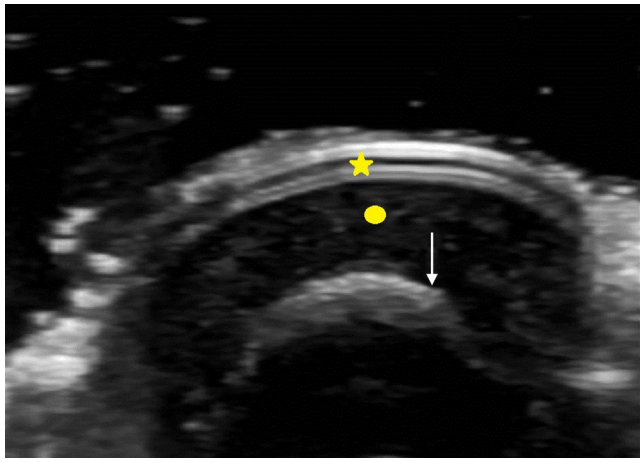

Figure 2 Cross-sectional view of nail in B (bright) mode, showing the nail plate (star), the nail bed (circle), and the distal phalanx. Photo courtesy of Dr Cerezo.

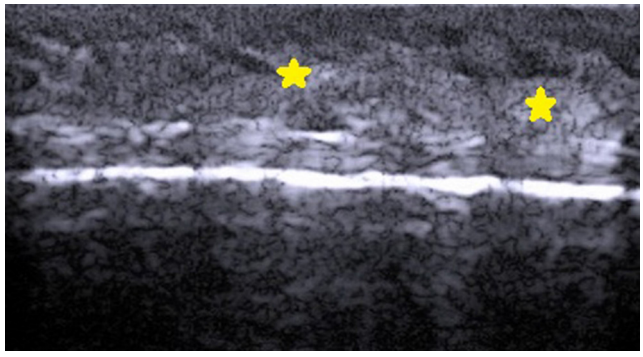

Figure 3 Longitudinal view of the hair on the scalp, showing the pilosebaceous follicle (stars) in the region of the bulb.

In a study of 183 benign subcutaneous lesions evaluated preoperatively, Kuwano et al.[9] reported that while palpation aided diagnosis in 64% of lipomas and in 93.5% of epidermal cysts, ultrasound was associated with a diagnostic sensitivity of 88.1% for lipomas ($P < .01$) (Fig. 4) and 99.3% for epidermal cysts ($P < .05$).

In a study of 4388 cutaneous lesions by Wortsman et al.,[10] the clinical diagnosis was correct in 73% of cases, but when ultrasound was added, diagnostic accuracy increased to 97% ($P > .001$).

The above findings suggest that ultrasound can improve the preoperative diagnosis of benign subcutaneous lesions.[11,12]

Nonmelanoma Skin Cancer

Level of local invasion and infiltration of surrounding structures is important for determining the course of treatment in nonmelanoma skin cancer, basal cell carcinoma (BCC), and squamous cell carcinoma (SCC), and for preventing damage to healthy adjacent structures.

The correlation between tumor thickness determined by ultrasound and histologic depth of invasion has been ana-