Microvascular Research 115 (2018) 28–33

Contents lists available at ScienceDirect

Microvascular Research

journal homepage: www.elsevier.com/locate/ymvre

Correlations between blood perfusion and dermal thickness in different skin areas of systemic sclerosis patients

B. Ruaro[a,*], A. Sulli[a], C. Pizzorni[a], S. Paolino[a], V. Smith[b], E. Alessandri[a], A.C. Trombetta[a], J. Alsheyyab[a], M. Cutolo[a]

[a] Research Laboratory and Academic Division of Clinical Rheumatology, Department of Internal Medicine and Medical Specialities, University of Genova, IRCCS Policlinico San Martino, Genova, Italy
[b] Department of Rheumatology, Ghent University Hospital, Department of Internal Medicine, Ghent University, Ghent, Belgium

ARTICLE INFO

Keywords:
Systemic sclerosis
Laser speckle contrast analysis
Skin high-frequency ultrasound
Nailfold videocapillaroscopy
Peripheral blood perfusion
Dermal thickness
Nailfold microangiopathy

ABSTRACT

Objective: To identify possible correlations between skin blood perfusion (BP) and dermal thickness (DT) in different skin areas of systemic sclerosis (SSc) patients.

Methods: Sixty-two SSc patients, according to 2013 EULAR/ACR criteria, and 62 healthy subjects (CNT) were enrolled. Skin BP was analysed by laser speckle contrast analysis (LASCA) at the level of dorsum of the middle phalanx of the third fingers, dorsal aspect of the hands and zygoma. DT was assessed by both skin high frequency ultrasound (US) and modified Rodnan skin score (mRSS) in the same above reported areas. All patients were studied also by nailfold videocapillaroscopy (NVC) to assess the proper pattern of microvascular damage ("Early", "Active", or "Late").

Results: At the level of finger dorsum a statistically significant negative correlation was observed in SSc patients between skin BP and both ultrasound-DT ($p = 0.0005$ $r = 0.43$) and mRSS ($p = 0.0007$ $r = 0.42$), but not at the level of hand dorsum and zygoma. No statistically significant correlation was present between skin BP and ultrasound-DT at any level in CNT. In detail, SSc patients, compared to CNT, showed a statistically significant lower BP only at level of fingers (median PU 72.6 vs 136.1 respectively, $p < 0.0001$) and a statistically significant higher ultrasound-DT at the level of dorsum of 3th finger bilaterally (median mm 0.9 vs 0.7, $p < 0.0001$), dorsum of hands (median mm 0.9 vs 0.7, $p < 0.0001$) and zygoma (median mm 0.8 vs 0.7, $p < 0.0001$). A significant positive correlation between ultrasound-DT and mRSS was observed in SSc patients at level of the three areas (dorsum of fingers $p < 0.0001$ $r = 0.51$; dorsum of hands $p = 0.03$ $r = 0.27$; zygoma $p = 0.0001$ $r = 0.45$). A progressive decrease of skin BP and increase of ultrasound-DT was found correlated with the progression of the severity of NVC patterns.

Conclusions: This study demonstrates for the first time in SSc patients a significant inverse relationship between skin BP, measured by LASCA, and DT, evaluated by both US and mRSS, at the level of dorsum of the middle phalanx of the third fingers.

1. Introduction

Systemic sclerosis (SSc) is a rare autoimmune connective tissue disease, characterized by typical clinical cutaneous alterations that include peripheral microangiopathy and decreased skin blood perfusion (BP), as well as increased dermal thickness (DT) (Gabrielli et al., 2009; Cutolo et al., 2010a; Barbano et al., 2017; Hesselstrand et al., 2008).

The morphological impairment of peripheral microcirculation may precede the other symptoms by many years, is a predictive factor for SSc progression, and may be assessed and classified by nailfold videocapillaroscopy (NVC) (Burmester et al., 2017; Cutolo et al., 2010a; Smith et al., 2010, 2016; Ingegnoli et al., 2013a,b).

Although NVC permits the observation of the column of red blood cells moving inside the capillaries, the blood flow cannot be quantified in standard conditions (Mugii et al., 2009).

Conversely, laser speckle contrast analysis (LASCA) is a method to quantify BP at level of different skin areas, such as face and hands, and a recent study demonstrated a very good inter-rater reliability of BP measurements by LASCA (Ruaro et al., 2014; Della Rossa et al., 2013; Lambrecht et al., 2016).

