Subintimal Dissection of the Coronary Arteries
A Complication of Selective Coronary Arteriography and the Transfemoral Percutaneous Approach

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SUMMARY
Selective coronary arteriography is now the procedure of choice in the determination of the existence and the delineation of the extent of chronic obstructive coronary artery disease. Since Sones and Shirey's original description of this technique, variations in the procedure and the approach have evolved. More recently, the percutaneous transfemoral artery approach to selective coronary arteriography has gained increasing favor because of the ease of intubation of both coronary arteries, stability of the catheter once positioned in the coronary ostium, and the high quality of cinefluorography and direct serial radiography.

Because of the tapered-tip design and positrol feature, the depth to which the coronary artery can be cannulated, and the angle formed by the tip of the catheter and the intima of the vessel, the possibility of subintimal dissection of the coronary arteries as an inherent complication of this approach arises.

Two such cases of subintimal dissection of the left coronary artery are described with cinefluorographic documentation.

It is recommended that after cannulation of the coronary vessels the catheter be withdrawn several millimeters from the lumen of the vessel in order to avoid this complication of an otherwise valuable diagnostic approach to selective coronary arteriography.

Additional Indexing Words:
Myocardial infarction

The recognized inadequacies of conventional methods in diagnosing coronary artery disease and the advent of myocardial revascularization procedures have fostered the need for techniques which would define in detail the nature and extent of obstructive coronary artery disease.

Since selective coronary arteriography was first described by Sones and Shirey in 1959, and shown to be a relatively safe procedure, it has become the method of choice.1 As with any diagnostic technique, sooner or later, variations in the approach, methods, and materials follow in its wake. Such an approach is the percutaneous transfemoral artery method and the catheters peculiar to this technique. With the advances in diagnostic procedures such as selective coronary arteriography, potential complications inherent in such techniques and their variations arise.

It is the purpose of this paper to present two cases of subintimal dissection of the left coronary artery using the Seldinger technique,2 the percutaneous transfemoral artery approach, and a commercially available catheter* (fig. 1).

Our experience with this type of catheter and technique has been rewarding in terms of success in cannulating both coronary ar-

*Ducor Disposable Guided Catheter, Cordis Corporation, Miami, Florida.
Commercially available end-hole, tapered-tip, positrol disposable, guided right and left coronary catheters (Ducor Disposable Guided Catheter, Cordis Corporation, Miami, Florida).

teries and shortening of time required for fluoroscopy. Yet, the ready facility to intubate the coronary arteries with this catheter and the depth to which it enters the lumen of the vessel can create problems if certain precautions are not taken.

Report of Cases

Case 1

C.M., a 21-year-old white female, experienced the sudden onset of severe substernal chest pain, nausea, and diaphoresis following exertion in February 1967. The electrocardiogram showed nonspecific T-wave changes at the time of admission and subsequently returned to normal over the next 5 days. She was hospitalized for 3 weeks during which time she had six to seven more episodes of left anterior chest pain, each lasting 5 to 10 minutes, associated with varying electrocardiographic T-wave abnormalities. Physical examination was normal throughout hospitalization. The serum glutamic oxalacetic transaminase was 62 units on admission, returning to normal over the next 5 days. Serial determinations of lactic dehydrogenase were within normal limits. The sedimentation rates and leukocyte counts, as well as serial chest roentgenograms, remained normal. Tests showed serum cholesterol values of 284 to 344 mg/100 ml and a serum triglyceride level of 404 mg%. The fasting and 2-hr postprandial blood glucose were 127 and 110 mg%, respectively. Results of the glucose tolerance test were normal. The patient smoked one pack of cigarettes daily, and there was a strong family history of diabetes.

In August 1967, she was transferred to Fitz-simons General Hospital for further evaluation and coronary arteriography, with a diagnosis of myocardial infarction secondary to coronary atherosclerosis. Physical examination was again normal. Results of the repeat laboratory studies were essentially unchanged, except for the glucose tolerance test which yielded a 2-hr blood glucose value of 144 mg%. The electrocardiogram was normal, as was the double Master's stress test.

