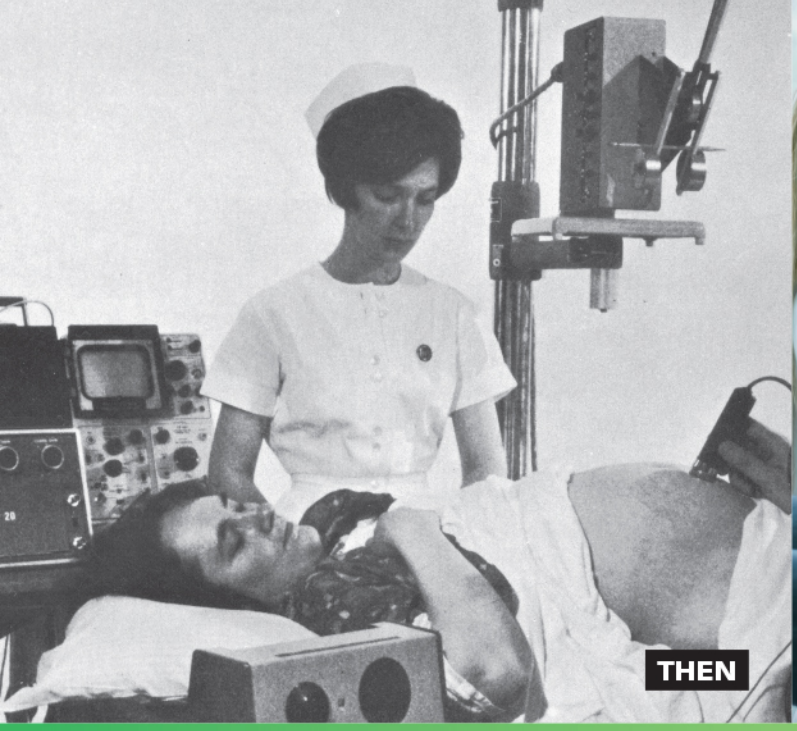

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Ultrasound Imaging of Nevus Sebaceous of Jadassohn

Ximena Wortsman, MD, Camila Ferreira-Wortsman, MS, Yamile Corredoira, MD

Nevus sebaceous of Jadassohn (NSJ) is a cutaneous hamartoma commonly found in the scalp and face and more frequent in children. Clinically, it presents as a yellowish and hairless plaque. In later stages, the NSJ can develop secondary tumors, including skin cancer. We reviewed the ultrasound characteristics of 9 patients (67% female; mean age, 3 years) with NSJ at 18 and 70 MHz. The ultrasound analysis covers the data on the location, thickness, echo structure, and vascularity. The provision of the ultrasound patterns of NSJ can support early diagnosis, avoid unnecessary biopsies, and support monitoring.

Key Words—basal cell carcinoma ultrasound; dermatologic ultrasound; nevus sebaceous; nevus sebaceous of Jadassohn; nevus sebaceous of Jadassohn ultrasound; nevus sebaceous ultrasound; skin ultrasound

Nevus sebaceous of Jadassohn (NSJ), also called nevus sebaceous or organoid nevus, is a cutaneous hamartoma commonly found in the scalp and face.[1–5] It is more frequent in children and supposedly results from postzygotic somatic mutations of the Ras protein family.[1,5] Clinically, it presents as a yellowish and hairless plaque that, over time, becomes thick and presents mamillonated and verrucous contours.[2,5] In early childhood, this lesion can mimic other dermatologic entities such as aplasia cutis,[6] and in adulthood, NSJ is known by its association with one or more secondary tumors.[2,4,5,7–9] These secondary neoplastic lesions include several benign adnexal tumors and skin cancer, particularly basal cell carcinoma (BCC).[2,5,9]

The management of NSJ is controversial, since there are recommendations of observation and excision in the literature.[10] Usually, children are clinically monitored, and the surgery is postponed until puberty or adulthood. Nevertheless, to date, it is not clear when it would be critical to perform the surgery.

Histologically, in the early phase, NSJ shows immature and abnormally formed hair follicles with rudimentary follicular buds, some acanthosis, and mild papillomatosis as well as small sebaceous glands. At puberty, sebaceous glands tend to enlarge, including a higher number of sebaceous lobules, and locate unusually highly in the dermis. The hair follicles are typically vellus hairs rather than terminal hairs, and ectopic apocrine glands can be seen at this stage.[3,5]

To date, the ultrasound morphologic features of NSJ have not been reported. Thus, the objective of this study was to assess the ultrasound features of NSJ.

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Abbreviations

BCC, basal cell carcinoma; NSJ, nevus sebaceous of Jadassohn

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Materials and Methods

Case Review

We reviewed the ultrasound database of the cases of NSJ from January 2017 to March 2020. All examinations followed the Helsinki principles of medical ethics, and the Institutional Review Board waived the need for signed informed consent; nevertheless, according to the protocol, all patients and guardians signed permission for publication of their images.

