The Percutaneous Femoral Artery Approach to Selective Coronary Arteriography

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SUMMARY
Experience in performing 267 selective coronary arteriograms by both the exposed brachial artery and percutaneous femoral artery techniques has proved the latter to be the technique of choice.

The percutaneous femoral artery approach obviates the need for performing a cutdown over the small caliber brachial artery with the associated difficulties of catheter manipulation from this vessel. We have been able to intubate the left coronary artery with ease in all of 122 patients in whom this approach was attempted. The right coronary has been selectively entered in approximately 90% of these patients. The stability of the position of the catheter in the coronary ostia during manipulation of the patient, coughing, and deep breathing is an outstanding feature of this technique.

Additional Indexing Words:
Seldinger technique Coronary sclerosis Arterial catheterization

Selective coronary arteriography is the method of choice of visualizing the coronary arterial tree in the living human. The Sones technique, performed by approaching the coronary arteries from the exposed right brachial artery, was introduced in 1959. Weidner and associates subsequently described a percutaneous axillary artery approach to the coronaries, which at least obviated the need for performing open arteriotomy but has the disadvantages of difficult catheter manipulation and potential trauma to the brachial plexus. In 1962, Rick-ettes and Abrams reported experience in performing selective coronary studies by means of percutaneous femoral artery punctures in animals and a small number of patients. The purpose of this paper is to relate our experiences with the percutaneous femoral artery approach.

We have performed 267 selective coronary arteriograms in the Cardio-pulmonary Department of St. Mary’s Hospital by means of both the exposed brachial artery and percutaneous femoral artery techniques. During our earlier experiences with the Sones technique, we frequently encountered the following difficulties: (1) inability to advance the catheter beyond the innominate artery, (2) failure to intubate the left coronary artery, particularly in the patient with a dilated aorta, (3) thrombosis or dissection of the brachial artery at the site of the arteriotomy, and (4) painful spasm of the small caliber brachial artery.

On the other hand, we were impressed by the ease with which the left coronary artery could be entered inadvertently or intentionally during retrograde left heart catheterization via the femoral artery. For this reason, we attempted to design catheters which would allow selective intubation of both the left and right coronary arteries from the leg.

Method
Catheters for a “left coronary” and a “right coronary” artery are shown in figures 1 and 2. The catheters are currently made by hand of medical grade radiopaque polyethylene tubing,* with an

* Becton-Dickinson and Co., Rutherford, New Jersey.
inside diameter of 0.054 mm, and an outside diameter of 0.094 mm. The tip is tapered by hand to an internal diameter of 0.035 mm. Total length of the catheter is 100 cm. Two lateral side holes are placed 10 mm proximal to the tip. The distal end of the right coronary catheter is made at right angles to the arm and of variable lengths from 1.5 to 2.5 cm (fig. 2B to C). The arm (fig. 2A to B) is at right angles to the body of the catheter and is made 9 cm long. The internal radius of the hook on the left coronary catheter (fig. 1A to B) is 3 to 6 cm. The gentle curve of the left catheter is begun 3 cm proximal to the tip, and the distal tip is angled inward at 20°.

After the usual sterile precautions, the right or left femoral artery is entered percutaneously by means of the Seldinger technique. Either the right or left coronary artery may be approached first. The left coronary catheter, after traversing the arch of the aorta, tends to fall back toward the orifice of the left coronary artery with the patient in the left anterior oblique position. Using small injections of contrast material, the ostium is easily located and intubated, and cineangiography is performed in the usual way in various projections. We have found two different degrees of left anterior obliquity and at least one view in the right anterior oblique projection necessary for adequate delineation of the left coronary vessel and its branches. This catheter is then removed over a guide wire and replaced with the right coronary catheter. The arm of this catheter tends to make it spring toward the anterior and rightward wall of the aorta, with the patient in the left anterior oblique position. Quite frequently the catheter will fall into the right coronary ostium with no further manipulation. Usually, however, small injections of contrast material will opacify the orifice, and the catheter is lifted or dropped into the orifice with ease.

Results

We have performed 122 selective coronary arteriograms via the percutaneous femoral artery approach since May 26, 1966. We have been unable to intubate the right coronary ostium in 12 patients; in six this occurred within the first 2 months of our experience. Revised and proper design of the tip of the right coronary catheter has allowed it almost always to enter the right coronary artery with ease. Failure to do so indicates unusual origin of the right coronary artery, such as origin from the posterior or even left aortic sinus, as subsequently visualized on aortic

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**Figure 1**
The left coronary artery catheter. See text for description.

**Figure 2**
The right coronary artery catheter. See text for description.
root injection. In one patient with an extremely dilated and tortuous aorta, earlier attempts at coronary arteriography via the Sones technique were unsuccessful for either coronary artery, and both were entered quite easily by means of the percutaneous technique. In six early patients, at a time when we were still using the Sones method, successful catheterization of the left coronary artery could be done only via the leg. The catheter has never failed to enter the left coronary artery from the leg.

Both coronaries can be completely studied in as brief a period of time as 20 minutes. When changes of the right coronary artery catheter are necessary to choose a proper length for the tip, ½ to 1½ hours may be required to complete the study. We have been impressed by the stability of the catheters after they have been placed in the respective coronary ostia while positioning the patient for various projections. The contrary has been our experience with the brachial artery technique. The percutaneous femoral artery technique is extremely expeditious in patients who require left ventricular catheterization for associated lesions, that is, for rheumatic heart disease. Left heart data and coronary arteriography can be obtained in these patients via a single arterial puncture. A few patients whom we have wished to restudy at a later date have consented to have this done, attesting to the ease of this procedure, and offering another advantage over the exposed brachial artery method. Typical coronary arteriograms for both the left and right coronary arteries are shown in figures 3 and 4.

Complications

In two patients thrombi developed at the site of femoral artery puncture; both were removed successfully under local anesthesia. One of these patients, with severe aortic stenosis, had become transiently hypotensive during the course of left ventricular catheterization, which immediately preceded studies of the coronary arteries.

In one additional patient, retrograde dissection developed to the level of the common iliac artery; this was repaired under general anesthesia without subsequent disability. We have had no other complications related to

Figure 3

Selective left coronary artery visualization. (A) In 45° of left anterior oblique projection. The arrows indicate the position of the catheter in the descending aorta and at the orifice of the vessel. Normal study; × 32. (B) In 65° of right anterior obliquity. The arrows indicate the position of the catheter in the descending aorta and at the origin of the vessel. Normal study after nitroglycerin; × 32.

Circulation, Volume XXXVI, November 1967
SELECTIVE CORONARY ARTERIOGRAPHY

Figure 4

Selective right coronary artery visualization. (A) In 45° of left anterior oblique projection. The arrows indicate the position of the catheter. Normal study after nitroglycerin; × 32. (B) In 30° of left anterior oblique projection. There is moderate disease of the middle third of the vessel after nitroglycerin; × 32.

the femoral artery approach. Patients with aorto-iliac prostheses or absence of femoral pulses are not considered for this approach. We have, however, used this technique without incident in some patients with vascular disease of the lower extremity who had reduced, but palpable, femoral arteries. The relative speed of the procedure obviates the need for prolonged catheterization of the femoral artery.

Addendum

Since submission of this manuscript we have performed an additional 45 procedures, and have been unable to enter the right coronary in only one patient. There have been no femoral artery complications. Wilson and associates\(^6\) have also recently reported experience in over 76 patients using the femoral artery approach with a high success and low complication rate. Personal communication from Dr. Judkins of the University of Oregon Medical School has revealed that his group has performed approximately 500 coronary arteriograms using the percutaneous femoral artery approach.

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