Prognosis in Patients With Transient Ischemic Attacks

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Abstract: The prognosis on 144 patients with transient ischemic attacks was determined over a minimum period of three years by quantitating, at intervals, the number of attacks and also the neurological disability by means of a disability score. No patients had neurological disability at the initiation of the study. Total cervicocephalic angiography was performed on 93 patients. Seven of the 144 patients were deceased at the end of the three-year period, five of them due to strokes. Seventeen patients (15.6%) developed persistent neurological disability during the three years, with the mean disability score being much higher for the patients with carotid attacks than those with basilar attacks. The cumulative number of attacks in both carotid and basilar groups rose steadily in the first 18 months, with a much larger number of attacks occurring in the basilar group. The attack rate leveled off after 18 months in the carotid group. Attacks tended to be consistent in nature over a period of time. Twenty-eight percent of those patients with basilar attacks and 12.5% of those patients with carotid attacks showed carotid stenosis on angiography. Study of carotid stenosis associated with subsequent neurological disability revealed that increased risk occurred only when carotid stenosis was more than 70%.

Additional Key Words: stroke cerebrovascular insufficiency angiography basilar artery carotid artery neurological examination neurological history vertigo mortality morbidity

The proper evaluation of prophylactic treatment for patients with attacks of transient vascular insufficiency to the brain has been handicapped by a lack of consistent data about the prognosis for such patients without specific treatment. Major decisions may hinge on this knowledge, namely, whether the risk of the recurrent cerebrovascular event outweighs the combined risk of angiography and possible subsequent surgery on a stenotic extracranial vessel. Although several studies have been done on the incidence of cerebral infarction, cerebral hemorrhage, and patient mortality following transient ischemic attacks, the findings for recurrent "stroke" occurring within a two-year to three-year period have varied from 10% to 40%.

Various explanations have been postulated for this diversity of findings. A different prognosis for patients with transient attacks of the basilar circulation from that of patients with attacks relevant to the carotid circulation has been found. It is generally thought that patients with carotid artery stenosis demonstrated by angiography and a history of transient ischemic attacks stand in greater danger of cerebral infarction than patients with normal vessels.

The present study describes (over a period of three years) the course of a series of patients with transient cerebral ischemic attacks. Most of these patients had complete four-vessel angiography, but none of them had carotid surgery and their course was carefully documented by standardized neurological history and neurological examination to determine the nature of morbidity and mortality during this period of time.

Methods

A study had originally been planned to evaluate, in patients with a history of transient ischemic attacks referred into the Kansas University Medical Center, Kansas City, Kansas, the benefit of surgery on atherosclerotic plaques in extracranial vessels in the prophylaxis of further strokes. Transient ischemic attack was defined as a period of cerebral dysfunction lasting less than 24 hours but more than 15 minutes; care was taken to exclude on grounds of clinical judgment seizure, syncopal and migrainous episodes. None of these patients were known to have had a previous episode of more prolonged disability ("stroke"). Angiography by the retrograde femoral route of the extracranial and intracranial circulation was done on most cases, and if 30% or more stenosis of a carotid artery was demonstrated, the cases were to be
randomly assigned to a surgical or a nonsurgical group for correction of this lesion. Since all individuals prior to angiography had to be suitable candidates for possible surgery, no cases were admitted to the study with (a) physical disease of such severity as to render them unsuitable for possible surgery (such as advanced cardiac disease, carcinoma, or extreme hypertension), or with (b) significant neurological disability as a residual from a previous cerebrovascular accident.

The cases reported here include (a) those with less than 30% stenosis of a carotid artery on angiography, and (b) those with such a degree of stenosis but falling into the "no surgery" group by the process of random selection. There were 144 such patients seen originally during hospitalization. Thereafter, an attempt was made to examine them at six-month to nine-month intervals as outpatients. At the original and follow-up examinations standardized questions were asked concerning 21 specific symptoms—whether each symptom had occurred and, if so, how frequently. These questions were designed to determine the type of attack, that is, basilar, carotid or mixed.