The inclusion criteria of the study were as follows: (1) patients referred by dermatologists for an ultrasound examination; (2) Color Doppler ultrasound examination with devices working at higher frequency ranges up to 18 and 70 MHz on the same day; and (3) clinically and histologically confirmed lesions. The exclusion criteria were as follows: (1) systemic dermatologic diseases; and (2) surgical history in the region of the lesion.

Ultrasound Protocol

All cases were scanned with 2 color Doppler ultrasound machines: LOGIQ E9 XD Clear (GE Healthcare, Waukesha, WI) with a compact linear transducer working with a maximum frequency of 18 MHz and Vevo MD (VisualSonics, Toronto, Ontario, Canada) with a linear transducer working with a maximum frequency of 70 MHz. In addition to the demographic description of the cases, the color Doppler ultrasound examination reported the echogenicity, thickness, and vascularity (type, maximum thickness in millimeters, and peak systolic velocity of the vessels in centimeters per second). At the 70-MHz frequency, the morphologic features of the hair follicles, sebaceous glands, and apocrine glands in the lesional area were recorded and correlated with the histologic descriptions of the cases and the literature. In addition, there was a comparison of the lesional tissue with the patterns already reported for the normal skin at both frequencies.[11,12]

The settings were the same for all cases and corresponded to the dermatologic presets previously configured in both machines. In Table 1, we list the main characteristics of the transducers and the settings. The coupling agent was a copious amount of gel that was previously heated at 37°C in a warmer device (Thermasonic gel warmer; Parker Laboratories, Inc, Fairfield, NJ). All of the examinations were performed by the same operator, a senior radiologist trained on dermatologic ultrasound, and the protocol followed the published guidelines for performing dermatologic ultrasound examinations.[13]

Results

The group included 9 patients (67% female and 33% male; mean age: 3 years; age range: 1 month–57 years). Of the total, 89% of the lesions (n = 8) were located in the scalp and 11% (n = 1) in the left cheek. All cases involved the epidermis and dermis.

At 18 MHz, NSJs appeared as hypoechoic bandlike lesions with areas of increased epidermal and dermal thickness, slight epidermal undulation, either the absence or a decreased number of hair follicles, and moderately defined borders. At 70 MHz, in all cases, multiple hyperechoic sebaceous glands were detected in the dermis, some of them clustering in the upper dermis. In the 2 adult cases, sebaceous glands were larger and higher in number in comparison with the pediatric cases. In 89% of cases, multiple areas with distorted and hypoechoic pilosebaceous units, as well as some hypoechoic focal upper dermal areas, were detected. In some segments of the lesions, there were small oval dermal structures adjacent to the pilosebaceous units that presented a "pseudo-ovary" appearance (mixed hypoechoic with anechoic zones) compatible with apocrine glands. In 100% of the patients observed with 70 MHz, the lesions presented parts without hair follicles and some zones with small and thin hair follicles, in addition to epidermal and dermal thickening with slight epidermal undulation.

