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Original Article

Assessment of Microcirculatory Kinetics Using the Microscopic Phase of the Nail Fold Capillary in Pregnant Women

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ABSTRACT

Background and Aim: Recently, the rapid development of science and technology has led to the development of capillary studies. Particularly, the observation of microcirculation in nail fold capillaries, called "ghost vessels", has attracted much attention from doctors. Therefore, we studied the microcirculatory kinetics of the nail fold capillary in pregnant women and the relationship between blood flow rate and passive smoking. **Methodology:** We took-up a case-control study with 83 normal pregnant women, 24 passive smoking pregnant women and 12 healthy non-pregnant women who hospitalized in Pyongyang University Hospital of Medical Sciences from May 2020 to February 2022. We analyzed the morphological indices and blood flow rate of the nail fold capillary in pregnant women according to the weeks of gestation and passive smoking. **Results:** The blood flow rate of the nail fold capillary in normal pregnant women significantly increased and in passive smoking pregnant women according to the weeks of gestation significantly decreased. **Conclusion:** Microcirculation is altered in normal pregnant women and microcirculatory behavior is different in passive smoking pregnant women.

Keywords: Microcirculatory kinetics, Nail fold capillary, Pregnancy, Blood flow rate.

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INTRODUCTION

Pregnancy necessitates significant adjustments in the circulatory system to ensure sufficient blood supply to both the mother and the developing fetus.[1] Beginning around the 5th week of gestation, there is a decrease in Peripheral Vascular Resistance (PVR), coupled with an increase in cardiac output achieved through elevated heart rate and stroke volume. This shift reflects a transition to a state of underfilled cardiovascular capacity, prompting an expansion of plasma volume through hormonal shifts and enhanced sodium and water reabsorption.

Around two weeks later, venous compliance starts to raise, a trend that persists throughout pregnancy, facilitating the creation of a reserve compartment in the splanchnic system. Between the 8th and 12th weeks of gestation, morphological alterations in the heart occur, potentially attributed to sustained elevated venous return and improved cardiac function. As the first trimester progresses, retrograde trophoblastic invasion into the spiral artery becomes evident, contributing to the augmentation of uteroplacental vascular compliance.[2]

Circulatory blood volume increases with pregnancy and reaches the peak in 32~34 weeks of gestation. The volume increases 40% higher than before pregnancy and tends to decrease gradually after that. 4~6 weeks after labor and delivery, it returns to prenatal levels. The blood flow rate increases during pregnancy. This increase in blood flow rate already occurs at 12 weeks of gestation and tends to increase further at the end of pregnancy.

Passive smoking delays blood flow rate in capillaries and impairs normal blood flow, thereby increasing the frequency of incomplete continuous phases. Research has indicated that Secondhand Smoke (SHS) decreases coronary flow velocity reserve in nonsmokers, while this remains unaffected in habitual smokers.[3] Additionally, SHS has been found to hinder endothelium-dependent dilatation of the brachial artery in non-smokers.[4,5] Furthermore, SHS disrupts microvascular function, as evidenced by changes in the peripheral arterial tonometry index.[6] Previous studies have demonstrated that smoking a single cigarette leads to an immediate and notable reduction in capillary blood flow velocity.[7,8]

Nailfold capillaroscopy serves as a highly sensitive, cost-effective, straightforward, secure and non-invasive imaging method employed for morphological examination of the nourishing capillaries located in the nailfold region. Only few papers exist on NVC in pregnancy.[9,10]

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Therefore, the present study was conducted to analyze the microcirculatory kinetics of the nail fold capillary in pregnant women and the relationship between blood flow rate and passive smoking.