Physical and neurological examinations were performed on the original examination and at all subsequent examinations with the results recorded on standardized forms. It should be noted that the first examination occurred at a variable interval after the onset of symptomatology. All data from the history, neurological examination and laboratory values were tabulated in digital form and transferred to IBM cards and subsequently to magnetic tape. At the original visit and every second follow-up visit, a battery of psychological tests also was performed, the data from which were handled in identical fashion and which will be the subject of subsequent reports.

The patient material in the current report consists of 109 individuals on whom we were able to obtain detailed follow-up data for at least three years from the onset of symptomatology. Follow-up information of some degree was obtained on an additional 35 individuals—data being obtained as to whether they were still alive and whether they had had catastrophic physical illness within three years after onset of their disease. We especially attempted to discover whether they had had an illness diagnosed as "stroke" during those three years.

Of the 109 patients followed, 70 were male and 39 were female; the mean age of the men was 59.7 and of the women 61.3.

A disability score (DS) was calculated from the standardized neurological examination. This score represented a large number of findings quantitated in two ways: (1) the degree of abnormality, and (2) the relative "disabling effect" of that particular abnormality as estimated on a 1 through 10 scale ("weighting") (table 1). Muscle weakness of an extremity, for example, was rated on a 1 through 3 scale depending on the degree of abnormality—that value then being multiplied by three as a weighting factor, considering the relative disabling effect of muscle weakness as compared to other deficits. Aphasia, in comparison, was weighted as 10 in its relative disabling effect. The final DS, then, was computed by summing such calculations over all findings. Since the study was concerned only with patients who did not have significant neurological disability at the onset, one of the criteria for inclusion in the study was a disability score on the original examination of 15 or less, since a DS of more than 15 on the initial examination was felt to be indicative of enough damage to the nervous system to strongly suggest clinically apparent residuals of previous cerebral damage (presumably from infarction or hemorrhage). Appearance of a score of more than 15 on follow-up examination gave us an indication that the patient, since the original examination, had suffered brain damage, again presumably from cerebrovascular disease in the absence of other history. Such patients were not deleted from the study as long as their original disability scores were 15 or less.

Three patterns of symptom grouping were studied in an attempt to determine whether attacks were indicative of insufficiency of the carotid system or of the vertebral system. Attacks consisting solely of aphasia, monoparesis, hemiparesis, monohypalgesia, hemihypalgesia, and/or a strictly monocular visual loss were considered to be "carotid" in nature. Vertebral or "basilar" artery attacks were defined as consisting of one or more of the following: diplopia, dysphagia, dysarthria, ataxia, vertigo and numbness of the face.

### TABLE 1

<table>
<thead>
<tr>
<th>Neurological sign</th>
<th>Possible degrees of abnormality</th>
<th>Weight (relative disabling effect)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Station and gait</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Romberg sign</td>
<td>1 or 2</td>
<td>10</td>
</tr>
<tr>
<td>Visual fields</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Nystagmus</td>
<td>1 or 2</td>
<td>3</td>
</tr>
<tr>
<td>Extraocular movements</td>
<td>1 or 2*</td>
<td>2</td>
</tr>
<tr>
<td>Ptosis</td>
<td>1 or 2*</td>
<td>3</td>
</tr>
<tr>
<td>Facial movements</td>
<td>1 or 2</td>
<td>2</td>
</tr>
<tr>
<td>Reflexes (asymmetry or clonus)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Babinski</td>
<td>1 or 2*</td>
<td>1</td>
</tr>
<tr>
<td>Limb strength</td>
<td>1, 2, or 3</td>
<td>3</td>
</tr>
<tr>
<td>Tremor</td>
<td>1, 2, or 3</td>
<td>2</td>
</tr>
<tr>
<td>Pin and touch sense</td>
<td>1 or 2*</td>
<td>2</td>
</tr>
<tr>
<td>Vibratory sense</td>
<td>1 or 2*</td>
<td>1</td>
</tr>
<tr>
<td>Cerebellar findings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right arm</td>
<td>1, 2, or 3</td>
<td>3</td>
</tr>
<tr>
<td>Left arm</td>
<td>1, 2, or 3</td>
<td>3</td>
</tr>
<tr>
<td>Legs</td>
<td>1, 2, or 3</td>
<td>3</td>
</tr>
<tr>
<td>Trunk</td>
<td>1, 2, or 3</td>
<td>3</td>
</tr>
<tr>
<td>Aproaxia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right arm</td>
<td>1, 2, or 3</td>
<td>3</td>
</tr>
<tr>
<td>Left arm</td>
<td>1, 2, or 3</td>
<td>3</td>
</tr>
<tr>
<td>Legs</td>
<td>1, 2, or 3</td>
<td>3</td>
</tr>
<tr>
<td>Hearing (left)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Hearing (right)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Cortical sensation</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

