

An Essential View in Coronary Arteriography

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SUMMARY A significant stenosis of the left main coronary artery is associated with a significant mortality and is one of the major indications for aortocoronary bypass surgery. The diagnosis of this lesion on clinical grounds is inconsistent and should be established by angiography. All routine projections during coronary arteriography cause foreshortening of the left main coronary artery. Well-collimated anteroposterior and shallow right and left anterior oblique views show the main segment best. These views also show the proximal segments of circumflex and anterior descending branches, and should be routinely used during every coronary arteriogram.

AMIDST THE CONTROVERSIES of indications for aortocoronary bypass surgery, one generally accepted indication is stenosis of the left main coronary artery (LMCA),^{1,2} which can be present in patients with either unstable or stable angina.³ Clinical features such as angina at rest and a strongly positive exercise treadmill test are not invariably present. Hence, the diagnosis of LMCA stenosis is the angiographer's responsibility. In this paper, we emphasize the importance of coned-down views in the anteroposterior (AP) projection in demonstrating LMCA disease during coronary arteriography.

Method and Results

The catheter was introduced a short distance into the left coronary artery to obtain an angiogram in the AP projection. Magnification is essential and sharp collimation is necessary because of the overlying vertebral density. In addition, very shallow right anterior oblique (RAO) and left anterior oblique (LAO) projections are made. A forceful injection of a small amount of contrast material (3–5 ml) results in reflux of contrast medium into the aortic sinus. This view may be supplemented with angled projections if a C-arm or U-arm is available.

One hundred twenty coronary arteriograms have been performed since we started using the AP view routinely. Significant stenosis of LMCA was present in eight patients. In five of these, LMCA stenosis was recognizable only in the AP projection (figs. 1–4). The AP view also showed stenoses in the proximal circumflex and anterior descending branches to better advantage. Significant stenoses of the proximal circumflex and anterior descending arteries were shown in one patient each. These stenoses were demonstrable only in AP views (figs. 5–8). The coronary artery stenoses in the above patients were not detectable,

even in retrospect, in any other view, including the angled projections.

Discussion

LMCA stenosis reportedly occurs in 8% of all patients with stable angina and 11.5% of patients with unstable angina.³ Several investigators consider this lesion an absolute indication for surgery^{2,4,5} and an important cause of sudden death in patients with ischemic heart disease.⁶ The clinical diagnosis of LMCA stenosis is inconsistent, and the incidence of complications during coronary arteriography is significantly greater in patients with this lesion.⁷ Therefore, the coronary arteriographer should look for LMCA stenosis early in the examination and be able to document its presence or absence in every patient.

The length of the LMCA may vary. After arising from the left coronary cusp, the LMCA runs more or less parallel to the table top and downward before dividing into its two major branches. McAlpine has shown that the direction of the left main branch varies from -30° to $+35^{\circ}$ in the horizontal plane.⁸ In oblique projections the main coronary artery is always foreshortened and even a severe stenosis can be missed. Techniques of selective left coronary artery catheterization that require the catheter to be looped in the coronary cusp (Sones and Amplatz) may obscure the proximal main coronary artery in oblique projections. In most patients, a straight AP view will display the entire length of the main coronary artery without significant foreshortening. Very shallow oblique views can also be important. In the LAO projection a portion of the main branch may overlie the spine, and in the RAO view it may be slightly foreshortened. However, there is no constancy in the course of the LMCA, and AP and shallow RAO and LAO views should be obtained in each patient (fig. 9). Sharp collimation and forceful injection are necessary to avoid underexposure and to cause reflux of contrast material into the aortic sinus.

Additionally, these views provide a better visualization of stenoses in the proximal circumflex and anterior descending arteries at their origin. Since the anterior descending branch runs anteriorly in the interventricular groove, superimposition by diagonal and obtuse muscular branches is avoided in the AP

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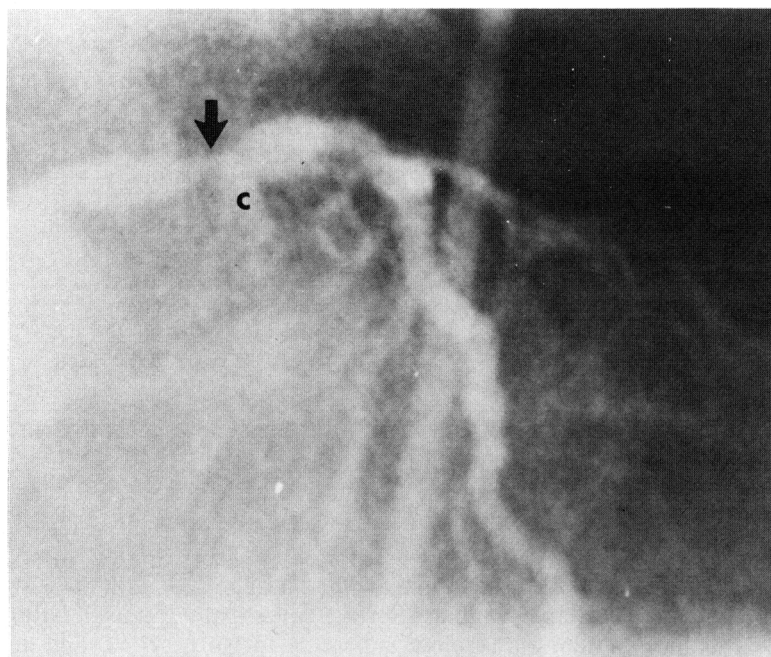