METHODOLOGY

Participants

We recruited 91 normal pregnant women (15 pregnant women in 10 weeks of gestation, 13 pregnant women in 12 weeks of gestation, 16 pregnant women in 20 weeks of gestation, 14 pregnant women in 30 weeks of gestation, 20 pregnant women in 32 weeks of gestation, 13 pregnant women in 40 weeks of gestation), 24 passive smoking pregnant women (11 pregnant women in 12 weeks of gestation, 13 pregnant women in 32 weeks of gestation) and 15 healthy non-pregnant women who hospitalized in Pyongyang University Hospital of Medical Sciences from May 2020 to February 2022.

Procedure

The laptop was directly connected to the capillary microscope. The subject was seated in the chair and the height of the test table was adjusted to the heart height of the subject. A drop of cedar oil was placed in the nail fold of the fourth finger and placed in the finger groove of the microscopic field of view. The structure of nailfold capillary ring was shown as Figure 1.

Parameters Assessed

Morphological indices such as arterial Diameter (Da), venous Diameter (Dv), transitive Diameter (Dt), capillary ring width (av) and blood flow rate (V) of the nail fold capillary was assessed through the computer-aided Image Analyzing Programme.

The mean values of more than 3 measurements are obtained for one subject.

Statistical Analysis of Data

SPSS version 16.0 was used to analyze the morphological indices and blood flow rate of the nail fold capillary in pregnant women according to the weeks of gestation and passive smoking. All the parameters were expressed as mean±SE. p value <0.05 was considered as statistically significant.

RESULTS AND DISCUSSION

Comparison of the Morphological Indices and Blood Flow Rate of the Nailfold Capillary in Pregnant and Non-Pregnant Women.

Comparison of the morphological indices and blood flow rate of the nail fold capillary in 12 weeks of gestation

Table 1 shows morphological indices and blood flow rate of the nail fold capillary in pregnant and non-pregnant women in 12 weeks of gestation and compared respectively. There were significant differences in the morphological indices of the nail fold capillary between pregnant women in 12 weeks of gestation and non-pregnant women, meanwhile blood flow rate increased significantly ($p<0.01$).

Comparison of the morphological indices and blood flow rate of the nail fold capillary in 32 weeks of gestation

Table 2 shows the morphological indices and blood flow rate of the nail fold capillary in pregnant and non-pregnant women in 32 weeks of gestation and compared respectively. There were significant differences in the morphological indices of the nail fold capillary between pregnant women in 32 weeks of gestation and non-pregnant women, meanwhile blood flow rate increased significantly ($p<0.01$).

Comparison of the Morphological Indices and Blood Flow Rate of the Nail Fold Capillary According To the Weeks of Gestation in Pregnant Women.

Comparison of the morphological indices and blood flow rate of the nail fold capillary according to the weeks of gestation and compared with 10 weeks of gestation.

Table 1: Comparison of the morphological indices and blood flow rate of the nail fold capillary in pregnant women in 12 weeks of gestation and non-pregnant women ($\bar{X}$±SE).

Indices	Control group Non-pregnant women (n=15)	Study group Pregnant women (n=13)
Da (μm)	7.2±0.21	7.5±0.23
Dv (μm)	10.5±0.42	10.8±0.43
Dt (μm)	12.2±0.51	12.6±0.52
Av (μm)	34.0±1.32	35.0±1.14
V (mm/s)	0.2±0.01	0.6±0.02**

**indicates p<0.01.Da: Arterial diameter; Dv: Venous diameter; Dt: Transitive diameter; Av: Capillary ring width; V: Blood flow rate.

Table 2: Comparison of the morphological indices and blood flow rate of the nail fold capillary in pregnant women in 32 weeks of gestation and non-pregnant women ($\bar{X}$±SE).

Indices	Control group Non-pregnant women (n=15)	Study group Pregnant women (n=20)
Da (μm)	7.2±0.23	8.0±0.31
Dv (μm)	10.5±0.36	11.0±0.27
Dt (μm)	12.2±0.46	12.8±0.34
Av (μm)	34.0±1.34	36.0±0.85
V (mm/s)	0.2±0.01	0.7±0.01**

** indicates p<0.01.Da: Arterial diameter; Dv: Venous diameter; Dt: Transitive diameter; Av: Capillary ring width; V: Blood flow rate.

