

**Original article:**

## **High resolution ultrasonography in dermatology; a psoriasis experience**

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**Abstract:**

**Context:** Ultrasonography has been increasingly used in dermatology as in inflammatory diseases like psoriasis as a tool for evaluation. Psoriasis is a common chronic inflammatory disease of the skin characterized by the presence of erythematous plaques. Severity of the psoriasis is determined by the area of involvement, intensity of the inflammation and elevation of the plaques. High-resolution variable frequency ultrasound imaging can be used increasingly for noninvasive objective evaluation of psoriasis lesions.

**Methodology:** This is a cross sectional study; 30 patients with plaque type of psoriasis diagnosed in Department of Dermatology were included in the study. These patients previously did not receive any topical medications for at least one month and were not on any systemic medications for the past three months.

**Results:** Healthy skin: Ultrasonography of the normal skin showed epidermis as a thin continuous hyperechoic with uniform thickness. The dermis appears comparatively less echoic, with uniform thickness, whereas the subcutaneous adipose tissue is characteristically hypoechoic separated by fibrous septa of connective tissue. Psoriatic plaques:

**Conclusion:** High-resolution gray scale sonography with power Doppler imaging is a real-time, easily available, cost-effective and noninvasive imaging technique that can be used for assessing activity and treatment response of psoriasis. It has already been used in the evaluation of many dermatological conditions, and the skin images are obtained in a noninvasive, reproducible and quantitative manner.

**Key words:** Power Doppler, High-resolution ultrasound, Skin, Psoriasis.

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**Introduction:**

Psoriasis is a common immune mediated inflammatory skin disease, characterized in its common form by the presence of inflammatory plaques. The evaluation of the disease is primarily clinical and the severity is assessed by the area of involvement, erythema and plaque thickness (Psoriasis Area and Severity Index or PASI).<sup>1</sup> These measurements are subjective and there is no

standardized evaluating method; gross difference may occur between examiners. Ultrasonography has proved to be a non-invasive imaging technique for studying soft tissue involvement in patients with dermatologic diseases.<sup>2, 3</sup> During the past decade, several studies have described the ability of sonography in both quantification of the disease activity and evaluation of the effect of different treatments in patients with psoriasis, but only a gray

scale technique was used. In the normal skin, the epidermis appears as a thin hyperechoic and continuous line with homogeneous thickness. The dermis appears as a less echoic and homogeneous band.<sup>4</sup> The morphological and structural changes in the psoriatic skin are easily distinguishable from the adjacent normal skin on sonography. In psoriatic plaques the epidermis and dermis appears thicker compared with the normal surrounding skin. Hypoechoic band in the upper lesion dermis can be also seen.<sup>4</sup> In active psoriatic plaques, power Doppler imaging allows sensitive detection of an increased blood flow that may be seen within the dermis. High frequency gray scale sonography with power Doppler imaging is a real-time and non-invasive imaging technique that can be used as an adjuvant to the clinical evaluation in assessing the extension and activity of psoriasis.

