

ORIGINAL ARTICLE

Ultrasonography patterns of atopic dermatitis in children

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Abstract

Background: Atopic dermatitis (AD) is one of the most common allergic diseases in children. The aim of the study was to evaluate the ultrasound picture of lesional and non-lesional skin in children with AD.

Materials and Methods: The study included a group of children with AD and a control group. Inclusion criteria were as follows: age 0-8 years and clinical diagnosis of AD. An ultrasound scanner with a 75 MHz transducer probe was used to produce B-mode skin images in lesions and non-lesional skin. The thickness and the echogenicity of epidermis, dermis, and subepidermal low-echogenic band (SLEB) were measured, and the ratio coefficient per body site was calculated.

Results: Ultrasonography of non-lesional skin in children with AD showed uneven epidermis contour, a tendency to increased epidermis and decreased dermis thickness, and the SLEB was observed in 77% of cases. In lesions, there was an increased thickness and a decreased echogenicity of epidermis and dermis, and epidermis had irregular contours in most cases. The SLEB was in all lesions, showing greater thickness and lower echogenicity compared with non-lesional skin.

Conclusion: HF-USG of the skin allows visualizing the epidermal barrier disruption and inflammation in dermis in children with AD on the entire surface of the skin.

KEYWORDS

atopic dermatitis, children, high-frequency ultrasound, subepidermal low-echogenic band

1 | INTRODUCTION

Atopic dermatitis (AD) is one of the most common allergic diseases in children.¹⁻³ Its prevalence among children is 15%-30%.^{4,5}

High-frequency ultrasonography (HF-USG) is used in various fields of dermatology, but requires more researches to be introduced into routine clinical practice. Nowadays, there is a problem of standardization of the method, of appropriate terminology, and of ultrasound criteria for assessing of skin diseases.⁶ Thus, it is necessary to accumulate and analyze a sufficient amount of data. To this day, information about skin ultrasound in young children with AD is not enough. Therefore, the aim of our research was to study ultrasound picture of the skin in children with AD.

2 | PATIENTS AND METHODS

2.1 | Patient and inclusion criteria

Twenty-two atopic dermatitis patients (eight boys and 14 girls) aged 0-8 years (mean $\pm$ SD = 3.7 $\pm$ 2.4) from outpatient dermatology clinics were included in the study. AD was diagnosed using Hanifin and Rajka's criteria. The SCORAD index was used to evaluate the clinical severity of AD. Disease severity was classified as mild (objective SCORAD < 15), moderate (objective SCORAD 15-40), and severe (objective SCORAD > 40). Eight patients were assessed as mild AD, eight were moderate, and six were severe patients.

Eighteen healthy children (seven boys and 11 girls) aged 0–8 years (mean SD = 3.9 ± 2.2) were included in the control group.

All parents of children provided their written informed consent before inclusion in the study.

2.2 | Study method

Skin ultrasonography was performed using a probe with a frequency of 75 MHz (Technical Product Marketing, Hamburg). Ultrasound beam penetration into the tissue was approximately 4 mm. Ultrasound examination in the form of presentation B was performed in selected representative regions of AD (cheek, ulnar, and popliteal fossae areas, in lesions of AD and healthy skin around). The results are presented in the form of ultrasound images (384×1024 pixel image, 12.8 mm of skin length).

A total of 133 sonograms of patients with AD and 108 sonograms of healthy children were performed in typical for AD regions (cheek, ulnar, and popliteal fossae areas). A total of 88 sonograms of patients with AD were performed in other inflammatory skin regions. The total number of ultrasound images was 329.

The echogenicity and thickness of the skin layers (epidermis and dermis) were observed with digital ultrasound imaging system (DUB®) from taberna pro medicum GmbH. Sonographic characteristics of epidermis and dermis were individual, and we could not compare results between patients with AD and healthy children. We introduced the ratio coefficient (RC). RC is the ratio of scanogram's data in the lesion with scanogram's data on the surrounding healthy skin.

