Systemic and Pulmonary Emboli before and after Mitral Commissurotomy

By Frederick Kellogg, M.D., Chi Kong Liu, M.D., I. William Fishman, M.D., and Roger Larson, M.D.

Systemic and pulmonary emboli are frequent and serious complications in mitral stenosis. It has been stated that systemic embolism occurring in patients with mitral stenosis is an indication for mitral commissurotomy, and surgery has been recommended as an urgent or emergency procedure in patients with recent systemic embolism to prevent more episodes.

In one series of 50 patients followed for 4½ to 7 years after commissurotomy no postoperative emboli were encountered. Others have noted systemic emboli during the first 2 years after commissurotomy but some have thought that the incidence was less than that of the preoperative occurrence.

In contrast to these reports, we have been impressed with the frequency of embolic phenomena following mitral commissurotomy; so we were prompted to investigate the relation of mitral commissurotomy to postoperative emboli.

Material and Methods

This study includes 149 patients who had mitral commissurotomy from 1950 to 1959 at Los Angeles County Harbor General Hospital, Torrance, and Long Beach Veterans Administration Hospital. It includes all the 75 patients operated upon at the Harbor General Hospital and 74 of 80 patients at the Veterans Hospital. There were 91 male and 58 female patients. Four were in the second decade, 18 in the third, 53 in the fourth, 53 in the fifth, and 21 in the sixth and seventh decades. According to the functional classification of the American Heart Association, six were in class I, 50 in class II, 82 in class III, nine in class IV, and two were unclassified.

Mitral stenosis was considered marked if the estimated valvular area at the time of surgery was less than 1 cm², moderate if the estimated area was from 1 to 1.5 cm² and slight if the estimated area was from 1.5 to 2 cm². One hundred ten patients had marked, 19 had moderate, and five had slight mitral stenosis. In 12 others the degree of stenosis was not mentioned. Three were found to have pure regurgitation. Mitral commissurotomy was considered adequate if the estimated opening of the mitral valve was larger than 2.5 cm².

Mitral regurgitation was considered marked if the regurgitant jet was estimated as greater than 10 ml.; moderate if 5 to 10 ml.; and mild if less than 5 ml. at surgery. Ten patients had marked regurgitation, 21 had moderate degree, 30 had slight insufficiency, but 75 had no regurgitation. Information was not available on 13 patients. After mitral surgery, mitral regurgitation was marked in 17, moderate in 32, slight in 26, and absent in 56. Information was not available on 18 patients. In no instance was the degree of regurgitation decreased by surgery.

Prior to surgery, 76 of the 159 patients had sinus rhythm, and 73 had atrial fibrillation. Of the 136 patients surviving surgery, 45 maintained sinus rhythm and 89 had atrial fibrillation.

Commissurotomy was considered adequate in 119 patients and inadequate in 15 patients. Information was not available in 15 patients.

The diagnosis of systemic emboli was based on the clinical symptoms and signs of cerebral, peripheral arterial, or visceral emboli (table 1). Cerebral emboli were manifested by unilateral motor paralysis except in two instances in whom right homonymous hemianopsia developed. Peripheral arterial emboli were characterized by sudden onset of pain, with absent pulse in the affected artery, and was verified in the majority by either arterial embolectomy or

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*The records of six patients were unavailable.

*Information unavailable in 2 patients.
amputation. Visceral emboli to the kidney or spleen were indicated by severe pain in the regions of affected organs with transient hema-
turia in the case of kidney emboli. Postmortem examination verified splenic emboli in three pa-
tients and renal emboli in two.

Pulmonary emboli were manifested by the symptoms and signs of pulmonary infarction.

### Results

There were 13 surgical deaths in the series of 149 patients with a surgical mortality rate of 8.7 per cent. Nine patients, four of whom had had preoperative systemic emboli, had systemic embolization associated with surgery, an operative embolic incidence of 6 per cent (table 2). Four with systemic emboli died and five survived.

The survivors were followed for an aver-
age of 3.2 years after surgery with a maxi-
num of 9 years. In 23 patients the follow-up
was less than 1 year. There were 11 (8.1 per
cent) late deaths in the 136 surviving pa-
tients, with four of these dying of cerebral embolism and four dying of pulmonary in-
farction and congestive heart failure.

