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Epidemiology of Cerebrovascular Disease in Korea

— A Collaborative Study, 1989-1990 —

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We present epidemiologic, etiologic, and clinical data for 3,021 patients with cerebrovascular disease admitted to the 17 regional hospital centers from all over Korea from 1989 to 1990. Each case was coded retrospectively into a computerized registry using a standard protocol. This study was conducted to provide baseline data on recent patterns on cerebrovascular disease in Korea and to evaluate any temporal trends compared with previous reports. It is the largest hospital-based study and gives a rough estimate of the current stroke profiles in Korea.

Although there meight be some selection bias in several hospitals, the distribution of cases by type of stroke was: thrombosis (27.2%), lacular infarction (11.2%), transient ischemic attack (3.0%), embolism (7.0%), intracerebral hemorrhage (31.4%), subarachnoid hemorrhage (18.0%), intraventricular hemorrhage)1.5%), and others (0.7%).

The overall incidence rate of cerebral thrombotic strokes (41.1%) was higher than that of intracerebral hemorrhage (31.4%) which was the reverse in most of previous reports before 1980s.

This study suggests a changing trend of stroke patterns in Korea and a multicenter prospective study using more complete registry protocols is required for an accurate evaluation.

Key Words: *cerebrovascular disease, ischemic stroke, hemorrhagic stroke, risk factors.*

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INTRODUCTION

Except for cancer, cerebrovascular disease (CVD) is the most common cause of death in Korea. It is often fatal because it causes severe sequelae and complications and gives devastating problems to patients, their families, and because our population is aging, to society. Recently, the incidence of CVD in Western countries has been decreasing due to the successful control of hypertension (Garraway et al., 1979: Levy, 1979: Homer et al., 1987) and Japan, our neighbor country, has shown a similar pattern of stroke incidence to that of Western countries since the mid 1970s, but in Korea CVD is considered to be still the most important cause of death (Kim, 1987). Now, our way of life is becoming westernized and some changes in the pattern of CVD in Korea are expected, compared with that in the past. There have been many reports on CVD in Korea, almost all of which were done at the one hospital level except for the epidemiologic study in 1989. This was a large hospital-based survey on 1,103 stroke patients admitted to four hospitals during a period of two years (Myung et al., 1989). Few reports, however, have been made in Korea that cover the relationships between CVD and a variety of risk factors such as hypertension (Kannel et al., 1970), diabetes (Davis et al., 1987), cardiac diseases (Friedman, 1968: Robert et al., 1983), transient ischemic attacks (Toole et al., 1975), polycythemia, alcohol, smoking, obesity, and hyperlipidemia.

Therefore, it is very important and indeed urgent that we study the recent epidemiologic trends of VCD in Korea and evaluate the risk factors for stroke by collecting and analyzing the data of the hospital centers all over the country involved in this project. This report summarizes findings from the latest 3,201 patients.

SUBJECTS AND METHODS

Data on 3,201 patients with CVD from 17 centers* all over the country were collected. We included the patients who were admitted to or visited the hospitals involved in this study from Jan 1, 1989 to Dec 31, 1990. The patients who were moved from one hospital to another were excluded from the study to avoid double registration. We used the stroke registry from designed by the Korean Neurological Association in which 53 data items, including: activity at onset, accompanying symptoms and signs, type of stroke, lesion site, brain computed tomography (CT) or magnetic resonance imaging (MRI) findings, past medical history, and initial laboratory data are listed to cover the various risk factorys for stroke. The neurologists from each hospital completed questionnaries on the registry form for stroke patients admitted to the hospital during the enrollment period. The completed registry forms were sent to SNUH, where the data were entered into a computerized data bank.

DEFINITION AND CLASSIFICATION OF CVD

CVD or stroke was defined as the occurrence of rapidly developing clinical signs of focal disturbance (or global disturbance in the case of deep coma and subarachnoid hemorrhage), for which there was no apparent cause other than a vascular accident. Transient cerebral ischemic attack was included in this definition. We diagnosed CVD based on the clinical signs of stroke and the findings of brain CT or MRI. In the rare patients who could not have neuroimaging studies due to poor medical condition, the clinical diagnosis of high credibility was also accepted. We modified the diagnostic criteria of the Harvard Cooperative Stroke Registry (1978) and classified CVD into 8 categories: 1. Thrombotic cerebral infarction, 2. Embolic cerebral infarction, 3. Lacunar cerebral infarction, 4. Intracerebral hemorrhage, 5. Subarachnoid hemorrhage, 6. Primary intraventricular hemorrhage, 7. Transient ischemic attack, 8. Others.

