Clinical Significance of Vertebral Artery Stenosis

Yo Han Jung

Department of Medicine
The Graduate School, Yonsei University

Clinical Significance of Vertebral Artery Stenosis

Directed by Professor Ji Hoe Heo

**The Master's Thesis submitted to the Department of Medicine,
The Graduate School of Yonsei University
In partial fulfillment of the requirements for the degree of Master of Medical Science**

Yo Han Jung

December 2008

This certifies that the Master's Thesis
of
Yo Han Jung is approved.

Thesis Supervisor : Ji Hoe Heo

Thesis Committee Member #1 : Won Taek Lee

Thesis Committee Member #2 : Eung Yeop Kim

The Graduate School
Yonsei University

December 2008

Acknowledgements

My inestimable gratitude goes to Dr Ji Hoe Heo in Yonsei University School of Medicine who gave most openly of his experience, advice, and teaching to me. This work would have been impossible without him. I gratefully acknowledge helpful comments and suggestions by Dr Won Taek Lee and Dr Eung Yeop Kim. I also give thanks to the fellows of the neurology section of Yonsei University School of Medicine who deserve my most sincere thanks for making work fun.

Finally, I do give thanks to my wife who spent much time without me and spared no effort to support me.

Yo Han Jung

Table of contests

List of Tables

List of Figures

Abstract

Clinical Significance of Vertebral Artery Stenosis

Yo Han Jung

Department of Medicine
The Graduate School, Yonsei University

(Directed by Professor Ji Hoe Heo)

Background

Infarctions occurring in the territory of the vertebrobasilar artery (VBA) account for 20%~25% of all infarctions. Vertebral artery (VA) stenosis has been implicated in up to 20% of ischemic strokes of the VBA territory. Atherosclerosis at the origin of the VA is most common in the VBA. However, patterns of stroke, and outcomes in patients with occlusive lesions in the origin of the VA have not been well studied.

Objectives

We investigated the demographic and imaging characteristics of infarctions in patients with the stenosis of the VBA, especially at the origin of the VA.

Methods

Patients with acute ischemic stroke in the VBA were reviewed. We included patients registered in the Yonsei Stroke Registry between February 1999 and April 2008 who underwent digital subtraction angiography (DSA). Patients were divided into four groups based on the location of lesions.

Results

Of 225 patients, 115 patients (51.1%) had stenosis in the VA. The VA origin (V1) was the most common location for stenotic lesions (70 patients, 31.1%). In patients with stenosis at V1, age, history of previous stroke, number of vascular risk factors and erythrocyte sedimentation rate were significantly higher than those in other groups ($p<0.05$). The most common anatomic location of infarctions was the pons (26.1%, 85 of 326 lesions), followed by the cerebellar hemisphere (20.9%, 68 of 326 lesions). Of 350 arterial lesions from 225 patients, the anteromedial branch of the basilar artery was most commonly involved (22.3%, 78 of 350), followed by the posterior inferior cerebellar artery (20.9%, 73 of 350). Stroke severity was not different among the groups.

Conclusions

In this study, based on DSA selection criteria, V1 was the most common stenotic lesion site in patients with infarction of the VBA terriory. V1 stenosis was associated with an increased number of vascular risk factors and concomitant atherosclerosis in other vessels.

Key words: Vertebral artery, cerebral infarction, atherosclerosis

Clinical Significance of Vertebral Artery Stenosis

Yo Han Jung

Department of Medicine
The Graduate School, Yonsei University

Directed by Professor Ji Hoe Heo

I. INTRODUCTION

Infarctions occurring in the territory of the vertebrobasilar artery (VBA) account for 20% - 25% of all infarctions,[1, 2] and have a high mortality rate.[3] Stenosis of the vertebral artery (VA) has been implicated in up to 20% of ischemic strokes of the VBA territory.[4]

The origin of the VA is the most common site of atherosclerosis in the VBA system.[3, 5, 6] However, patterns of stroke, clinical features, and outcomes in patients with occlusive lesions of the origin of the VA have not been thoroughly studied, mainly because previous studies were based on the findings of autopsy reports or magnetic resonance angiography (MRA).[6, 7] MRA has limitation in accurate visualization of the origin of the VA.[8] Although conventional angiography is the gold standard for the diagnosis of the origin of the VA as well as other cerebral arteries, few studies have investigated demographics and imaging related to lesions of the origin of the VA based on conventional angiographic studies.[6, 9]

This study was aimed at verifying the clinical significance of stenosis at the VA, especially at its origin, using data from patients who underwent digital-subtraction angiography (DSA).

