Complications of Aortography

By Bruce A. Kottke, M.D., John F. Fairbairn II, M.D., and George D. Davis, M.D.

Recent interest in the surgical treatment of renal hypertension has brought about the widespread use of retrograde aortography. The percutaneous transfemoral technic described by Seldinger 1 has produced improved arteriograms and is reported to be relatively free from complications. In a recent paper, Adeney and Fraser 2 reported no complications from percutaneous retrograde aortography in 103 cases during a 4-year period. Others, including ourselves, have not been so fortunate. In June 1963, McGraw 3 reported five major complications in 372 arteriograms done via the percutaneous transfemoral route. Complications included three acute arterial obstructions; one resulting in amputation and another was associated with an acute myocardial infarction and cardiac arrest. One cleared after 12 hours of conservative treatment. In addition, there was one false aneurysm and one penetration of the aortic wall with resultant dissection, multiple embolization, and death. Recently, Lang 4 made a survey of 11,402 retrograde percutaneous arteriograms and found seven deaths, 81 serious complications, and 325 minor complications. Arterial occlusion at the site of puncture was the most common serious complication.

Material and Methods

In this study (June 1960 through January 1963) we reviewed a series of translumbar arteriograms (80 cases) done on patients without peripheral arterial occlusive disease and a concurrent series of retrograde percutaneous transfemoral arteriograms (195 cases). In both of these groups, almost all of the arteriograms were done for evaluation of possible renal artery disease. In addition, a series of retrograde thoracic arteriograms done via either the percutaneous transfemoral (44 cases) or a brachial artery cut-down technic (32 cases) also has been reviewed.

All arteriograms were done by two radiologists. The patients were admitted on the vascular service the night prior to the procedure and remained in the hospital for at least 24 hours after the procedure.

Peripheral pulses were checked and recorded after the procedure in 92.8 per cent of retrograde abdominal arteriograms, 86 per cent of retrograde transfemoral thoracic arteriograms, and 90 per cent of thoracic arteriograms done via a brachial artery cut-down technic.

The arterial cut downs were done by several surgeons. Twelve thoracic arteriograms were done by other technics and will be listed separately.

Results

Percutaneous Transfemoral Retrograde Abdominal Aortography

One hundred ninety-five abdominal arteriograms were done by the percutaneous transfemoral route as described by Seldinger. 1 The group included 114 males and 81 females with an average age of 45.1 years. A total of 24 complications occurred for an incidence of

<table>
<thead>
<tr>
<th>Complication</th>
<th>Patients Required operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arterial occlusion</td>
<td>11</td>
</tr>
<tr>
<td>Hematoma</td>
<td>3</td>
</tr>
<tr>
<td>False aneurysm</td>
<td>1</td>
</tr>
<tr>
<td>Loss of spring-wire tip</td>
<td>1</td>
</tr>
<tr>
<td>Aortic perforation</td>
<td>1</td>
</tr>
<tr>
<td>Allergy to radiopaque media</td>
<td>2</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>5</td>
</tr>
<tr>
<td>Intramural injection</td>
<td>2</td>
</tr>
<tr>
<td>Episode of hypotension and bradycardia</td>
<td>1</td>
</tr>
<tr>
<td>Tender quadriceps muscle</td>
<td>2</td>
</tr>
<tr>
<td>Probable arterial occlusion</td>
<td>(2)*</td>
</tr>
<tr>
<td>Total</td>
<td>24</td>
</tr>
</tbody>
</table>

* These are not included in the totals.

From the Mayo Clinic and the Mayo Foundation, Rochester, Minnesota.

Read at the meeting of the American Heart Association, Los Angeles, California, October 25 to 27, 1963.
12.3 per cent. The incidence of definite acute arterial occlusion was 5.7 per cent (table 1). Evidence of ischemia consisted of absent distal pulses, pallor on elevation of extremity, and, in most instances, comment regarding decreased temperature of the distal extremity. Three complications required surgical exploration, which included evacuation of 5,000 ml. of clotted blood in a hematoma, resection of a false aneurysm, and search for the tip of the spring guide-wire that was lost during the procedure. Eleven of the occlusions occurred immediately after the procedure. In one patient, the pulses were first noted to be absent 4 to 8 hours after the procedure; the pulses were not recorded immediately after the aortogram. In another, the patient’s pulses were definitely normal 8 hours after the procedure but were noted to be absent 20 hours after. This patient had steatorrhea and had been given vitamin K₁ (phytonadione) for several days prior to the making of the aortogram.