Embolic cerebral infarction was diagnosed when the patients with cerebral infarction had cardiac diseases which could cause cerebral embolism or when multiple infarct lesions were found in different cerebroarterial territories without the presence of atherosclerosis or other cause of occlusion in the cerebral vessel. Others were the miscellaneous etiologies of cerebral infarction or hemorrhage.

RESULTS

Patients

A total of 3,201 patients were included; 1,668 men

and 1,533 women. The distribution of patients according to individual hospital is indicated in table 1. the mean age was 57.5 years (men 57.0 years, women 58.0 years). Of all the patients' age groups the fifties and sixties were the most frequent: in cerebral infarction the sixties were the most frequent and in intracerebral hemorrhage the fifties were the most common (Table 2).

Type of CVD

The 3,201 cases classified as thrombotic infarction (27.2%), embolic infarction (7.0%), lacunar infarction (11.2%), transient ischemic attack (TIA) (3.0%), intracerebral hemorrhage (ICH) (31.4%), subarachnoid hemorrhage (SAH) (18.0%), intraventricular hemorrhage (IVH) (1.5%), and others (0.7%). Others consisted of moyamoya disease, hypertensive encephalopathy, and Takayasu's arteritis, etc. The overall incidence of cerebral infarction (45.4%), in which thrombotic, embolic, and lacunar infarctions were included, was higher than that of intracerebral hemorrhage (31.4%). To divide CVD into ischemic and hemorrhagic strokes, ischemic strokes (including thrombotic infarction, embolic infarction, lacunar infarction, and TIA) was 48.4% and hemorrhagic strokes (including ICH, SAH and primary IVH) 50.9% (Table 3.) We also examined the type distribution of stroke according to the individual hospital (Table 4).

Lesion distribution of ischemic strokes (Table 5)

We analyzed the lesion sites according to the vascular territory in 1,107 ischemic stroke patients of which lesions could be localized by brain CT or MRI. The middle cerebral artery (MCA) territory was the most common (63.4%). The vertebrobasilar artery territory was the next (19.6%), followed by the posterior cerebral artery (PCA) territory 5.7%, anterior cerebral artery (ACA) territory 4.7%, internal cerebral artery (ICA) territory 3.4%, and borderzone area between ACA and MCA or MCA and PCA 3.2%.

Location of ICH (Table 6)

Hematomas were documented by brain CT or MRI. The location of the 1,038 hemorrhages was most often basal ganglia (41.8%), followed in order of frequency by thalamus (20.9%), lobar (17.6%), brain stem (7.8%), and cerebellar (7.4%).

Aneurysm site in SAH (Table 7)

Among 576 patients with SAH, 304 patients were found to have an aneurysm on cerebral angiography.

Table 1. Patients (N=3,201)

	AS	BS	CA	CH	CN	HY	IJ	JN	KM	KS	ME	NM	SC	SN	WJ	YC	YN	Total
M	58	36	128	82	299	74	49	66	214	59	58	56	42	303	56	58	40	1,668
F	60	20	76	111	334	91	46	48	222	41	39	39	57	235	43	44	17	1,533
Total	118	56	204	193	633	165	95	114	436	100	97	95	99	538	99	102	57	3,201

AS=Asan Medical Center, BS=Busan National University Hospital, CA=Catholic University Hospital, CH=Chung Ang University Hospital, CN=Choongnam National University Hospital, HY=Hanyang University Hospital, IJ=Inje University Hospital, JN=Jeonnam National University Hospital, KM=Keimyung University Hospital, KS=Keungsang University Hospital, ME=Maryknoll Hospital, NM=National Medical Center, SC=Soonchunhyang University, SN=Seoul National University Hospital, WJ=Yonsei University Wonju Hospital, YC=Yeongdungpo City Hospital, YN=Yeungnam University Hospital

Table 2. Age Distribution

Age	TIA	Thr	Emb	Lac	ICH	IVH	SAH	Total
<30	1	17	8	1	35	5	14	81
30-39	2	31	16	5	52	11	45	162
40-49	11	83	27	41	176	8	133	479
50-59	35	250	47	100	346	19	189	986
60-69	31	290	65	134	260	6	137	923
>70	16	199	60	78	137	1	58	549
	96	870	223	359	1,006	50	576	3,180*