2.3 | Statistical methods

To analyze statistically significant differences between scanograms of AD and healthy skin, the nonparametric test ANOVA was used to appropriate. The difference of the results from different parts of the skin echogenicity and thickness was considered to be statistically significant if P value was $< .05$. The median was used as the measurement of the thickness and the echogenicity of skin layers [25; 75 percentile]. The ratio coefficient was assessed by means of the standard deviation.

3 | RESULTS

3.1 | The group of children without AD

Ultrasound of the skin in children without AD in all regions showed two layers: epidermis and dermis. The epidermis was a hyperechoic narrow band. The dermis was the underlying less hyperechoic layer (Figure 1). The dermoepidermal junction was smooth.

The thickness of the epidermis was variable. The lowest epidermis thickness was in the cheek area skin ($59.5 [54.0; 68.0] \mu\text{m}$), the highest—in the ulnar and popliteal fossae skin ($101.0 [90.0; 103.5]$ and $106.0 [81.5; 110.0] \mu\text{m}$, respectively; Table 1). The highest epidermis echogenicity was in the popliteal fossa skin ($114.5 [91.5; 123.0] \text{cu}$), the lowest—in the cheek skin ($76.0 [60.5; 98.5] \text{cu}$).

The highest dermis thickness was in the area of popliteal fossa skin (up to $1597.5 [958.25; 1710.0] \mu\text{m}$), the lowest—in the ulnar fossa skin ($1118.0 [1034.0; 1677.0] \mu\text{m}$; Table 1). The highest dermis echogenicity was in the area of popliteal fossa skin ($16.0 [14.0; 24.0] \text{cu}$), the lowest—in the cheek skin ($6.5 [6.0; 67.75] \text{cu}$).

The SLEB was in skin of four children (22% of cases) without AD. In one child, it was in the area of ulnar fossa skin and in three children—in the popliteal fossa skin. The highest SLEB thickness was in the area of popliteal fossa skin ($92 \mu\text{m}$), the lowest—in the ulnar fossa skin ($53 \mu\text{m}$). The highest SLEB echogenicity was in the area of ulnar fossa skin (13cu), the lowest—in the popliteal fossa skin (4cu).

3.2 | The group of children with AD

Ultrasound of the skin in children with AD in different regions is in the Table 2. The images of the ultrasound picture of non-lesional skin in patients with SCORAD < 15 (Figure 2), SCORAD = 15–40 (Figure 3), and SCORAD > 40 (Figure 4) are presented.

The highest epidermis thickness of non-lesional skin was in the regions of popliteal fossa ($141.0 [113.0; 169.0] \mu\text{m}$), the lowest—in the cheek area ($57.0 [54.0; 70.0] \mu\text{m}$; Table 2). The highest epidermis density was in the skin of popliteal fossa ($115.0 [99.0; 139.0] \text{cu}$), the lowest—in the cheek regions ($78.0 [65.0; 92.0] \text{cu}$). The epidermis