Table 1. Parameters and Settings of the 18- and 70-MHz Transducers

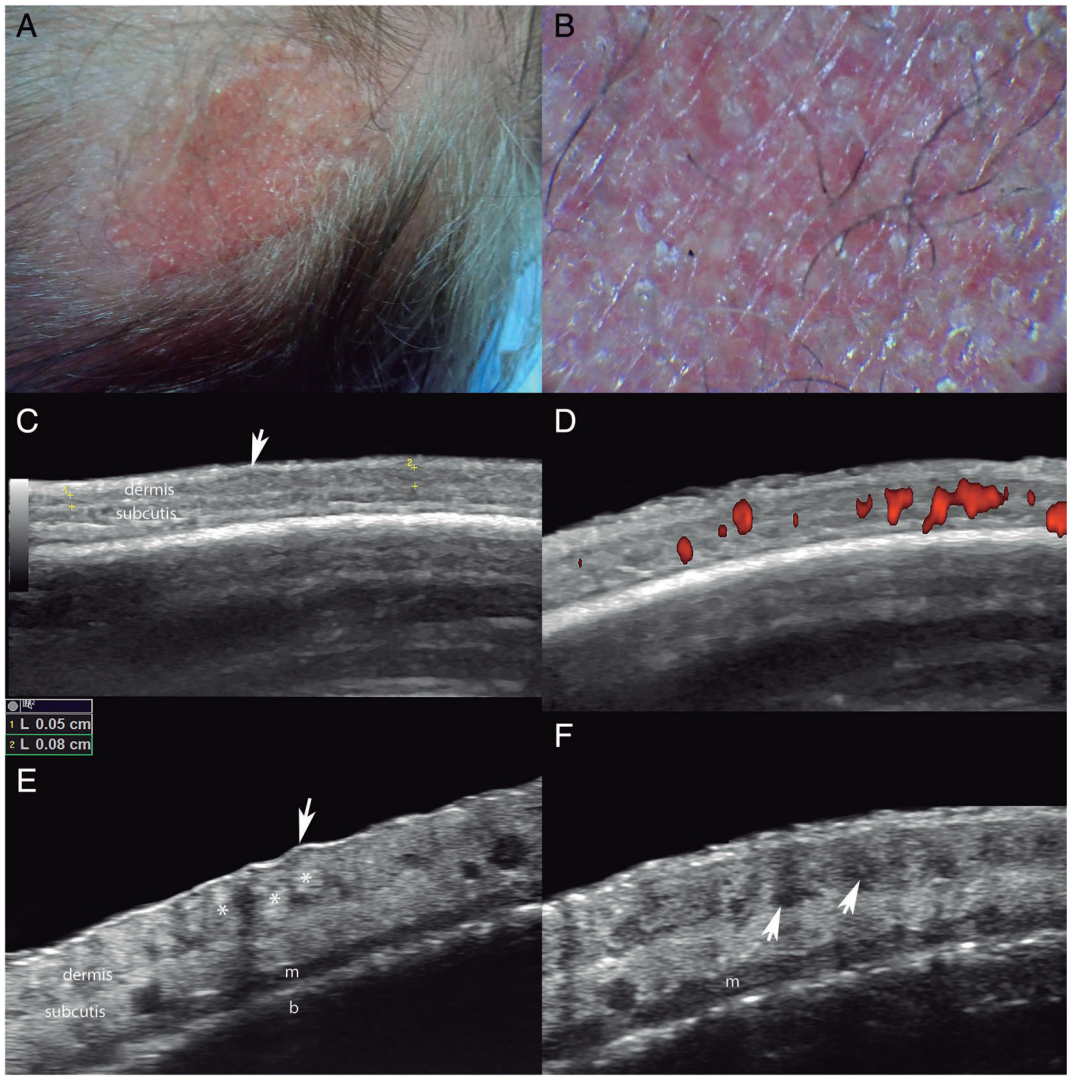
Parameter	18 MHz	70 MHz
Bandwidth, MHz	8–18	29–71
Axial resolution, μm	100	30
Maximum image depth, mm	60	10
Transducer length, mm	25	9.7
Grayscale gain, dB	37	42
Grayscale dynamic range, dB	66	65
Color Doppler frequency, MHz	12.5	40
Doppler wall filter	141	Low[a]

[a]Automatic preset of the machine.

The mean thickness of the lesions was 1.4 mm (SD, 0.7 mm). Increased internal vascularity with slow-flow vessels was detected in 89% of the lesions. Of these, 56% were arterial, and the remaining lesions presented mixed arterial and venous vessels. In 11% (n = 1), no vascularity was detected within the lesion. The maximum mean thickness of these vessels was 0.6 mm (SD, 0.3 mm), and the maximum peak systolic velocity of the arterial vessels was 3.8 cm/s (SD, 1.4 cm/s; Figures 1–6).

In our series, we did not observe a secondary lesion within or at the periphery of the NSJ; however, in the database, 1 adult case presented an NSJ associated with a BCC and was excluded from the study because it was only examined with 18 MHz and lacked the accompanying 70-MHz study. In addition

Figure 1. Nevus sebaceous of Jadassohn in a 1-month-old neonate. **A**, Clinical photograph of the scalp lesion. **B**, Dermoscopy. **C–F**, Ultrasound images (**C** and **D**, at 18 MHz; **C**, grayscale; **D**, color Doppler; **E** and **F**, grayscale at 70 MHz) show mild thickening of the epidermis and dermis, slight undulation of the epidermis (arrows pointing down), and hypoechogenicity of the dermis (between markers and measuring 0.8 mm in comparison with the perilesional area that measures 0.5 mm). In addition, there is increased dermal and subcutis vascularity in **D**. In **E**, there are prominent sebaceous glands (asterisks), and in **F**, there are distorted hypoechoic pilosebaceous units (arrows pointing up); b indicates bony margin of the skull; and m, epicranius muscle.



to sharing similar ultrasound characteristics with the rest of the included cases at 18 MHz, the BCC associated with this NSJ was eccentrically located and presented mixed anechoic-hypoechoic echogenicity with some anechoic oval cystic areas and multiple hyperechoic spots. The histologic result was compatible with an adenoid-cystic subtype of BCC.[14–16]

Neither signs of calcifications nor ultrasound alterations of the subcutis or deeper layers were detected within the lesions. The main ultrasound signs suggestive of NSJ at 18 and 70 MHz are shown in Table 2.