II. SUBJECTS AND METHODS

1. Patients

Consecutive patients with acute ischemic stroke within 7 days of onset, who were admitted to the Severance hospital, Yonsei University, and who were registered in the Yonsei Stroke Registry (YSR) between February 1999 and April 2008 were considered for this study. The YSR is the prospective hospital-based acute ischemic stroke registry that has been running since October 1994.[10] Patients were included if they had an ischemic stroke in the territory supplied by the VBA and its branch arteries and had undergone DSA. Patients with cardioembolism (CE), other causes of stroke, transient ischemic attack (TIA), or co-existing infarctions involving both the carotid and VBA territories were excluded.

2. Categorization of patients

Enrolled patients were divided into 4 groups: Group 1, Patients with isolated stenosis at the origin of the VA; Group 2, patients with combined stenosis at the origin of the VA and the other portions of the VA; Group 3, patients with stenosis in the VBA other than the origin of the VA; Group 4, patients with no relevant arterial lesion in the VBA.

3. Definition of risk factors

Hypertension was defined when a patient had high blood pressure recordings (systolic ≥140 mm Hg or diastolic ≥90 mm Hg) or when a patient had been treated with antihypertensive medications. Diabetes mellitus was diagnosed when a patient had a high fasting plasma glucose value (≥7 mmol/L) or had been treated with oral hypoglycemic agents or insulin. Hypercholesterolemia was defined as a high lipid profiles (fasting serum total cholesterol level ≥6.2 mmol/L, LDL-cholesterol >4.1 mmol/L) or a history of lipid-lowering drugs after being diagnosed as hypercholesterolemia. Patients were regarded as smokers if they smoked within the three-month period prior to admission. History of previous stroke included old ischemic strokes, and history of ischemic heart disease included myocardial infarction, unstable angina, coronary artery angioplasty or stent, and coronary artery bypass graft surgery.

4. Arterial status and involved arterial territory

Any abnormalities in arterial segments and branch arteries were determined at a weekly stroke conference based on a neuroradiologist's report and the consensus of stroke specialists, and the data were entered into the YSR. The VA was divided into the V1 (segment of the VA that begins at its origin and passes into the neck and enters the transverse foramen of C6), the V2 (segment that ascends through the transverse foramen from C6 to C2), the V3 (segment that exits the transverse foramen of C2, winds around C1 posteriorly in a tortuous manner, and enters the dura at the foramen magnum), and V4 (segment that begins at the foramen magnum and unites with the contralateral VA to form the basilar artery) segments.[11, 12] The

basilar artery was divided into proximal or distal portion at the site of the anterior inferior cerebella artery (AICA) origin. The degree of stenosis was measured in any segment with a lesion based on the North American Symptomatic Carotid Endarterectomy Trial (NASCET) method.[13] Stenosis was defined when the artery showed any degree of stenosis. The determination of arterial territory involved was based on predetermined templates.[14, 15]

5. Severity of Stroke

The clinical severity of stroke was assessed at admission and discharge using the National Institutes of Health Stroke Scale (NIHSS). Functional outcomes were assessed at discharge using a modified Rankin scale (mRS).

6. Statistical Analysis

Statistical analysis was performed with SPSS 13.0 for Windows statistical software (SPSS Inc). The chi-square test was performed for cross tabulation. Student's t-test and one-way ANOVA were performed to compare differences between the groups. Statistical significance was set at $p<0.05$.

III. RESULTS

There were 1,138 patients with ischemic stroke in the VBA territory. After excluding CE (233 patients), other causes of stroke (37 patients), and co-existing infarctions in the carotid and VBA territories (62 patients), 225 patients, all of whom had undergone DSA, were finally enrolled in this study (Figure 1).