*total number of patients except for others (n=21) of stroke TIA=transient inschemic attack, Thr=thrombotic infarction, Emb=embolic infarction, Lac=lacunar infarction, ICH=intracerebral hemorrhage, IVH=intraventricar hemorrhage, SAH=subarachnoid hemorrhage

Anterior communicating artery aneurysm was the most common (32.2%). The next most frequent sites of aneurysm were middle cerebral artery (28.6%), posterior communicating artery (20.1%), anterior cerebral artery (6.6%), the bifurcation of the internal carotid artery (4.9%), and the posterior cerebral artery (1.7%). The posterior cerebellar artery, superior cerebellar artery, basilar artery tip, and ophthalmic artery were the rarest sites of aneurysm.

Symptoms at the onset of stroke (Table 8)

Focal neurologic deficit at onset was observed more often (58.9%) in patients with headache, vomiting, and altered consciousness were much more common in patients with hemorrhage than in those with infarction. Convulsions at onset were observed at a similar frequency in both types of stroke.

Table 3. Types of Stroke

	No. of Patients
1. Ischemic Stroke (N=1,548)	
Thrombotic	870 (27.2%)
Embolic	223 (7.0%)
Lacunar	359 (11.2%)
TIA	96 (3.0%)
2. Hemorrhagic Stroke (N=1,632)	
Intracerebral	1,006 (31.4%)
Subarachnoid	576 (18.0%)
Intraventricular	50 (1.5%)
3. Other* (N=21)	0.7%
Total	3,201 (100%)

*moyamoya disease, hypertensive encephalopathy, Takayasu's arteritis, temporal arteritis, superior sagittal sinus thrombosis.

Table 4. Distribution of Patients from Individual Hospitals (N=3,201)

	SN	BS	CN	JN	YN	KS	KM	CA
Thr	178 (33.1%)	37 (66.1%)	113 (17.9%)	26 (22.8%)	28 (49.1%)	26 (26.1%)	77 (17.7%)	62 (30.4%)
Emb	63 (11.7%)	6 (10.7%)	45 (7.1%)	3 (2.6%)	4 (7.0%)	8 (8.0%)	17 (3.9%)	5 (2.4%)
Lac	31 (5.8%)	5 (8.9%)	85 (13.4%)	16 (14.0%)	2 (3.5%)	0 (0.0%)	42 (9.6%)	43 (21.1%)
TIA	11 (2.0%)	1 (1.8%)	23 (3.6%)	1 (0.9%)	7 (12.3%)	1 (1.0%)	24 (5.5%)	0 (0.0%)
ICH	156 (29.0%)	6 (10.7%)	213 (33.7%)	58 (50.9%)	10 (17.5%)	41 (41.0%)	143 (32.8%)	56 (27.4%)
SAH	86 (16.0%)	1 (1.8%)	136 (21.5%)	9 (7.9%)	5 (8.8%)	24 (24.0%)	118 (27.1%)	32 (15.7%)
IVH	9 (1.7%)	0 (0.0%)	11 (1.7%)	1 (0.9%)	1 (1.8%)	0 (0.0%)	14 (3.2%)	3 (1.5%)
Others	4 (0.7%)	0 (0.0%)	7 (1.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (0.2%)	3 (1.5%)
	538 (100%)	56 (100%)	633 (100%)	114 (100%)	57 (100%)	100 (100%)	436 (100%)	204 (100%)

	HY	JA	SC	IJ	HD	NM	WJ	YC	ME
Thr	68 (41.2%)	33 (17.1%)	43 (43.4%)	16 (16.8%)	22 (18.6%)	68 (71.6%)	10 (10.1%)	31 (30.4%)	32 (33.0%)
Emb	12 (7.3%)	10 (5.2%)	5 (5.1%)	4 (4.2%)	14 (11.9%)	1 (1.0%)	8 (8.1%)	4 (3.9%)	14 (14.4%)
Lac	9 (5.5%)	2 (1.0%)	22 (22.2%)	0 (0.0%)	24 (20.3%)	4 (4.2%)	25 (25.3%)	22 (21.6%)	27 (27.8%)
TIA	6 (3.6%)	2 (1.0%)	0 (0.0%)	1 (1.1%)	4 (3.4%)	6 (6.3%)	4 (4.0%)	3 (2.9%)	2 (2.1%)
ICH	30 (18.2%)	81 (42.0%)	21 (21.2%)	62 (65.3%)	34 (28.8%)	13 (13.7%)	34 (34.3%)	32 (31.4%)	16 (16.5%)
SAH	37 (22.4%)	63 (32.7%)	7 (7.1%)	6 (6.3%)	19 (16.1%)	3 (3.2%)	16 (3.2%)	8 (7.8%)	6 (6.2%)
IVH	1 (0.6%)	1 (0.5%)	0 (0.0%)	6 (6.3%)	1 (0.9%)	0 (0.0%)	1 (1.0%)	1 (1.0%)	0 (0.0%)
Others	2 (1.2%)	1 (0.5%)	1 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (1.0%)	1 (1.0%)	0 (0.0%)
	165 (100%)	193 (100%)	99 (100%)	95 (100%)	118 (100%)	95 (100%)	99 (100%)	192 (100%)	97 (100%)

