

Ph.D.thesis

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**MATERNAL CEREBRAL BLOOD-FLOW IN HEALTHY AND  
PREECLAMPTIC PREGNANCIES**



**János Zatik MD.**

Supervisor:  
**Prof. Dr. Tóth Zoltán**

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Department of Obstetrics and Gynecology  
University of Debrecen  
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## **I. Introduction**

Clinical and pathophysiological aspects of preeclampsia and eclampsia have been found to be responsible for the majority of maternal mortality, but the exact role of the cerebral hemodynamic and autoregulation is still unknown. It is conceivable that altered cerebral hemodynamics and autoregulation is responsible for the neurological complications. The background of the cerebral processes is still not clarified. In the thesis I summarize the changes of cerebral circulation which develop during normal pregnancy and during preeclampsia.

## **II. Aim**

1: to clarify of the maternal cerebral hemodynamics and autoregulation in healthy pregnant women and preeclamptic pregnancies.

2: To compare cerebral autoregulatory responses obtained during roll over tests in healthy pregnant women and those with pre-eclampsia in order to assess the middle cerebral artery velocity changes in relation to the roll over test in normotensive and pre-eclamptic women.

3: Investigation of cerebral arteriolar vasoreactivity function in preeclampsia and healthy pregnancy by transcranial Doppler sonography of the middle cerebral artery at rest and after 60 seconds of hyperventilation.

4 : Investigation of cerebral arteriolar vasoreactivity function in preeclampsia and healthy pregnancy by transcranial Doppler sonography of the middle cerebral artery at rest and after 30 seconds of brath holding.

### **III.Methods**

Preeclamptic and healthy pregnant , as well as non-pregnant women underwent transcranial Doppler blood flow velocity measurements of the middle cerebral artery. Rest mean blood flow velocities of the middle cerebral artery were compared between the different groups. I compare cerebral autoregulatory responses obtained during roll over tests in healthy pregnant women and those with pre-eclampsia in order to assess the middle cerebral artery velocity changes in relation to the roll over test in normotensive and pre-eclamptic women. Systolic, mean and diastolic blood flow velocities and mean arterial blood pressures were recorded in the left lateral position and five minutes after turning to the supine position. Absolute values of mean blood flow velocities, mean arterial blood pressure values and calculated cerebral blood flow indices as well as cerebrovascular resistance area products were compared at different positions among the groups. We investigated cerebral arteriolar vasoreactivity function in preeclampsia. Preeclamptic and healthy pregnant and non pregnant women underwent transcranial Doppler sonography of the middle cerebral artery at rest and after 60 seconds of hyperventilation. Systolic, diastolic, and mean blood flow velocities were recorded. The percentage change of the blood flow velocities after HV was calculated. Resting middle cerebral artery blood-flow velocities were also measured followed by a repeated measurement 30 seconds after breath holding in healthy and preeclamptic pregnancies. Mean blood flow velocities of the middle cerebral artery were compared between the different groups. ANOVA combined with Bonferroni correction was used for statistical analysis

### **III.Results:**

1: Comparison of cerebral blood flow velocity in preeclamptic, healthy pregnant, and nonpregnant women:

Preeclamptic (n=21) and healthy pregnant (n=17), as well as non-pregnant (n=29) women underwent transcranial Doppler blood flow velocity measurements of the middle cerebral artery.

MCAV was significantly higher in non-pregnant women (means $\pm$ SE: 73.0 $\pm$ 2.12 cm/s) as compared to healthy pregnant women (67.0 $\pm$ 1.8 cm/s, p=0.0356). Preeclamptic women showed significantly higher middle cerebral artery mean blood flow velocity values (mean $\pm$ SE:83.5 $\pm$ 2.1 cm/s) compared to non-pregnant females (73.0 $\pm$ 2.12 cm/s, p=0.0014). Similar to non-pregnant women, healthy pregnant women showed lower middle cerebral artery mean blood flow velocity values (mean $\pm$ SE:67.0 $\pm$ 1.8 cm/s,) compared with preeclamptic women (83.5 $\pm$ 2.1 cm/s, p=0.001). After Bonferroni correction MCAVs in patients suffering from preeclampsia were still statistically significantly higher as compared to the two other groups.