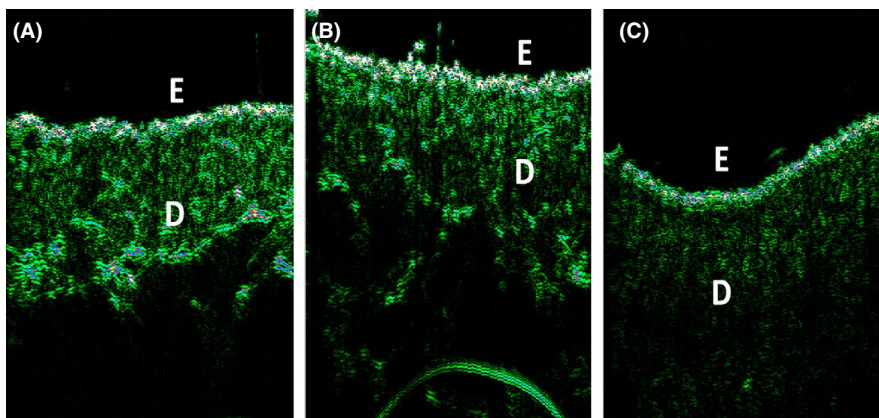


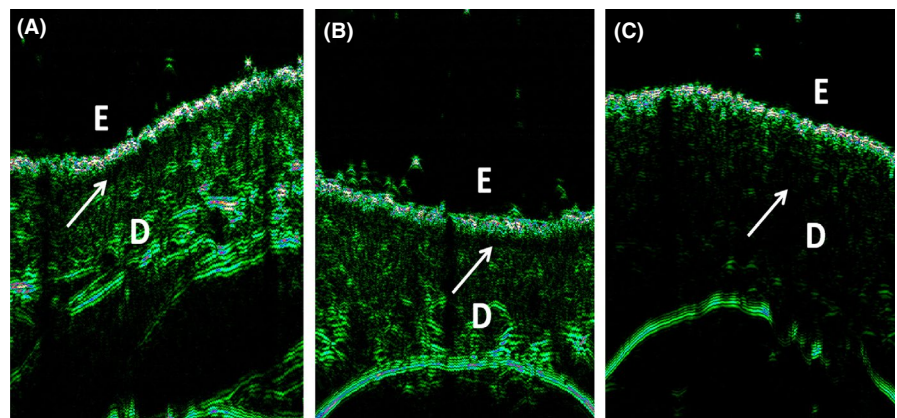
FIGURE 1 Ultrasound picture of healthy skin in the area of ulnar fossa (A), popliteal fossa (B), and cheek (C) in a patient without AD (E—epidermis, D—dermis). 75 MHz sensor. Scanning depth 4 mm

TABLE 1 The average thickness and echogenicity of the epidermis and dermis in children without atopic dermatitis (median [25; 75 percentile])

	Thickness of epidermis, μm	Echogenicity of epidermis, cu	Thickness of dermis, μm	Echogenicity of dermis, cu
Left cheek	61.0 [54.0; 69.5]	76.0 [60.5; 98.5]	1270.0 [1082.8; 1479.0]	6.5 [6.0; 67.8]
Right cheek	59.5 [54.0; 68.0]	86.5 [78.75; 99.8]	1327.0 [1222.5; 1516.3]	8.0 [7.0; 9.8]
Left ulnar fossa	101.0 [90.0; 103.5]	85.0 [74.5; 99.5]	1188.0 [1032.5; 1377.5]	13.0 [9.5; 14.5]
Right ulnar fossa	75.0 [73.5; 105.5]	79.0 [65.5; 100.5]	1153.0 [1001.5; 1177.5]	12.0 [9.5; 17.0]
Left popliteal fossa	106.0 [81.5; 110.0]	103.0 [96.5; 122.5]	1118.0 [1034.0; 1677.0]	16.0 [14.0; 24.0]
Right popliteal fossa	96.5 [92.0; 104.8]	114.5 [91.5; 123.0]	1597.5 [958.3; 1710.0]	15.0 [14.0; 17.8]

TABLE 2 The average values of the thickness and echogenicity of the epidermis and dermis in the foci (f) and in the area of apparently healthy skin (h) in children with atopic dermatitis, (median [25; 75 percentile])