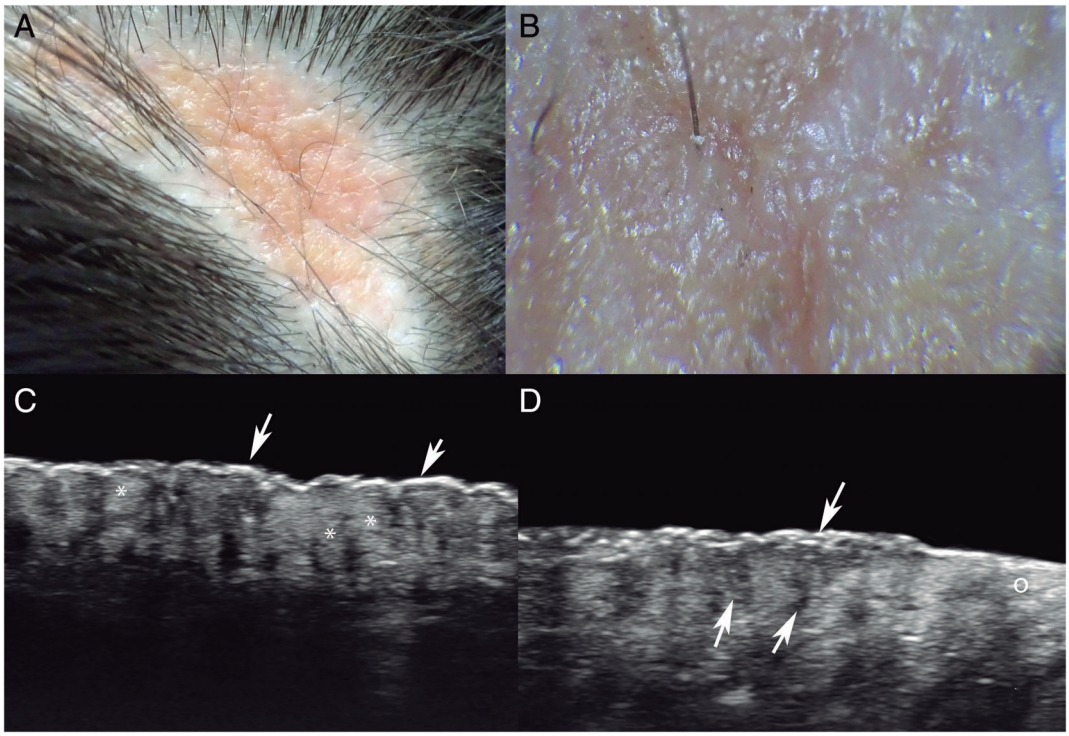
Discussion

The ultrasound morphological findings of NSJ parallel the histologic descriptions (Figure 7)[2,3,5] and provide useful signs to diagnose such a condition. Thus, the provision of a pattern suggestive of NSJ in a basal ultrasound examination might offer the possibility to postpone an early biopsy together with enabling an anatomic follow-up. The latter approach can be of particular relevance in infants, in whom the performance of unnecessary invasive procedures is usually avoided. Since the clinical examination only has access to the epidermal surface, clinicians can suspect the diagnosis, but it is not possible to confirm it just by the naked-eye examination or palpation of the lesion.

Importantly, ultrasound is able to facilitate a differential diagnosis between NSJ and aplasia cutis, another condition that can also present clinically in children as a focal site of alopecia in the scalp. In contrast with NSJ, aplasia cutis presents on ultrasound imaging as a decreased thickness or absence of the dermis and subcutis and sometimes deeper layers, in addition to lacking sebaceous and apocrine glands.[17]

Additionally, ultrasound can help with the early detection of nonmelanoma skin cancer, particularly with the development of BCC, which had widely

Figure 2. Nevus sebaceous of Jadassohn in a 3-year-old child. **A**, Clinical photography of the scalp lesion. **B**, Dermoscopy. **C** and **D**, Gray-scale ultrasound images at 70 MHz show epidermal thickening and undulation (arrows pointing down), an increased number of large sebaceous glands, some of them located in the upper part of the dermis and displacing upward the epidermis (asterisks), distorted and hypoechoic pilosebaceous units (arrows pointing up), and areas with an absence of hair follicles (o).



reported ultrasound morphologic features characterized by hypoechoic lesions with hyperechoic spots.[14–16,18] Although the ultrasound appearance of several of the adnexal tumors associated with NSJ is still not described in the literature, ultrasound can be a warning tool for detecting focal changes of the echo structure or vascularity over time. The latter can support the proper planning of the time of surgery.

Interestingly, there is a difference in the size and number of sebaceous glands between pediatric and adult cases, with such structures being larger and more numerous in adult cases, which also correlates with the histologic reports.[3,5] Consistently, in all cases, sebaceous glands maintain their already described ultrasound morphologic features.[12,19]

The presence of distorted and hypoechoic pilosebaceous units, as well as areas with small, thin, absent, or decreased numbers of hair follicles, also correlates well with the histologic findings. Thus, the presence of villus types of hair follicles and rudimentary follicular buds are some of the characteristic histopathologic findings of NSJ.[3]

Moreover, other ultrasound features, such as hypoechoic upper dermal areas, seem to correspond well

Figure 3. Nevus sebaceous of Jadassohn in a 3-year-old boy. **A**, Clinical photography of the scalp lesion. **B**, Dermoscopy. **C–F**, Ultrasound images (**C** and **D**, at 18 MHz, **C**, grayscale; **D**, color Doppler; **E** and **F**, grayscale at 70 MHz) show epidermal and dermal thickening. Decreased dermal echogenicity (**C**) and hypervascularity of the dermis and subcutis (**D**) are observed at 18 MHz. A slight undulation of the epidermis (arrows pointing down) and distorted hypoechoic pilosebaceous units (arrows pointing up) are detected in **C**, **E**, and **F**; however, these are more evident in **E** and **F**. A hypoechoic upper dermal area (h) is observed in **F**.

