Uneven temperature among fingers after cold-water immersion of hands is a useful parameter to identify disturbed peripheral circulation

Masanobu HORIKOSHI1, Shigeko INOKUMA1, Mika KOBUNA1, Erika MATSUBARA1, Rika OKADA1, Ryo TAKAHASHI1, Shoko KOBAYASHI1, Yasuo KIJIMA2
1) Department of Allergy and Rheumatic Diseases, Japanese Red Cross Medical Center, Tokyo, Japan
2) Laboratory center, Japanese Red Cross Medical Center, Tokyo, Japan

Background: Peripheral circulation is often disturbed in patients with connective tissue diseases (CTDs) and its objective evaluation is an important issue. Infrared thermography has been used for the purpose for decades [1]. Raynaud phenomenon (RP) is prevalent in and considerably characteristic of CTDs and we have long noticed colour unevenness among fingers in patients during RP attacks. We hypothesized that temperature unevenness among fingers detected by thermography would be a useful parameter to evaluate peripheral circulation.

Objectives: To evaluate temperature unevenness among fingers as a thermographic parameter by comparing it with other parameters validated in previous studies.

Methods: Patients who visited our hospital and had been diagnosed as having RP by their attending physicians and underwent thermographic examinations were included and compared with healthy volunteers. Skin temperatures of dorsum of hands at 10 fingers’ nail folds and MCP joints were measured at baseline. Then hands were immersed in 10°C water for 10 seconds. Skin temperatures were measured at 0, 3, 5, 10, 15, 20, and 30 min after immersion. Mean temperature, recovery rate (temperature recovery from immersion/decrease by immersion), and coefficient of variation (standard deviation/mean temperature) of nail fold temperature were calculated. Higher coefficient of variation means temperature among fingers is more uneven. Distal-dorsal difference (DDD: measured by subtracting mean temperature of MCP from that of nail fold) was also calculated and these parameters were compared between the two groups. Receiver operating characteristic (ROC) curve was generated to compare these parameters in terms of their capability of differentiating patients with RP from HCs.

Results: Thirty-one patients with RP (10 with primary Raynaud, 11 with systemic sclerosis (SSc), 11 with other CTDs) were included and compared with 25 healthy controls (HCs). Baseline nail fold temperature was significantly lower in patients of RP than in HC (30.8 ± 3.1 °C vs. 33.2 ± 1.8 °C, p=0.0002). Cold-water immersion of hands revealed patients with RP had lower recovery rate, lower DDD, and higher coefficient of variation than did HCs. The differences in these parameters were the most evident at 5 min after immersion (patients with RP vs HCs: recovery rate; 49.6 ± 27.7 vs 71.5 ± 26.8, p=0.004 DDD; -1.4 ± 2.8 vs 0.85 ± 2.7, p=0.0008 coefficient of variation; 0.053 ± 0.024 vs 0.021 ± 0.015, p=1.2x10^-6). On the basis of ROC curve analyses for these parameters, coefficient of variation of nail fold temperature most effectively differentiated patients with RP from HCs (Area under the curve; recovery rate: 0.64 DDD: 0.79 coefficient of variation).
Conclusions: Unevenness of temperature among fingers was the most useful thermographic parameter to evaluate disturbed peripheral circulation.

Keywords: Cold stimuli, Peripheral circulation, Connective tissue disease, Raynaud phenomenon, Infrared thermography