Laser speckle contrast imaging to assess peri-oral microcirculation in systemic sclerosis

Sirs,

Microvascular dysfunction is a key component in systemic sclerosis (SSc), representing the earliest morphological and functional manifestation of the disease (1). Histopathological evaluation of skin biopsies has demonstrated the presence of vasculopathy as a universal feature in SSc, regardless of the extent of skin fibrosis (2). Distribution of skin fibrosis tend to follow cutaneous sites typically involved in thermoregulation, namely the fingers, forearm, face and feet (3). Laser speckle contrast imaging (LSCI) is drawing interest as a non-invasive measure of superficial microcirculation. It is based on capturing fluctuations in speckle pattern caused by moving particles in superficial tissues when illuminated with a coherent laser beam (4).

To evaluate the use of LSCI in SSc we compared LSCI measurements in 10 female patients with limited or diffuse forms of SSc who had facial and peri-oral fibrosis limiting their mouth opening. Peri-oral and lip LSCI measurements were compared to mouth-opening measurements (cm) using a plastic cone and Mouth Handicap in Systemic Sclerosis (MHISS) scores. LSCI measurements were also performed on the forearm, selected as an area that can be affected by both limited and diffuse forms of SSc. Furthermore, we assessed whether LSCI could detect differences in peri-oral, lip and forearm measurements of SSc compared to 5 sex-matched controls.

Subjects were placed upright in a temperature-controlled room (23±1°C) and rested for 10 minutes. The laser head was placed at a distance of 15–20 cm from subject and the polarising filter adjusted. An opaque object was placed next to the area of interest to calibrate for unwanted background scatter. The lights were switched off and subjects were imaged for 10 seconds. Analysis was performed offline. Regions of interest (ROI) were selected in the upper and lower lips, upper and lower peri-oral regions and forearms (Fig. 1). Results were expressed as laser speckle perfusion units (LSPU).

Results demonstrated a strong correlation of lip and peri-oral perfusion (r=0.81, $p<0.05$). There were varied associations with mouth-opening outcomes. A moderate correlation was found between mouth-opening to lip and peri-oral perfusion (r=0.57, $p<0.10$; r=0.56, $p<0.10$, respectively). Poor correlations were found between MHISS scores and both lip and peri-oral perfusion (r=-0.49, $p>0.10$; r=-0.36, $p>0.10$). Perfusion of the lip and peri-oral regions were not reflected in the forearm (r=-0.08 and r=0.05, respectively). Unpaired t-test showed no significant difference in perfusion between SSc and controls in the lip ($p=0.22$), peri-oral ($p=0.23$) and forearm ($p=0.11$).

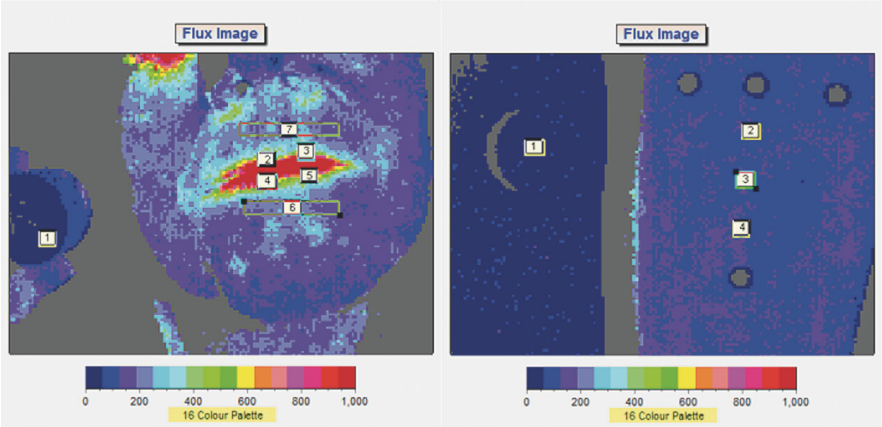

Fig. 1. Laser speckle contrast imaging of the face (left) and forearm (right) in a 52-year-old female with limited systemic sclerosis. Colours correspond to LSPU values as per calibrated colour scale.

Oro-facial fibrosis causes progressive restriction in mouth opening and thinning of the lips, affecting mastication, speech phonation and salivary continence (5). Microvascular changes precede tissue fibrosis, with capillary enlargement followed by capillary loss and changes in overall vascular morphology and architecture (6). These features have been well documented in the nailfold, and similar changes are present in all affected organs (6). Microvascular assessment has been limited to laser doppler flowmetry, which gives a single-point measurement of blood flow. LSCI is gaining popularity as it allows non-contact dynamic evaluation of tissue perfusion over a higher spatial and temporal resolution. This is the first study to report the use of LSCI for assessment of peri-oral vasculature, but limited to a small sample size. A good correlation was found between peri-oral and lip LSCI to mouth-opening in SSc patients, however no significant difference was found between SSc and controls. Studies have reported variable correlation between nailfold capillaroscopy and LSCI. Ruaro *et al*. (7) found significantly lower perfusion in SSc patients compared to controls, correlating with capillaroscopy findings, whilst Murray *et al*. (8) found no significant difference in perfusion between SSc and healthy control at baseline.

LSCI remains promising as a useful tool in microvascular assessment due to its short acquisition time, low intra-operator variability and non-contact nature. Future studies will require consideration of dynamic studies.

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