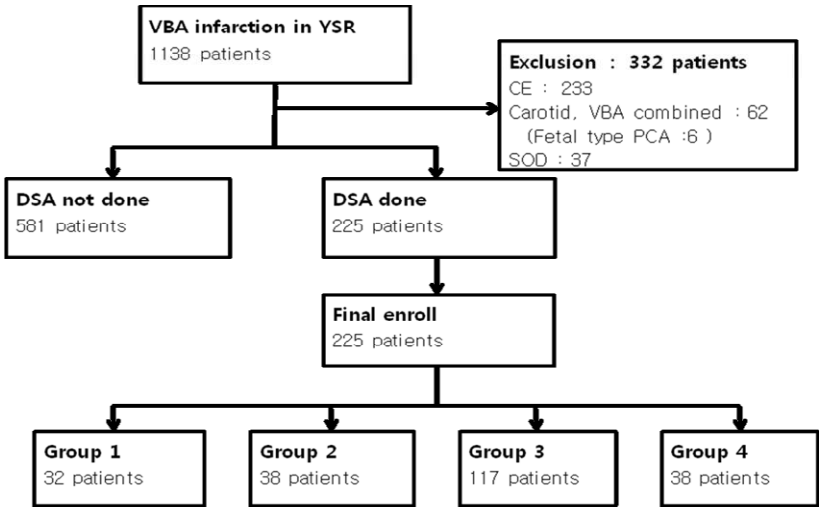

Figure 1. Flow diagram showing patients selection (CE; cardioembolism, DSA; digital subtraction angiography, PCA; posterior cerebral artery, VBA; vertebrobasilar artery, SOD; stroke of other determined etiology).

1. Demographic characteristics

Patients with DSA were younger than those without, and more men than women had DSA. A comparison of patients with DSA to those without, did not show a significant difference in the severity of infarction (NIHSS at admission, difference between NIHSS at admission and discharge, or mRS). In patients with DSA, hypercholesterolemia was more common, and the number of risk factors was greater (Table 1).

Patients with stenosis at V1 (70 patients) were older, had a higher frequency of previous stroke history, and high erythrocyte sedimentation rate values, when comparing with the group 3 and 4 ($p<0.05$) (Table 2). There were no significant differences in the severity of stroke among the groups. The number of risk factors was significantly higher in group 2 than in other groups ($p=0.013$).

Table 1. Comparison of demographics between patients with digital subtraction angiography and those without

Group	DSA (n=225)	non DSA (n=581)	Total (n=806)	p-value
Men/Women*	160 (71.1%) /65 (28.9%)	353 (60.8%) /228 (39.2%)	513 (63.6%) /293 (36.4%)	0.006
Age, mean(SD), y†	61.5 ± 10.9	64.8 ± 11.1	63.9 ± 11.1	< 0.001
Severity of cerebral infarction†				
NIHSS at admission	3.5 ± 4.2	3.4 ± 4.3	3.4 ± 4.3	0.713
NIHSS at discharge	2.2 ± 3.1	2.7 ± 5.0	2.6 ± 4.5	0.091
dNIHSS[1]	-1.3 ± 2.6	-0.6 ± 3.6	-0.8 ± 3.3	0.053
mRS	1.5 ± 1.3	1.5 ± 1.3	1.5 ± 1.3	0.881
Vascular risk factors*				
Hypertension	183 (81.3%)	439 (75.6%)	622 (77.2%)	0.08
Diabetes mellitus	98 (43.6%)	261 (44.9%)	359 (44.5%)	0.726
Hypercholesterolemia	29 (12.9%)	19 (3.3%)	48 (6.0%)	< 0.001
Smoking	100 (44.4%)	238 (41.0%)	338 (41.9%)	0.369
Myocardial infarction	1 (0.4%)	3 (0.5%)	4 (0.5%)	0.896
Previous stroke	42 (18.7%)	89 (15.3%)	131 (16.3%)	0.248
Metabolic syndrome	43 (19.1%)	106 (18.2%)	149 (18.5%)	0.776
No. of risk factors†	2.3	2	2.1	0.013
Laboratory results†				
hsCRP	9.1	6.9	7.6	0.45
ESR	15.3	17.1	16.6	0.244
Glucose (mg/dL)	151.6	155.7	154.6	0.502
Total-C (mg/dL)	185.1	185.1	183.4	0.495
LDL-C (mg/dL)	73.7	65.6	68.2	0.17
TG (mg/dL)	147.8	143.2	144.5	0.528
HDL-C (mg/dL)	40.8	43.5	42.8	0.008
WBC	8839	8298	8448	0.036
PT (INR)	0.93	0.94	0.93	0.953
PTT	30.4	31.3	31.1	0.084

Values are mean ± SD or number (percentage) of patients

* by chi-square test, † by one-way ANOVA test

ESR, erythrocyte sedimentation rate; HDL-C, high density lipoprotein cholesterol; hsCRP, high sensitivity C-reactive protein; LDL-C, lower density lipoprotein cholesterol; mRS, modified Rankin score; NIHSS, National Institute of Health Stroke Scale; TG, triglyceride; Total-C, total cholesterol; dNIHSS[1], NIHSS at discharge – NIHSS at admission

