Journal of Clinical & Experimental Cardiology

Tubek et al., J Clin Exp Cardiolog 2012, 3:5
DOI: 10.4172/2155-9880.1000189

Research Article Open Access

# Skin Microcirculation in Primary Arterial Hypertension

**Slawomir Tubek[1]*, Malgorzata Sobieszczanska[2] and Renata Szygula[3]**

[1]Department of Internal Diseases, Voivodeship Hospital, Opole, Poland
[2]Department of Pathophysiology, Wrocław Medical University, Poland
[3]Department of Physical Education and Physiotherapy, Technical University, Opole, Poland

## Abstract

Laser Doppler Fluxometry (LDF) was used to assess basic flow (PP) of microcirculation (mc) of dorsal hand skin in 10 healthy persons of both sex (k) – of age 41,3 ± 7,18 years and 10 persons suffering from primary arterial hypertension (nt) – of age 41,3 ± 10,95 years. In obtained record it has beed evaluated: basic flow (PP – in arbitray units of perfusion – PU) and, by analysing frequency spectrum – heart rhythm (RS) and its variation (ZRS), respiratory rhythm (RO), myogenic rhythm of precapillary sphincters tone (RM) and its amplitude (RMa), neurogenic rhythm of precapillary sphincters tone (RN) and its amplitude (NRa) and endothelium-dependent rhythm of precapillary sphincters tone (RE) and its amplitude (REa). The rhythm was assessed in cycles per minute (Hz) and the amplitude by value of signal power in arbitrary units. Means ($\bar{x}$) and standard deviations (± SD) were defined; differences were assessed using t-Student test.

In the group of individuals, suffering from arterial hypertension, the decrease of heart rhythm variability, acceleration of respiratory rhythm and neurogenic rhythm on the microcirculation level was observed, what testifies to higher sympathetic activity. In people with arterial hypertension such regularity was not observed, which can prove the endothelium dysfunction.

LDF enables complex, noninvasive assessment of circulatory system functioning that can be widely used in clinical practice, i.e. in order to monitor therapy effectiveness.

**Keywords:** Microcirculation; Arterial hypertension; Laser doppler fluxometry; Vasodilatation rhythm

## Introduction

Complex assessment of circulatory system functioning, including microcirculation (mc) is important element of planning and controlling both the effects of circulatory system diseases therapy, and planning and carrying out actions in the field of primary prophylaxis of those pathological states.

In the course of arterial hypertension, at first, it comes to functional changes in mc that, with time, as the hypertension lasts through the stage of functional-structural changes, undergoes fixation (structural changes).

Laser Doppler Fluxometry is noninvasive method that, apart from local assessment of examined area of microcirculation, allows determining the heart rhythm and respiratory rhythm, thus, indirectly assess functioning of vegetative nervous system on the level of heart labour and respiratory action and directly local functioning.

## Goal

The goal of this experiment was assessment of microcirculation function in arterial hypertension with regard to parameters of local function and parameters of heart labour and respiratory system, recorded on its level with use of noninvasive method – LDF.

## Material and Method

Two groups of peoples were assessed: - suffering from primary arterial hypertension, untreated so far, without insulin-independent diabetes and not obese and – healthy, with negative family history of arterial hypertension disease, with insulin-independent diabetes and have no obesity.

The basic flow (PP) of the dorsal hand skin in 10 healthy persons of both sex (k) – age 41,3 ± 7,18 years and 10 persons suffering from primary arterial hypertension (ah) – age 41,3 ± 10,95 years. In obtained record there has beed assessed: basic flow (PP – in arbitrary units of perfusion – PU) and, by analysing frequency spectrum – the heart rhythm (HR) and its variability (vHR), respiratory rhythm (Rr), myogenic rhythm of precapillary sphincters tone (MR) and its amplitude (MRa), neurogenic rhythm of precapillary sphincters tone (NR) and its amplitude (NRa) and endothelium-dependent rhythm of precapillary sphincters tone (ER) and its amplitude (ERa). The rhythm was assessed in cycles per minute and the amplitude by value of signal power in arbitrary units. Means ($\bar{x}$) and standard deviations (± SD) were defined; differences were assessed using t-Student test.

The flow in dorsal hand skin microcirculation was examined with use of laser doppler fluxometry apparatus Periflux 4001 from the Perimed company, generating laser light of 632,8 μm wavelength. Optode was located on the dorsal hand skin of the dominant extremity between the first and the second metacarpal bone. It was attached to the hand with the help of two-sided adhesive tape. Surface area of measurement was 1,2 $mm^2$ and the light penetration into the skin depth was about 2 mm.