Table 3: Measurement of the morphological indices and blood flow rate of the nail fold capillary according to the weeks of gestation in normal pregnant women ($\bar{X}$±SE).

Indices	10 weeks of gestation (n=15)	20 weeks of gestation (n=16)	30 weeks of gestation (n=14)	40 weeks of gestation (n=13)
Da (μm)	7.6±0.28	7.9±1.33	8.0±0.24	8.1±0.25
Dv (μm)	10.5±0.31	10.7±0.45	10.9±0.26	11.4±0.44
Dt (μm)	12.7±0.39	12.9±0.43	13.4±1.51	13.6±0.58
Av (μm)	38.0±1.09	40.0±1.87	39.0±1.49	39.0±1.89
V (mm/s)	0.5±0.08	0.6±0.05	0.7±0.05*	0.7±0.02*

* indicates p<0.05.**Da:** Arterial diameter; **Dv:** Venous diameter; **Dt:** Transitive diameter; **Av:** Capillary ring width; **V:** Blood flow rate.

Table 4: Comparison of the morphological indices and blood flow rate of the nail fold capillary in passive smoking and normal pregnant women at 12 weeks of gestation ($\bar{X}$±SE).

Indices Groups	Da (μm)	Dv (μm)	Dt (μm)	Avμm)	V (mm/s)
Study group (n=11)	6.9±0.15	10.1±0.21	11.3±0.12	35.2±0.54	0.5±0.03*
Control group (n=13)	7.2±0.08	10.5±0.11	11.6±0.14	36.1±1.33	0.6±0.05

* indicates p<0.05.Da: Arterial diameter; Dv: Venous diameter; Dt: Transitive diameter; Av: Capillary ring width; V: Blood flow rate.

Table 5: Comparison of the morphological indices and blood flow rate of the nail fold capillary in passive smoking and normal pregnant women at 32 weeks of gestation ($\bar{X}$±SE).

Indices Groups	Da (μm)	Dv (μm)	Dt (μm)	Av (μm)	V (mm/s)
Study group (n=13)	7.4±0.27	10.4±0.31	11.5±0.33	35.2±0.05	0.5±0.01*
Control group (n=20)	8.1±0.21	11.5±0.34	12.3±0.41	36.1±0.29	0.7±0.02

* indicates p<0.05.Da: Arterial diameter; Dv: Venous diameter; Dt: Transitive diameter; Av: Capillary ring width; V: Blood flow rate.

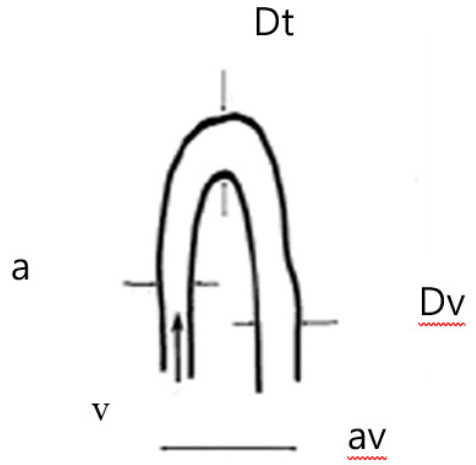

Figure 1: Structure of nail fold capillary ring.

Da: Arterial diameter; Dv: Venous diameter; Dt: Transitive diameter; av: Capillary ring width; V: Blood flow rate.

Table 3 shows morphological indices and blood flow rate of the nail fold capillary in pregnant women at varied gestational weeks and compared with 10 weeks of gestation. There were significant differences in the morphological indices of the nail fold capillary according to the weeks of gestation in pregnant women.

Comparison of the Morphological Indices and Blood Flow Rate of the Nail Fold Capillary in Passive Smoking and Normal Pregnant Women at 12 and 32 Weeks of Gestation.