Table 2. Comparison of baseline clinical characteristics between groups

Group	Group 1 (n=32)	Group 2 (n=38)	Group 3 (n=117)	Group 4 (n=38)	P value
Men/Women*	23/9	25/13	84/33	28/10	0.877
Age, mean(SD), y†	65±9	63±8	62±11	56±12	0.001
Severity of cerebral infarction†					
NIHSS at admission	3.6 ± 4.3	3.7 ± 4.3	3.8 ± 4.6	2.4 ± 2.2	0.314
NIHSS at discharge	2.3 ± 3.6	2.8 ± 3.4	2.2 ± 3.1	1.6 ± 2.5	0.497
dNIHSS[1]	-1.3 ± 5.0	-0.9 ± 2.1	-1.4 ± 1.9	-0.4 ± 1.6	0.279
mRS	1.2 ± 1.3	1.6 ± 1.4	1.7 ± 1.3	1.1 ± 1.1	0.126
Vascular risk factors*					
Hypertension	30 (93.8%)	30 (78.9%)	97 (82.9%)	26 (68.4%)	0.051
Diabetes mellitus	13 (40.6%)	20 (52.6%)	50 (42.7%)	15 (39.5%)	0.643
Hypercholesterolemia	4 (12.5%)	5 (13.2%)	17 (14.5%)	3 (7.9%)	0.769
Smoking	10 (31.3%)	17 (44.7%)	56 (47.9%)	17 (16.9%)	0.421
Myocardial infarction	0 (0%)	0 (0%)	1 (0.9%)	0 (0%)	0.819
Previous stroke	8 (25.0%)	13 (34.2%)	16 (13.7%)	5 (13.2%)	0.023
Peripheral vascular disease	2 (6.3%)	1 (2.6%)	1 (0.9%)	0 (0%)	0.166
Number of risk factors†	2.3	2.6	2.3	1.8	0.013
Laboratory results†					
hsCRP	10.9	8.4	10.5	3.4	0.845
ESR	15	22.1	15.1	9.7	0.01
Glucose (mg/dL)	141.8	165.4	156.2	132.1	0.105
Total-C (mg/dL)	185.1	184.1	190	171.1	0.202
LDL-C (mg/dL)	52.8	93.5	79	56.7	0.051
TG (mg/dL)	136.7	155.1	148.7	147.2	0.902
HDL-C (mg/dL)	42.2	39.4	40.9	40.7	0.867

Values are mean ± SD or number (percentage) of patients

* by chi-square test, † by one-way ANOVA test

ESR, erythrocyte sedimentation rate; HDL-C, high density lipoprotein cholesterol; hsCRP, high sensitivity C-reactive protein; LDL-C, lower density lipoprotein cholesterol; mRS, modified Rankin score; NIHSS, National Institute of Health Stroke Scale; TG, triglyceride; Total-C, total cholesterol

dNIHSS[1], NIHSS at discharge – NIHSS at admission

2. Arterial lesions

Of 225 patients, 115 (51.1%) had stenosis in the VA, with a V1 stenotic lesion (70 patients, 31.1%) being the most common. Tandem lesions in the VA patients (54.3%, 38 of 70) were found in 38 patients (intracranial VBA in 25 patients and extracranial VA in 13 patients). Fourteen patients (6.2%) had isolated stenosis of the V1 without any lesions in carotid and VBA territories. Stenosis of the V2 or V3 was found in 15.1% (34 patients) and that of the V4 was found in 19.6% (44 patients). Stenosis at the proximal basilar artery was 16.4% (37 patients) and that of the distal basilar artery was 7.6% (17 patients). Stenosis of the posterior cerebral artery (PCA) was found in 27 patients (Figure 2).