Table 5. Involved Territories of Ischemic Stroke

	No. of Patients
Internal Carotid Artery	38 (3.4%)
Middle Cerebral Artery	702 (63.4%)
Anterior Cerebral Arter	52 (4.7%)
Posterior Cerebral Artery	63 (5.7%)
Vertebrobasilar Artery	217 (19.6%)
Borderzone area	35 (3.2%)
Total No. of Patients	1,107 (100%)

Table 6. Location of Hematoma in Intracerebral Hemorrhage

	No. of Patients
Basal ganglia	434 (41.8%)
Thalamus	217 (20.9%)
Lobar	182 (17.6%)
Brainstem	182 (7.8%)
Cerebellum	77 (7.4%)
Above+Ventricle	47 (4.5%)
Total No. of Patients	1,038 (100%)

Table 7. Location of Ruptured Aneurysms in SAH

	No. of Patients.
Bifurcation of ICA	15 (4.9%)
Anterior Cerebral Artery	20 (6.6%)
Middle Cerebral Artery	87 (28.6%)
Posterior Cerebral Artery	5 (1.7%)
A-com	98 (32.2%)
P-com	61 (20.1%)
Other	18 (5.9%)
Total No. of Patients	304 (100%)

ICA=Internal carotid artery, A-com=anterior communicating artery, P-com=posterior communicating artery

Table 8. Symptoms at the Onset of Stroke

	Infarction (N=1,548)	Hemorrhage (N=1,632)
Severe headache	247 (20.0%)	791 (48.5%)
Vomiting	233 (15.1%)	575 (35.2%)
Seizures	20 (1.3%)	28 (1.7%)
Focal neurologic deficit	911 (58.9%)	425 (26.0%)
Altered consciousness	285 (18.4%)	613 (37.6%)
Others	272 (17.6%)	126 (7.7%)

Infarction: All kinds of ischemic strokes
Hemorrhage: All kinds of hemorrhagic strokes.

Table 9. History of Hypertension

	Hypertensive/Total
Infarction	678/1,444 (47.0%)
Hemorrhage	766/1,538 (49.8%)
Total	1,444/2,982 (48.4%)

Risk factors

The distribution of risk factors between cerebral infarction and hemorrhage is summarized in the following tables (Table 9-15)

Hypertension was present in 48.4% of the patients overall: the prevalence of hypertension was higher in

Table 10. History of DM and Values of HbAlc

	DM/Total	HbAlc (>7.0)/Total
Infarction	225/1,401 (16.1%)	91/177 (51.4%)
Hemorrhage	89/1,506 (5.9%)	25/76 (32.9%)
Total	314/2,907 (10.8%)	116/253 (45.9%)

Table 11. Distribution of Heart Disease

	Normal	Valvular	AF	Arrhythmia	MI	Other
Infarction (N=1,325)	967 (73.0%)	82 (6.2%)	111 (8.4%)	40 (3.0%)	58 (4.4%)	67 (5.0%)
Hemorrhage (N=1,480)	1,352 (91.3%)	13 (0.9%)	17 (1.2%)	39 (2.6%)	25 (1.7%)	34 (2.3%)
Total (N=2,805)	2,319 (82.7%)	95 (3.4%)	128 (4.5%)	79 (2.8%)	83 (3.0%)	101 (3.6%)

Valvular: valvular heart disease, AF: artial fibrillation
Arrhythmia: other arrhythmias except AF, MI: myocardial infarction
Other: other heart diseases

