

A Study on the Recent Trend and Risk Factors of Cerebrovascular Disease

Hee Tae Kim, M.D., Myung Ho Kim, M.D.

Department of Neurology, College of Medicine, Hanyang University Seoul, Korea

Six hundred eighty seven cases of cerebrovascular disease, confirmed by C-T scan, were evaluated at Hanyang University Hospital from January 1985, to December 1988, and the following results were obtained.

- 1) The incidence of cerebral infarction was markedly increased in the last 5 years.*
- 2) Cerebral hemorrhage showed a peak age of incidence in the fifties, cerebral infarction in the sixties.*
- 3) Among the preceding diseases at the onset of cerebrovascular disease, hypertension was the most common.*
- 4) Total lipid, Total-cholesterol/HDL-cholesterol ratio were significantly higher in cerebral infarction than in cerebral hemorrhage.*
- 5) Triglyceride concentration and total cholesterol concentration were also higher in cerebral infarction than those of cerebral hemorrhage, but statistically not significant.*
- 6) In cerebral infarction HDL-cholesterol concentration was significantly lower than that of cerebral hemorrhage. ($p < 0.01$.)*
- 7) In cerebral infarction, hematocrit and hemoglobin concentration were significantly higher, respectively, than those of cerebral hemorrhage.*

Key Words: *Trend, risk factor, cerebrovascular disease*

INTRODUCTION

Cerebrovascular disease is one of the 4 most common causes of death for adults in Korea. According to 1985 government statistics, the top causes of death in adults are malignancy (78.4/100,000), cerebrovascular disease (65.5/100,000), accidents (65.6/100,000), and cardiovascular disease (45.7/100,000) in that order. The recent increase of cerebrovascular disease is due to multifactors such as the prolongation of life span, the development of diagnostic techniques, the increase of precipitating factors, and the increase of attention and knowledge

to health.

In this study, we classified cerebrovascular disease into two categories, cerebral hemorrhage and cerebral infarction. In Korea, the ratio of incidence of the two is considered to be changing. The tendency of cerebral infarction is noted to be increasing while that of cerebral hemorrhage is decreasing.

The change of incidence of cerebral hemorrhage, cerebral infarction and precipitating factors, as age, sex, hypertension, diabetes, cardiac diseases, hyperlipidemia, hemoglobin and hematocrit are observed and discussed comparatively.

SUBJECTS AND METHODS

Six hundred eighty seven cases of cerebrovascular disease, confirmed by CT-scan and neurological

Address for Correspondence: *Hee Tae Kim, M.D., Dept. of Neurology, College of Medicine, Hanyang University, Haeng Dang-Dong 17, Seoung Dong-Ku, Seoul 133, Korea. (02) 293-3111*

study, were evaluated at the Department of Neurology, College of Medicine, Hanyang University.

In this study, subarachnoid hemorrhage due to secondary rupture of aneurysm or arteriovenous malformation was excluded.

Risk factors such as age, sex, hypertension, diabetes mellitus, cardiac disease, hyperlipidemia, hemoglobin and hematocrit were observed.

The blood pressure of each patient during the first four hospital days were carefully observed for analysis, and hypertension was defined to be when the mean diastolic pressure is above 90mmHg.

Lipid determinants were measured in an overnight fasting state. Hemoglobin and hematocrit were measured at the time of admission.

RESULTS

Distribution of cerebrovascular disease by age and sex

The ratio of incidence between male and female is 1.07:1 in cerebral hemorrhage, 1.47:1 in cerebral infarction.

The age distribution of cerebral hemorrhage disclosed that the sixth decade patients were the most predominant. In cerebral infarction cases 7th, 8th and

6th decades were the most predominant, in that order. (Table 1)

Annual distribution of cerebrovascular disease

In the late 1970's, the frequency of cerebral hemorrhage was more common than that of cerebral infarction.

In the last 5 years, the relative incidence of cerebral infarction has markedly increased more than double that of cerebral hemorrhage. (Table 2)

Risk factors

1. Hypertension

Hypertension was noted in 64.8% of cerebrovascular disease, in 79.4% of cerebral hemorrhage and in 59.2% of cerebral infarction.