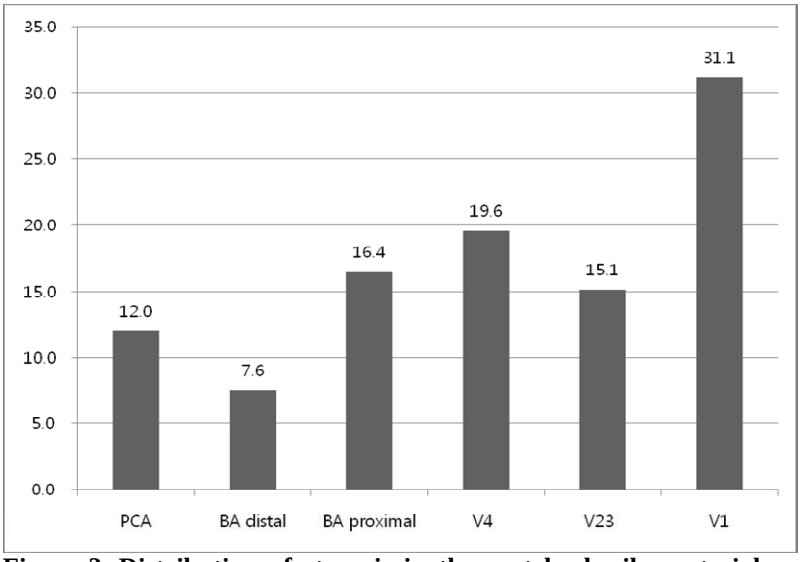

Figure 2. Distribution of stenosis in the vertebrobasilar arterial system (BA, basilar artery; PCA, posterior circulation infarction).

3. Anatomic location of the lesions

The most common anatomic location of infarctions was the brainstem (45.4%, 148 of 326 lesions), followed by the cerebellum (26.7%, 87 of 326 lesions). The pons

constituted 57.4% of the brainstem lesions (85 of 148 lesions) and the midbrain constituted 12.2% (18 of 148 lesions). Among the cerebellar lesions, involvement of the cerebella hemisphere was more common than that of the vermis (Table 3).

Table 3. Anatomic locations of infarctions in the VBA territory

Anatomic location	Group 1 (n=32)	Group 2 (n=38)	Group 3 (n=117)	Group 4 (n=38)	Total
Cerebral hemisphere					
occipital cortex	5 (12.8)	5 (9.3)	33 (17.4)	1 (2.3)	44 (13.5)
subcortical white matter	1 (2.6)	2 (3.7)	9 (4.7)	0 (0)	12 (3.7)
Diencephalon					
thalamus	4 (10.3)	7 (13.0)	18 (9.5)	6 (14.0)	35 (10.7)
Brainstem					
midbrain	2 (5.1)	4 (7.4)	6 (3.2)	6 (14.0)	18 (5.5)
pons	9 (23.1)	17 (31.5)	42 (22.1)	17 (39.5)	85 (26.1)
medulla oblongata	7 (17.9)	8 (14.8)	25 (13.2)	5 (11.6)	45 (13.8)
Cerebellum					
hemisphere	9 (23.1)	9 (16.7)	44 (23.2)	6 (14.0)	68 (20.9)
vermis	2 (5.1)	2 (3.7)	13 (6.8)	2 (4.7)	19 (5.8)
Total	39 (100.0)	54 (100.0)	190 (100.0)	43 (100.0)	326 (100.0)

Values are number (percentage) of patients.

There was no heterogeneity among the groups in anatomic locations except the occipital cortex. In group 1, the anatomic locations of infarctions included brainstem (46.2%, 18 of 39), cerebellum (28.2%, 11 of 39), diencephalon (17.9%, 7 of 39), and cerebral hemisphere (15.4%, 6 of 39). The anatomic locations of group 2 were similar to those of group 1; the brainstem (53.7%, 29 of 54), cerebellum (20.4%, 11 of 54), diencephalon and cerebral cortex (13.0%, 7 of 54). In contrast to

the groups 1 and 2, cortical involvement was higher in group 3 (22.1%, 42 of 190) (p=0.016).

4. Arterial territories involved

Of 350 arterial lesions in 225 patients with infarction in the VBA territory, lesions involving the territory of the anteromedial branch of the basilar artery were most common, followed by those in the posterior inferior cerebellar artery (PICA), the cortical branch of the PCA, the thalamogeniculate artery of the PCA, the lateral PICA , and the superior cerebellar artery (SCA) (Table 4).

Among PCA branches or perforators, infarction involving the cortical branch of the PCA (42.2%, 43 of 102) was most common, followed by the thalamogeniculate arteries (25.5%, 26 of 102). In group 1, the most common arterial territory was the anteromedial part of the basilar artery (17.1%, 6 of 35) and the PICA in the cerebellum (14.3%, 5 of 35).

Involvement of single arterial territory was more common in patients with V1 stenosis than those without V1 stenosis ($p<0.05$) (Figure 3). This was similar to what was seen in all patients with infarction in the VBA territory.