	Thickness of epidermis, μm	Echogenicity of epidermis, cu	Thickness of dermis, μm	Echogenicity of dermis, cu	Thickness of SLEB, μm	Echogenicity of SLEB, cu
Left cheek, h	62.0 [53.0; 70.0]	94.0 [60.0; 107.0]	1219.0 [1096.0; 1590.0]	6.0 [5.0; 11.0]	106.0 [77.0; 110.0]	4.0 [3.0; 5.0]
Right cheek, h	57.0 [54.0; 70.0]	78.0 [65.0; 92.0]	1237.0 [1039.0; 1500.0]	7.0 [5.0; 8.0]	99.0 [98.0; 100.0]	4.0 [3.0; 5.0]
Left ulnar Fossa, h	79.0 [74.0; 88.0]	96.0 [80.0; 111.0]	973.0 [832.0; 1285.0]	18.0 [12.0; 22.0]	68.0 [60.0; 77.0]	4.5 [3.0; 7.0]
Left ulnar Fossa, f	123.0 [90.0; 132.0]	74.0 [67.0; 127.0]	1558.0 [1213.3; 1712.3]	8.5 [7.0; 11.8]	125.5 [105.5; 137.3]	2.0 [2.0; 3.3]
Right ulnar fossa, h	88.0 [67.0; 114.0]	100.0 [78.0; 122.0]	1010.0 [893.0; 1157.0]	14.0 [12.0; 18.0]	79.0 [56.3; 92.0]	4.0 [3.25; 4.8]
Right ulnar fossa, f	109.0 [101.0; 114.0]	82.0 [63.0; 103.0]	1407.5 [1318.3; 1672.3]	7.0 [5.0; 10.3]	106.0 [101.0; 116.5]	2.0 [2.0; 2.0]
Left popliteal fossa, h	92.0 [79.0; 106.0]	115.0 [99.0; 139.0]	1175.0 [1012.0; 1219.0]	17.0 [14.0; 21.0]	84.0 [72.5; 90.0]	5.0 [4.0; 6.0]
Left popliteal fossa, f	141.0 [113.0; 169.0]	91.5 [86.5; 98.8]	1434.5 [1310.5; 1642.5]	5.5 [5.0; 12.3]	114.0 [110.8; 127.3]	2.0 [2.0; 3.3]
Right popliteal fossa, h	84.0 [75.0; 101.0]	105.0 [92.0; 117.0]	1098.0 [858.0; 1347.0]	14.0 [12.0; 20.0]	84.0 [75.0; 88.0]	6.0 [5.0; 10.0]
Right popliteal fossa, f	109.0 [87.25; 126.25]	80.5 [69.0; 92.0]	1421.0 [1307.0; 1621.3]	7.5 [6.25; 8.0]	114.0 [110.0; 119.0]	2.0 [2.0; 3.0]

FIGURE 2 Ultrasound picture of apparently healthy skin in the area of ulnar fossa (A), popliteal fossa (B), and cheek (C) in a patient with AD (SCORAD < 15; E—epidermis, D—derma, SLEB is marked by an arrow). 75 MHz sensor. Scanning depth 4 mm

thickness in lesions ranged from 109.0 [87.25; 126.25] to 141.0 [113.0; 169.0] μm , and the echogenicity was from 74.0 [67.0; 127.0] to 91.5 [86.5; 98.75] cu.

The unevenness of the epidermis contours was observed with any degree of severity of AD, both in non-lesional skin in 59% and in lesions—in 68% of cases.

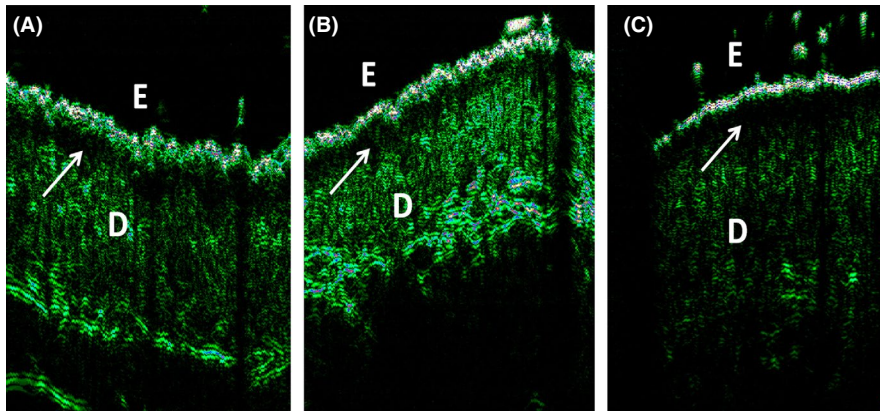


FIGURE 3 Ultrasound picture of apparently healthy skin in the area of ulnar fossa (A), popliteal fossa (B), and cheek (C) in a patient with AD (SCORAD 15-40), (E—epidermis, D—derma, SLEB is marked by an arrow). 75 MHz sensor. Scanning depth 4 mm