2. Diabetes mellitus

Diabetes mellitus was noted in 15.7% of cerebrovascular disease, in 17% of cerebral infarction and in 13.2% of cerebral hemorrhage.

3. Atrial fibrillation

Atrial fibrillation was observed in 6.6% of cerebrovascular disease, in 8.2% of cerebral infarction, and in 2.1% of cerebral hemorrhage.

4. Ischemic heart disease

Myocardial infarction was found in 4.8% of

Table 1. Age and Sex Distribution of Cerebral Hemorrhage and Infarction

Sex	Hemorrhage		Infarction		Total	
	Male	Female	Male	Female		
Age	No (%)	No (%)	No (%)	No (%)	No (%)	
<39	13 (6.9)	11 (5.8)	14 (2.8)	9 (1.8)	47 (6.8)	
49-49	18 (9.5)	8 (4.2)	55 (11.1)	21 (4.2)	102 (14.9)	
50-59	30 (15.9)	26 (13.7)	91 (18.3)	47 (9.4)	194 (28.2)	
60-69	24 (12.7)	23 (12.2)	78 (15.7)	71 (14.3)	196 (28.5)	
70-	13 (6.9)	23 (12.2)	58 (11.6)	54 (10.8)	148 (21.6)	
	98 (51.9)	91 (48.1)	295 (59.4)	202 (40.6)	687 (100.0)	

Table 2. Incidence of Cerebrovascular Disease

Year	Hemorrhage		Infarction		Hemo:Inf (%)	Total (%)	Remarks
	Male	Female	Male	Female			
1963-67	146	95	201	114	43.3:56.7	556	Kim et al., 1968
1967-71	84	64	77	73	49.7:50.3	298	Kim, 1971
1975-77	59	53	54	66	47.7:52.3	235	Lee et al., 1987
1975-78	48	39	54	32	50.2:49.8	173	Kim et al., 1980
1978-80	49	45	52	21	56.3:43.7	167	Yang et al., 1982
1982-83	33	48	37	29	55.1:44.9	147	Moon et al., 1985
1982-84	84	48	33	17	72.5:27.5	182	Cho et al., 1985
1985-88	98	91	296	202	27.5:72.5	687	Present study

Hemo.: Hemorrhage

Inf. :Infarction

Table 3. Comparison of Hypertension Between Hemorrhage and Infarction

(687 cases)

	Hemorrhage (189)		Infarction (498)		Total
	Male	Female	Male	Female	
	No (%)	No (%)	No (%)	No (%)	
Normotensive (Diastolic Pr 90mmHg)	24 (24.5)	15 (16.5)	125 (42.2)	78 (38.6)	242 (35.2)
Hypertensive (Diastolic Pr 90mmHg)	74 (75.5)	76 (83.5)	171 (57.8)	124 (61.4)	445 (64.8)

Table 4. Comparison of Lipid Profile Between Hemorrhage and infarction

	Hemorrhage (N=189)			Infarction (N=498)		
	Male	Female	Total	Male	Female	Total
	(M±SD)	(M±SD)		(M±SD)	(M±SD)	
TL (mg/dl)	538.0±108.4	571.4±101.6	554.5±104.3	583.1±121.7	614.3±117.9	598.7±119.1*
TC (mg/dl)	187.6±51.7	197.1±38.2	192.4±44.5	190.8±41.3	199.8±41.6	195.3±41.5
HDL-Chol (mg/dl)	65.4±20.8	64.3±19.5	64.9±20.2	53.2±22.1	52.1±13.9	52.7±18.1*
TC/HDL-Chol	2.86±0.9	3.06±1.1	2.97±0.9	3.58±1.3	3.83±1.4	3.71±1.3*
TG (mg/dl)	138.1±90.6	132.7±60.5	135.2±81.1	150.3±96.7	130.8±62.4	143.0±77.6

TL: Total lipid

TC: Total cholesterol

HDL-Chol: High density lipoprotein cholesterol

TC/HDL-Chol: Total cholesterol: High density lipoprotein cholesterol ratio

TG: Triglyceride

*: P< 0.01, T-test

Table 5. Comparison of Hematocrit and Hemoglobin Between hemorrhage and Infarction