Table 4. Arterial territories of infarction in the VBA territory

Artery	Branches	N	%
PCA			
	Polar	4	1.1
	Paramedian	8	2.3
	Thalamogeniculate	26	7.4
	Medial posterior choroidal	4	1.1
	Lateral posterior choroidal	5	1.4
	splenial	10	2.9
	Cortical branches	43	12.3
	Perforators in brainstem	2	0.6
Basilar artery			
	Anteromedial	78	22.3
	Anterolateral	17	4.9
	Lateral	6	1.7
SCA		29	8.3
AICA		15	4.2
PICA		73	20.9
Anterior spinal artery		5	1.4
Posterior spinal artery		0	0.0
Vertebral artery			
	Anteromedial	8	2.3
	Anterolateral	7	2.0
	Lateral	10	2.9
Total		350	100

AICA, anterior inferior cerebella artery; PCA, posterior cerebral artery; PICA, posterior inferior cerebellar artery; SCA, superior cerebellar artery

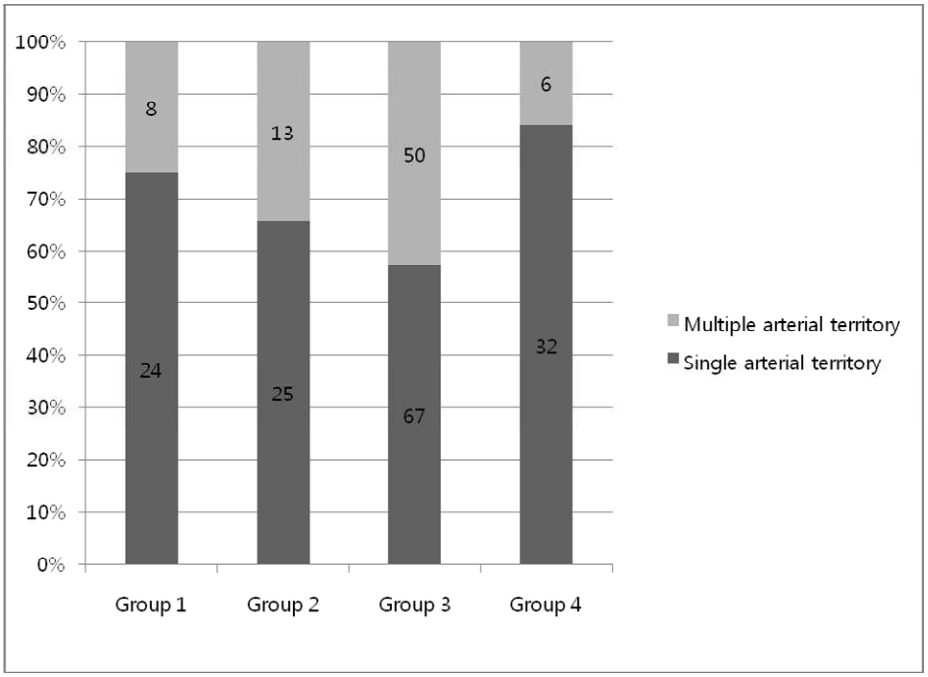

Figure 3. Involvement of single arterial territory between groups.

IV. DISCUSSION

In this study, approximately half of the patients with infarctions in the VBA territory, excluding those with CE or other causes, had stenosis of the VA, with stenosis at the origin of the VA being the most common. Although previous studies also noted frequent involvement of the V1 segment among patients with infarction in the VBA territory as in our study,[4] we found the frequency of the V1 lesion (31.1%) to be higher than that seen in the previous studies (14.6%-20%).[3, 16] This might be because we included only patients with DSA, which resulted in a higher detection rate of V1 lesions, and we excluded patients with CE or other causes of stenosis, which increased the relative frequency of atherosclerotic lesions.

In the present study, V1 stenosis showed significantly higher number of risk factors for ischemic stroke, history of previous stroke, and combined atherosclerosis in other vessels, suggesting that V1 stenosis may be a marker of more widespread atherosclerotic disease.

We found that the most common anatomic lesion in patients with infarction in the VBA territory was the paramedian pons, followed by the cerebellar hemisphere. In concert with the anatomic lesion, the anteromedial branch of the basilar artery and the PICA, which supply the paramedian pons and the cerebellum, respectively, were the most commonly involved arterial territories. In a previous study of infarctions in the VBA territory, which included patients with cardioembolism, the paramedian pons of the brainstem was the most commonly involved site, followed by the cerebellum.[18] These findings were also observed in our study, which excluded cardioembolic stroke and other causes, suggesting that the anteromedial branches of the basilar artery and PICA are the most frequent predilection site of involvement for atherothrombotic infarctions in the territory of the VBA.