Table 12. Uric Acid Levels

	>7.0 mg/dl	Average Serum Uric Acid
Infarction (N=845)	118 (14.0%)	5.3 mg/dl
Hemorrhage (N=744)	61 (8.2%)	4.5 mg/dl
Total (N=1,589)	179 (11.3%)	4.9 mg/dl

Table 13. Serum Cholesterol Levels

	>240 mg/dl	>300 mg/dl	Average Level (total)
Infarction (N=1,392)	209 (15.0%)	50 (3.6%)	194.2 mg/dl
Hemorrhage (N=1,148)	147 (12.8%)	24 (2.1%)	191.0 mg/dl
Total (N=2,540)	356 (14.0%)	74 (2.9%)	192.8 mg/dl

Table 14. Serum Triglyceride Levels

	>250 mg/dl	>500 mg/dl	Average Level (total)
Infarction (N=1,120)	163 (14.6%)	40 (3.6%)	167.4 mg/dl
Hemorrhage (N=703)	63 (9.0%)	21 (3.0%)	134.5 mg/dl
Total (N=1,823)	226 (12.4%)	61 (3.4%)	154.7 mg/dl

Table 15. Hematocrit Values (%)

	<30	31-35	35-40	41-45	46-50	51-55	56-60	>61
Infarction (N=1,436)	56 (3.9%)	147 (10.2%)	390 (27.2%)	493 (34.3%)	284 (19.8%)	56 (3.9%)	6 (0.4%)	4 (0.3%)
Hemorrhage (N=1,603	66 (4.1%)	221 (13.8%)	540 (33.7%)	482 (30.1%)	238 (14.8%)	48 (3.0%)	6 (0.4%)	2 (0.1%)

patients with hemorrhage (49.8%) than in those with infarction (47.0%). Diabetes mellitus showed the opposite findings: 16.1% in patients with infarction and 5.9% in those with hemorrhage. We investigated a variety of cardiac disorders as risk factors: valvular heart disease, atrial fibrillation, other arrhythmias, myocardial infarction, congestive heart failure, cardiomyopathy, endocarditis, etc. Of these valvular heart disease and atrial fibrillation were much more common in patients with infarction (6.2% and 8.4%) than in those with hemorrhage (0.9 and 1.2%). Hyperuricemia (>7.0 mg%) was found more often in patients with infarction (14.0%) than in those with hemorrhage (8.2%). Hypercholesterolemia (>240 mg%) was detected in 15.0% in 15.0% of patients with infarction and in 12.8% of those with hemorrhage, respectively. Triglyceridemia (>250 mg%) was found in 14.6% of patients with infarction and in 9.0% of those with hemorrhage. Hematocrit of >0.45 was observed in 24.4% of patients with infarction and 18.3% of those with hemorrhage.

DISCUSSION

The mortality rate of CVD has decreased since 1969 and the tempo acclerated since 1973 (Whelton, 1982; Baum and Goldstein, 1982). This is a general tendency in Western countries (Whelton and Klag, 1987), largely owing to successful control of hypertension (Garraway et al., 1979; Tuomilheto et al., 1985). Except for SAH the incidence of CVD has also decreased in those countries (Garraway et al., 1983). Korean epidemiologic studies have been undertaken by one or several hospitals in unit and, as a result, could not represent the whole. The most recent and largest one was the collaborative study done in 1989, in which Seoul National University, Choongnam National University, Hanyang University, and Chung Ang University Hospital were joined and data on 1,103 patients with strokes were analysed (Myung, et al., 1989). It was a rather limited study and showed only the basic epikemiologic profiles such as patient distribution, types of CVD, lesion sites, and so forth. It did not cover the evaluation of the risk factors of stroke. Our study was designed to get over the limitations of previous ones and confirm the changing trends of CVD that occurred nationwide. And we also tried to evaluate a variety of risk factors of stroke and their correlation with stroke.

