Fatal Cerebral Embolism Complicating Transseptal Left Heart Catheterization

By Warren A. Kossowsky, M.D., and Selvyn B. Bleifer, M.D.

The technic of transseptal left heart catheterization began with the demonstration in the experimental animal that the intact interatrial septum could be punctured by means of a needle passed through a catheter into the right atrium by way of the femoral vein. The relative ease and safety with which the left side of the heart could be entered via the transseptal route has led to the widespread acceptance of this technic and, indeed, the transseptal approach is generally considered the preferred method of entry into the left atrium.

Reports of serious complications with the transseptal technic have been relatively few and, to our knowledge, no case of fatal cerebral embolism from this procedure has been reported. The following case report is presented to call attention to this disaster.

Case Report

A 40-year-old World War II Army veteran was admitted for evaluation for mitral valve surgery. In 1945 while in Service, the patient was hospitalized with a bout of acute rheumatic fever. He was discharged from Service 1 year later because of symptomatic rheumatic heart disease. The patient was reasonably well and was employed as a truck driver until June 1957, when he gave up his job because of increasing shortness of breath on exertion.

On hospitalization in February 1958 a diagnosis of rheumatic heart disease with mitral stenosis, mitral insufficiency and aortic stenosis was made. The patient was re-admitted in December 1959 with a history of right-sided chest pain, cough, and hemoptysis and was noted to be in congestive heart failure. He was in normal sinus rhythm and a diagnosis of pulmonary embolus was not definitely established.

The patient became increasingly incapacitated from 1960 until September 1964 when walking less than half a city block caused dyspnea. Atrial fibrillation was noted and mitral stenosis was thought to be the predominant lesion. There was no history suggestive of recent pulmonary or systemic embolization, and he was transferred to Wadsworth General Hospital for consideration for mitral valve surgery.

The patient was a thin white man who appeared chronically ill. Blood pressure was 115/70, pulse 72 and irregular. The neck veins were not distended and the lungs were clear to percussion and auscultation. The heart was enlarged to the left. A systolic thrill was palpable at the apex and the rhythm was irregularly irregular. A grade III/VI harsh holosystolic murmur was heard at the apex and was well transmitted to the left axilla. A grade II/VI apical diastolic rumbling murmur was heard, and M1 was accentuated. P2 was loud and split. A grade II/VI rough systolic ejection murmur was heard at the second intercostal space along the right sternal border and was well transmitted to the neck. A2 was diminished but not absent. The liver was palpable one fingerbreadth below the right costal margin and there was no peripheral edema. Neither history nor physical examination suggested systemic embolization.

Laboratory examinations, including blood count, urinalysis, creatinine, fasting blood sugar, and serum electrolytes, were all normal. The electrocardiogram showed atrial fibrillation, digitalis effect, and probable combined ventricular hypertrophy. X-ray showed considerable enlargement of the heart in its transverse diameter with a prominent pulmonary artery segment and a large left atrium.

On the seventh hospital day, a transseptal left heart catheterization was performed in the usual manner. The atrial septum was traversed easily on the first attempt and after blood samples were taken and the transseptal needle was removed, the catheter was advanced toward the left ventricle. When the left ventricle was entered, as confirmed by fluoroscopy and pressure tracings, the patient became cyanotic and began a generalized tonic-clonic convulsion. The catheter was immediately withdrawn and an endotracheal tube was in-
served. Blood pressure at this time was 130/80 and the pulse rate 50 per minute. Neurologic examination revealed no spontaneous movements, and the patient responded only sluggishly to deep pain. Cranial nerve examination revealed fixed divergent strabismus without any doll-head movements, and the pupils were dilated and fixed. There was flaccidity of all four extremities, a positive snout reflex, and bilateral Babinski signs. The patient showed progressive deterioration and died 48 hours later.

**Autopsy Findings**

The heart weighed 550 Gm., and all chambers were moderately dilated. There was calcific stenosis of the mitral valve, and the aortic valve was thickened by collagenous tissue. A punctate subendocardial hemorrhage was visible in the atrial membranous septum at the site of the transseptal puncture. There was an area of organizing and superimposed fresh mural thrombus on the posterior left atrial wall (fig. 1). Microscopically the superficial mural thrombus showed a laminated pattern with early capillary proliferation along its attachment (fig. 2).

The other major pathologic findings were found in the brain, kidneys, and spleen. The intracranial segment of both internal carotid arteries and many of their branches were occluded by red-gray, friable thrombi. Microscopically many of these appeared structurally similar to the superficial mural thrombus in the left atrium (fig. 3). The pons and multiple areas of the cerebrum showed early ischemic changes consisting of perivascular hemorrhages, nuclear pyknosis, and cellular degeneration. The kidneys and spleen showed recent and old infarctions.

**Comments**

The complications encountered with transseptal left heart catheterizations have been said to be few and in the early experience...
with this procedure, no fatal complications were reported.\textsuperscript{2-7}

The largest single experience reported with this technic is that of Brockenbrough, Braunwald, and Ross,\textsuperscript{8} who in review of 450 consecutive transseptal left heart catheterizations reported no deaths from this procedure. They did, however, point out that in their first 294 cases there were three instances of puncture of the wall of the heart and two deaths directly attributable to the procedure.

Adrouny et al.\textsuperscript{9} reported 191 consecutive transseptal catheterizations; their experience included nine instances of puncture of the wall of the heart and two deaths directly attributable to the procedure.

Peckham et al.\textsuperscript{10} reviewed their experience with 158 transseptal left heart catheterizations. Their report included two instances of aortic puncture with one death resulting from the puncture, two instances of puncture of the right atrial wall, and one of the left atrial wall. They further reported three instances of systemic emboli, one cerebral, one renal, and one splenic, all within 48 hours of the catheterization. In each case of embolus the effects were transient.

Bopp et al.\textsuperscript{11} in a review of 50 cases of transseptal left heart catheterizations reported one instance in which a fragment of thrombus was aspirated through the Brockenbrough needle from the left atrium. Pinkerson, Kelser, and Adkins\textsuperscript{12} studied a patient at autopsy 7 days after transseptal catheterization and found an adherent mural thrombus attached to the atrial endocardium at the site of septal puncture.

The case described here is, to our knowledge, the first one reported in which a fatal cerebral embolus was a direct result of the transseptal catheterization and represents the only serious complication in approximately 200 of these procedures performed at this hospital. It must be added to the list of potential hazards of this important and useful technic.

\textbf{Summary}

A case of fatal cerebral embolism complicating transseptal left heart catheterization is presented. Some of the previously reported complications of this procedure are reviewed. Fatal cerebral embolism must now be added to the list of potential hazards of this procedure.

\textbf{References}

Fatal Cerebral Embolism Complicating Transseptal Left Heart Catheterization
WARREN A. KOSSOWSKY and SELVYN B. BLEIFER

Circulation. 1965;32:811-813
doi: 10.1161/01.CIR.32.5.811

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://circ.ahajournals.org/content/32/5/811

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published in Circulation 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 Circulation is online at:
http://circ.ahajournals.org//subscriptions/