In the present study, when comparing the groups with V1 involvement (group 1 and 2) with the group with VBA atherosclerosis without V1 stenosis (group 3), we found that group 3 patients had cortical involvement of the PCA territory and multiple infarctions more frequently. The majority of PCA territory infarctions have been suggested to be caused by cardiac or proximal arterial embolism.[19] These findings suggest that arterial embolism might be a common mechanism of stroke in

group 3 patients, while V1 lesion might be an innocent bystander in some patients.

We evaluated the stroke severity of infarctions in the VBA territory by using NIHSS at admission and discharge and using the mRS. Reported prognosis of patients with infarction in the VBA territory is different among studies. Some reported that the mortality associated with a infarction in the VBA territory was 20-30%, which was significantly greater than that for a carotid circulation stroke.[17, 18] In contrast, the mortality was low in another study.[19] Although this study did not compare patients with stroke in the VBA and the carotid artery, the mortality seemed low in patients with infarction in the VBA territory. Neurologic severity and outcomes at discharge were not different between patients with and without V1 stenosis in this study. However, in the New England Medical Center Posterior Circulation Registry[20], severe stenosis of the extracranial VA was associated with a good prognosis, This discrepancy might be because, in this study, any degree of stenosis was included in the V1 stenosis groups.

This study does have some limitations. There was a selection bias in this study because only patients with DSA were enrolled. Therefore, this study is limited to show whole features of infarctions in the VBA territory. In addition, in patients with multiple atherosclerosis of the VBA, the clinically relevant artery is uncertain. Therefore, an exact determination of the lesion location and arterial territory, which were assessed based on arterial lesion, was limited.

V. CONCLUSION

In our study, V1 was the most common stenotic lesion found in patients with infarction in the VBA territory. Although V1 stenosis was associated with an increase in the number of vascular risk factors and atherosclerosis in other vessels, patients with V1 stenosis did not show differences in clinical severity, anatomic location of the infarct lesions, and arterial territories of infarctions involved when compared with those with stenosis in the VBA other than V1.

REFERENCES

1. Savitz SI, Caplan LR. Vertebrobasilar disease. N Engl J Med 2005 Jun 23;352(25):2618-26.

2. Bamford J, Sandercock P, Dennis M, Burn J, Warlow C. Classification and natural history of clinically identifiable subtypes of cerebral infarction. Lancet 1991 Jun 22;337(8756):1521-6.

3. Caplan L. Posterior circulation ischemia: then, now, and tomorrow. The Thomas Willis Lecture-2000. Stroke 2000 Aug;31(8):2011-23.

4. Cloud GC, Markus HS. Diagnosis and management of vertebral artery stenosis. QJM 2003 Jan;96(1):27-54.

5. Schwartz CJ, Mitchell JR. Atheroma of the carotid and vertebral arterial systems. Br Med J 1961 Oct 21;2(5259):1057-63.

6. Wityk RJ, Chang HM, Rosengart A, Han WC, DeWitt LD, Pessin MS, et al. Proximal extracranial vertebral artery disease in the New England Medical Center Posterior Circulation Registry. Arch Neurol 1998 Apr;55(4):470-8.

7. Cloud GC, Markus HS. Vertebral Artery Stenosis. Curr Treat Options Cardiovasc Med 2004 Apr;6(2):121-7.

8. Oder B, Oder W, Lang W, Marschnigg E, Deecke L. Hypoplasia, stenosis and other alterations of the vertebral artery: does impaired blood rheology manifest a hidden disease? Acta Neurol Scand 1998 Jun;97(6):398-403.

9. Wehman JC, Hanel RA, Guidot CA, Guterman LR, Hopkins LN. Atherosclerotic occlusive extracranial vertebral artery disease: indications for intervention, endovascular techniques, short-term and long-term results. J Interv

Cardiol 2004 Aug;17(4):219-32.

10. Lee BI, Nam HS, Heo JH, Kim DI. Yonsei Stroke Registry. Analysis of 1,000 patients with acute cerebral infarctions. Cerebrovasc Dis 2001;12(3):145-51.

11. Shin JH, Suh DC, Choi CG, Leei HK. Vertebral artery dissection: spectrum of imaging findings with emphasis on angiography and correlation with clinical presentation. Radiographics 2000 Nov-Dec;20(6):1687-96.