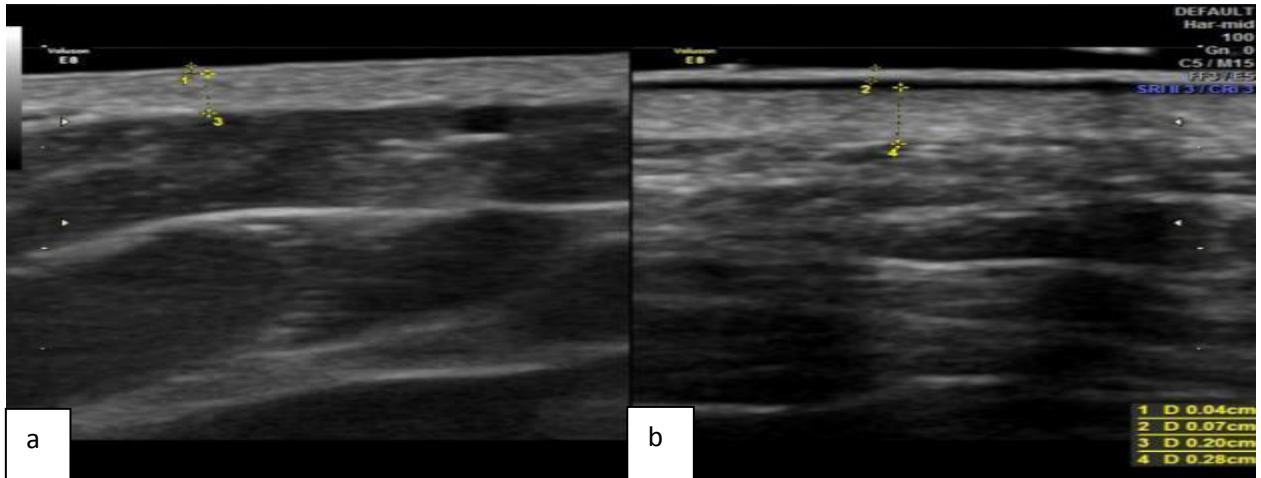
#### **Subjects and methods:**

This is a cross sectional study; 30 patients with plaque type of psoriasis diagnosed in Department of Dermatology were included in the study. These patients previously did not receive any topical medications for at least one month and were not on any systemic medications for the past three months. High resolution ultrasound study was done in the Department of Radio Diagnosis. Ultrasonography was done with high frequency probes and power Doppler using a real time ultrasound with GE VOLUSON E8 and 11 L-D linear phased array (4-11 MHZ) transducer. The sonographic examinations were performed, with the patient in a supine or prone position or seated with the forearm in extension over the table according to the location of the psoriatic plaques. Lesion from upper limb and surrounding

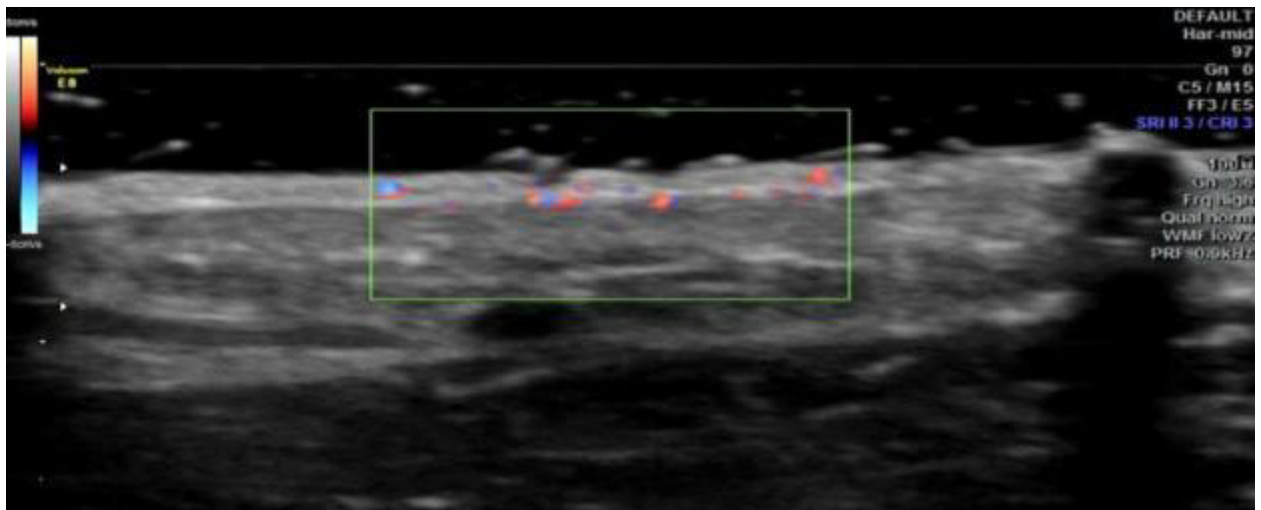
normal unaffected area were studied. Skin lesions were scanned in the grayscale mode to detect morphological, structural changes and along with the high definition (HD) power Doppler technique to detect abnormal blood flow. Care was taken not to compress the plaque during examination to avoid the “blanching” of the HD power Doppler signal and compression of the lesion, by the transducer pressure; by creating a thick gel layer of approximately 0.5cm over the lesion and placing the transducer over the gel without touching the skin. Imaging findings were then correlated by studying thickness of epidermis and dermis in these patients along with comparison to adjacent normal skin. The Institutional Ethical Committee approved the study, and informed consent was obtained from all participants.

#### **Results:**

**Healthy skin:** Ultrasonography of the normal skin showed epidermis as a thin continuous hyperechoic with uniform thickness. The dermis appears comparatively less echoic, with uniform thickness, whereas the subcutaneous adipose tissue is characteristically hypoechoic separated by fibrous septa of connective tissue. **Psoriatic plaques:** The main sonographic features of psoriatic skin detected in our study were thickened epidermis and dermis, absence of involvement of subcutaneous tissue and increased vascularity in power Doppler study. In the gray scale examination, the epidermis and dermis appear comparatively thicker than that of normal surrounding skin (Picture 1). In active psoriatic plaques, power Doppler imaging helped in detection of increased vascularity in the dermis compared to that of normal adjacent skin (Picture 2).