	Hemorrhage (N=189)			Infarction (N=498)		
	Male	Female	Total	Male	Female	Total
	(M±SD)	(M±SD)		(M±SD)	(M±SD)	
Hematocrit (%)	41.7±7.2	40.9±6.9	41.2±7.12	46.8±7.1	43.7±4.8	45.3±6.1*
Hemoglobin (gm/dl)	13.4±2.1	12.9±1.8	13.2±1.9	15.1±1.9	14.2±1.5	14.7±1.6*

*: p< 0.01, t-test

Table 6. Underlying Diseases of Cerebrovascular Disease (687 cases)

	Hemorrhage	(189 cases)	Infarction	(498 cases)	Total
		(%)		%	
Hypertension	150	(79.4)	295	(59.2)	445
Ischemic heart disease		(3.2)	27	(5.4)	33
Atrial fibrillation	4	(2.1)	41	(8.2)	45
Diabetes Mellitus	25	(13.2)	85	(17.0)	108
Others	18	(9.5)	79	(15.9)	97

cerebrovascular disease, in 5.4% of cerebral infarction, and in 3.2% of cerebral hemorrhage. (Table 6)

5. Lipids

The concentration of total lipid was significantly higher in cerebral infarction (598.7 ± 119.1) than in cerebral hemorrhage (554.5 ± 104.3). ($p < 0.01$)

The total cholesterol concentration was also higher in cerebral infarction (195.3 ± 41.5) than in cerebral hemorrhage (192.4 ± 44.5), but not statistically significant.

The HDL-cholesterol concentration was significantly lower in cerebral infarction (52.7 ± 18.1) than in cerebral hemorrhage (64.9 ± 20.2). ($p < 0.01$)

The total cholesterol/HDL-cholesterol ratio was significantly higher in cerebral infarction (3.7 ± 1.3) than in cerebral hemorrhage (2.97 ± 0.9). ($p < 0.01$)

The triglyceride concentration was higher in cerebral infarction (143 ± 77.6) than in cerebral hemorrhage (135.2 ± 81.1), but statistically not significant.

6. Hematocrit

Hematocrit was significantly higher in cerebral infarction (45.3 ± 6.1) than in cerebral hemorrhage (41.2 ± 7.12). ($p < 0.01$)

7. Hemoglobin

The hemoglobin concentration was significantly higher in cerebral infarction (14.7 ± 1.6) than in those of cerebral hemorrhage (13.2 ± 1.9). ($p < 0.01$)

Preceding disease

The most common preceding diseases of cerebrovascular disease were hypertension (64.8%), diabetes (13.2%), atrial fibrillation (5.1%) and ischemic heart disease (3.5%), in that order.

DISCUSSION

Cerebrovascular disease is considered to be one of the most common causes of death in Korea along with malignancy, cardiac disease and accidents. Due to such factors as the prolongation of life, the advance of diagnostic techniques, the increase of precipitating factors in the population, the heightening of attention of health, and the advance of medical knowledge, the reported incidence of cerebrovascular disease has been on the rise. In general, the incidence of cerebrovascular disease has been increasing at a rate proportional to the increase in human life span. For every ten years above the age of 55, the rate of incidence of cerebrovascular disease more than doubles. (Aho et al., 1980) The ratio of the reported incidence of the two types of cerebrovascular disease, cerebral hemorrhage and cerebral infar-

tion, has been changing. According to reports (Seo, 1963; Kim et al., 1980; Yang et al., 1982), cerebral hemorrhage was more common than cerebral infarction in Korea through the 1970's. Particularly, the incidence of cerebral hemorrhage was noted higher after new diagnostic techniques, including brain CT, were developed. In the last 5 years, however, the authors noticed that the incidence of cerebral infarction has been markedly increasing in comparison with that of cerebral hemorrhage. In this report, the frequency of cerebral infarction in the cases observed was 72.5%, as compared to 27.5% for cerebral hemorrhage. (Table 2) The frequency of cerebral infarction was highest in 7th decade patients with 30% and 6th decade with 27.7%. The frequency of cerebral hemorrhage was highest in in 6th decade with 29.6%.