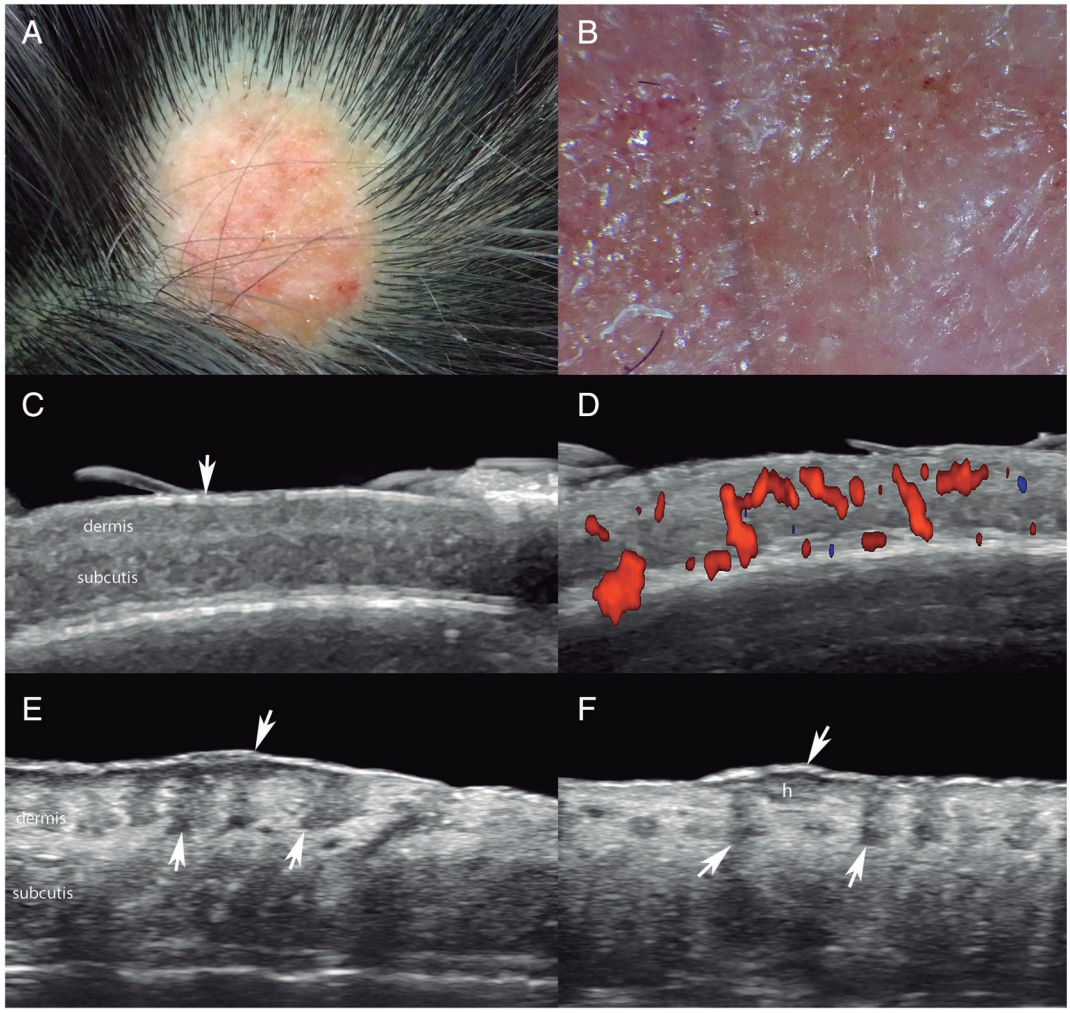
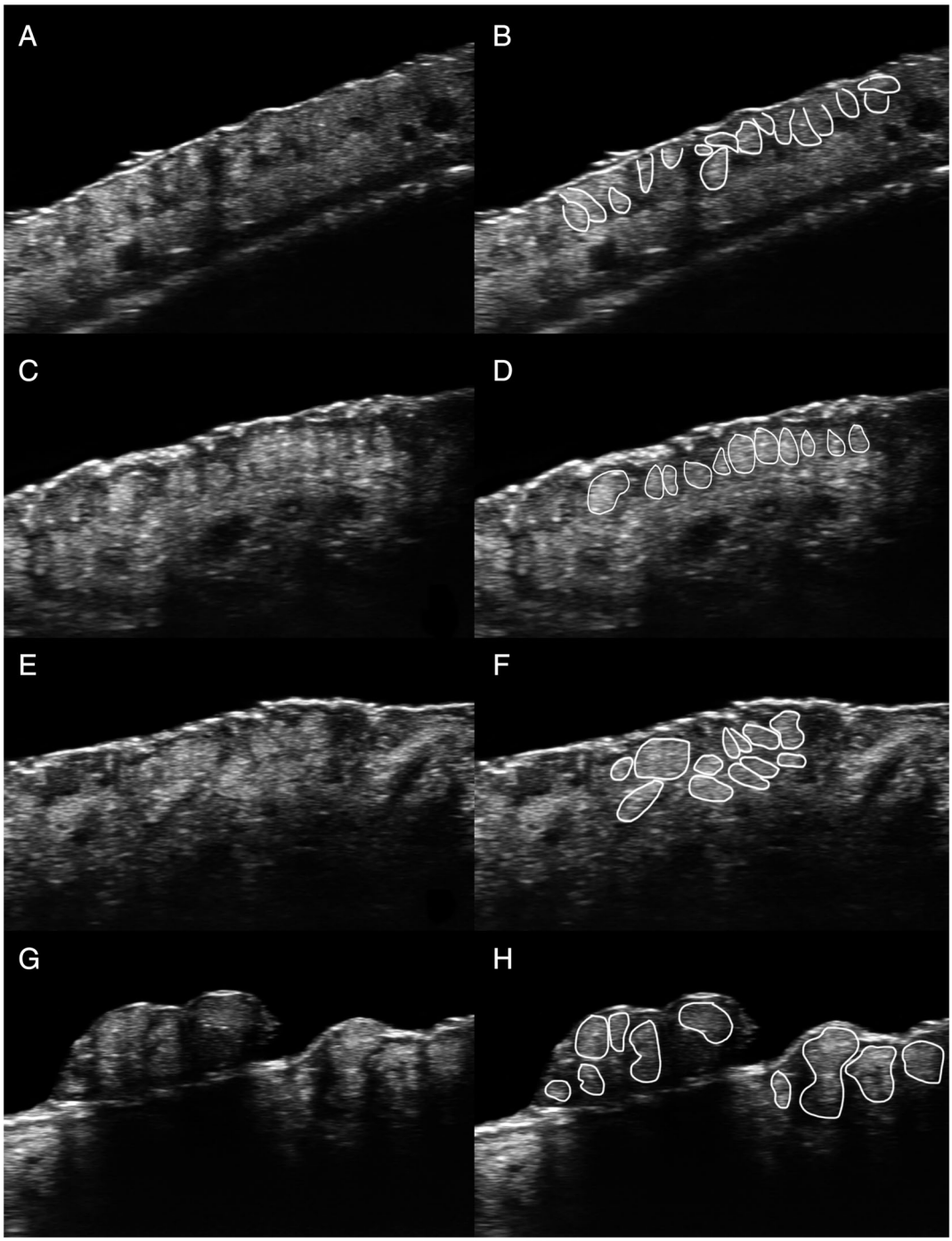