* Corresponding author at: Research Laboratory and Academic Division of Clinical Rheumatology, Department of Internal Medicine, University of Genova, Viale Benedetto XV, n° 6, 16132 Genova, Italy.
E-mail address: 3611906@studenti.unige.it (B. Ruaro).

http://dx.doi.org/10.1016/j.mvr.2017.08.004
Received 24 July 2017; Received in revised form 18 August 2017; Accepted 19 August 2017
Available online 20 August 2017
0026-2862/

Table 1
Clinical findings in systemic sclerosis (SSc) patients and healthy subjects (CNT).
(RP = Raynaud's phenomenon; ANA = antinuclear antibodies; IIF = indirect immunofluorescence; centr = centromeric, spec = speckled; spec + nucl = speckled + nucleolar, ENA = extractable nuclear antigens: Scl70 = anti-topoisomerase autoantibodies, RNAP = anti RNA polymerase III autoantibodies, neg = ENA negative, BP = skin blood perfusion; DT = dermal thickness (ultrasound evaluation); mRSS = modified Rodnan skin score; Early, Active, Late = patterns of micro-angiopathy at nailfold videocapillaroscopy; lcSSc = limited cutaneous SSc; dcSSc = diffuse cutaneous SSc; PU = perfusion units; # = number of cases; IQR = interquartile range).

	Age (years)	Sex (males/females)	RP duration (years)	SSc duration (years)	ANA IIF-pattern (centr/spec/spec + nucl)	ENA (Scl70/RNAP/neg)	BP (PU) fingers/hands/face	DT (millimetres) fingers/hands/face	mRSS (score) fingers/hands/face
CNT (#62) median (IQR)	64.0 (16)	5/57	–	–	–	–	136.1/49.6/126.2 (55.8/20.0/41.6)	0.7/0.7/0.7 (0.1/0.1/0.1)	–
SSc (#62) median (IQR)	66.0 (16.5)	6/56	8.5 (7)	5.0 (4)	35/4/23	21/3/17	72.6/48.4/131.9 (35.1/20.0/35.3)	0.9/0.9/0.8 (0.3/0.2/0.2)	2.0/0.0/0.0 (2.0/1.0/1.0)
SSc vs CNT statistical signific.	–	–	–	–	–	–	$p < 0.0001/=0.3/=0.3$	$p < 0.0001$ for all areas	–
Early (#15) median (IQR)	63.0 (20)	1/14	4.0 (3)	1.8 (1.5)	11/2/2	2/0/11	88.7/57.4/135.5 (24.0/24.0/58.5)	0.8/0.8/0.8 (0.1/0.1/0.1)	1/0/0 (1.0/0.0/0.0)
Active (#19) median (IQR)	59.0 (19)	2/17	7.0 (5)	4.0 (3)	13/0/6	5/2/3	67.5/51.0/137.2 (42.4/18.0/26.5)	0.9/0.9/0.9 (0.2/0.2/0.1)	2/0/0 (1.5/0.0/0.0)
Late (#28) median (IQR)	69.5 (23)	3/25	13.7 (9)	7.5 (6)	11/2/15	14/1/3	60.7/46.6/121.3 (31.7/15.8/39.4)	1.0/1.0/0.9 (0.3/0.3/0.1)	3/1/1 (1.0/1.0/1.0)
E vs L statistical signific.	–	–	–	–	–	–	$p < 0.0001/=0.06/=0.2$	$p = 0.0015/=0.0003/< 0.0001$	< 0.0001 for all areas
lcSSc (#45) median (IQR)	65.0 (21,5)	2/43	7.0 (5)	4.0 (3)	32/3/10	9/1/11	79.6/51.0/133.1 (25.2/24.1/59.3)	0.9/0.9/0.9 (0.1/0.2/0.1)	2.0/0/0 (1.0/0.0/0.0)
dcSSc (#17) median (IQR)	62.0 (21)	4/13	9.0 (8)	7.0 (6)	3/1/13	12/2/6	63.9/44.2/121.5 (34.0/13.4/41.6)	1.1/0.9/0.9 (0.3/0.2/0.1)	3.0/1.0/1.0 (1.0/0.0/0.0)
lcSSc vs dcSSc statistical signific.	–	–	–	–	–	–	p = 0.02/0.4/0.7	p = 0.002/0.028/0.0002	p = 0.0002/0.0001/0.0001