On August 7, 1967, the patient underwent coronary arteriography. For this the percutaneous transfemoral artery technique was used with the Ducor catheter and 60% methylglucamine diatrizoate (Renografin) as the contrast medium. Following the second injection of contrast medium...
into the left coronary artery, the patient suddenly experienced substernal chest pain associated with ST-T wave changes on the electrocardiogram. Fluoroscopy revealed a linear stain in the left main coronary artery, which cleared in 3 minutes (figs. 2 and 3). Hypotension and associated multifocal premature ventricular contractions, ventricular tachycardia, and ultimately ventricular fibrillation developed in rapid sequence. Normal sinus rhythm was finally maintained after the third successful attempt at defibrillation combined with intravenous use of lidocaine (Xylocaine). The patient remained stable thereafter without further evidence of arrhythmia and the electrocardiographic injury pattern cleared without evolving into an infarction pattern. Twenty-four hours later the electrocardiogram resembled the tracing of the day prior.

Figure 4
Electrocardiograms in case 2: January 11, 1968, prior to coronary arteriography, January 12, 1968, following coronary arteriography, showing the pattern of acute lateral-wall infarction.
to catheterization. No areas of obstruction were present in either coronary artery. Recovery was complete, and the patient was discharged with a diagnosis of probable pericarditis.

Case 2

B.H., a 52-year-old white woman, was hospitalized November 1, 1967, for abdominal hysterectomy because of postmenopausal vaginal bleeding. A routine preoperative electrocardiogram showed nonspecific flattening of the T waves. Another electrocardiogram was performed in the fasting state on the following day. This electrocardiogram showed diffuse and symmetrically inverted T-wave changes, suggestive of acute subendocardial infarction. Absolutely no history of chest pain or any symptoms could be elicited from the patient during the preceding 24 to 48 hours. The history was unremarkable, except for a family history of maternal diabetes mellitus. Physical examination was normal. A diagnosis of silent subendocardial myocardial infarction was made, and the patient was treated with anticoagulants and rest in bed. She was discharged from the hospital 4 weeks later. In that period she had remained totally asymptomatic.

On January 11, 1968, she was readmitted to the hospital for coronary arteriography. Physical examination remained normal. The results of tests for the fasting and the 2-hr postprandial blood glucose, serum cholesterol, and total serum lipids were all normal. The electrocardiogram showed only borderline T-wave abnormalities (fig. 4), and a graded exercise stress test was negative. Chest roentgenograms were normal.

On January 12, 1968, the patient underwent selective coronary arteriography, utilizing the percutaneous transfemoral artery technique with the Ducor catheters. The right coronary artery was studied by cinefluorography and rapid direct radiography without incident, and appeared normal. The left coronary artery was easily cannulated and 5 cc of 60% methylglucamine diatrizoate (Renografin) was injected by hand without event. The left anterior descending artery in the left anterior oblique position appeared narrowed, slightly irregular, with increased tortuosity and rigidity of the distal third of the vessel. Following a second and similar injection, the patient suddenly complained of severe substernal chest pain, nausea, and diaphoresis. The electrocardiogram showed progressive S-T segment depression. Fluoroscopy showed a stain in the area of the bifurcation of the left main coronary artery which cleared within 5 minutes (figs. 5 and 6). In spite of clearing of the contrast medium, the patient’s status rapidly and progressively deteriorated. Premature ventricular contractions and paroxysms of ventricular tachycardia ensued. The arrhythmias responded to intravenous injection of lidocaine. Hypotension responded to norepinephrine. Morphine sulfate and oxygen were administered for relief of pain, and dyspnea. The next 48 hours were characterized by ventricular arrhythmias, ventricular gallop rhythm, hypotension, and oliguria. The electrocardiogram showed an acute lateral wall infarction pattern (fig. 4). The concentration of serum glutamic-oxalacetic transaminase rose to 369 units. She was successfully managed with continuous intravenous administration of lidocaine, digitalis, metaraminol, and isoproterenol. After 96 hours, the patient’s condition stabilized, and

Figure 5

Case 2. Left coronary artery in the left anterior oblique position showing irregularity, diffuse narrowing, and increased tortuosity of the left anterior descending artery.

Figure 6

Case 2. Subintimal dissection with stain at the bifurcation of the main coronary artery demonstrating the depth to which the vessel can be penetrated by the catheter.
management thereafter was that usually employed in the treatment of myocardial infarction. She was ambulatory and asymptomatic 1 month later.

