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Doppler ultrasound identifies increased resistive indices in SSc

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Cutaneous lesions in patients with systemic sclerosis (SSc) are characterised by fibrosis as well as by changes in the microvasculature. Various methods, including nailbed capillaroscopy, laser Doppler flow monitoring, thermography, and plethysmography, have been used to evaluate distal digital vascularisation and to assess the microvascular damage.[1–4] In studies using Doppler flowmetry and iontopheresis, patients with SSc showed reduced vasodilatory reserve of the skin microvasculature in response to ischaemia.[5 6] A new colour Doppler ultrasound (DU) technique of the nail bed appears to be able to detect and quantify early vascular damage in patients with connective tissue disease.[7] However, none of these methods has been generally introduced and accepted in clinical routine.

METHODS

This study aimed at assessing the digital blood flow of patients with SSc by DU. We compared the resistive indices (RIs) of 14 healthy subjects and 19 patients with SSc. Patients with SSc were classified as affected by limited SSc or diffuse SSc according to the criteria proposed by LeRoy *et al*.[8] The measurements were performed with an Ultramark 9 HDI duplex Doppler ultrasound (HDI; Advanced Technology Laboratories) after at least 15 minutes of thermal acclimatisation in our ultrasound laboratory. A 10 mHz probe was used for visualising digital vessels (Doppler filter 100 Hz, minimal flow velocity 10 cm/s). The outcome variable was the RI of the distal palmar arteries (arteriae digitales palmares propriae) of the thumb and the forefinger of the right and left hand (dig I and II). The arteries were identified by colour DU. The Doppler samples were obtained at the distal part of the digital artery, and the RI was determined by analysis of the spectral waveforms (fig 1). The RI was calculated according to the standard formula:

$$RI = (peak_{SV} - end_{DV})/peak_{SV}$$

where SV = systolic velocity; DV = diastolic velocity.

The RI of each of the digital arteries was determined in duplicate, and the mean of the resulting eight measurements was used for statistical analysis. Measurements were incomplete in seven patients with SSc, because it was impossible to identify all four digital arteries. In these seven patients we used the available measurements for statistical analysis. Statistical analysis was performed using the Mann-Whitney rank test.

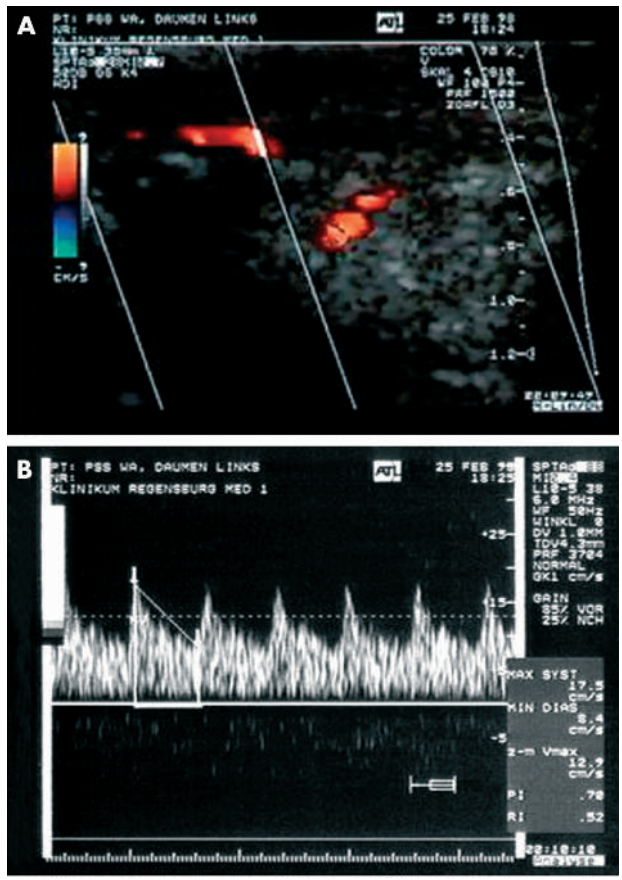

Figure 1 Picture of a colour Doppler ultrasound (A) and the associated spectral waveform (B) of the distal artery of the left thumb (patient with diffuse disease).

RESULTS

Table 1 shows the clinical characteristics of patients and controls. The mean of all measurements of all fingers showed a significantly higher RI for patients with SSc (limited and diffuse disease) (RI = 0.66) than for healthy controls (RI = 0.59; p = 0.01). However, there was a considerable overlap between the two groups. Individual digital analysis

Table 1 Patients characteristics

	SSc	Controls
Male	8	8
Female	11	6
Age (mean) years:		
Limited disease	50.3* (p = 0.001)	30.9
Diffuse disease	44.2 (p = 0.11)	
Raynaud's phenomenon	17	None
Unknown	1	None
Smoking	1	3
Unknown	1	None
Limited disease	10	–
Diffuse disease	9	–
Immunosuppressive drugs	3	None
Vasodilators	5	None

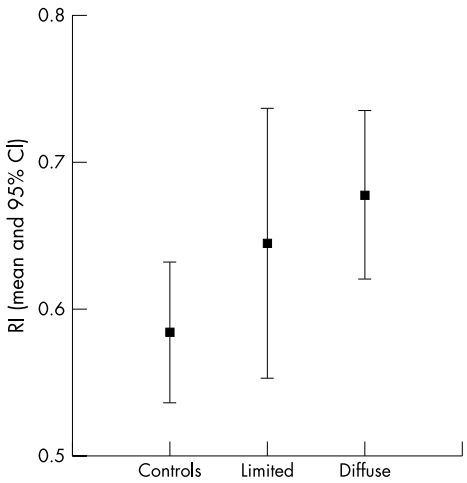

Figure 2 Mean resistive indices and 95% confidence interval of all measurements of patients with limited disease (n = 10), diffuse disease (n = 9), and controls (n = 14).

showed that the mean of the RI of the left thumb ($p = 0.01$) and the right thumb ($p = 0.035$) were significantly higher in patients with SSc than in normal controls. In contrast, there was no significant difference between the right and left forefinger, and the RI of the individual fingers of the patients did not show a consistent correlation.

We analysed patients with diffuse and limited disease separately, and found no significant difference between healthy controls and patients with limited disease (fig 2). However, patients with diffuse disease showed a significantly higher RI of the left thumb ($p = 0.005$), the right thumb ($p = 0.033$), the left forefinger ($p = 0.031$), the right forefinger ($p = 0.046$), and for the mean of all measurements ($p = 0.013$) in comparison with the healthy controls. In addition, no significant difference between the patients with limited and diffuse disease was found when calculating the mean of all measurements, but in individual digital analysis patients with diffuse disease showed a significantly higher RI of the right forefinger ($p = 0.04$).

In summary DU is an economic and simple non-invasive investigation technique, which may help to provide more information on the status of the digital microvasculature in patients with SSc. The increased RI values may reflect structural changes in digital arterial walls associated with a low vessel compliance, but, owing to the overlap of the RI between both groups, the diagnostic value of the RI measurements in the present group of patients was limited.

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