Fig. 1. Segments of the internal carotid artery - - - - - 10
Table 1. Distribution of the internal carotid artery stenosis -------------------------- 15
Table 2. Comparison of risk factors for acute ischemic stroke among intracranial, extracranial, and combined intracranial and extracranial internal carotid artery stenosis groups -------------------------- 16
Table 3. Comparison of laboratory data among intracranial, extracranial, and combined intracranial and extracranial internal carotid artery stenosis groups - 17
Table 4. Odds ratios among intracranial, extracranial, and combined intracranial and extracranial internal carotid artery stenosis groups on risk factors of ischemic stroke -------------------------- 18

- iv -
Table 5. Comparison of the combined stenosis of the other cerebral arteries among intracranial, extracranial, and combined intracranial and extracranial internal carotid artery stenosis groups - - - - - - - - - - - - 19
1997 7 2000 9 Yonsei Stroke Registry

300 (intracranial internal carotid stenosis
group: IICA group, extracranial internal carotid stenosis group: EICA group, combined intracranial and extracranial stenosis group: combined group)

36% (107) IICA group 45, EICA group 42, combined group 20
(50.2%, 49.6%, 56.8%: \( p = 0.34 \)). \[ \text{Tr}\]

\( p > 0.05 \).
I. Introduction

Transcranial Doppler Study (transcranial doppler study) showed that magnetic resonance angiography, MRA (magnetic resonance angiography, MRA) also showed that angioplasty, stent (angioplasty, stent) was more effective than endarterectomy (endarterectomy) in 1,2,3.

4-10.
II. 

1. 

Yonsei Stroke Registry\[13\] has been the subject of numerous investigations. From 1997 to 2000, 9,000 patients were enrolled in the Yonsei Stroke Registry. Among the 300 patients, 6,000 had completed the study. Of these, 2,000 patients were classified into intracranial internal carotid stenosis group (IICA group), 2,000 into extracranial internal carotid stenosis group (EICA group), and 2,000 into the combined group.
intracranial and extracranial stenosis group, combined group). 

2.  

3.  

TOAST (Trial of Org 10172 in Acute Stroke Treatment) 14, 15, 16.  

(1)  

Bouthillier 15 Gibo 16.
(cervical portion, C1), (dural portion, C2), (petrous bone portion, C2), (cavernous sinus portion, C3), (supraclinoid portion, C4) (Fig. 1). C1, C2, C3, C4

(2) 

Percentage of stenosis(%) = [(1 - diameter of the most severe stenosis/diameter of the proximal normal artery)] x 100

North American Symptomatic Carotid Endarterectomy Trials (NASCET)²
(3) IICA group, EICA group, combined group

IICA group, EICA group, combined group

erythrocyte sedimentation rate (ESR)
90 mmHg, 90 mmHg 240 mg/dl 200 mg/dl. ESR 10 mm/hr, 20 mm/hr (anterior circulation), intracranial and extracranial posterior circulation).

ANOVA, Chi-square test, logistic regression SPSS(version 10.0).
Fig. 1. Segments of the internal carotid artery

C1: cervical portion
C2: petrous portion
C3: cavernous sinus portion
C4: suprACLinoid portion

C1 represents the extracranial portion of internal carotid artery.
C2, C3 and C4 are parts of the intracranial internal carotid artery.
III. TOAST

1. The TOAST criteria were applied to classify stroke etiology.

- 300 (66.6%)
- 101 (33.4%)
- 58.8 (11.5%)
- 30%, 25%, 25%
- 300 (268) TIA, 32 (transient ischemic attack, TIA) TOAST large artery atherosclerosis 34.7%, lacunar stroke 21.0%, undetermined cause 19.0%, cardiac embolism 11.3% other determined cause 3.3%.
2. IIICA group, EICA group, combined group

IIICA group, EICA group, combined group 151

IIICA group 107 45 (42%) EICA group 42 (39%), combined group 20 (19%).

C1 62 22 C2, C3, C4 60 12 50% C1 22 C2, C3, C4 5 25 8 C1 20 C2, C3, C4 2 22 2 (Table 1).

