Complications of coronary arteriography and left heart catheterization

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The first selective coronary arteriograms were performed in the Cardiac Laboratory of The Cleveland Clinic Foundation in 1959. Since that time, through the calendar year 1976, 52,953 angiographic studies which included selective coronary arteriography and left ventriculography have been performed. The complications encountered in this group of patients are summarized in the *Table*.

Thirty-nine patients (0.07%) died during or subsequent to the procedure. The majority of these died within 24 hours. A few died as long as a week after catheterization as a result of a chain of events which began at the time of catheterization.

Myocardial infarction was encountered in 16 instances (0.03%). These accounted for 12 of the deaths previously noted.

Documented dissection of a coronary artery was seen seven times (0.013%); four patients died; three recovered after prompt surgical intervention with appropriate placement of bypass vein grafts.

There were two instances of coronary embolization. One of these occurred following left ventriculography in a patient with a prosthetic aortic valve. The other occurred immediately

Table. Complications of coronary arteriography and left heart catheterization; 1959 through 1976 (52,953 studies)

	Number	Percent
Death	39	0.07
Myocardial infarction	16	0.03
Dissection of coronary artery	7	0.013
Coronary emboli	2	0.004
Cerebral emboli long-term deficit	4	0.008
Perforation innominate artery	4	0.008
Perforation left ventricle	4	0.008
Brachial artery occlusion	1482	2.8
Brachial arteriovenous fistula	2	0.004
Median nerve injury	7	0.013
Ventricular fibrillation or tachycardia	432	0.82

1974 through 1976—18,196 studies—6 deaths (0.033%).

after selective left atrial opacification in a patient with severe mitral stenosis.

Cerebral vascular accidents which resulted in long-term neurologic deficits have been encountered on four occasions (0.008%). These occurred as complications of difficult catheter manipulation in patients with elongated aortas and tortuous innominate-subclavian systems or incidental to left ventriculography. Catheter perforation of the subclavian or innominate artery has occurred in four patients (0.008%) with similar anatomic problems.

Perforation of the left ventricle occurred in four patients as a complication of intramyocardial injection of contrast media into the left ventricle during the performance of left ventriculography. These patients developed cardiac tamponade within 1 to $2^1/_2$ hours, due to the high osmotic pressure exerted by the presence of contrast media within the pericardium. This leads to a gradual accumulation of fluid within the pericardium and the gradual development of tamponade. All patients were treated surgically by opening the pericardium, and removing the fluid by pericardial lavage. In no instance was there evidence of active bleeding from the heart, because the perforations had closed spontaneously. All made uneventful recoveries and were discharged from the hospital within 7 days.

Ventricular fibrillation or ventricular tachycardia requiring DC cardioversion occurred in 432 patients (0.82%). Seven of these patients died. The others responded to standard cardiopulmonary resuscitation.

In our experience brachial artery occlusion has been the most frequently encountered complication, occurring in 1482 patients (2.8%). In the early years of our experience no attempt was made to correct this unless the patient had clear-cut ischemic symptoms. Fewer than 10% of these showed any long-term disability, because of the excellent potential for the development of adequate collateral blood flow around isolated brachial artery occlusions at the level of the antecubital fossa. With increasing experience we realized that many of these patients required subsequent angiographic studies, making preservation of their available arterial pathways of vital importance to their long-term well-being. Since 1970 all patients showing evidence of this problem have been promptly referred to our colleagues in the Department of Peripheral Vascular Surgery. Since that time more than 98% of these problems have been successfully corrected by the institution of appropriate and prompt surgical procedures under local anesthesia.

In two patients brachial arteriovenous fistulae developed subsequent to brachial artery catheterization. Both were corrected surgically. There have been seven instances of

median nerve injury incident to brachial artery mobilization in the antecubital fossa or injection of local anesthetic into the nerve. Fortunately this complication has been rare; it causes severe disability which rarely clears in less than 6 months, and may be permanent. It is preventable by taking simple precautions.

I suspect the most important complication of left heart catheterization and selective coronary arteriography is inadequate technical performance of the study and interpretation of the data. When we recognize this occurrence it has been our policy to simply tell the patient the truth. Whenever possible, the deficiency has been corrected by prompt repetition of the study to correct the recognized technical failure. In no instance in my experience has the patient refused to cooperate in this effort. Despite our best current effort, I am sure that an unknown number of these "complications" are unrecognized. We must continue to do everything possible to better understand and eradicate them.