Cerebral Microembolism Detected by Transcranial Doppler During Cardiac Procedures

Jan Stygall, MSc; Robert Kong, FRCA; J. Malcolm Walker, MD, FRCP; Suzanna M.C. Hardman, PhD, FRCP; Michael J.G. Harrison, DM, FRCP; Stanton P. Newman, DPhil, Dip Psych

Background and Purpose—Cerebral embolism with clinical sequelae may rarely complicate cardioversion and cardiac catheterization. Transcranial Doppler sonography has recently been introduced to monitor microemboli entering the middle cerebral artery in cardiac and carotid surgery. We therefore used this technique to evaluate the risk of asymptomatic embolism during common cardiac procedures.

Methods—Patients were monitored by transcranial Doppler while undergoing direct current cardioversion (n = 15) and cardiac catheterization (n = 17).

Results—Microemboli were detected in all patients having cardiac catheterization but in only 1 patient after cardioversion.

Conclusions—Microembolism occurred frequently during cardiac catheterization and rarely during cardioversion. It is not yet known whether this has clinical relevance. (Stroke. 2000;31:2508-2510.)

Key Words: cardiac catheterization ■ cardioversion ■ embolism ■ ultrasonography, Doppler, transcranial
ing insertion or change of catheters (11/17), manipulation of
the catheter tip in the aorta or left ventricle (7/12), any other
manipulation of the catheter (6/17), and change of manifold
or syringe (5/17). The number of signals recorded varied from
zero to too numerous to count. The cases and number of
signals recorded are shown in the Table. No patient suffered
a neurological complication.

Direct Current Cardioversion
No microemboli were recorded before cardioversion. One
patient’s recordings revealed 2 MEE: 1 at 4 minutes and 1 at
18 minutes after the onset of sinus rhythm. No others had any
evidence of microembolization. Four patients remained in
atrial fibrillation.

Discussion
This small study confirms previous research (eg, References 2
and 6) that cardiac catheterization, coronary angiography, and
angioplasty are all accompanied by the presence of microem-
bulic signals on TCD recordings. Whether these events have any
detectable influence on cerebral function remains to be seen. In
the case of coronary artery bypass graft with cardiopulmonary
bypass, there is evidence that such emboli are causally linked to
neuropsychological impairment after surgery that persists for up
to 5 years.5-7 Although less data on the subject exist, carotid
endarterectomy and angioplasty are both accompanied by sim-
ilar microembolism, but there is little evidence of comparable
cognitive impairment.9 Studies of neuropsychological function
after catheterization appear warranted.

It is likely that most of the signals recorded during
angiography consist of gaseous material, and Markus et al10
have shown that the rate of injection affects their numbers, in
accord with that interpretation. The embolic signals caused by
manipulation of the catheter or guidewire and during balloon-
ing of vessels are more likely to be solid and theoretically
more likely to have pathological sequelae.

Cardioversion, by contrast, was only accompanied by
microembolic signals in 1 case. This contrasts with the
accepted risk of cerebral macroembolism in this clinical
context. However, the entire period of clinical risk was not
covered by continuous recordings. There was no instru-
mentation to cause trauma to the endothelium, nor were
injections made. The conversion of atrial rhythm, however,
was associated with rapid changes in the left atrium with
the development of echo contrast, and this is when
preformed atrial thrombus may dislodge and embolize. It
seems possible that full anticoagulation, which all our
patients received, successfully prevented the formation of
atrial thrombus. This speculation may be verified by
performing recordings during emergency procedures in
which a number of patients may not be receiving antico-
agulation treatment. The absence of MEE supports the
success of this policy, although the conclusions are inse-
cure because of the small sample size.

<table>
<thead>
<tr>
<th>Patient</th>
<th>Diagnostic Procedure</th>
<th>Number of Emboli During Coronary Injections</th>
<th>Catheter and Guidewire Manipulation</th>
<th>Balloon Inflation/Deflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>LV, CA, PTCA</td>
<td>LV, 8</td>
<td>25</td>
<td>9</td>
</tr>
<tr>
<td>2</td>
<td>LV, CA</td>
<td>LV, multiple</td>
<td>6</td>
<td>21</td>
</tr>
<tr>
<td>3</td>
<td>LV, CA</td>
<td>LV, 41</td>
<td>2</td>
<td>54</td>
</tr>
<tr>
<td>4</td>
<td>LV, CA</td>
<td>LV, 14</td>
<td>12</td>
<td>17</td>
</tr>
<tr>
<td>5</td>
<td>LV, CA</td>
<td>LV, 13</td>
<td>0</td>
<td>19</td>
</tr>
<tr>
<td>6</td>
<td>LV, CA</td>
<td>LV, 2</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>CA, PTCA</td>
<td></td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>8</td>
<td>Aortogram</td>
<td>Aorta, 0</td>
<td>…</td>
<td>…</td>
</tr>
<tr>
<td>9</td>
<td>LV, CA</td>
<td>LV, 20</td>
<td>8</td>
<td>28</td>
</tr>
<tr>
<td>10</td>
<td>Aorta, LV, CA</td>
<td>Aorta, 5</td>
<td>3</td>
<td>47</td>
</tr>
<tr>
<td>11</td>
<td>Aorta, LV, CA</td>
<td>Aorta, 6</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>12</td>
<td>LV, CA</td>
<td>LV, 15</td>
<td>10</td>
<td>21</td>
</tr>
<tr>
<td>13</td>
<td>CA, PTCA</td>
<td></td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>14</td>
<td>LV, CA</td>
<td>LV, 1</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>15</td>
<td>CA</td>
<td></td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>16</td>
<td>CA, PTCA</td>
<td></td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>17</td>
<td>LV, CA</td>
<td>LV, 13</td>
<td>0</td>
<td>19</td>
</tr>
</tbody>
</table>

Angiogram includes test dose. LV indicates left ventricle; CA, coronary artery.
If neuropsychological testing were to demonstrate subtle but definite impairments after cardiac catheterization and PTCA, the question of antithrombotic prophylaxis in these common procedures would be raised. However, Fischer et al. were unable to demonstrate significant differences in the number of emboli detected during left heart catheterization when heparin and aspirin were used. The situation might prove a good test for newer antiplatelet agents.

References
Cerebral Microembolism Detected by Transcranial Doppler During Cardiac Procedures
Jan Stygall, Robert Kong, J. Malcolm Walker, Suzanna M. C. Hardman, Michael J. G. Harrison
and Stanton P. Newman

Stroke. 2000;31:2508-2510
doi: 10.1161/01.STR.31.10.2508
Stroke is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 2000 American Heart Association, Inc. All rights reserved.
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:
http://stroke.ahajournals.org/content/31/10/2508

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published in Stroke can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the Permissions and Rights Question and Answer document.

Reprints: Information about reprints can be found online at:
http://www.lww.com/reprints

Subscriptions: Information about subscribing to Stroke is online at:
http://stroke.ahajournals.org/subscriptions/