Figure 4. Sebaceous glands in NSJ. Variable sizes, numbers, and distributions of the sebaceous glands from 4 different cases at 70 MHz are shown. (Right and left images are the same; on the right side, the sebaceous glands are outlined). Ages: **A** and **B**, 1 month old; **C** and **D**, 3 years old; **E** and **F**, 26 years old; and **G** and **H**, 57 years old. Notice the more prominent clusters of sebaceous glands in the adult cases (**E–H**) in comparison with the pediatric cases (**A–D**).



with the clusters of rudimentary follicular buds and inflammatory infiltrates. The presence of apocrine glands can also be a useful sign for diagnosing NSJ, since normally, there are no apocrine glands in the dermis of the scalp or the face.[2,3,12] The ultrasound thickening and mild undulation of the epidermis in

Figure 5. Pilosebaceous units in NSJ. Distorted hypoechoic pilosebaceous units (arrows), some of them short, in different cases at 70 MHz are shown. Ages: **A**, 6 months old; **B**, 1 year old; and **C**, 3 years old. Notice the lack of normal hair follicles and the mild thickening and undulation of the epidermis in all cases. Adjacent to the bottom of the pilosebaceous units, there are areas with mixed hypoechoic and anechoic echogenicity that present a pseudo-ovary appearance compatible with small apocrine glands (arrowheads). A hypoechoic upper dermal focal area (h) is also detected.