FIGURE 1. Anteroposterior view of left coronary angiogram. There is severe narrowing of the main coronary artery (arrow), and the circumflex branch (C) is occluded.

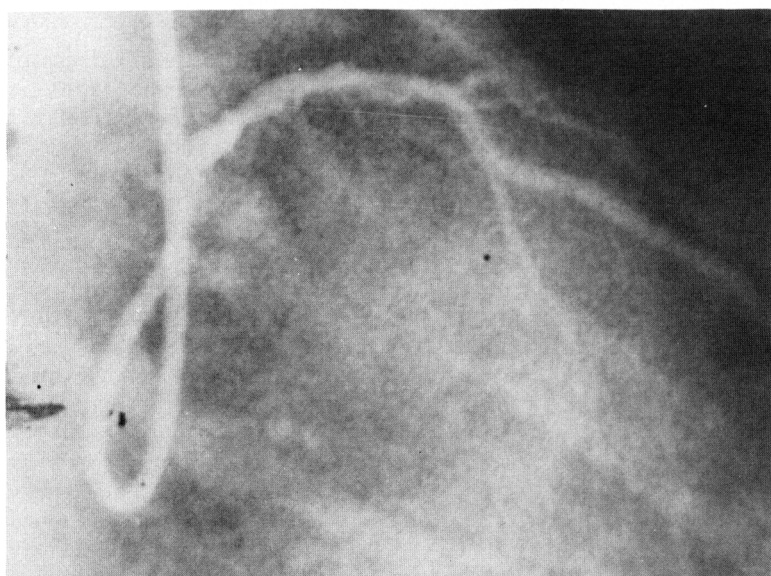


FIGURE 2. Right anterior oblique view of left coronary angiogram in figure 1. Stenosis of the main coronary artery is not recognizable.

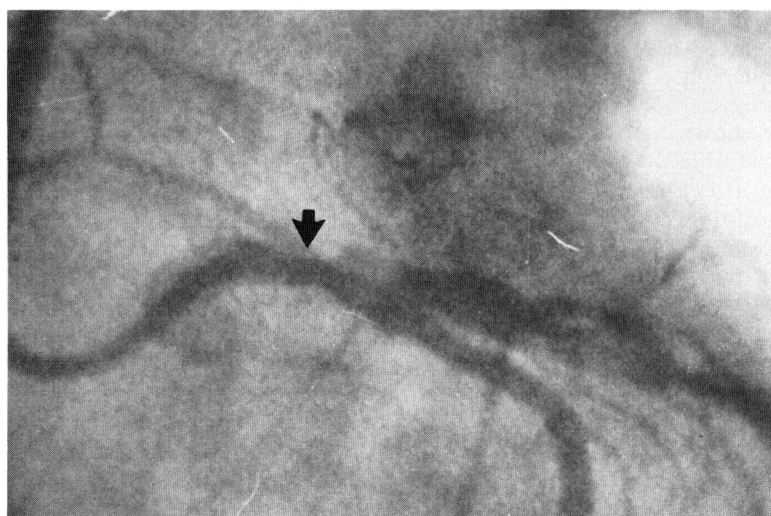


FIGURE 3. Shallow right anterior oblique view of left coronary angiogram. A long segment stenosis of the main coronary artery is seen (arrow).