2:Cerebral hemodynamics during roll over test in healthy pregnant women (26) and women with pre-eclampsia(28): Mean arterial blood pressure increased in both groups while turning from the left lateral to the supine position. In women with pre-eclampsia both mean arterial blood pressure and absolute values of mean blood flow velocity values were higher in both positions, compared with healthy pregnant women. In both groups, changing the position resulted in a decrease of absolute values of mean blood flow velocities. Calculated cerebral blood flow indices did not change, while cerebrovascular resistance area products increased significantly in the groups

during roll over testing. In women with pre-eclampsia, the increase of cerebrovascular resistance area products was more pronounced as compared with healthy pregnant women.

3: Hyperventilation on cerebral blood flow velocity in preeclamptic (26) and healthy pregnancies (30): Systolic, diastolic, and mean blood flow velocities were recorded. The percentage change of the blood flow velocities after HV was calculated. Mean blood flow velocity of the middle cerebral artery was higher in preeclamptic women as compared with healthy pregnant women. No difference could be detected in percentage change of middle cerebral artery blood flow velocities after HV between the two groups.

4: Breath holding on cerebral flow velocity in preeclamptic (34) and healthy pregnant patients (26): Absolute blood flow velocities were higher in preeclamptic pregnant women both at rest and after breath holding. The percent increase of cerebral blood-flow velocity after breath holding-cerebral vasoreactivity was similar in both groups. There is no evidence of a small-vessel vasoconstriction among preeclamptic patients

#### **IV. Conclusion:**

The mean blood flow velocity of the middle cerebral artery (MCAV) was significantly higher in nonpregnant women as compared with healthy pregnant women. Preeclamptic women showed significantly higher MCAV values as compared with nonpregnant females. Similar to nonpregnant women, healthy pregnant women showed lower MCAV values as compared with preeclamptic

women.

Mean arterial blood pressure increased in both groups while turning from the left lateral to the supine position. In women with pre-eclampsia both mean arterial blood pressure and absolute values of mean blood flow velocity values were higher in both positions, compared with healthy pregnant women. In both groups, changing the position resulted in a decrease of absolute values of mean blood flow velocities. Calculated cerebral blood flow indices did not change, while cerebrovascular resistance area products increased significantly in the groups during roll over testing.

In women with pre-eclampsia, the increase of cerebrovascular resistance area products was more pronounced as compared with healthy pregnant women. Absolute blood-flow velocities were lower after hyperventilation in healthy pregnant and preeclamptic pregnant groups. No difference could be detected in percentage change of middle cerebral artery blood flow velocities after HV between the two groups.

Absolute blood flow velocities were higher in preeclamptic pregnant women both at rest and after breath holding. The percent increase of cerebral blood-flow velocity after breath holding-cerebral vasoreactivity was similar in both groups.

There is no evidence of a small-vessel vasoconstriction among preeclamptic patients. The role of vasoconstriction of the large cerebral arteries and vasodilation of the resistance arterioles, as well as a combination of these 2 pathomechanisms, in determining cerebral blood flow in preeclampsia and eclampsia should be investigated in further studies. Cerebral hemodynamical studies are only helpful in better understanding the pathophysiological background of preeclampsia-eclampsia syndrome at present. Cerebral vasoreactivity is preserved in pregnant women with mild preeclampsia.

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6. **Zatik J**, Aranyosi J, Mihálka L, Páll D, Major T, Fülesdi B: Comparison of cerebral blood flow velocity as measured in preeclamptic, healthy pregnant and non-pregnant women by transcranial Doppler sonography- Gynecol.Obstet Invest 2001;51:111-118.
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Lectures and abstracts:

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