In 10 of 13 patients the block occurred at the site of the puncture. In three patients, the block was located distal to the popliteal pulse. Seven (54 per cent) of the patients with definite or probable occlusive complications received anticoagulant therapy. The duration of the occlusions varied from 1 to 72 hours: that is, two were from 1 to 3 hours; three from 4 to 8 hours; two from 10 to 12 hours; 1 for 24 hours; two for 30 hours; and three for 72 hours. All of the patients in this group recovered without any permanent residuals.

The yearly complication rate was surprisingly constant throughout the period studied (table 2). In addition, the use of a second injection of radiopaque medium to obtain a second series of films did not appear to alter the complication rate. Analysis of the types of radiopaque media and of catheters used and of the ages of the patients also did not reveal any correlation of these factors with the rate of complications.

### Translumbar Aortography

The adverse effects noted in a series of 80 translumbar aortograms were allergic reaction to sodium acetrizoate (Urokon Sodium) in one case, back pain plus blood pressure drop (possible retroperitoneal hematoma) in two, bilateral sciatic leg pain in one, periaortic injection of test dose in three, needle placed in renal artery in two, and severe abdominal pain without pressure drop in one. The group included 52 males and 28 females. These aortograms were done as a portion of a hypertensive evaluation. Most of the complications were minor, and only two could possibly be considered as major. None resulted in permanent residuals. The relative safety of this procedure is in agreement with a series of 3,000 translumbar procedures reported by Beall and associates.⁵

### Transfemoral Percutaneous Thoracic Aortography

Retrograde thoracic aortography via the percutaneous transfemoral route resulted in 11 complications in a series of 44 procedures for an incidence (excluding probable occlu-
Complications (of 25.0 per cent. This is more than twice the incidence of all complications in abdominal aortograms done by the same technic. The group included 31 males and 13 females with an average of 47.1 years. The procedures were done primarily because of suspected aneurysms of the thoracic aorta. Most of the complications were occlusive, the rate being 18.2 per cent for definite arterial occlusions (table 3). In patients with probable arterial occlusions, the pulses were described as being definitely diminished but not absent. This rate is almost four times the rate of occlusive complications that was found in abdominal aortography via percutaneous transfemoral technic. One of the occlusions in this group required thromboendarterectomy. This occurred in a 50-year-old man in whom an aortogram was done because of a suspected aneurysm of the aortic arch. Figure 1 shows results of a femoral arteriogram done 4 days after the aortogram. When the patient failed to respond by the fourth day of conservative therapy, including anticoagulants, the femoral artery was explored. An organized thrombus was found to be adherent to the vessel wall at the level of the previous arterial puncture. The thrombus had a 2-inch tail, and additional thrombotic material was removed from the popliteal space. The patient made a satisfactory recovery with the presence of normal pedal pulses and later underwent successful operation for his aneurysm.

Three patients in this group had residual complications. Two had intermittent claudication: one after 2 weeks and the other after 3 months. Neither had received anticoagulant treatment for the acute occlusion. One patient had persistently diminished peripheral pulses after 9 months. He had received anticoagulants at the time of his acute occlusion. Six of the 11 definite and probable occlusions occurred immediately after the procedure. Two patients had normal pulses at the conclusion of the procedure; pulses were absent 3 to 4 hours after the procedure. One of these had an associated transient occlusion of the opposite superficial femoral artery and transient symptoms and signs of cerebral vascular insufficiency, suggesting a possibility of multiple emboli from the upper aortic region. The other patient with delayed onset of the occlusion had a block located below the pop-
littel pulse, again suggesting embolus. An occlusion secondary to a delayed hematoma developed in one patient 3 days after the aortogram was done.

In eight of 11 patients with occlusion, the occlusion was located at the site of the puncture. The duration of the occlusions varied from 6 hours to 3 days in those who did not have long-term residuals. In one, the duration was uncertain. The durations in the others were 6 to 8 hours in one, 24 to 30 hours in two, and 2 to 3 days in three. Three had long-term residuals, and one was normal after endarterectomy. Fifty-five per cent of the patients with occlusive complications were treated with anticoagulant agents.