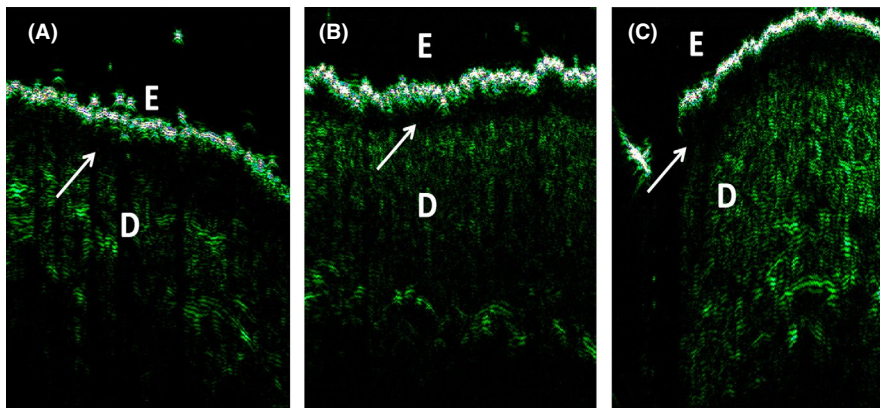


FIGURE 4 Ultrasound picture of apparently healthy skin in the area of ulnar fossa (A), popliteal fossa (B), and cheek (C) in a patient with AD (SCORAD > 40), (E—epidermis, D—derma, SLEB is marked by an arrow). 75 MHz sensor. Scanning depth 4 mm

TABLE 3 The average ratio coefficient in patients with atopic dermatitis, depending on the severity of the disease (mean $\pm$ SE)

SCORAD	Thickness of epidermis	Echogenicity of epidermis	Thickness of dermis	Echogenicity of dermis	Thickness of SLEB
<15	0.941 $\pm$ 0.050*	0.885 $\pm$ 0.311	0.809 $\pm$ 0.103	1.500 $\pm$ 0.098	0.943 $\pm$ 0.378
15-40	0.805 $\pm$ 0.125*	1.370 $\pm$ 0.526	0.802 $\pm$ 0.121*	2.087 $\pm$ 0.911*	1.002 $\pm$ 0.251
>40	0.725 $\pm$ 0.195*	1.510 $\pm$ 0.368*	0.789 $\pm$ 0.153*	2.288 $\pm$ 0.995*	0.856 $\pm$ 0.312

*The differences are significant compared with the values of healthy skin, $P < .05$.

The highest dermis thickness in non-lesional skin was in the cheek area (1237.0 [1039.0; 1500.0] μ m), the lowest—in the ulnar fossa (973.0 [832.0; 1285.0] μ m; Table 2). The highest dermis echogenicity was in the ulnar fossa area (18.0 [12.0; 22.0] cu), the lowest—in the cheek (6.0 [5.0; 11.0] cu). The dermis thickness in lesions ranged from 1407.5 [1318.25; 1672.25] to 1558.0 [1213.25; 1712.25] μ m, the echogenicity—from 5.5 [5.0; 12.25] to 8.5 [7.0; 11.75] cu.

The SLEB was observed in non-lesional skin in all the studied areas. In 17 children (77%), the SLEB was observed at least in one site of apparently healthy skin. The maximum thickness of the SLEB was 106.0 [77.0; 110.0] μ m in the cheek area, the minimum—68.0 [60.0; 77.0] in the ulnar fossa (Table 2). The highest SLEB echogenicity of non-lesional skin was in the popliteal fossa area (6.0 [5.0; 10.0] cu), the lowest—in the cheek (4.0 [3.0; 5.0] cu) and the ulnar fossa (4.0 [3.25; 4.75] cu). In the area of all foci, the SLEB was visualized, its thickness ranged from 106.0 [101.0; 116.5] to 125.5 [105.5; 137.25] μ m, and the echogenicity averaged 2.0 cu.

In patients with mild severity of AD (SCORAD < 15), an increase in the thickness of epidermis (average indicators of RC = 0.941 $\pm$ 0.050) was observed in lesions compared with non-lesional skin. There was no significant difference between the echogenicity of epidermis and between the thickness and the echogenicity of dermis in non-lesional skin and in rash areas (Table 3). The SLEB was visualized in non-lesional skin in 62% of cases.

In patients with moderate severity of AD (SCORAD = 15-40), an increase in epidermis and dermis thickness and a decrease in dermis echogenicity were observed, compared to visually healthy skin. The epidermis echogenicity was comparable to that in non-lesional skin (Table 3, Figures 5-7). In 75% of cases, the SLEB was visualized in the area of non-lesional skin.