Discussion

Initially, we used the technique as described by Sones and Shirey for selective coronary arteriography, combining cinefluorography and direct serial radiography. Because of occasional difficulty in manipulation of the catheter through tortuous subclavian-innominate arteries, and frequent difficulty in obtaining satisfactory opacification and delineation of detail of the left coronary artery, particularly in patients with dilated aortic roots and especially in the presence of aortic valvular incompetence, the percutaneous transfemoral artery technique as described by Judkins has been used since June 1967.

With the Sones technique, the reported complications have included infrequent ventricular fibrillation and, more commonly, a 5% incidence of thrombosis of the brachial artery at the arteriotomy site. No evidence of intimal dissection or disruption of an atheromatous plaque with myocardial infarction has occurred in our experience, using the Sones procedure. Only one such instance occurred in Sones' series of 4,200 cases. In Sewell's series, no similar complication was described employing the Sones technique.

In 1962, the percutaneous transfemoral artery approach to selective coronary arteriography was described by Ricketts and Abrams. Judkins reported his results in 100 cases in which he used this method of selective coronary arteriography. He used individually designed right and left coronary catheters with end-hole tapered tips and posiotrol features, and found a startling ease and consistency of intubation of both coronary vessels and high quality delineation of the coronary arteries. No complications occurred with this procedure. Spellberg and Ungar also recently reported their success with this technique. These authors used right and left tapered-tip coronary catheters fashioned by hand from medical-grade radio-opaque polyethylene tubing, with the additional feature of two lateral side holes, in 167 cases. They commented on the ease of cannulation of both coronary vessels, complete visualization of both vessels in 20 minutes, and the stability of the catheters once placed in the coronary ostia. They described two instances of thrombosis at the site of femoral puncture, both treated successfully, and one additional case in which retrograde dissection developed to the level of the common iliac artery.

Since the percutaneous transfemoral artery approach to selective coronary arteriography has been used, in the 58 cases studied to date, both vessels have been successfully intubated when using this procedure and the Ducor catheter. Cinefluorography and direct serial radiography at 3 frames/sec for 2 sec have consistently been of high quality. Fluoroscopy time has been reduced by 37%, and approximately 50% less contrast medium has been required. We have shared the same experience of Judkins and Spellberg and Ungar in the amazing ease of intubation of both coronary vessels, especially the left, and the stability of the catheters in the coronary ostia when repositioning the patient into right and left oblique positions.

The two cases reported represent the extent of our complications with this procedure, namely, intimal dissection in two cases with clinical and electrocardiographic documentation of myocardial infarction in one case.

Wilson and associates reported two cases of electrocardiographically proven myocardial infarction among 76 cases in which biplane selective coronary arteriography was used via the percutaneous transfemoral artery approach. The exact mechanism was not clear to the authors, and it was speculated that fibrin deposits may have dislodged from the guide wire left in the catheter during coronary catheterization.

In both of our cases, subintimal dissection was documented by fluoroscopy and cinefluorography. There was no clinical evidence to suggest pericarditis or hemopericardium and the possibility of perforation of the left

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coronary artery. The stains of contrast medium cleared in 3 and 5 minutes, and could conceivably have been missed if fluoroscopy had not been performed immediately after the onset of chest pain and institution of treatment, thereby precluding any speculation of fibrin deposits or atheromatous debris embolizing into the coronary vessels and its radicals.

The rarity of this complication with the Sones technique and catheter might tend to imply that this represents an inherent risk of the tapered-tip, Positrol, transfemoral catheters used by different authors, varying basically only in the design of the curvature of the catheter. The startling ease with which the left coronary artery can be cannulated, the depth to which this vessel is penetrated, as shown in case 2, and the angle formed by the position of the tip of the catheter in the lumen and the longitudinal axis of the curvature of the left coronary artery tend to support this hypothesis. In neither case did dampening of the pressure occur to suggest wedging of the catheter.

Early in the use of the transfemoral approach, wedging of the right coronary catheter, and dampening of the pressure curve were noted. From the beginning, therefore, the catheter in the right coronary artery has been regularly withdrawn several millimeters prior to the injection. To date, no complications have occurred.

At present, a similar maneuver is utilized in the approach to the left coronary artery, namely, withdrawal of the catheter several millimeters after the vessel has been intubated. It is hoped by this simple maneuver to avoid further serious complications while continuing to obtain excellent delineation of detail of the coronary vessels via the transfemoral artery approach to selective coronary arteriography.

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