The yearly complication rate was quite constant throughout the period studied (Table 4). Analysis of data showed that the types of catheter and radiopaque media used and the ages of the patients were not related to the complication rate.

### Table 4

<table>
<thead>
<tr>
<th>Year</th>
<th>Aortography total</th>
<th>Total</th>
<th>Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1961</td>
<td>9</td>
<td>2</td>
<td>22.2</td>
</tr>
<tr>
<td>1962</td>
<td>9</td>
<td>3</td>
<td>33.3</td>
</tr>
<tr>
<td>(Jan.-June)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1962</td>
<td>12</td>
<td>4</td>
<td>33.3</td>
</tr>
<tr>
<td>(July-Dec.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1963</td>
<td>14</td>
<td>5</td>
<td>35.7</td>
</tr>
</tbody>
</table>

but developed an occlusion several hours later.

The duration of the occlusion varied from 45 minutes to more than 17 days. In three, the duration of occlusion was uncertain. It was 45 minutes to 1 or 2 hours in two; 6 to 14 hours in two; 24 to 30 hours in five; 2 to 6 days in five; and more than 17 days in one. Three patients had persistent arm and hand claudication: two each, 5 months, and one, 6 months after the procedure. As with the transfemoral technics, the yearly complication rate was quite constant throughout the period studied. The types of catheter or radiopaque media used or ages of the patients did not correlate with the complication rate.

A summary of the complications of miscellaneous technics of aortography according to procedure shows that there were no complications in either the one case of radial cutdown aortography or the one case of percutaneous transaxillary thoracic aortography. In the three cases of percutaneous brachial thoracic aortography, three occlusions were noted: one lasted 12 hours, one lasted 8 days, and one resulted in loss of digits. In the five cases of thoracic aortography via femoral cut down, two occlusions were noted: one with no residual lasted from 2 to about 8 hours, and the other with residual lasted 7 days. An abdominal aortogram via femoral cut down was done in two cases, resulting in one occlusion with persistent block claudication after 17 months.

### Comment and Conclusions

The complication rate in this study is considerably higher than that reported by other investigators, probably because all adverse effects and minor complications have been included. Only a few of the complications reported could be considered as major. In this study, we have emphasized minor complications because we believe that many of them have the potential of becoming major and because they often are considered major by the patient.

The striking difference in the complication rate in abdominal and thoracic aortography...
via the percutaneous femoral route, that is, 12.3 per cent versus 31.9 per cent agrees with the reports of McGraw, who noted one major complication in 281 abdominal aortograms via this route and three major complications in 28 thoracic aortograms done via this route. The major technical differences between these two procedures refer to the length of the catheter used and to the amount of radiopaque medium used. An analysis of catheter diameter and types of radiopaque medium used and ages of the patients did not show any correlation with the complication rate. The occlusive complications in the extremities can be placed into two general etiologic groups: those due to hemorrhage with subsequent pressure on the artery resulting in occlusion and those due to thrombosis or embolism or both either in situ or distal to the site of the puncture. The incidence of occlusions in thoracic aortograms done via a brachial artery cut down was very high (65.6 per cent), and three of 32 patients in this series had persistent hand and arm claudication.

Aortography is a procedure that requires hospitalization and cannot be done as safely as an outpatient procedure. Patients should be informed of the approximate type and degree of risk of aortographic procedures before these procedures are done. All patients must be observed closely after the procedure by a physician who is familiar with vascular problems. When an acute arterial occlusion develops during or after the procedure, it should be treated with vasodilators, warm environment, and a slightly dependent position of the affected extremity. When hemorrhage appears to be controlled and is not a significant part of the problem, consideration should be given to the use of anticoagulant drugs in addition to the above measures. Facilities should be available for prompt vascular surgery should this be required.

References


Constituents of Medicine

The constituents of which medicine is made up are readily discernible; they are three—a practical art, an applied science, and an experimental science.—The Collected Papers of Wilfred Trotter, F.R.S. London, Oxford University Press, 1946, p. 157.

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