The area of measurement – the dorsal hand skin – was selected considering the significantly rare occurrence of disturbances in venous system functioning and haemodynamically significant atherosclerotic

***Corresponding author:** Slawomir Tubek, Department of Internal Diseases, Voivodeship Hospital, Opole, Kośnego Street 53, Poland, E-mail: slawomir.tubek@hipokrates.org

**Received** February 21, 2012; **Accepted** April 30, 2012; **Published** May 03, 2012

**Citation:** Tubek S, Sobieszczanska M, Szygula R (2012) Skin Microcirculation in Primary Arterial Hypertension. J Clin Exp Cardiolog 3:189. doi:10.4172/2155-9880.1000189

changes in arterial system in upper extremity that affects the function of microcirculation, peripherally from the place of venous and arterial vessels.

## Results

Comparison of groups' k and ah :

- systolic pressure 120,5 ± 9,85 vs 161,0 ± 8,76 mmHg, p<0,001;
- diastolic pressure 79,5±7,97 vs 105,0 ± 4,08 mmHg, p<0,001;
- PP 14,25±4,75 vs 12,02±3,29, ns;
- HR 70,32±8,77 vs 72,97±10,99, ns;
- vHR 16,73±6,84 vs 12,0±3,82, p<0,03;
- Rr 14,09±3,11 vs 18,1±4,07, p<0,02;
- MR 4,83±1,04 vs 4,26±0,90, ns;
- aMR 0,56±0,36 vs 0,75±0,38, ns;
- NR 1,99±0,28 vs 2,35±0,47, p<0,02;
- aNR 0,81±0,38 vs 0,89±0,58, ns;
- ER 0,9±0 vs 0,86±0,13, ns;
- aER 1,02±0,73 vs 0,78±0,52, ns.

In group k the vasodilatation amplitude was significantly arising from aRM to aRS (aRM-aRN p<0,001; aRM-aRS p<0,003; aRN-aRS ns [p<0,09]), however in group ah such relation was not observed and the tendency was even inverse (aRM-aRN ns; aRM-aRS ns; aRN-aRS p<0,03). In group k the amplitudes revealed high correlation coefficients (over 0,9), in group ah such high correlation was revealed only between aRN i aRS.

The decrease of heart rhythm variability, rhythm acceleration, respiratory rhythm acceleration as well as neurogenic rhythm on the level of microcirculation testifies to higher sympathetic activity in examined group of people suffering from arterial hypertension. The physiologically highest amplitude has the endothelial component of vasodilatation. Such relation was not observed in persons suffering from arterial hypertension, which can testify to endothelium dysfunction.

## Discussion

In group ah the results clearly show the higher activity of sympathetic part of autonomic nervous system and point out the changes in blood flow regulation on the level of microcirculation, by increasing the neurogenic role and decreasing the endothelium regulatory function.

In persons suffering from family history of arterial hypertension the changes in reactivity of central derived microcirculation, which resulted from altered sympathetic -vagal balance, accompanied by decreasing of parasympathetic activity [1,2], were observed. Similar results was obtained in previous own researches on persons suffering from arterial hypertension [3].

If we assume that the primary dysfunction in arterial hypertension concerns the endothelium, the changes of vegetative nervous system can be regarded as compensating in relation to such dysfunction. The primary signal for vegetative nervous system can be the signal about oxygen deficiency in tissues. Maybe this is all about the primary mechanism of microcirculation hyperfussion that sometimes leads to its thinning. The primary endothelium dysfunction by disturbing the local flow regulation compensates the neurogenic vasodilatation component. The hyperfussion leads to further increase of general tone of sympathetic nervous system as a defensive mechanism against excessive perfusion of tissues and excessive oxygen supply [4]. Unsettling the reflex vasodilatating balance on the level of microcirculation that regulates the tissue oxygen supply, between its particular components, with time leads to its, initially functional and then, structural thinning, by excluding fragments of microcirculation nets. This begins to be the reason of real ischemic changes.

Widely known is that the earlier appropriate nonpharmacological and, if required, pharmacological treatment of arterial hypertension is administered as the better qualitative result (arterial hypertension control) or quantitative result (life-span) which can be obtained.

## Conclusions

1. Using LDF the increase of sympathetic nervous system activity in group ah was observed both on central level (heart and respiratory system) and microcirculation level in examined area.
2. LDF allows assessing changes in the sphere of three components of microcirculation regulation – in group ah the neurogenic regulation component increased.
3. LDF allows on complex, noninvasive assessment of circulatory system functioning that can be widely used in clinical practice, i.e. for purposes of monitoring of therapy effectiveness.

### References

1. Maver J, Strucl M (2000) Microvascular reactivity in normotensive subjects with familiar predisposition to hypertension. Microvasc Res 60: 241-248.
2. Maver J, Strucl M, Accetto R (2004) Autonomic nervous system and microvascular alternations in normotensines with a family history of hypertension. Blood Press 13: 95-100.
3. Tubek S, Tubek I, Szygula R (2002) Evaluation of microcirculation by laser doppler fluxometry in patients with arterial hypertension with use hyperaemic and vegetative tests. Kardiol Pol 57: II-43 (abstract).
4. Przybylski J (1981) Do arterial chemoreceptors play a role in the pathogenesis of hypertension. Med Hypotheses 7: 127-131.