IIICA group, EICA group, combined group 18.9% 9.0% 20.0% 18.5% (p=0.34).

IIICA group, EICA group, combined group
... combined group (p>0.05). The IICA group (30.0%), IIIB group (6.7%), EICA group (9.5%) and combined group (p=0.02).

Logistic regression analysis indicates that IICA group, IIIB group, EICA group, combined group, IIIB group and combined group, ++TIA++, ++++++ ESRR+ and odds ratio++ in each group (Table 3).

++IICA group, EICA group, combined group+ +++ ++++++++ anterior circulation, intracranial posterior
circulation, extracranial posterior circulation IICA group, EICA group, combined group anterior circulation 42%, 40%, 45% intracranial posterior circulation 40%, 26%, 40% extracranial posterior circulation 15%, 12%, 25% (Table 5).
<table>
<thead>
<tr>
<th>Location</th>
<th>Extracranial</th>
<th>Intracranial</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C1</td>
<td>C2</td>
</tr>
<tr>
<td>Left</td>
<td>25(5)</td>
<td>11(3)</td>
</tr>
<tr>
<td>Right</td>
<td>17(15)</td>
<td>9(1)</td>
</tr>
<tr>
<td>Bilateral</td>
<td>20(2)</td>
<td>2(1)</td>
</tr>
<tr>
<td>Total</td>
<td>62(22)</td>
<td>22(5)</td>
</tr>
</tbody>
</table>

Values are numbers of patients.

Values in parenthesis are numbers of patients with internal carotid artery stenosis greater than 50%.

C1 : cervical portion
C2 : petrous portion
C3 : cavernous sinus portion
C4 : supraclinoid portion

ECST criteria was applied for measurement of degree of stenosis at the extracranial portion of internal carotid artery.

Samuel’s method was applied for measurement of degree of stenosis at intracranial portion of internal carotid artery.
Table 2. Comparison of risk factors for acute ischemic stroke among intracranial, extracranial, and combined intracranial and extracranial internal carotid artery stenosis groups

<table>
<thead>
<tr>
<th>Risk factors</th>
<th>IICA group (n=45)</th>
<th>EICA group (n=42)</th>
<th>Combined group (n=20)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (mean±SD, years)</td>
<td>60.9 ± 9.7</td>
<td>61.5 ± 7.7</td>
<td>63.8 ± 8.2</td>
<td>0.45</td>
</tr>
<tr>
<td>Sex (male: female)</td>
<td>27:18</td>
<td>28:14</td>
<td>15:5</td>
<td>0.49</td>
</tr>
<tr>
<td>Hypertension (%)</td>
<td>80.0</td>
<td>61.9</td>
<td>80.0</td>
<td>0.12</td>
</tr>
<tr>
<td>Diabetes mellitus (%)</td>
<td>46.7</td>
<td>35.7</td>
<td>25.0</td>
<td>0.23</td>
</tr>
<tr>
<td>Smoker (%)</td>
<td>26.7</td>
<td>23.8</td>
<td>35.0</td>
<td>0.65</td>
</tr>
<tr>
<td>Previous TIA (%)</td>
<td>6.7</td>
<td>9.5</td>
<td>30.0</td>
<td>0.02*</td>
</tr>
<tr>
<td>Previous stroke (%)</td>
<td>35.6</td>
<td>33.3</td>
<td>35.0</td>
<td>0.97</td>
</tr>
<tr>
<td>Coronary disease (%)</td>
<td>4.4</td>
<td>2.3</td>
<td>10.0</td>
<td>0.41</td>
</tr>
</tbody>
</table>

TIA : transient ischemic attack
Table 3. Comparison of laboratory data among intracranial, extracranial, and combined intracranial and extracranial internal carotid artery stenosis groups