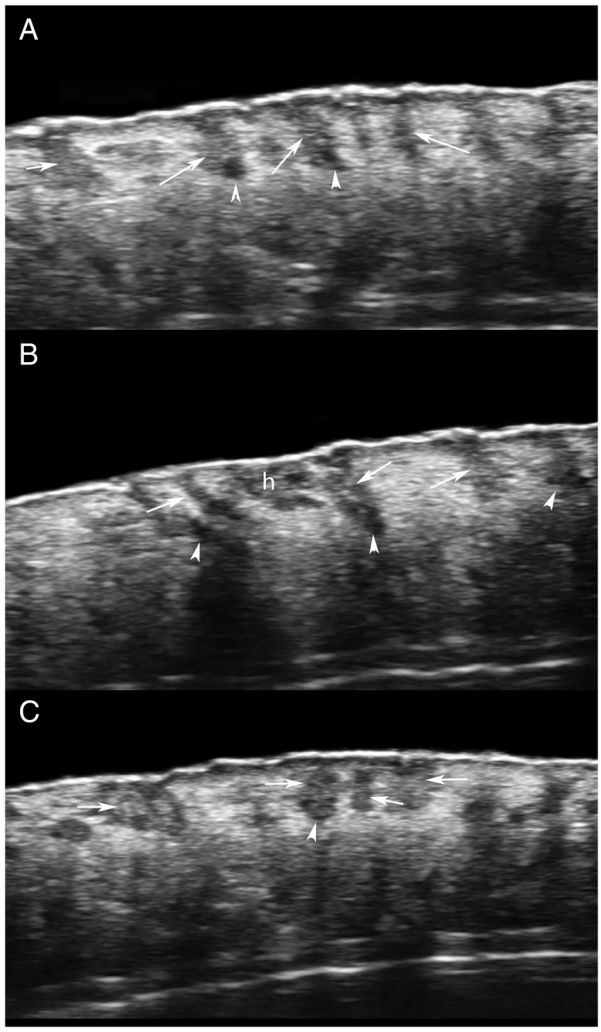


Figure 6. Transitional areas between the normal part and NSJ of the scalp at 70 MHz in 2 different patients. Ages: **A**, 6 months old; and **B**, 1 year old. The white band separates the normal (left) versus the nevus regions. Notice the presence of distorted hypoechoic dermal pilosebaceous units (arrows pointing right) in both cases. In **B**, there is an area without pilosebaceous structures (o). Thickening and slight undulation of the epidermis are also detected. A hypoechoic upper dermal area (h) is observed in **B**. Terminal hair follicles (arrows pointing left) are shown on the left side of both images. Hair tracts (arrows pointing down) with a bilaminar appearance are observed in **A**.

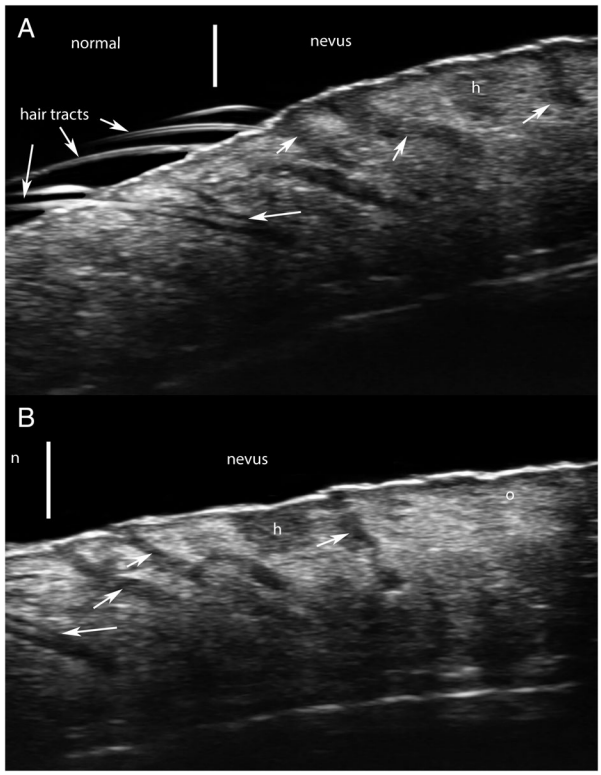


Table 2. Ultrasound Signs of NSJ

Ultrasound Sign	18 MHz	70 MHz
Bandlike hypoechoic structure	+	+
Epidermal increased thickness	+	+
Dermal increased thickness	+	+
Slight epidermal undulation	+	+
Prominent sebaceous glands	NA	+
Short, distorted, and hypoechoic pilosebaceous units	NA	+
Focal hypoechoic upper dermal areas	NA	+
Small perifollicular areas with a pseudo-ovary appearance	NA	+
Slow flow vascularity	+	+