In patients with severe AD (SCORAD > 40), an increased epidermis thickness and a decreased epidermis echogenicity were observed. The dermis thickness was significantly increased, and its echogenicity was reduced (Table 3). The SLEB was observed in non-lesional skin in 100% of cases.

4 | DISCUSSION

Atopic dermatitis (AD) is a multifactorial inflammatory skin disease. The diagnosis of AD is made clinically because there are no biomarkers and objective diagnostic methods to establish the diagnosis of AD and to distinguish it from other chronic dermatoses.

HF-USG is a diagnostic technique that allows for a detailed analysis of skin structures and to determine skin thickness and density *in vivo*, in real time that is comparable to a histological examination of the skin.^{7,8} With help of ultrasound, it is possible to visualize pathological processes in the skin and to evaluate the effectiveness of therapy with fixing the stages of resolving of the inflammatory process and restoring of normal structure of the skin in conditions of dynamic observation of patient.

The advantages of HF-USG are its versatility, unlimited reproducibility with high diagnostic accuracy, and absence of risk to the patient. This non-invasive method is absolutely painless, and it is extremely important for working with children who are mostly diagnosed with AD.

Before evaluation of ultrasound patterns of AD, we need to understand that this dermatosis is associated with both disruption of the epithelial skin barrier and allergic inflammation in the skin.⁹ HF-USG allows us to see these features; therefore, ultrasonic skin picture of patients with AD has inherent changes compared to healthy skin, such as changes in the thickness of the skin layers, decrease in their echogenicity, and presence of the SLEB. We were tasked to investigate the features of these patterns in the skin of children with AD aged from 0 to 8 years old. In addition, to assess the differences in the skin parameters in the area of rash and in the area of non-lesional skin, the ratio coefficient was first time introduced.

Disruption of the epithelial skin barrier is a part of pathogenesis of AD which is largely associated with filaggrin (FLG) dysfunction. FLG is a protein presented in the epidermis which is important for normal desquamation, for maintaining the skin barrier and for skin hydration.⁹⁻¹¹ In our research, we identified changes in contour of the epidermis, namely its uneven external and internal outlines, in the area of lesions, and in

the area of non-lesional skin in patients with AD. Similar changes of the epidermis have also been described in the literature.¹¹ These structural changes could be due to mutation in the FLG gene. Besides, we found that, regardless of the severity of AD, ultrasonography showed an increase in the thickness of the epidermis in lesions. In case of mild severity of the disease, minimal changes were detected on the scans. In severe course of AD, the epidermis echogenicity was reduced.

Inflammation in the skin, as was mentioned, also has its ultrasound pattern. In inflammatory dermatoses, such as AD, the subepidermal low-echogenic band (SLEB) is the main ultrasonographic characteristic that can be easily detected. The SLEB is observed mainly due to edema and inflammatory cell infiltration of the papillary dermis that is correlated with the severity of the disease. The thickness of the SLEB is correlated with the degree of hyperkeratosis, parakeratosis, spongiosis, and the intensity of inflammatory infiltration.^{8,12-16} Moreover, there was a high correlation between the density of the SLEB and the skin-redness which is most prominent in the acute inflammatory stage and is caused by dilatation and elongation of the capillaries.¹⁷

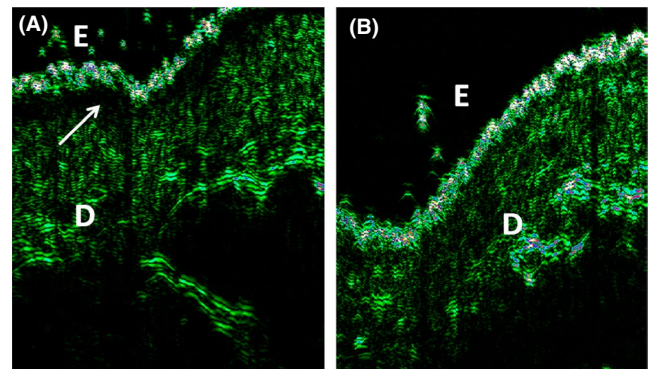


FIGURE 6 Ultrasound picture of the foci (A) and of apparently healthy skin (B) in the area of ulnar fossa in a patient with AD (SCORAD 15-40); (E—epidermis, D—derma, SLEB is marked by an arrow). 75 MHz sensor. Scanning depth 4 mm