<table>
<thead>
<tr>
<th>Laboratory data</th>
<th>IICA group (n=45)</th>
<th>EICA group (n=42)</th>
<th>Combined group (n=20)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemoglobin (mg/dl)</td>
<td>13.9±2.6</td>
<td>14.0±1.3</td>
<td>14.6±1.1</td>
<td>0.41</td>
</tr>
<tr>
<td>Hematocrit (%)</td>
<td>41.8±4.0</td>
<td>41.4±3.9</td>
<td>43.1±3.9</td>
<td>0.28</td>
</tr>
<tr>
<td>PT (INR)</td>
<td>0.99±0.2</td>
<td>0.99±0.39</td>
<td>0.93±0.12</td>
<td>0.77</td>
</tr>
<tr>
<td>PTT (sec)</td>
<td>30.5±4.6</td>
<td>31.4±6.1</td>
<td>31.1±4.0</td>
<td>0.67</td>
</tr>
<tr>
<td>Hypercholesterolemia (%)</td>
<td>37.8 (n=17/45)</td>
<td>21.1 (n=8/38)</td>
<td>26.3 (n=5/19)</td>
<td>0.12</td>
</tr>
<tr>
<td>Hypertriglyceremia (%)</td>
<td>44.2 (n=19/43)</td>
<td>34.2 (n=13/38)</td>
<td>35.0 (n=7/20)</td>
<td>0.61</td>
</tr>
<tr>
<td>Elevated CRP (%)</td>
<td>17.2 (n=5/29)</td>
<td>18.8 (n=6/32)</td>
<td>26.7 (n=4/15)</td>
<td>0.75</td>
</tr>
<tr>
<td>Elevated ESR (%)</td>
<td>50.0 (n=11/22)</td>
<td>29.2 (n=7/24)</td>
<td>25.0 (n=3/12)</td>
<td>0.23</td>
</tr>
</tbody>
</table>

PT : prothrombin time
PTT : partial thromboplastin time
INR : international normalized ratio
CRP : chronic reactive protein
ESR : erythrocyte sedimentation rate
Table 4. Odds ratios among intracranial, extracranial, and combined intracranial and extracranial internal carotid artery stenosis groups on risk factors of ischemic stroke

<table>
<thead>
<tr>
<th>Independent variables</th>
<th>IICA - EICA</th>
<th>IICA - Comb</th>
<th>EICA - Comb</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR</td>
<td>OR</td>
<td>OR</td>
</tr>
<tr>
<td></td>
<td>(95% CI)</td>
<td>(95% CI)</td>
<td>(95% CI)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>0.26</td>
<td>2.73</td>
<td>15.41</td>
</tr>
<tr>
<td></td>
<td>(0.05, 1.23)</td>
<td>(0.16, 46.59)</td>
<td>(0.66, 360.41)</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>1.04</td>
<td>0.66</td>
<td>1.56</td>
</tr>
<tr>
<td></td>
<td>(0.23, 0.61)</td>
<td>(0.07, 6.14)</td>
<td>(0.15, 16.13)</td>
</tr>
<tr>
<td>Previous TIA</td>
<td>0.30</td>
<td>4.69</td>
<td>15.96</td>
</tr>
<tr>
<td></td>
<td>(0.02, 5.82)</td>
<td>(0.31, 0.70)</td>
<td>(0.52, 490.89)</td>
</tr>
<tr>
<td>Hematocrit</td>
<td>1.03</td>
<td>1.24</td>
<td>1.28</td>
</tr>
<tr>
<td></td>
<td>(0.85, 1.24)</td>
<td>(0.86, 1.78)</td>
<td>(0.89, 1.84)</td>
</tr>
<tr>
<td>Hypercholesterolemia</td>
<td>0.41</td>
<td>0.20</td>
<td>1.34</td>
</tr>
<tr>
<td></td>
<td>(0.08, 2.01)</td>
<td>(0.01, 2.81)</td>
<td>(0.07, 26.85)</td>
</tr>
<tr>
<td>Elevated ESR</td>
<td>0.29</td>
<td>0.22</td>
<td>0.56</td>
</tr>
<tr>
<td></td>
<td>(0.06, 1.39)</td>
<td>(0.02, 3.33)</td>
<td>(0.04, 7.97)</td>
</tr>
</tbody>
</table>