Prior to surgery (table 2), 42 of the 149
patients, or 28 per cent, had a total of 62
systemic emboli. Twenty-eight patients had a single episode, 11 patients had two, and the other three patients had three, four, and five episodes respectively. Sixteen (28 per cent)
of the 56 patients in functional classification I and II, 24 (25 per cent) of the 91 patients
in classes III and IV, and two unclassified
patients had systemic emboli prior to surgery.
Thirteen (table 3), or 17 per cent, of the 76
patients with sinus rhythm and 29, or 40 per
cent, of the 73 patients with atrial fibrillation
had preoperative systemic emboli.

### Table 1

<table>
<thead>
<tr>
<th>Systemic Emboli</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peripheral or abdominal arteries</td>
</tr>
<tr>
<td>Preoperative</td>
</tr>
<tr>
<td>Operative</td>
</tr>
<tr>
<td>Postoperative</td>
</tr>
</tbody>
</table>

*One patient also had renal infarction found at autopsy.

Postoperatively, 17 (12.5 per cent) of the
136 surviving patients had 21 late systemic emboli. Thus the incidence of late systemic emboli was 4.8 per cent per patient-year dur-
ing the follow-up period. Twelve of these 17
patients had systemic emboli after surgery
for the first time. Inclusion of the operative
emboli made a total of 30 episodes of systemic emboli in 25 patients, or an incidence of
18.5 per cent.

Of the surviving patients, 11 were in func-
tional class I, 80 in class II, 37 in class III,
seven in class IV; and one was unclassified.
Nine (10 per cent) of the 91 in classes I
and II and eight (17 per cent) of the 44 in
classes III and IV had postoperative systemic emboli. Five patients (table 3) or 11 per cent
of the 45 with sinus rhythm and 12 patients
or 13.5 per cent of the 89 with atrial fibril-
ation had subsequent embolic episodes. Of
the 17 patients with postoperative systemic emboli, 13 (85 per cent) had an adequate
mitral commissurotomy, and three had inade-
quate surgery. Information was not available
on one patient.

The 12 patients who had systemic emboli
for the first time following commissurotomy
ranged in age from 19 to 59. Ten were in
functional class II, one in III, and one in IV;
eight had predominant mitral stenosis and
four had significant insufficiency; eight were noted to have calcification of the valve.
Eleven were considered to have an adequate
commissurotomy and five of the 12 were clini-
cally improved one functional class follow-
ing surgery. Three had atrial fibrillation
prior to surgery; six had this arrhythmia
following surgery, and three continued to
have sinus rhythm following surgery.

Thirty-two (table 4) (21 per cent) of the
149 patients had atrial thrombi at surgery.
Nine (28 per cent) of these 32 patients had
preoperative systemic embolic episodes; two
had operative, and two had postoperative
systemic emboli.

Eighty-one (table 4) (54 per cent) of the
149 patients had a calcified mitral valve.
Twenty-three (28 per cent) of these 81 pa-
Table 2

Systemic Emboli before, during, and after Surgery

<table>
<thead>
<tr>
<th></th>
<th>Number of emboli</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Preoperative emboli</td>
<td>28</td>
<td>11</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>42</td>
</tr>
<tr>
<td>(149 Patients)</td>
<td>Total number of emboli</td>
<td>28</td>
<td>11</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Operative emboli</td>
<td>Number of emboli or patients</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(149 Patients)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Postoperative emboli</td>
<td>Number of patients</td>
<td>13</td>
<td>4</td>
<td></td>
<td></td>
<td>17</td>
</tr>
<tr>
<td>(136 Patients)</td>
<td>Total number of emboli</td>
<td>13</td>
<td>8</td>
<td></td>
<td></td>
<td>21</td>
</tr>
</tbody>
</table>

