MIDDLE CEREBRAL ARTERY (MCA) occlusion is a much less frequent lesion than internal carotid artery (ICA) occlusion in the Caucasian population. In the American Joint Study of Extracranial Arterial Occlusion, 1 MCA occlusion was only 1/4 as common as ICA occlusion. Lascelles and Burrows 2 estimated a similar ratio. The therapeutic option of extracranial to intracranial (EC/IC) bypass surgery makes it important to know as much as possible about the natural history of patients afflicted with this lesion. We have undertaken a retrospective review of 24 patients from one unit who presented with either MCA trunk or branch occlusion.

Patients and Methods

The cerebral angiographic records of patients examined at University Hospital, London, Ontario between 1972 and 1982 were reviewed. This yielded 35 patients with radiologic evidence of middle cerebral artery occlusion. Seven of these patients went on to have an ipsilateral EC/IC bypass procedure and were therefore excluded. A further four patients were lost to follow-up. The remaining 24 patients form the basis of this report.

Follow-up was carried out by clinical visits in the majority of cases. Information on those patients who died outside our center was obtained from hospital
summarized and death certificates. The end-points for the study were stroke and death.

### Results

#### Clinical Findings

The mean age at the time of initial presentation was 58.8 years with a range of 21 to 74. There were 15 males and 9 females. The right hemisphere was affected in 13 patients and the left in 11 patients. Seventeen patients had MCA trunk occlusions and seven had branch occlusions. The clinical presentation is detailed in Table 1. Five patients (21%) presented with TIA. The remaining 19 patients presented with stroke and in eight of these, this was a major disabling event. Only eight of the patients who presented with stroke had had a previous ischemic event so that more than half of this group had no prior warning of their ictus. Two of the patients with MCA branch occlusions were asymptomatic on the side of their MCA disease.

Risk factors for vascular disease were common. Over half of the patients had a long history of cigarette smoking and a third had a history of hypertension. Maturity-onset diabetes was present in 20% of the patients. In addition, about one-third of the patients had a history of ischemic heart disease. All patients in this series were Caucasian.

#### Angiographic Features

The associated angiographic features in these patients are given in Table 2. Eleven patients (46%) had otherwise normal angiography or evidence of minimal disease consisting of mild smooth narrowing in the proximal ICA. Five of the patients in this group had suggestive evidence of cardioembolic disease on the basis of mitral valve prolapse and two, atrial fibrillation in two and an old anterior wall myocardial infarction in a single patient. One of these patients with mitral valve prolapse and a branch occlusion demonstrated a normal MCA on repeat angiography three years later.

Eleven patients (46%) showed significant ipsilateral proximal ICA disease. Only one of these patients had an endarterectomy and this was uneventful. An additional two patients showed contralateral MCA stenosis. Five patients in the entire group also had significant contralateral proximal ICA disease as defined by the presence of ulceration, greater than 50% stenosis or occlusion.

#### Follow-Up

Five patients died during the acute phase of their presenting stroke (Table 3). All of these patients had experienced an MCA trunk occlusion. Only two of them had suggestive evidence of cardioembolic disease. The remaining 19 patients were followed for a mean of 54.2 months (range 19-123 months). These patients were treated with risk factor management and antiplatelet agents and only one was anticoagulated.

Two patients died as a result of subsequent stroke, both in the territory of the artery known to be occluded; there were two cardiac deaths; one death was due to sepsis. Of the remaining 14 patients, only 5 had further ischemic events: 4 had TIAs and 1 experienced a partial non-progressive stroke again in the territory of the occluded artery. Therefore, of those patients who survived the presenting ischemic event, 12 (63%) remained completely functional in terms of activities of daily living.