12. Chen CJ, Tseng YC, Lee TH, Hsu HL, See LC. Multisection CT angiography compared with catheter angiography in diagnosing vertebral artery dissection. AJNR Am J Neuroradiol 2004 May;25(5):769-74.

13. Beneficial effect of carotid endarterectomy in symptomatic patients with high-grade carotid stenosis. North American Symptomatic Carotid Endarterectomy Trial Collaborators. N Engl J Med 1991 Aug 15;325(7):445-53.

14. Tatu L, Moulin T, Bogousslavsky J, Duvernoy H. Arterial territories of the human brain: cerebral hemispheres. Neurology 1998 Jun;50(6):1699-708.

15. Pullicino PM. Diagrams of perforating artery territories in axial, coronal and sagittal planes. Adv Neurol 1993;62:41-72.

16. Stenting of Symptomatic Atherosclerotic Lesions in the Vertebral or Intracranial Arteries (SSYLVIA): study results. Stroke 2004 Jun;35(6):1388-92.

17. Jones HR, Jr., Millikan CH, Sandok BA. Temporal profile (clinical course) of acute vertebrobasilar system cerebral infarction. Stroke 1980 Mar-Apr;11(2):173-7.

18. Patrick BK, Ramirez-Lassepas M, Synder BD. Temporal profile of vertebrobasilar territory infarction. Prognostic implications. Stroke 1980 Nov-Dec;11(6):643-8.

19. Bogousslavsky J, Regli F, Maeder P, Meuli R, Nader J. The etiology of posterior circulation infarcts: a prospective study using magnetic resonance imaging and magnetic resonance angiography. Neurology 1993 Aug;43(8):1528-33.

20. Glass TA, Hennessey PM, Pazdera L, Chang HM, Wityk RJ, Dewitt LD, et al. Outcome at 30 days in the New England Medical Center Posterior Circulation Registry. Arch Neurol 2002 Mar;59(3):369-76.

Abstract (in Korean)

척추동맥 협착의 임상적 중요성

<지도 교수 허지회>

연세대학교 대학원 의학과

정요한

배경

척추뇌바닥 동맥 영역에서 발생하는 뇌경색은 전체 뇌경색의 20~25%를 차지한다. 이 중 척추동맥 협착은 약 20% 정도를 차지한다. 특히 척추동맥 기시부에서 동맥 경화가 가장 흔히 발생하는 것으로 알려져 있다. 하지만 척추동맥, 특히 기시부 협착으로 인한 뇌경색의 특징, 임상 양상, 예후 등은 많이 알려져 있지 않다.

목적

뒤순환 영역에서의 뇌경색 환자 중 고식적 뇌혈관 조영술을 시행한 환자들의 특징을 살펴 봄으로써 척추동맥, 특히 기시부의 협착의 임상적 중요성을 확인한다.

방법

1999년 2월부터 2008년 4월까지 Yonsei Stroke Registry (YSR) 에 등

록된 뇌경색환자 중 뒤순환 영역의 뇌경색 병변이 있고 뇌혈관 조영술을 시행한 환자군을 대상으로 혈관 병변, 뇌경색 부위, 임상적 중등도를 분석하였다.

결과

225명 중 115명 (51.1%)에서 척추동맥 협착을 보였으며, 척추동맥 기시부가 가장 흔한 부위였다 (70명, 31.1%). 척추 동맥 기시부에 협착이 있는 환자 군에서 과거 뇌졸중 병력, 뇌졸중 위험인자의 수, 적혈구 침전 속도 등이 협착이 없는 군에 비해 의미 있는 차이를 보였다 ($p<0.05$). 뒤순환 경색에서 가장 흔한 해부학적 위치는 뇌교 (26.1%, 326 중 85개)이었으며, 다음이 소뇌 반구 (20.9%, 326 중 68개). 가장 흔한 동맥 영역은 뇌바닥 동맥의 앞중간 가지였다 (22.3%, 350 중 78개).

결론

고식적 뇌혈관 조영술을 시행한 뒤순환 영역의 뇌경색 환자에 있어서 척추동맥 기시부는 뒤순환 영역 중 가장 흔한 협착 부위였다. 임상적 중증도에서는 차이가 없었으나 척추동맥 기시부 협착이 있는 환자군에서 없는 군에 비해 뇌졸중의 위험 인자 및 다른 부위의 동반된 협착이 많았다.

핵심 되는 말: 척추동맥, 뇌경색, 동맥경화