Comparison of the morphological indices and blood flow rate of the nail fold capillary in passive smoking and normal pregnant women at 12 weeks of gestation.

Table 4 shows comparison of the morphological indices and blood flow rate of the nail fold capillary in passive smoking and normal pregnant women at 12 weeks of gestation. There were significant differences in the morphological indices of the nail fold capillary between the passive smoking and normal pregnant women, meanwhile blood flow rate decreased significantly (p<0.05).

Comparison of the morphological indices and blood flow rate of the nail fold capillary in passive smoking and normal pregnant women at 32 weeks of gestation.

Table 5 shows comparison of the morphological indices and blood flow rate of the nail fold capillary in passive smoking and normal pregnant women at 32 weeks of gestation. There were significant

differences in the morphological indices of the nail fold capillary between the passive smoking and normal pregnant women, meanwhile blood flow rate decreased significantly ($p<0.05$).

CONCLUSION

We conclude that blood flow rate of the nail fold capillary in normal pregnant women significantly increase. Further, it is confirmed that blood flow rate of the nail fold capillary in passive smoking pregnant women according to the weeks of gestation significantly decrease.

CONFLICT OF INTEREST

The author declares no conflict of interest.

ABBREVIATIONS

Da: Arterial Diameter; **Dv:** Venous Diameter; **Dt:** Transitive Diameter; **av:** Capillary Ring Width; **V:** Blood Flow Rate.

REFERENCES

1. Robson SC, Hunter S, Boys RJ, Dunlop W. Serial study of factors influencing changes in cardiac output during human pregnancy.*Am J Physiol*. 1989;256:H1060-5.
2. Vonck S, Staelens AS, Bollen I, Broekx L, Gyselaers W. Why non-invasive maternal hemodynamics assessment is clinically relevant in early pregnancy: a literature review.*BMC Pregnancy Childbirth*. 2016;16:302.
3. Otsuka R, Watanabe H, Hirata K, Tokai K, Muro T, Yoshiyama M, *et al.* Acute effects of passive smoking on the coronary circulation in healthy young adults. J Am Med Assoc. 2001;286:436-41.
4. Celermajer DS, Adams MR, Clarkson P, Robinson J, McCredie R, Donald A, *et al.* Passive smoking and impaired endothelium-dependent arterial dilatation in healthy young adults. N Engl J Med. 1996;334:150-4.
5. Frey PF, Ganz P, Hsue PY, Benowitz NL, Glantz SA, Balmes JR, *et al.* The exposure-dependent effects of aged secondhand smoke on endothelial function. J Am Coll Cardiol. 2012;59:1908-13.
6. Bonetti PO, Lardi E, Geissmann C, Kuhn MU, Bruesch H, Reinhart WH. Effect of brief secondhand smoke exposure on endothelial function and circulating markers of inflammation. Atherosclerosis. 2011;215:218-22.
7. Lu Q, Bjorkhem I, Xiu R, Henriksson P, Freyschuss A. N-acetylcysteine improves microcirculatory flow during smoking: new effects of an old drug with possible benefits for smokers. Clin Cardiol. 2001;24:511-5.
8. Zhang J, Ying X, Lu Q, Kallner A, Xiu RJ, Henriksson P, Bjorkhem I. A single high dose of vitamin C counteracts the acute negative effect on microcirculation induced by smoking a cigarette. Microvasc Res. 1999;58:305-11.
9. Linder HR, Reinhart WH, Hanggi W, Katz M, Schneider H. Peripheral capillaroscopic findings and blood rheology during normal pregnancy.*Eur J Obstet Gynecol Reprod Biol*. 1995;58:141-5.
10. Rusavy Z, Pitrova B, Korecko V, Kalis V. Changes in capillary diameters in pregnancy-induced hypertension.*Hypertens Pregn*. 2015;34:307-13.

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