*1 = one side only, 2 = both sides.
†1 = one extremity only, and 2 = one side of body.
Where various combinations of the above symptoms occurred, attacks were defined as “mixed.” Ninety-three of the 109 individuals were subjected to retrograde angiography of the extracranial and intracranial circulations within two weeks of the time of the first examination.

Results

Mortality

Of the original 144 patients seven were known to be deceased by the end of the three-year follow-up period, with an additional ten persons known to have died at variable times after three years. Five of the seven deaths in the three-year follow-up group were due to strokes, one to a myocardial infarction. Of the ten deaths after three years (all less than ten years), three were due to strokes and seven to myocardial infarction. Nine of the 144 individuals (6%) were completely lost to follow-up.

Morbidity

Neurological Disability

Seventeen (15.6%) of the 109 patients examined in the follow-up period had developed a disability score of more than 15, which we used as identification for those patients who had suffered a “stroke” and showed residuals. The number of such patients related to their type of attack is shown in table 2. Of the 26 additional patients not examined for the full three years but on whom reliable information was obtained, five (19.2%) were reported to have suffered a “stroke” within three years.

The mean disability score at the end of the three-year follow-up period was about twice as high for those patients with carotid attacks as for those with basilar attacks (table 3), with the means for both groups showing a sharp rise for approximately the first 18 months and a leveling off during the remainder of the period. The average DS of the “mixed” patient group was intermediate between the other two groups, the three-year mean being just over 6 (table 3 and fig. 1). The means DS for the “mixed” group also showed the leveling-off phenomenon after 18 months.

It is of interest that when those individuals developing DS scores of more than 15 (“strokes”) are removed from the analysis, the rise in mean DS scores for both the carotid and basilar patient groups was still present although much less pronounced, with all three groups ending up with average disability scores of 3 to 3.5 at the end of the three-year period.

The standard deviations for the carotid attack group were very large when stroke-level scores were left in the calculation. When all “stroke” scores were removed, standard deviations were significantly reduced, particularly in the carotid and mixed attack groups.

Cumulative Number of Attacks

During the three-year follow-up period the mean total number of attacks in the basilar artery group was about 23 as compared to eight in those with carotid attacks. Again, the score for those individuals classified as mixed attacks was a value between these two, about 14. The cumulative number of attacks for the basilar group rose steadily during the period of observation, while in contrast the carotid group showed a leveling off between 18 and 24 months after the onset of the illness. The number of attacks in the mixed group also rose steadily throughout the period in a manner similar to the basilar group (fig. 2).

Variation in the Attack Pattern Over a Period of Time

The consistency of the attack pattern over the follow-up period was studied to determine whether those patients with attacks originally identifiable as basilar artery insufficiency continued to have such attacks, or subsequently had attacks that seemed more likely to be classifiable as carotid artery insufficiency.