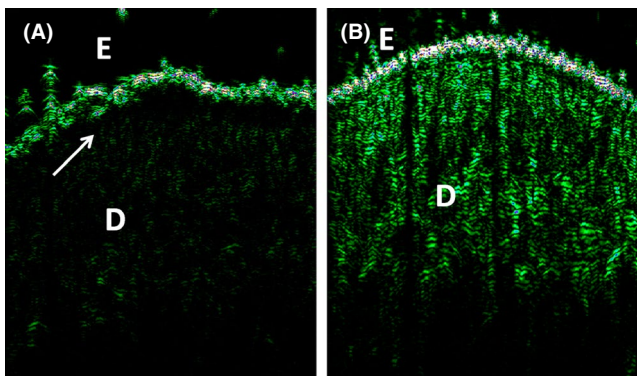


FIGURE 5 Ultrasound picture of the foci (A) and of apparently healthy skin (B) in the cheek area in a patient with AD (SCORAD 15-40; E—epidermis, D—derma, SLEB is marked by an arrow). 75 MHz sensor. Scanning depth 4 mm

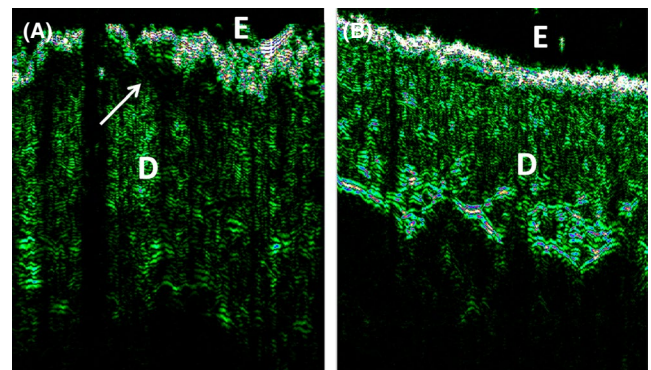


FIGURE 7 Ultrasound picture of the foci (A) and of apparently healthy skin (B) in the area of popliteal fossa in a patient with AD (SCORAD 15-40; E—epidermis, D—derma, SLEB is marked by an arrow). 75 MHz sensor. Scanning depth 4 mm

However, the presence of the SLEB is not pathognomonic for AD. First, it was described during examination of photo-damaged skin. It can also be observed in malignant T-cell lymphomas.¹⁸ In inflammatory skin diseases like AD, eczema, and psoriasis, the SLEB of varied thickness in combination with decreased echogenicity of the other layers as another pattern of inflammatory infiltration may be shown in lesions. Furthermore, the echogenicity of the dermis is one of the main relevant parameters, influenced by several factors, such as orientation of collagen fibers, ground substance, and water content. Fiber damage will lower the echogenicity of the dermis.¹⁶

In our research, in patients with mild severity of AD the dermis in the lesion area was unchanged. In patients with moderate and severe AD, an increase of the thickness and a decrease of the echogenicity were found in upper layers of dermis, which confirms an inverse correlation between the level of skin echogenicity and the intensity of inflammatory infiltration.¹¹ Turns out that, the lower is echogenicity, the more pronounced inflammatory process is, accompanied by edema and infiltration by inflammatory cells. The absence of changes in patients with SCORAD < 15 may indicate a minimal degree of inflammation.

The SLEB was observed in all groups of patients with AD in lesions, but it was also visualized in healthy skin. The thickness of the SLEB was greater in lesions, and its echogenicity was 2-3 times lower in lesion than in apparently healthy skin.