IICA : IICA group  
EICA : EICA group  
Comb : Combined group  
OR : odds ratio  
CI : confidence interval  
TIA : transient ischemic attack  
ESR : erythrocyte sedimentation rate
Table 5. Comparison of the combined stenosis of the other cerebral arteries among intracranial, extracranial, and combined intracranial and extracranial internal carotid artery stenosis groups

<table>
<thead>
<tr>
<th>Combined stenosis</th>
<th>IICA group (n=45)</th>
<th>EICA group (n=42)</th>
<th>Combined group (n=20)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior stenosis</td>
<td>42.2</td>
<td>40.5</td>
<td>45.0</td>
<td>0.94</td>
</tr>
<tr>
<td>Intracranial posterior stenosis</td>
<td>40.0</td>
<td>26.2</td>
<td>40.0</td>
<td>0.34</td>
</tr>
<tr>
<td>Extracranial posterior stenosis</td>
<td>15.6</td>
<td>11.9</td>
<td>25.0</td>
<td>0.70</td>
</tr>
</tbody>
</table>

Values are percentages.
IV. 

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th>300%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>107% (36%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Heyman 5593, 911, 55.5%, 29.4%, 42%, 16%, 9%, 43%, 23.

1989 1993 C1 C3 carotid siphon cavernous portion 72% petrous bone portion 16%, supraclinoid portion 12%
Northern Manhattan 1960–1990 Extracranial/Intracranial Bypass Study 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 24, 30.
IICA group, EICA group, combined group®

anterior circulation, intracranial posterior circulation, extracranial posterior circulation®®

IICA group, EICA group, combined group®®®

combined group®® IICA group®
EICA group®®®

combined group®® IICA group®
(angioplasty and stent)". However, in a series of studies in the future, 2,3,31. "

"MRA"

"selection bias"

"TOAST"

"Lee"

"Yonsei Stroke Registry"13 "large artery atherosclerosis" "cardiac embolism" undetermined cause. Lee"
undetermined etiology [40.6%] and TOAST [undetermined etiology] are compared. large artery atherosclerosis [undetermined etiology] is also compared. cardiac embolism [undetermined etiology] is also compared.
V. 

1. 300 out of 107 (36%) were allocated to IIICA group 45, EICA group 42, combined group 20.

2. 

3. IIICA group EICA group


Abstract

Characteristics of internal carotid artery stenosis in patients with acute ischemic stroke.

Won Seok Oh

Department of Medicine
The Graduate School, Yonsei University

(Directed by Associate Professor Ji Hoe Heo)

It has been generally accepted that Asians are more likely to develop intracranial stenosis than extracranial internal carotid artery (ICA) stenosis. However, there has been very few systemic investigation about characteristics of ICA stenosis. We investigated the clinical and angiographical characteristics of ICA stenosis in patients with acute ischemic stroke. From data of Yonsei Stroke Registry, a total 300 acute ischemic stroke patients who were undertaken conventional cerebral angiography from July, 1997 to September, 2000 were investigated. We
divided patients into three groups - isolated intracranial ICA stenosis (IICA group), isolated extracranial ICA stenosis (EICA group), and combined stenosis of intracranial and extracranial ICA stenosis (combined group).

A total 107 patients had stenotic lesion in the ICA. Forty five patients were classified to IICA group, 42 patients to EICA group, and 20 patients to combined group. There were no differences among three groups in the degree of stenosis (50.2%, 49.6%, 56.8% each : p = 0.34) and risk factors of ischemic stroke. Frequencies of combined stenosis in anterior and posterior circulation were similar in three groups.

ICA stenosis was common in patients with acute ischemic stroke patients. Significant differences of the frequency and risk factors between intracranial and extracranial ICA stenosis were not found. ICA stenosis at the extracranial portion as well as intracranial portion should be considered as a potentially common source of ischemic stroke.

Key words: carotid stenosis, cerebral angiography, ischemic stroke