

# HEMODYNAMIC CHANGE OF CEREBRAL BLOOD FLOW USING CAROTID DUPLEX ULTRASONOGRAPHY IN PATIENTS WITH HEMODIALYSIS.

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## Introduction

During hemodialysis, hemodynamic alteration can be occurred by changes of flow via arteriovenous fistula (AVF). Also it can affect cerebral blood flow (CBF). However, there has been few study to evaluate hemodynamic change of CBF during hemodialysis. We evaluated whether hemodynamic alteration during hemodialysis can be detected by carotid duplex ultrasonography (CDU). And we also assessed the correlation of change in CBF with clinical symptom and hemodialysis-related factors, such as AVF flow volume and age of AVF.

## Methods

We prospectively enrolled patients who receive hemodialysis via AVF on upper extremity. Before and during hemodialysis, blood pressure (BP) and presence of dizziness were monitored. We performed CDU twice, just before and 1 hour after start of dialysis. With CDU, we checked peak systolic velocity (PSV) and flow volume in bilateral common carotid artery (CCA) and vertebral artery (VA). We calculated total volume of CBF by sum of flow volumes of 4 insonated neck vessels. The differences ( $\Delta$ ) of these hemodynamic variables before and during dialysis were measured and compared according to the side to the AVF. We also evaluated the correlation of various factors, such as patient age, BP, cerebral flow, and AVF flow volume.

## Results

	n=81
Age	61.1±10.7
Sex, M:F	49:32(60:40)
AV shunt side (Rt:Lt)	20:61(25:75)
C-V risk factors	
Diabetes	
Hypertension	
Smoking - current	
- former	
Hyperlipidemia	
Prev. coronary dis.	
Prev. stroke	
Duration of hemodialysis	60.9±80.4 (Data□ ■ )
Age of AV fistula	56.4±41.4 (Data□ ■ )
Flow volume of AV shunt during HD	1111.1±598.3

Table 1. Clinical characteristics of patients with hemodialysis

	AVF side (n=81)	non-AVF side (n=81)	p-value
<b>Before hemodialysis</b>			
CCA-PSV (cm/sec)	71.2±19.4	64.5±21.7	0.001
CCA-flow volume (ml/min)	527.9±183.2	465.9±167.5	0.002
VA-PSV (cm/sec)	45.9±22.8	54.3±16.7	0.007
VA-flow volume (ml/min)	95.2±81.8	132.1±77.6	0.018
<b>During hemodialysis</b>			
CCA-PSV (cm/sec)	64.4±20.0	61.5±21.5	0.130
CCA-flow volume (ml/min)	431.7±158.8	412.6±138.5	0.272
VA-PSV (cm/sec)	41.2±21.2	52.4±16.8	0.000
VA-flow volume (ml/min)	84.6±79.7	131.0±83.6	0.004
$\Delta$ CCA PSV (cm/sec)	-6.7±10.2	-3.0±12.9	0.012
$\Delta$ CCA flow volume (ml/min)	-94.3±109.7	-52.6±119.1	0.007
$\Delta$ VA PSV (cm/sec)	-4.2±6.7	-1.7±6.7	0.009
$\Delta$ VA flow volume (ml/min)	-11.9±23.1	-1.3±23.1	0.002

Table 2. Side to Side comparison of hemodynamic variables before and during hemodialysis

	Before dialysis	During dialysis	p-value
Systolic BP	146.2±21.9	136.1±24.6	0.000
Diastolic BP	76.6±13.8	74.2±13.5	0.080
<b>AVF side</b>			
CCA-PSV (cm/sec)	71.2±19.4	64.4±20.0	0.000
CCA-flow volume (ml/min)	527.9±183.2	431.7±158.8	0.000
VA-PSV (cm/sec)	45.9±22.8	41.2±21.2	0.000
VA-flow volume (ml/min)	95.2±81.8	84.6±79.7	0.000
<b>Non-AVF side</b>			
CCA-PSV (cm/sec)	64.5±21.7	61.5±21.5	0.041
CCA-flow volume (ml/min)	465.9±167.5	412.6±138.5	0.000
VA-PSV (cm/sec)	54.3±16.7	52.4±16.8	0.017
VA-flow volume (ml/min)	132.1±77.6	131.0±83.6	0.668
Total cerebral blood flow (ml/min)	1221.9±344.9	1085.8±319.2	0.000