### Discussion

The literature contains very few studies of the prognosis to be anticipated in patients who have been afflicted with an MCA occlusion. Lascelles and Burrows analyzed 41 cases of MCA occlusion of whom only 22% made a good recovery. On the other hand, Allcock collected 29 cases involving only the MCA trunk and found that 65% recovered sufficiently to function as useful citizens. The period of follow-up however was not given. Kaste and Waltimo detailed their results on 78 patients who were followed for a mean of 30.3 months and reported that 72% of the patients who survived the acute stage of stroke remained fully independent in activities of daily living. Our study compares favourably to that of Kaste and Waltimo with a further extension of the mean follow-up to 54.2 months. In addition in our series there were only three strokes in follow-up giving an annual stroke rate of 3.5%. This is in the same range as two studies indicating that the annual stroke rate ipsilateral to ICA occlusion is 2% to 5% suggesting that MCA occlusion and ICA occlusion carry a similar prognosis.

#### Table 1 Clinical Presentation (24 Patients)

<table>
<thead>
<tr>
<th></th>
<th>MCA Trunk Occlusion</th>
<th>MCA Branch Occlusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>TIA</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Reversible ischemic neuro. deficit</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Partial non-progressive stroke</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Major stroke</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>17</td>
<td>7</td>
</tr>
</tbody>
</table>

#### Table 2 Associated Angiographic Features

<table>
<thead>
<tr>
<th>Feature</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Otherwise normal or minimal disease</td>
<td>11</td>
</tr>
<tr>
<td>Ipsilateral ICA ulceration at origin</td>
<td>2</td>
</tr>
<tr>
<td>Ipsilateral ICA stenosis (&gt; 50%) at origin (with or without ulceration)</td>
<td>5</td>
</tr>
<tr>
<td>Ipsilateral ICA occlusion at origin</td>
<td>4</td>
</tr>
<tr>
<td>Contralateral ICA stenosis</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>24</td>
</tr>
</tbody>
</table>

#### Table 3 Cause of Death

<table>
<thead>
<tr>
<th>Cause</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial stroke</td>
<td>5</td>
</tr>
<tr>
<td>Subsequent stroke</td>
<td>2</td>
</tr>
<tr>
<td>Cardiac</td>
<td>2</td>
</tr>
<tr>
<td>Sepsis</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>10</td>
</tr>
</tbody>
</table>
in those individuals who survive the initial ischemic event.

The limited number of patients in the present study does not allow for detailed analysis of factors that might predict outcome and there is conflicting information in the literature as to prognostic markers following MCA occlusion. In Lascelles and Burrows' study a poor prognosis seemed to be related to a history of hypertension, age greater than 40 years and the presence of coma. Allcock did not find the prognosis to be related to age, sex or site of the lesion along the MCA. In neither of the above reports or in the report of Sindermann et al was there any correlation between the degree of leptomeningeal anastomoses and the clinical outcome. However, Krayenbuhl and Yasargil as well as Fisher in his account of 40 patients with MCA occlusion found that the richness of the collateral circulation seemed to predict the degree of recovery. The pathogenesis of MCA occlusion might help to clarify these discrepancies in that such factors as the state of the collateral circulation might not be of utmost importance. Several authors have recognized that atherosclerotic thrombosis of the MCA is probably a rare event. In an autopsy series of 31 cases of MCA occlusion, Lhermitte et al found only two cases of atherosclerotic occlusive thrombosis of the MCA. The great majority were embolic either from disease in the proximal ICA or from the heart. In addition, it has been well established that a repeat angiogram will often show spontaneous disappearance of the occlusion or at least some improvement in blood flow. Unfortunately, only one of our patients had repeat angiography and this was three years after the initial ischemic event. In Allcock's series, ten patients with MCA occlusion had repeat angiography within three weeks of the initial examination and in five cases the angiograms had returned to normal and three showed improvement. Fragmentation of the embolus with early reperfusion of the ischemic vascular territory may be a crucial factor in recovery of function and clinical and radiological parameters may not predict its incidence. The fact that the five patients in our series who died acutely all had MCA trunk occlusions suggests that failure of fragmentation of the embolus may have some bearing on the prognosis but this could only be determined definitively by serial angiography on a larger number of patients.

The present study indicates that MCA occlusions can have a reasonably benign course with medical therapy alone and the efficacy of bypass surgery will have to be considered within the context of its pathogenesis. Important factors to consider are the presence of potentially-treatable disease at the origin of the ipsilateral ICA and in the heart in addition to the state of the middle cerebral circulation in the month subsequent to the initial angiogram.

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