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**TABLE 2**

<table>
<thead>
<tr>
<th>Type of Attack</th>
<th>No. of Individuals</th>
<th>No. with DS* more than 15 (“stroke”) during three years</th>
<th>% of each type with “stroke”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carotid attacks</td>
<td>19</td>
<td>3</td>
<td>15.8</td>
</tr>
<tr>
<td>Basilar attacks</td>
<td>44</td>
<td>3</td>
<td>6.8</td>
</tr>
<tr>
<td>Mixed attacks</td>
<td>46</td>
<td>11</td>
<td>23.9</td>
</tr>
<tr>
<td>Total</td>
<td>109</td>
<td>17</td>
<td>15.6</td>
</tr>
</tbody>
</table>

*Disability score.
The patterns of subsequent types of attack occurring within the first three years as they related to the original type of attack are seen in table 4. It is apparent that comparatively few of the patients with attacks diagnosed originally as either basilar or carotid showed changing clinical attack patterns in the three ensuing years (about 16% for each group). The somewhat larger figure (24%) for the mixed group was accounted for entirely by patients showing on follow-up examination, basilar symptoms only.

ASSOCIATION OF ANGIOGRAPHICAL FINDINGS WITH CLINICAL DATA

Ninety-three patients were subjected to four-vessel angiography by the retrograde method, the catheter being inserted in the femoral artery. Although intracranial and extracranial circulations were both visualized, clearly apparent and definable abnormalities of the intracranial circulation were rare in those patients whose criterion for study was absence of neurological disability. The subsequent findings are related only to extracranial carotid artery disease for two reasons: (a) there is marked variability in the visualization of the vertebral system; it was often difficult to say with certainty whether the vertebro-basilar system was poorly visualized due to atherosclerotic disease or other causes, and (b) only the extracranial carotid artery system is amenable to surgery. Therefore, we were more interested in the comparison of carotid artery stenosis with the clinical data.

The angiographical patterns of the carotid arteries in their extracranial portion were divided into four groups depending on the degree of stenosis

<table>
<thead>
<tr>
<th>Original type of attack</th>
<th>Subsequent type of attack (within three years)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carotid</td>
<td>Basilar</td>
<td>Mixed</td>
</tr>
<tr>
<td>16</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Basilar</td>
<td>1</td>
<td>37</td>
</tr>
<tr>
<td>Mixed</td>
<td>0</td>
<td>11</td>
</tr>
</tbody>
</table>

TABLE 4

Number of Patients With Each Type of Attack Originally, and Changes Within Three Years

Stroke, Vol. 4, July-August 1973
found in at least one carotid. When abnormality was found bilaterally, “carotid stenosis” in subsequent tables refers to the carotid with the highest degree of narrowing. Results correlated with clinical attack patterns are shown in table 5. It is apparent that only a small percentage (12.5%) of patients with carotid attacks had demonstrable carotid artery stenosis. However, 28% of patients with only basilar symptoms showed significant carotid stenosis (at least 30% stenosis). Of the 21 patients with 50% or more carotid stenosis, almost one-third gave no clinical indication of carotid artery disease. It is of interest that the largest number of patients with this angiographical finding occurred in the group whose attacks were of a mixed nature.

Since vertigo is a particularly difficult symptom to evaluate, patients with vertigo (or vertigo with ataxia) as their only symptom were studied with respect to carotid artery stenosis. Of seven patients with vertigo alone, two had 40% stenosis of one carotid artery; of the eight with vertigo and ataxia, one had occlusion of one carotid artery, one had 50% stenosis and one had 20% stenosis of one carotid artery.