The changing ratio observed between the two types of cerebrovascular disease can be attributed to several factors. One reason for the high reported incidence of cerebral hemorrhage in the past is probably due to the severity of its symptoms. Because its symptoms are so severe, it is likely that hospitalization due to cerebral hemorrhage was more frequent than that for cerebral infarction. Another reason for the high reported incidence of cerebral hemorrhage is that the diagnosis of cerebral hemorrhage was relatively easy. Because of relatively poor diagnostic technique for cerebral infarction, many cases of cerebral infarction were previously misdiagnosed as cerebral hemorrhage. Lately, the rising incidence of cerebral infarction can be attributed to such factors as the development of diagnostic techniques, the increasing frequency of hospitalization, the development of medical knowledge in the general population and increase of precipitating factors. Such factors include hypertension, hyperlipidemia and diabetes mellitus, which are influenced by changes in dieting, by smoking and drinking habits as well as stree, obesity and the use of birth control pills.

A factor which may have contributed significantly to the relative decline of cerebral hemorrhage in recent years is the adequate management of hypertension. (Garraway and Whisnant, 1987) Hypertension, well known as an important factor in cerebrovascular disease, is early discovered and has been rather well controlled in recent years. (Whelton, 1982) In this report, cerebral hemorrhage cases associated with hypertension was 79.4% as compared to 59.2% for cerebral infarction. This means that the incidence of cerebral hemorrhage could be decreased both relatively and in absolute terms by hypertension control. It is also possible to minimize complications and

repeated attacks of cerebrovascular disease with adequate hypertension control. (Johnston et al., 1982)

The increasing incidence of cerebrovascular disease overall can also be linked with other factors. In Korea, the incidence of diabetes mellitus, for example, has been increasing lately due to numerous factors including the change of dietary habits, the advance in diagnosis, etc. Diabetes mellitus may cause the disturbance of myointestinal proliferation, connective tissue synthesis and platelet functioning which may contribute to the higher incidence of cerebrovascular disease. It is very well known that the incidence of cerebrovascular disease is almost 3 times higher in cases with than in cases without diabetes mellitus. (Kannel, 1983) It has been noted that 30 to 40% of diabetes had hyperlipidemia. (Wilson et al., 1976) Hyperlipidemia also increases the incidence of cerebrovascular disease through arteriosclerosis and can be the precipitating factor mainly responsible for cerebral infarction.

Additionally, there seems to be some relation between cerebrovascular disease and serum level of cholesterol (Solberg & Strong, 1983), triglyceride (Terrence & Rao, 1983), HDL (Crouse et al., 1987), LDL (Postglione et al., 1985), lipoprotein (Zenker et al., 1986), and cholesterol/HDL-cholesterol ratio. (Ford et al., 1985) However, there seems to be no difference of serum cholesterol levels between cerebral hemorrhage and cerebral infarction in this report. This area of inquiry awaits further evaluation. Hemoglobin concentration and hematocrit are also known precipitating factors of cerebrovascular disease (Kannel et al., 1972), have no relation with prognosis of cerebrovascular disease. (Wade, et al., 1987), In this report, the concentration of hemoglobin and hematocrit in cerebral infarction were definitely higher than those of cerebral hemorrhage. Despite contrary claims by Herman (1982), smoking can also be an important factor in cerebrovascular disease, particularly for those below the age of 55. Smoking could cause not only coronary heart disease but also toxic injury to vascular endothelial cell. (Astrup & Kjeldsen, 1974; McGill, 1984) Cardiac disease can also cause cerebral infarction by embolism but it could be better prevented with advanced diagnostic techniques including echocardiogram etc. In addition, alcohol intake, obesity and lack of physical exercise could be precipitating factors of cerebral infarction. (Rhoads & Kagan, 1983)

