Sonography of Cutaneous and Ungual Lumps and Bumps

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KEYWORDS

• Skin ultrasound • Ultrasound dermatology • Skin imaging • Cutaneous sonography
• Nail ultrasound • Nail sonography • Skin cancer • Cutaneous tumors

KEY POINTS

- Ultrasonography provides anatomic information in common cutaneous and ungual conditions.
- Measurements in all axes, including depth, as well as the echostructure and vascularity patterns of the lesions may support the diagnosis and the medical and surgical management.
- Discrimination of the dermatologic and nondermatologic origin of the conditions can also be possible.

INTRODUCTION

Cutaneous and ungual applications of sonography have been increasing in recent years, mostly related to the development of a new generation of ultrasound machines that have probes with higher variable frequencies, more channels, and color Doppler sensitivity. Thus, this more sophisticated equipment give us reasonable resolution for identifying the skin layers and deeper structures without losing definition when changing the focal region of study.[1] Additionally, patients and physicians are demanding information about anatomic data that can support an early diagnosis and adequate management as well as improve the cosmetic result in dermatologic entities.

The skin is the largest organ in the body and is a complex structure where multiple physiologic processes take place. It is both our visible presentation to society and an efficient defensive organ to the hostile external environment. Thus, any injury to the skin can affect our quality of life or self-esteem.[2,3]

On the other hand, the nail is an integral part of the digital tip and a complex enthesis where the ungual and periungual tissues are closely interconnected with the joint, ligaments, capsule, and tendinous structures. The nail is also an organ that responds to systemic changes.[4] Biopsies of the nail can be difficult to perform, however, and may leave cosmetic sequels. This may favor the usage of imaging techniques in this structure.[5,6]

Both the skin and nail may be affected by various primary and secondary conditions. These latter are generated in neighboring structures, such as muscle, cartilage, or bone and secondarily involve the skin or ungual regions.

Sonography has many advantages for studying the skin and nail, among them are a suitable balance between resolution and penetration, and a real-time provision of anatomic information, which includes the assessment of the characteristics of blood flow, the lack of radiation effects, or confinement of the patient in a reduced space. Limitations of this technique are few and currently include epidermal-only lesions, or those that measure less than 0.1 mm, and the detection of pigments, including melanin.[1] However, small calcium deposits and fragments of hair can be easily identified.

Thus, owing to the high sensitivity of the color Doppler in the new generation of machines, contrast medium is rarely used in baseline cutaneous sonographic studies; this may prevent the potential development of adverse reactions. During the examinations, moreover, there is a full, live interaction between the patient and the sonographer that allows the correlation of the visible dermatologic

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findings with the sonographic images on the screen. Furthermore, the sonographer can make immediate decisions in vivo, such as whether to include another body region not primarily requested.[3]

The aim of this article was to review the potential of sonography in common dermatologic lesions that may clinically show as lumps or bumps in the skin or nail.

TECHNICAL CONSIDERATIONS

It is recommended that this type of examination should be performed with multichannel machines and variable frequency probes that reach frequencies of 15 MHz or higher. The latter comment does not detract from the use of lower frequencies but commonly the definition of the skin layers improves at higher frequencies. Usually, compact linear probes (hockey stick type) adapt better to the concavities and convexities of the cutaneous or nail surface, which may be important, for example in the face, or when dealing with lesions in small corporal segments, such as the fingers. Nevertheless, wider linear probes are also used in large-size lesions to cover the whole extent of the abnormalities or when comparing normal versus abnormal tissues.

Extended field of view, compound software, and 3-dimensional reconstructions, as well as sensitive color Doppler capabilities, may facilitate the provision and understanding of information by the clinician.

After a visual inspection of the lesion(s) the sonographer applies a copious amount of gel to the skin or nail surface. Commonly, no stand-off pads are required; furthermore, any potential compression of the skin vessels should be avoided.

Nails are examined with the finger or toe fully extended. If necessary, a pad or towel can be used to support the thumbs. A gray-scale and color Doppler sweep that includes at least 2 perpendicular axes is then performed.

For better definition of the hair follicles in the scalp, it is recommended to avoid softening softwares (ie, median filtering) and to displace the hair tracts from the area of the lesion.

Sedation is used in our department on children younger than 4 years to avoid artifacts derived from crying or moving. We use chloral hydrate (50 mg/kg) orally administered 30 minutes before the examination and after an informed consent is signed by the parent or guardian. The modified Aldrete score may be used to monitor the children during the sedation process. This score includes the evaluation of activity, respiration, circulation (blood pressure), consciousness, and oxygen saturation. Nine or more points are used to discharge the patient.

The settings include power Doppler to detect slow-flow, low-pulse repetition frequencies and wall filters, and a color gain below the noise threshold to acquire high-quality images.

Three-dimensional reconstructions are commonly performed by making 5-second to 8-second sweeps within the area of the lesion, to highlight the presentation of the lesion.[1,3]

NORMAL SONOGRAPHIC ANATOMY OF THE SKIN, NAIL, AND HAIR

Anatomically, the skin presents 3 layers: epidermis, dermis, and hypodermis, also called subcutaneous tissue. These layers are closely connected, and many of the pathologic conditions may involve more than one layer. The echogenicity of the cutaneous layers depends on their main components. For example, the echogenicity of the epidermis is a result of the high content of keratin; in the dermis, it depends on the collagen content and in the hypodermis, the echogenicity is a result of the fatty tissue. On sonography, the epidermis appears as a bright hyperechoic line in nonglabrous skin (all but the palms and soles) and as a bilaminar parallel hyperechoic structure in the palmar and plantar skin. The dermis shows as a hyperechoic band; however, less bright than the epidermis. Nevertheless, because of the damage produced by UV radiation over time, a deposit of glycosaminoglycans, also called elastosis, may be shown in the upper dermis, which can be detected on ultrasound as a subepidermal low-echogenicity band. The hypodermis presents hypoechogenicity, owing to fatty lobules, with hyperechoic fibrous septa in between. On color Doppler, low-flow arterial and venous vessels are detected in the hypodermis but rarely in the dermis (**Fig. 1**).[3]

The nail presents 2 main parts: the ungual and periungual regions. The ungual part is composed of the nail bed (which includes the matrix region) and the nail plate. The periungual tissue is composed of the lateral and proximal nail folds, as well as the bony margin of the distal phalanx. On sonography, the nail bed appears hypoechoic, and occasionally turns to slightly hyperechoic in the proximal region underneath the ungual matrix. The nail plate appears as a bilaminar structure made up of 2 hyperechoic, parallel lines called the dorsal (dp) and ventral (vp) plates. The origin of the nail plate is usually distal to the level of the distal interphalangeal joint. The proximal and lateral nail folds present the same cutaneous echostructure as the rest of the body, but mostly