ASSOCIATION OF ANGIOGRAPHICAL RESULTS WITH DISABILITY SCORE
Table 6 shows the association between the degree of carotid stenosis and the prognosis of the patients as shown by their disability scores at three years compared to the original disability score. This table shows that whereas the two stenosis groups were not significantly different in their average disability scores at the beginning of their disease, the amount of increased disability experienced by the advanced stenosis group was significantly greater than that occurring in those who had less than 50% stenosis. Since the very large standard deviation in scores of the high stenosis group at the end of three years might have been the result of a few high disability values in patients who had suffered overt massive strokes, we determined the number of individuals at each stenosis level whose disability score rose to a value of more than 15 (our definition of stroke level) during the period of three years from the onset of symptoms. These figures are seen in table 7. This table shows that the risk of subsequent stroke in this study to patients with carotid artery stenosis of less than 70% remained relatively small. It also shows that there is no apparent increase in the risk of stroke until stenosis reaches a level of 70% or more. In the latter group almost half developed a stroke during the observation period.

RELATIONSHIP OF PATIENT AGE TO CAROTID STENOSIS AND PROGNOSIS
The mean value for degree of carotid stenosis in patients for each age group by decades was calculated, and is shown in table 8 along with the numbers and percentages of patients in each group having a greater than 30% stenosis of the carotid artery. Also shown is the mean disability score at the end of three years and the number of strokes occurring in each age group.

Comments and Discussion
NUMBER OF ATTACKS
The present study confirms other studies in that the prognosis in terms of recurrent attacks of cerebral ischemia is different for patients with a “basilar artery syndrome” from those with carotid artery symptoms. The patients with attacks suggesting brain stem vascular insufficiency had a mean number of occurrences almost three times that of patients with carotid attacks. Those individuals having attacks classified as mixed gave an intermediate figure.

Our data show that in the group with carotid attacks both the DS and the cumulative number of attacks rise steeply in the first 18 months of the disease and then level off. The basilar patients in contrast showed absence of this leveling-off phenomenon. In both the present series and others, however, the patients with carotid attacks had fewer episodes occurring in those who had less than 50% stenosis.

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than those with basilar attacks. The explanation for the difference in prognosis between the number of basilar and carotid attacks remains uncertain, although it has been postulated that among the patients with transient ischemic attacks there is a group with an initial period of “active disease”—the first two years, during which there is a much greater tendency to a cataclysmic stroke which terminates the history of transient ischemia.5, 6 Our data would confirm this hypothesis and identify this group as those with carotid attacks, as did Marshall in 1964.2

In our data, all three of the strokes occurring in carotid patients took place within the first 18 months of disease, while all strokes of basilar patients occurred in the last half of the three-year time period, and strokes of “mixed” patients were spaced rather evenly throughout the period.

NEUROLOGICAL DISABILITY

Our results on neurological disability are calculated obviously in a somewhat different way from those of other studies. Since the duration and extent of neurological disability forms a continuum from patients with characteristic transient ischemic attacks to those with massive residuals of a cerebral infarction, we felt it obligatory to define what was meant by evidence of a “stroke” on neurological examination. It is well known that most patients with cerebral infarctions recover either completely or to a large extent—the clinical diagnosis of these attacks of cerebral ischemia as opposed to that of “transient” ischemic attacks being based on duration of disability. The figure of a DS of more than 15 used on our neurological examination to define a “stroke” is low enough to identify patients with a fairly minor amount of neurological disability. Using such criteria for a diagnosis of stroke, the findings of the present study are in accord with those of others that those patients with attacks of carotid symptoms show a higher number of “strokes” than do those with basilar attacks. Compared to other studies on the natural history of transient ischemic attacks the total figure is low (13.8%) but strikingly similar to the figure derived by Friedman in his study of TIs in a community,7 and only slightly higher than the figure of Bradshaw and McQuaid,8 who studied only vertebrobasilar attacks. They found that one-fifth of their patient population “did not do well”—which included recurrent attacks and some neurological disability. Why results in different series as to numbers of cerebral infarcts that follow TIs have varied so markedly is difficult to explain. The series of Whisnant et al.9 reported a 31% incidence of subsequent infarction but this was in a follow-up period ranging up to 15 years. Even other series with follow-up periods more closely comparable to ours have shown disparity of results; Acheson and Hutchinson10 found at the end of 39 months 51% of their patients had had cerebral infarcts, Baker et al.11 used a follow-up period averaging 41 months and found 22%, and Fields et al.12 with a variable follow-up period of a large sample covering 42 months found 13%. The disparity in prognosis may be due to variables of sample selection or of definition of outcome. Part of our own transient ischemic attack patient population was similar to the recent series of Marshall and Wilkinson13 in that it consisted of patients without carotid stenosis on angiography. However, ours may have been a group even more free of extracranial vascular disease than Marshall’s and Wilkinson’s, since their patients were known to have normal only the “appropriate” carotid with the possibility that the opposite side was affected. Our patients had four-vessel angiography. Also included in our population, however, was a patient group with varying degrees of carotid