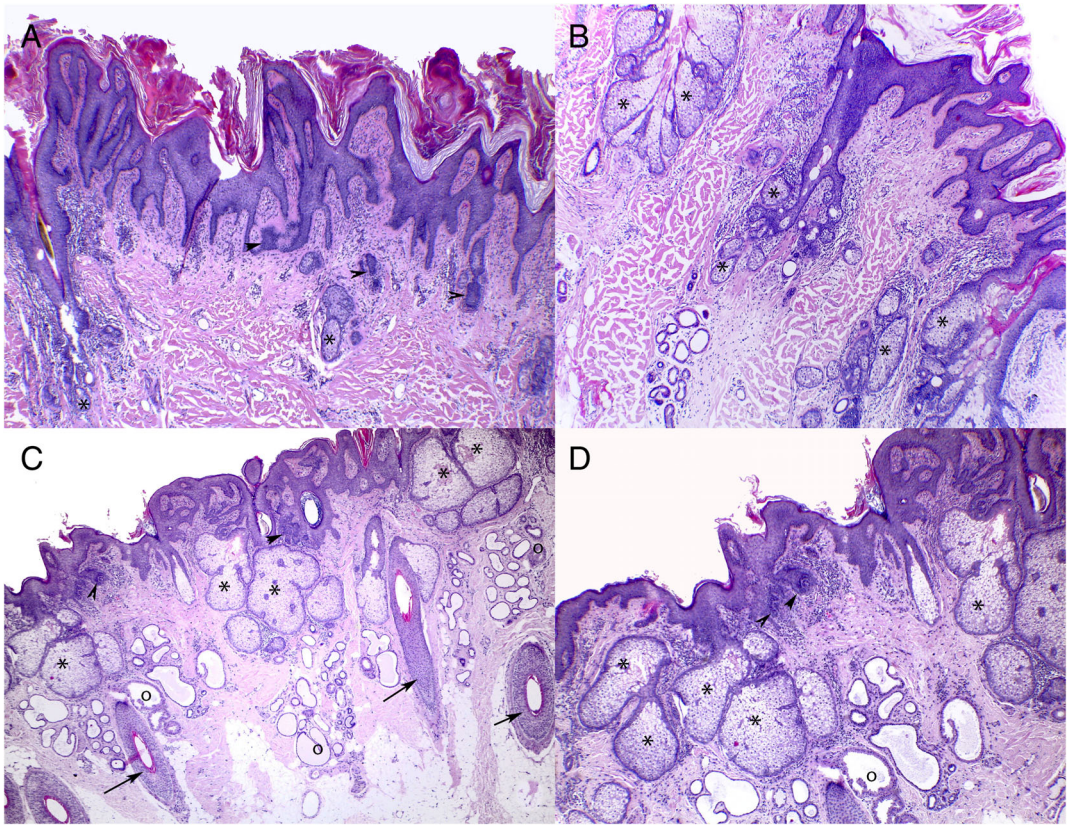
NA indicates not available because of the lower axial resolution.

NSJ correlates with the histologic presence of acanthosis (ie, overgrowth of the stratum spinosum of the epidermis) and papillomatosis (ie, a hyperkeratotic and undulating appearance of the epidermis usually associated with hyperplasia).[2,3]

Although a limitation of this series is the small number of cases, to our knowledge, this article represents the first ultrasound description of NSJ. Other limitations are related to the capabilities of ultrasound, which are the lack of detection of abnormalities of 0.1 mm or smaller at 18 MHz and 0.03 mm or smaller at 70 MHz.[12,20]

Even though the images at 70 MHz are clearly closer to the histologic findings, it should be kept in mind that higher frequencies have a lower depth of penetration and color Doppler sensitivity. Therefore, considering the performance of a standardized dermatologic protocol (for studying any type of dermatologic lesion and ruling out a simulator of a dermatologic lesion), it would be useful to start with a frequency of 18 MHz (≥15 MHz according to the guidelines for performing dermatologic examinations[13]). This would allow us to confirm the epidermal and dermal location of the alteration, check the patterns of vascularity, and then move to a higher-frequency transducer such as 70 MHz to get a better definition of the abnormalities.

Figure 7. Histologic specimens of NSJ (hematoxylin–eosin) of different ages. **A** and **B**, Child case (11 years old). **A**, Panoramic view (original magnification ×200). Several rudimentary hair structures (arrowheads) and very few and tiny sebaceous glands (asterisks) are shown. The surface of the lesion presents papillomatosis and hyperkeratosis, and there is a dermal lymphocytic infiltrate. **B**, A few small sebaceous glands (asterisks) with rudimentary follicular buds are shown (original magnification ×200). **C** and **D**, Adult case (57 years old). **C**, Panoramic view (original magnification ×200). Multiple and large sebaceous glands (asterisks) and some apocrine glands (o) in the deep dermis are shown. There are a few rudimentary follicular buds (arrowheads) and some terminal hair follicles (arrows), which are located in the dermohypodermic junction and the hypodermis. **D**, Large sebaceous glands (asterisks), dilated apocrine glands (o), and 2 rudimentary hair follicles (arrowheads) are shown (original magnification ×400).



Since nowadays, 70-MHz transducers are not available everywhere because they are mostly found in some advanced and research centers, it is also possible to look for suggestive signs of NSJ at 18 MHz. The use of 18 MHz may additionally support the differential diagnosis with other conditions such as aplasia cutis[17] or detect a BCC within the NSJ.[14,16,18]

In conclusion, color Doppler ultrasound can be a potent tool to support the early diagnosis and assist in the follow-up of NSJ.

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