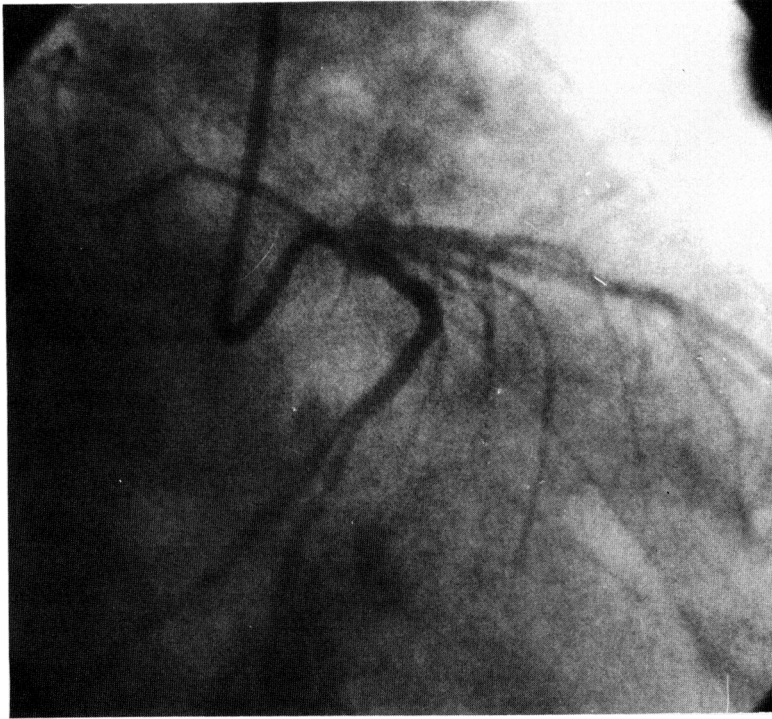


FIGURE 4. Routine right anterior oblique view of the angiogram in figure 3. Stenosis of the main segment can be easily missed.

view. The proximal segments of both arteries are better visualized in this view than in routine oblique projections. A shallow LAO view is particularly useful in displaying the origin of anterior descending branch (figs. 7 and 8). The frontal projection also gives an additional and different view of the circumflex artery that has proven useful in our patients (figs. 5 and 6).

With the exception of an article by Lipton et al.,⁹ the value of these special views of the left coronary artery is not stressed in the literature on techniques of coronary arteriography. AP and shallow LAO and RAO views are very important and should be performed routinely in addition to oblique, lateral, and angled projections.

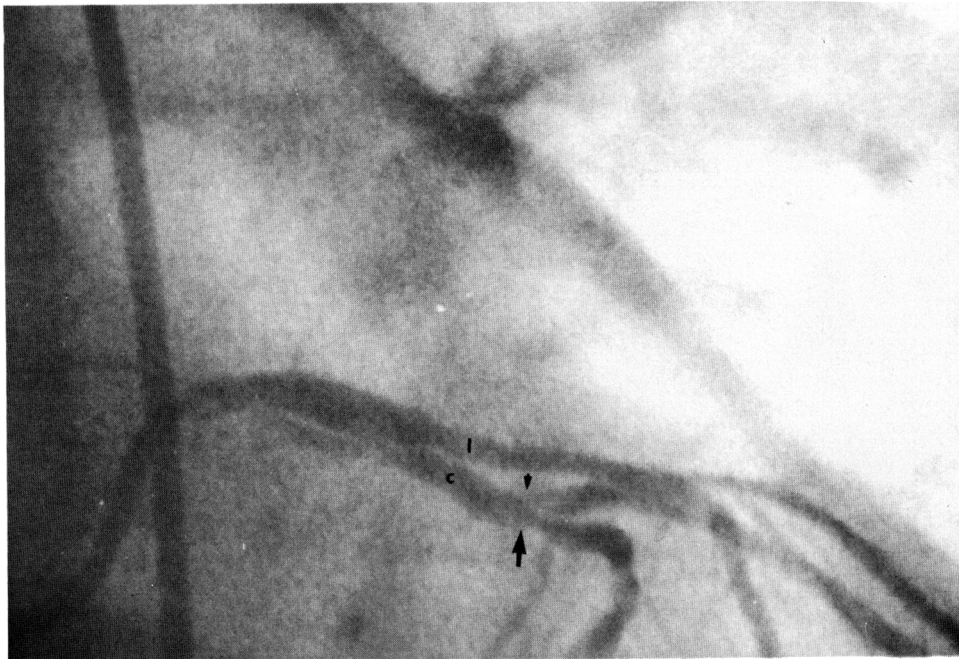


FIGURE 5. Anteroposterior view of left coronary angiogram. There are two stenoses: in the muscular branch (arrowhead) and circumflex artery (C) (arrow). l = anterior descending artery.