Analogous to our one, another research was conducted with a group of 10 patients aged from 15 to 74 years and diagnosed with AD, and index SCORAD was more than 25. It was shown that AD affects the overall skin barrier, with presence of the SLEB. In this study, the non-lesional SLEB thickness was 12 times lower than the lesional one; the non-lesional skin thickness was 1.3 times lower than the lesional one; and the non-lesional echogenicity was 1.6 times higher than in lesions.¹⁹ Similar results were observed in our study among children aged from 0 to 8 years (Table 1): The thickness of the SLEB was greater in the area of lesions; the SLEB echogenicity was lower in the area of lesions; the thicknesses of the epidermis and the dermis was higher in the lesions; and the echogenicity was higher in non-lesional skin in children with SCORAD index more than 15.

Other studies have also shown changes in the structure of unaffected skin,¹¹ supporting the hypothesis of a failure of the barrier and involving in the inflammatory process of the entire surface of the skin. It is known that the increase in the indices of transepidermal water loss during AD is increased both in affected and unaffected skin surface, as well as significantly reduced content of ceramides, increased level of epidermal proliferation, and reduced filaggrin expression. Accordingly, "healthy" skin in patients with AD may differ from healthy skin of people without dermatoses.¹³

In our study, we also decided to compare ultrasonic pictures of the skin in children without AD and of the apparently healthy skin in children with AD in similar areas. There was no significant difference in the echogenicity of the epidermis and dermis between two groups. At the same time, there was a tendency to an

increase in the thickness of the epidermis in the group of children with atopic dermatitis (the median, the 25th percentile, and 75th percentile were 1.3, 1.4, and 1.5 times greater, respectively). The minimum index of the thickness of the epidermis was commensurable in both groups.

On the contrary, the maximum thickness of the dermis tended to decrease in the group of children with AD (the median was 1.3 times less), as well as the minimum thickness of the dermis (the 75th percentile was 1.3 times less).

In the group of children with AD, the SLEB was observed at least in one of the areas of apparently healthy skin in 17 of 22 children (77% of cases) and was visualized in all of the studied areas. In the group of children without AD, the SLEB was observed in four of 18 children (22% of cases) and was visualized in the areas of ulnar and popliteal fossae. The SLEB, visualized in the healthy skin of children without AD, probably corresponds to the unaltered papillary layer of the dermis, which can be visualized by using a sensor with a frequency of >50 MHz, because such a frequency allows distinguishing more delicate structures, such as transition of the epidermis into the dermis.⁷ The maximum thickness of the SLEB was similar in children of both groups, but the minimum thickness was 1.3 times greater in the group of children with AD. The minimum indexes of the SLEB echogenicity also did not differ among both groups, while the maximum echogenicity was 2.2 times lower in the group of children with AD.

The presence of the SLEB in the area of healthy skin may indicate the presence of subclinical inflammatory process that may lead to occurrence of exacerbation in these areas in the future. Thus, it is advisable to use proactive therapy on these sites and to care for the entire surface of the skin, also during remission.

As the SLEB thickness measurement correlates with the severity of skin lesions in patients with AD, it can be used as an objective parameter for monitoring the course of disease.¹⁶ And HF-USG is the only available method of monitoring the invisible inflammation with the naked eye and, apparently, promising for a complete assessment of patients. Observation of the SLEB within intact skin may reflect patients who will benefit most from proactive treatment.²⁰

5 | CONCLUSION

With the using of HF-USG, we demonstrated that:

1. The ultrasonic picture of non-lesional skin of children with AD differs from healthy skin in children without AD: It has uneven contours of the epidermis in 59% of cases, a tendency to increased epidermis thickness and to decreased dermis thickness; the presence of the SLEB was observed in 77% of cases with lower echogenicity compared to the control group.
2. In lesional skin of patients with AD, increased epidermis and dermis thickness and decreased epidermal and dermal echogenicity were observed, and the severity of these changes depended on the severity of AD. In all lesion regions, the SLEB was visualized, its thickness was greater, and its echogenicity was lower in lesions

than in non-lesional skin; the lesional epidermis had irregular contours in 68% of cases.

Thus, ultrasound of the skin allows to visualize two main components of pathogenesis of AD: the epidermal barrier disruption (presented by the thickening and the irregularity of the epidermis contours) and inflammation in the dermis (presented by the SLEB, thickening of the dermis and reduction of its echogenicity) both in lesional and non-lesional skin of children with AD. In addition, this diagnostic method can be used for monitoring of the course of the disease.

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