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**TABLE 7**

Association of Carotid Artery Stenosis With Occurrence of "Stroke" Within Three Years of Disease Onset

<table>
<thead>
<tr>
<th>Greatest % stenosis</th>
<th>No.</th>
<th>No. &amp; % of &quot;stroke&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-9</td>
<td>58</td>
<td>6 (10)</td>
</tr>
<tr>
<td>10-29</td>
<td>8</td>
<td>1 (12)</td>
</tr>
<tr>
<td>30-49</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>50-69</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>70-99</td>
<td>9</td>
<td>4 (44)</td>
</tr>
<tr>
<td>Total</td>
<td>93</td>
<td>11 (11.8)</td>
</tr>
</tbody>
</table>

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**TABLE 8**

Carotid Stenosis and Prognosis by Age Group, 105* TIA Patients

<table>
<thead>
<tr>
<th>Age</th>
<th>No.</th>
<th>No. with arteriogram</th>
<th>Carotid stenosis at original examination</th>
<th>Three-year prognosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>40-49</td>
<td>16</td>
<td>15</td>
<td>Average % stenosis 27</td>
<td>Average three-year DS 9.6</td>
</tr>
<tr>
<td>50-59</td>
<td>31</td>
<td>28</td>
<td>Average % stenosis 14</td>
<td>4.6</td>
</tr>
<tr>
<td>60-69</td>
<td>48</td>
<td>42</td>
<td>Average % stenosis 18</td>
<td>5.0</td>
</tr>
<tr>
<td>70-79</td>
<td>10</td>
<td>6</td>
<td>Average % stenosis 34</td>
<td>3.2</td>
</tr>
</tbody>
</table>

*Age was unknown in four of the 109 patients followed three years.

*Stroke, Vol. 4, July-August 1973*
stenosis. These latter patients were a randomly selected half of the total number showing carotid stenosis, as discussed in the Methods section. Thus our sample is heavily weighted with persons with less than 30% stenosis. Even when this factor is taken into account and adjustment is made for it, the expected percent of all patients who would experience a stroke within three years is only about 12.5% of those undergoing arteriography.

PATTERN OF ATTACKS

We found, as have others, that the number of patients with carotid attacks showing high disability at the end of the evaluation period was much higher than those with "basilar" attacks—over twice the number. However, the difficulty in making the clinical differentiation between the attack of basilar insufficiency and that of carotid insufficiency must not be underestimated. We elected to identify basilar attacks as those presenting with signs of cranial nerve dysfunction. It is clear, of course, that hemiplegia and hemihyphalgia may be signs of basilar artery disease as well as of carotid artery disease. In view of these possibilities it is of interest that the majority of patients identified as having carotid or basilar attacks continued in their course to have attacks which were similarly identifiable. The larger number of patients presenting basilar attacks subsequent to an initial mixed attack probably reflects the increased vulnerability of the basilar system to whatever mechanisms are operative in bringing on TIAs. The sizeable number of cases with only clinical basilar attacks but showing varying degrees of carotid artery stenosis on angiography (up to 50% or more) emphasizes the fact that transient ischemic attacks cannot always be equated with disease in any particular vessel system.