In our study, cerebral infarction (45.4%) exceeded intracerebral hemorrhage (31.4%), which is consistent with previous reports. It is a worldwide trend that there has been a gradual reduction in the incidence of hemorrhagic cerebral vascular disease, but the resultant increase in longevity has been accompanied by a gradual increase in ischemic cerevral vascular disease. In Western countries ischemic stroke is considered twice as common as hemorrhagic stroke (Garraway, 1983). The Korean study in 1989 also indicated that ischemic stroke (51.1%) exceeded hemorrhagic stroke (47.5%). These data suggest that the epidemiologic pattern of CVD in Korea is getting closer to that in the Occident. But the incidence of intracerebral hemorrhage in Korea is still high compared with other countries. There may be several reasons for this. We Koreans still have a dietary habit of preferring salty food, Dietary measures for preventiog hypertension are not yet well educated and advertised to the public. And there are so many hypertensive patients who seldom seek medical attention or easily stop antihypertensive medication at will. Successful blood pressure control is still far from satisfactotry in Korea. Subarachnokd hemorrhage was recorded as much higher than expected (18.1%). In the last report (1989) SAH was 11.8% of CVD, which is consistent with other studies (Kim, 1982; Phillips II et al., 1980). There might have been some selection bias (sampling error) in this study. It is less likely that the real incidence of SAH was increased to as much as 6.3%. Too many SAH cases were collected, resulting in an increase in the total proportion of hemorrhagic stroke. In our study embolic cerebral infarction was 14.4% of all ischemic strokes, which is similar to the other reports (Cerebral embolism Task Force, 1986).

The mean age of incidence was 57.5% years. This shows that the incidence of CVD has moved to a more elderly group compared with the early reports (Kim, 1970; Myung, 1989). The mean age of ischemic stroke

was higher (58 years) than that of hemorrhagic stroke (57 years). which is consistent with other reports (Gross, 1984). Among the lesion sites of ischemic stroke MCA territory was 63.4% and more than three times as common as vertebro-basilar artery territory. This corroborated previous report findings (Mohr et al., 1978). Embolic infarctions and lacunal infarctions were relatively infreqent. Basal ganglia hemorrhage was the most common (41.8%) of all ICH, whereas infratentorial hemorrhage was rather infrequent and only 15.2% of ICH. Primary intraventricular hemorrhage was 3.1% of hemorrhagic stroke. Unfortunately, the incidence of secondary IVH could not be known because the item for it was omitted on the stroke registry form. So we failed to find out haw many IVHs were associated with ICH or SAH and which ICH was the most frequent primary site causing IVH. As for the aneurysm sites detected on cerebral angiogram, the anterior communicating artery (32.2%), middle cerebral artery (28.6%), posterior communicating artery (20.1%) were the most frequent, which is similar to other reports.

Past history of hypertension was found at a disappointingly low rate in ischemic stroke (47.0%) and hemorrhagic stroke (49.8%). The reason why it was so underestimated is hard to explain. There must have been so many insufficient data interfering with the true result. As was expected, the patients with cerebral infarction had a history of diabetes mellitus (16.1%) much more often than those with intacerebral hemorrhage (5.9%). A direct risk factor relationship has been established for many cardiac abnormalities, particularly with cerebral infarction. The statistically most important are consicered to be myocardial infarction, EKG abnormality, rheumatic valvular disease with atial fibrillation, and prosthetic heart valves (Komrad et al., 1984). In our study, valvular heart disease and atrial fibrillation were overwhelmingly common in the cerebral infarct patients compared with the ICH patientw. We couldn't find a significant difference in uric acid, cholesterol, triglyceride, and hematocrit values between the two groups.

This was a multicenter collaborative study with 17 regional centers participating. As many as 3,201 patients were recruited for the study. We started this study with the hope that we could investigate the various epidemiologic profiles in detail and grasp the current status of CVD in Korea in a straight forwards manner, but we were not so successful in doing so because we encountered many unexpected problems and had some limitations. There was so much difference in the number and distribution of patients among hospitals. One hospital had 56 patients and another had 633 patients. The types of CVD also were so variable that ICH, for example, ranged from 10.7% to 65.3% according to hospitals. It could suggest either marked differences in patient population or intercenter variability in application of diagnostic criteria. Even so, it can hardly be accepted that these figures were reliable and reflected regional difference. Furthermore, we found many data insufficient and inadequate. Many of the items were unanswered on the stroke registry form. There was a lack of enthusiam for more complete recording of data and adherence to standardixed diagnostic and classiriaction protocols. More thought and time should have been given to them. These may be the inevitable problems inherent to any retrospective study which is totally dependent on medical chart review. Nevertheless, much can be said for this study because it is the largest epidemiologic study in Korea that gives an overview on recent trends of CVD in our country and can be used as a good reference for further studies.

Any future study should be a prospective one using a well-designed stroke registry form and, in the long run, a field survey should be done in cooperation with epidemio-logists to study more precise and detailed profiles of CVD.

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