Table 3

Relation of Systemic Embolization to Cardiac Rhythm

<table>
<thead>
<tr>
<th></th>
<th>Rhythm</th>
<th>Number of patients</th>
<th>Number of systemic emboli</th>
<th>Per cent of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preoperative,</td>
<td>Sinus</td>
<td>76</td>
<td>13</td>
<td>17</td>
</tr>
<tr>
<td>149 patients</td>
<td>atrial fibrillation</td>
<td>73</td>
<td>29</td>
<td>40</td>
</tr>
<tr>
<td>Postoperative,</td>
<td>Sinus</td>
<td>45</td>
<td>5</td>
<td>11</td>
</tr>
<tr>
<td>134 surviving patients*</td>
<td>atrial fibrillation</td>
<td>89</td>
<td>12</td>
<td>13.5</td>
</tr>
</tbody>
</table>

*Information on rhythm postoperatively unavailable in two patients.

tients had preoperative systemic emboli; three had operative, and 10 had postoperative systemic emboli.

Ten patients (6 per cent) had pulmonary infarction prior to surgery and 10 (7.3 per cent) had pulmonary infarction after surgery. Four of the latter died of pulmonary infarction and congestive heart failure in the follow-up period.

**Discussion**

The incidence of systemic emboli prior to surgery of 28 per cent is higher than that of many series but is comparable with the observations of Olesen on the natural history of mitral stenosis.

The incidence of systemic emboli complicating surgery of 6 per cent is significant and is comparable to the rates of 2 to 8.4 per cent reported by others. Anticoagulant therapy begun prior to surgery and continued through the immediate postoperative period has been shown to decrease this surgical complication.

Following surgery the incidence of systemic embolization is less than the preoperative incidence but represents 4.8 per cent per patient-year, which is eight times the incidence reported by Ellis. It is difficult to determine the preoperative incidence of emboli per patient-year but if one arbitrarily assumed 10 years as a preoperative period of vulnerability, our preoperative incidence would have been 3 per cent per patient-year, which is comparable to the incidence in Olesen's series of 4 per cent per patient-year. (Several of our patients had emboli 6 years prior to surgery and one had an embolus 9 years before.)

It is also noteworthy that 12 patients had their initial systemic emboli following surgery. Thus our findings would suggest that mitral commissurotomy neither prevents nor decreases the incidence of systemic embolization. It has been reasonably hoped that the improved circulatory hemodynamics following adequate commissurotomy would decrease the incidence of systemic emboli. Perhaps the endothelial defect is more important in the production of mural thrombi than a reduced
flow across the mitral valve. Unless there are other indications for mitral commissurotomy, systemic embolization may best be prevented with prolonged anticoagulant therapy.\textsuperscript{14}

Atrial fibrillation appears to predispose to systemic emboli before commissurotomy.\textsuperscript{15} Following surgery the incidence of emboli was less in functional classes I and II than in III and IV, but prior to surgery the incidence was essentially the same in the two groups.

Contrary to a published report,\textsuperscript{16} the presence of atrial thrombosis or calcified mitral valve was not accompanied by an increased incidence of preoperative systemic emboli.

The observations concerning pulmonary infarction suggest that mitral commissurotomy has little effect on the incidence of pulmonary emboli, which probably occur as late manifestations in the course of rheumatic heart disease.

Conclusion

In a series of 149 patients subjected to mitral commissurotomy, 28 per cent had preoperative systemic embolization. Nine patients, or 6 per cent, had systemic emboli associated with surgery. Of the 136 patients surviving surgery, 12.5 per cent had subsequent systemic emboli with an incidence of 4.8 per cent per patient-year, comparable to the reported natural incidence of systemic emboli of 4.0 per cent per patient-year.

This study suggests that mitral commissurotomy does not prevent systemic emboli and does not decrease the natural incidence of such emboli.

Table 4

<table>
<thead>
<tr>
<th>With systemic emboli</th>
<th>Preoperative</th>
<th>Operative</th>
<th>Postoperative</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left atrial thrombosis</td>
<td>9 (28%)</td>
<td>2</td>
<td>2</td>
<td>32</td>
</tr>
<tr>
<td>Calcified mitral valve</td>
<td>23 (28%)</td>
<td>3</td>
<td>10*</td>
<td>51 81</td>
</tr>
</tbody>
</table>

*Five of the 10 patients also had preoperative systemic emboli.

References

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