In studying the relationship of demonstrated carotid artery stenosis with subsequent neurological disability, our data show that approximately 10% of the patients with a less than 10% stenosis of a carotid artery have a disability in the "stroke" range at the end of three years. This result is very similar to that recently reported by Marshall and Wilkinson. More surprising was the low number of patients with high disability scores in patients showing higher degrees of stenosis of the carotid artery. An exception was the group with a 70% to 99% degree of stenosis. Of the nine individuals with this degree of very advanced stenosis, four were in the high disability score group at the end of three years. These results suggest that whereas there is some increased risk of a stroke for all patients with transient ischemic attacks, the risk does not differ in patients with or without carotid stenosis unless a high degree of stenosis occurs (70% or more). Patients with the latter finding appear to be at high risk.

AGE EFFECTS

Our data concerning the occurrence of carotid stenosis, disability scores and number of strokes at the end of three years suggest that there may be two populations under observation in the study (table 8). The young age group (40 to 49) showed, on the average, a greater percent of carotid stenosis and a larger proportion with significant (greater than 30%) stenosis than any other age group except the oldest (70 to 79). In addition, the average DS at the end of three years of this young group was the highest of any age group, and a greater proportion suffered strokes within three years than any other age group. It is well known that atherosclerosis progresses with increasing age, and it would be reasonable to expect atherosclerotic narrowing to progressively affect the carotid artery among other vessels. The somewhat surprising finding of the high degree of carotid stenosis and large number of strokes among comparatively youthful patients suggests one or more other etiological factors, some possibly genetic. The number of strokes in each of our TIA age groups was compared with the expected occurrence of stroke in these age groups in the general population. We found a highly significant increase over expected number of strokes in each TIA age group with the exception of the oldest (70 to 79). Other studies also have shown the increased risk of stroke among TIA patients in general.

DRUG EFFECTS

No attempt was made in this study to control various medical treatments. A few patients were on antihypertensive drugs, and a few on vasodilators. Several patients were on oral anticoagulants intermittently. The only use made of this latter information was the determination that strokes occurred with equal frequency in those patients on anticoagulants through the entire study and in the remainder of the group. These findings support those recently reported by Baker.

MORTALITY

Our data showed an equal number of deaths due to cardiovascular and cerebrovascular causes, similar to findings of the Mayo Clinic, Rochester, Minnesota, study. However, it is important to note that deaths from "stroke" occurred for the most part within the first three years of initial symptoms, while those from myocardial infarction occurred later.

This fact recalls the finding of the rapid rise in DS in the first 18 months with subsequent leveling off, and a similar phenomenon in attack rate in the carotid group. All these data support the concept of an "active" phase of the disease.

EKG RESULTS

In this series of patients with TIA, as in others, the lethal event is as likely to be myocardial infarction.
as cerebral infarction. Earlier studies had demonstrated the ominous import of an abnormal EKG on the prognosis of the patients with TIAs, and it is of interest that more than half of the patients in this study had an abnormal EKG on initial examination as defined by myocardial ischemia, arrhythmia, or conduction defect. This fact reinforces the recent admonitions of several investigators that TIAs are frequently warning symptoms of generalized vascular disease, and cardiovascular disease in particular. In making decisions as to surgery on carotid stenoses, it is well to consider that these patients may comprise a very high risk population from the point of view of cardiac disease, whereas their prognosis for future "stroke" does not seem to be increased by stenosis of a carotid artery unless that stenosis reduces the lumen to less than half the original diameter.

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Stroke. 1973;4:666-673
doi: 10.1161/01.STR.4.4.666

Stroke is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
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Print ISSN: 0039-2499. Online ISSN: 1524-4628

The online version of this article, along with updated information and services, is located on the
World Wide Web at:
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