Table 3. Hemodynamic change before and during hemodialysis

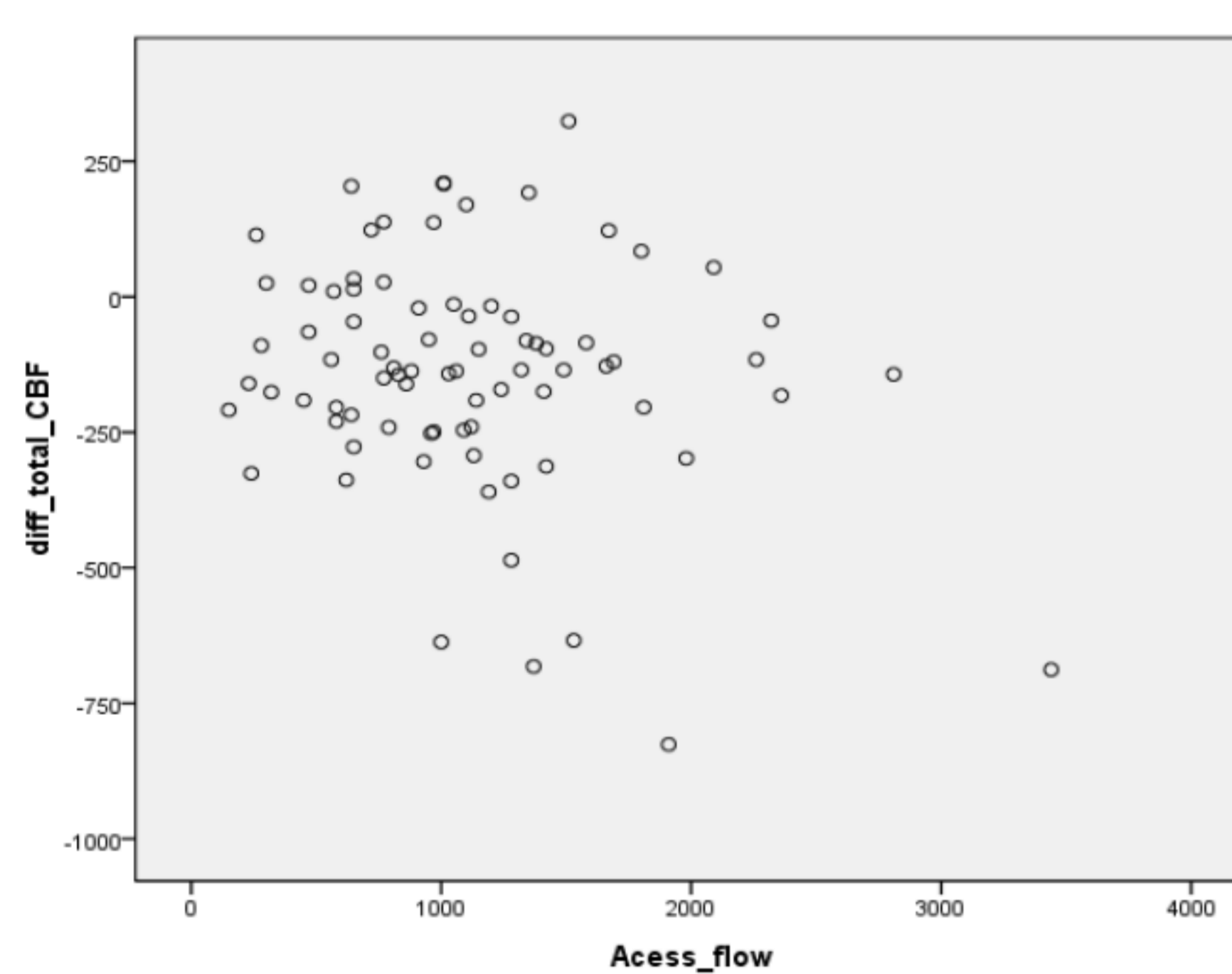


Figure 1. Change of total cerebral blood flow during hemodialysis according to the blood flow via AV fistula ( $r=-0.223$ ;  $p=0.046$ )