Picture 1: High resolution USG image showing the thickness of the epidermis and dermis in normal patient (a) and in patient with psoriasis (b). In normal patient, the thickness of the epidermis measures 0.04cm (1) and in the psoriatic patient, it is 0.07cm (2). The dermis measures 0.20cm (3) in normal patient and 0.28cm (4) in patient with psoriasis.



Picture 2: Power Doppler image in a patient with psoriatic plaque in the upper limb displaying increased vascularity. In our study of thirty patients, twenty four patients were males and 70% of the patients were above the age of forty years. Mean age was 48 years. All patients were chronic plaque type or psoriasis vulgaris. Mean epidermal and dermal thickness have been shown in table 1. Difference in the measurement was highly significant in psoriatic skin lesions compared to normal skin ( $p < 0.0001$ ). Increased vascularity was clearly visualized in power Doppler study over the active psoriatic plaque predominately involving the dermis, however it was not possible to quantify the difference.

Table 1: Mean thickness of skin of normal patients compared with psoriatic patients (n=30)

SKIN LAYER	EPIDERMIS		DERMIS	
	NORMAL	PSORIASIS	NORMAL	PSORIASIS
USG DOPPLER SITE				
MEAN ± SD	0.051±0.015	0.088±0.019	0.186±0.065	0.278±0.084
P VALUE	< 0.0001		< 0.0001	

**Discussion:**

Psoriasis is one of the most common chronic inflammatory skin diseases, affecting approximately 1 to 3% of the world’s population.<sup>5</sup>Psoriasis is a disease with significant morbidity and poor quality of life. Many therapeutic modalities have been researched and are currently available both in topical and systemic forms. It is hence necessary to evaluate their efficacy using machine based tool, which shall be full proof and objective. Ultrasonography can be one such tool.

There has been an increasing interest in the field of radiological imaging for the assessment of dermatological diseases. Several studies have been conducted, but in most occasion sonographic equipment provided with single and fixed frequency probes and only the gray scale technique have been utilized.<sup>4</sup>Only few literatures are available on this topic by using high end ultrasound machines, probes along with assessment of vascularity of psoriatic lesions using power Doppler.

The power Doppler technique has high sensitivity in depicting skin lesion in patients with psoriasis, and shows increased vascularity predominately involving the dermis. It is mainly due to the elongation, twisting and dilatation of dermal vessels especially is case of active psoriatic plaques. Thickening of both the epidermis and dermis is most constant sonographic pathologic finding in psoriatic plaques as found in our study too.<sup>6,7</sup>The main gray scale sonographic findings at the psoriatic plaque level are

epidermal and dermal thickening as a result of increased keratinocyte proliferation and an abnormal concentration of pro inflammatory infiltrating cells.<sup>8,9</sup>Advantages of these techniques is an accurate measurement of the epidermal and dermal thickness and serial evaluation following treatment can be utilized to assess the efficacy of a given topical and systemic treatment. Comparative evaluation of serial color Doppler images taken at specific time gap can also assess the vascularity and hence the intensity of inflammation.

Ultrasonography is a non-invasive and affordable tool. It can be utilized in all age groups and even during pregnancy for the measurement of disease activity and follow-up studies of psoriasis. Reduction in the thickness of dermis and epidermis, and reduced vascularity of the dermis can be used as a reliable indicator of therapeutic efficacy. Normal sonographic values of thickness in the different layers of the skin varies.<sup>10,11</sup> We used a thick coupling gel which was cost-effective in comparison to acrylic cup filled with distilled water and petrolatum used in other studies to compare thickness of epidermis and dermis of normal skin with psoriatic skin.<sup>9,12</sup>

**Conclusion:**

High-resolution gray scale sonography with power Doppler imaging is a real-time, easily available, cost-effective and noninvasive imaging technique that can be used for assessing activity and treatment response of psoriasis. It has already been used in the evaluation of many dermatological conditions, and the skin images are obtained in a noninvasive,

reproducible and quantitative manner.<sup>12,13</sup> Other conditions where this too can be explored include skin tumors, morphea, scleroderma, lipodermatosclerosis and hypertrophic scars.<sup>14</sup>

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