REFERENCES

- Aho K, Harmsen P, Hatano S, Marquardsen J, Sminnov VE, Strasser T: *Cerebrovascular disease in the community; results of a who collaborative study. Bull Who* 58:113-130, 1980.
- Astrup P, Kjeldsen K: *Carbon monoxide, smoking and atherosclerosis. Med Clin North Am* 58:323-330, 1974.
- Cho HK, Park YK, Choi BH, Sul SY: *A clinical study of cerebrovascular disease. Kor J Int Med* 29:80-88, 1985.
- Crouse JR, Toole JF, Mckinney WM, Dignan MB, Howard G, Kahl FR, McMahan MR, Harpold GH: *Risk factors for extracranial carotid artery atherosclerosis. Stroke* 18:990-996, 1987.
- Ford CS, Crouse Jr III, Howard G, Toole JF, Ball MR, Frye J: *The role of plasma lipids in carotid bifurcation atherosclerosis. Ann Neurol* 17:301-303, 1985.
- Garraway WM, Whisnant JP: *The changing pattern of hypertension and the declining incidence of stroke. JAMA* 258:214-217, 1987.
- Herman B, Leyten ACM, Van Lwijk JH, Frenken CWGM, Op de coul AAW, Schulte BPM: *Epidemiology of stroke in Tilberg the Netherlands. Stroke* 13:629-634, 1982.
- Johnston JH, Beevers DG, Duun FG, Larkin H, Titterington DM: *The importance of good blood pressure control in the prevention of stroke recurrence in hypertensive patients. Postgrad. Med* 57:690-698, 1981.
- Kannel WB, Wolf PA: *Epidemiology of cerebrovascular disease in vascular disease of the central nervous system, second ed, Churchill Livingstone Edinbergh* 1, 1983.
- Kannel WB, Gordon T, Wolf PA, Mcnamara P: *Hemoglobin and the risk of cerebral infarction The Framingham Study. Stroke* 3:409-420, 1972.
- Kim DH: *A clinical study of cerebrovascular accident. Kor J Int Med* 14: No 10, 7-20, 1971.
- Kim DJ, Kim HB, Han SA, Kim KW: *Clinical investigation of CVA-An analysis of 740 cases. Kor J Int Med* 11:647-654, 1968.
- Kim JS, Lee SW, Hyun Co, Cho DW, Kim Y, Suh SA: *Clinical observations of CVA in Korea. Kor J Int Med* 23:1097-1106, 1980.
- Lee KJ, Choi DH, Yang JD, Kim SB: *A clinical study on CVA. Kor J Int Med* 21:700-708, 1978.
- Moon JS, Park DH, Kim W, Kim BT, Koh YB, Shun DJ: *Computerized tomographic findings and clinical observations of CVA. Kor J Int Med* 29: No 4, 499-507, 1985.
- McGill HC Jr: *Persistent problems in pathogenesis of atherosclerosis. Arteriosclerosis.* 4:443-451, 1984.
- Postiglione A, Rubba P, De Simone B, Patti L, Cicerano U, Mancini M: *Carotid atherosclerosis in familial hypercholesterolemia. Stroke* 16:658-661, 1985.
- Rhoads GG, Kagan A: *The relation of coronary disease,*

- stroke, and mortality to weight in youths and middle age. *Lancet*, i: 492-495, 1983.
- Seo SJ: Cerebrovascular accident. *Kor J Int Med* 6:No 11:45-62, 1963.
- Solberg LA, Strong JP: Risk factors and atherosclerotic lesions. A review of autopsy studies. *Arteriosclerosis* 3:187-198, 1983.
- Terrence CF, Rao GR: Triglycerides as a risk factor in extracranial atherosclerotic cerebrovascular disease. *Angiology* 34:452-460, 1983
- Wade JPH, Taylor DW, Varnett HJM, Hachinski VC: Hemoglobin concentration and prognosis in symptomatic obstructive cerebrovascular disease. *Stroke* 18:69-71, 1987.
- Whelton PK: Declining mortality from hypertension and stroke. *South Med J* 75:33-38, 1982.
- Wilson DE, Schreibman PH, Day VC: Hyperlipidemia in an adult diabetic population. *J Chronic Dis* 23:501-506, 1970.
- Yang IM, Kim DH, Song JS, Kim MH: A clinical study of cerebrovascular accident. *Kor J Int Med* 25: No 2, 174-181, 1982.
- Zenker G, Koltringer P, Bone G, Niederkorn K, Pfeiffer K, Jurgens G: Lipoprotein as a strong indicator for cerebrovascular disease. *Stroke* 17:942-945, 1986.