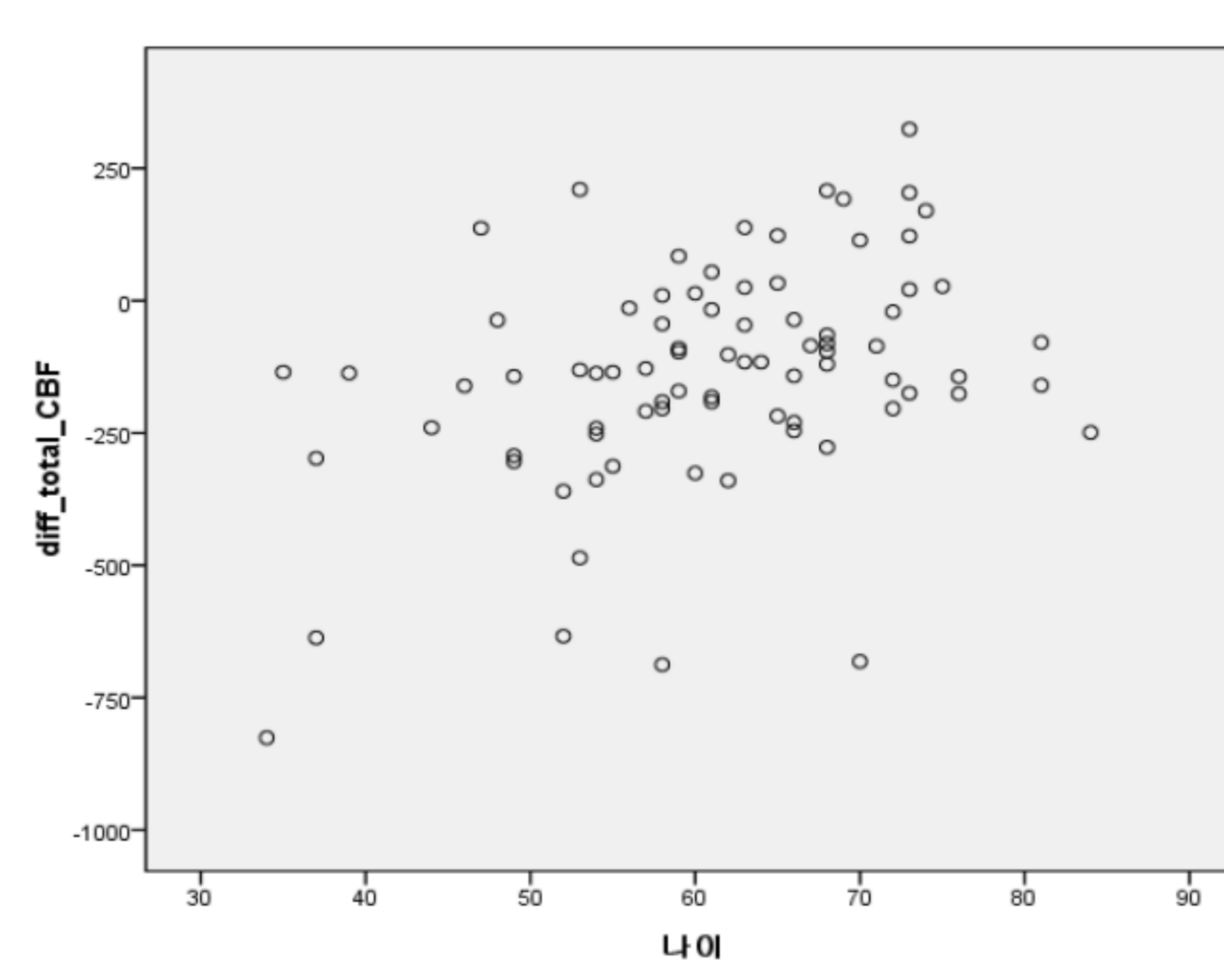


Figure 2. Change of total cerebral blood flow during hemodialysis according to age ( $r=0.388$ ;  $p=0.000$ )

	Dizzy patients (n=15)	No symptom (n=66)	p-value
$\Delta$ Systolic BP	-10.2±25.4	-10.1±19.2	0.993
$\Delta$ Diastolic BP	0.2±16.8	-3.0±10.9	0.493
<b>AVF side</b>			
$\Delta$ CCA PSV (cm/sec)	-6.5±8.3	-6.7±10.7	0.958
$\Delta$ CCA flow volume (ml/min)	-90.0±110.1	-95.3±110.4	0.867
$\Delta$ VA PSV (cm/sec)	-2.3±7.0	-4.6±6.6	0.232
$\Delta$ VA flow volume (ml/min)	-10.5±18.4	-12.2±24.2	0.807
<b>Non-AVF side</b>			
$\Delta$ CCA-PSV (cm/sec)	-4.7±8.6	-2.5±13.7	0.55
$\Delta$ CCA-flow volume (ml/min)	-90.9±81.6	-43.9±124.9	0.169
$\Delta$ VA-PSV (cm/sec)	-2.5±6.6	-1.5±6.8	0.588
$\Delta$ VA-flow volume (ml/min)	-5.7±20.4	-0.3±23.7	0.416
$\Delta$ Total cerebral blood flow (ml/min)	-187.1±168.8	-124.5±218.6	0.301

Table 5. Changes in hemodynamic variables of neck vessels according to the clinical symptom

## Conclusions

In the present study, we found hemodynamic alteration in cerebral blood flow during hemodialysis were significant, independent to systemic BP change, and related to the side to the AVF. Even though those alterations did not correlate with the clinical symptom significantly, the study results can be helpful for understanding the hemodynamic change during hemodialysis.