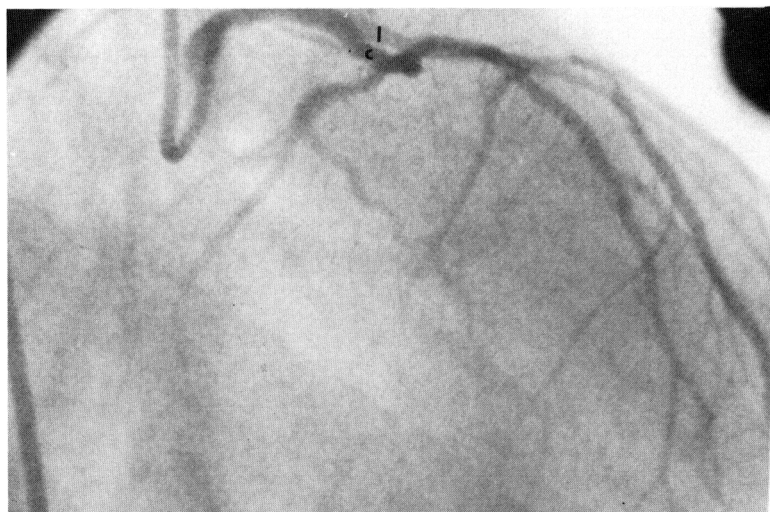


FIGURE 6. *Right anterior oblique view of the angiogram in figure 5. Stenoses in the circumflex artery (C) cannot be detected. Those were the only lesions in this patient and were not recognizable in any other view. I = anterior descending artery.*

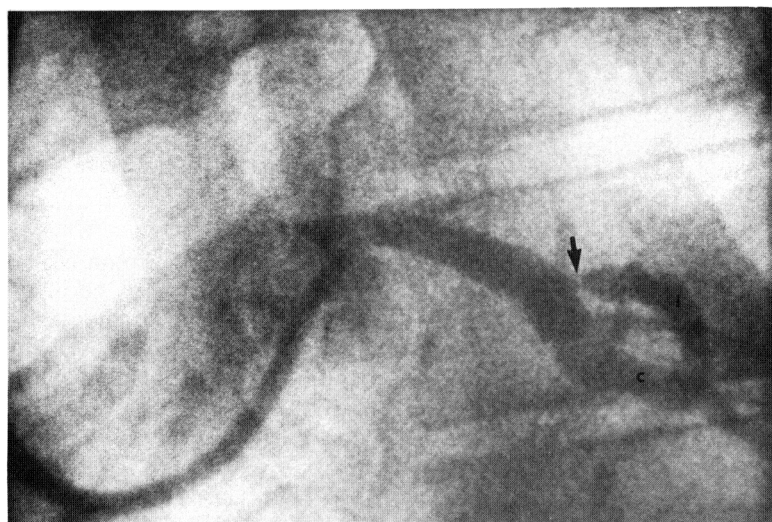


FIGURE 7. *Shallow left anterior oblique view of left coronary artery. High-grade narrowing of the origin of anterior descending artery (I) (arrow). C = circumflex.*

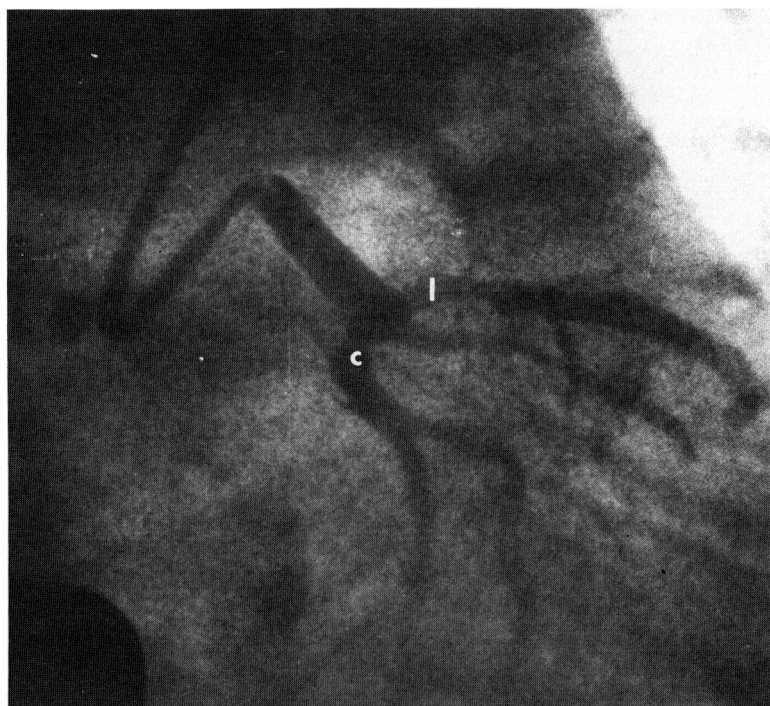


FIGURE 8. *Right anterior oblique view of angiogram in figure 7. Narrowing of the anterior descending artery (I) cannot be seen, nor was it detectable in any other view. C = circumflex branch.*

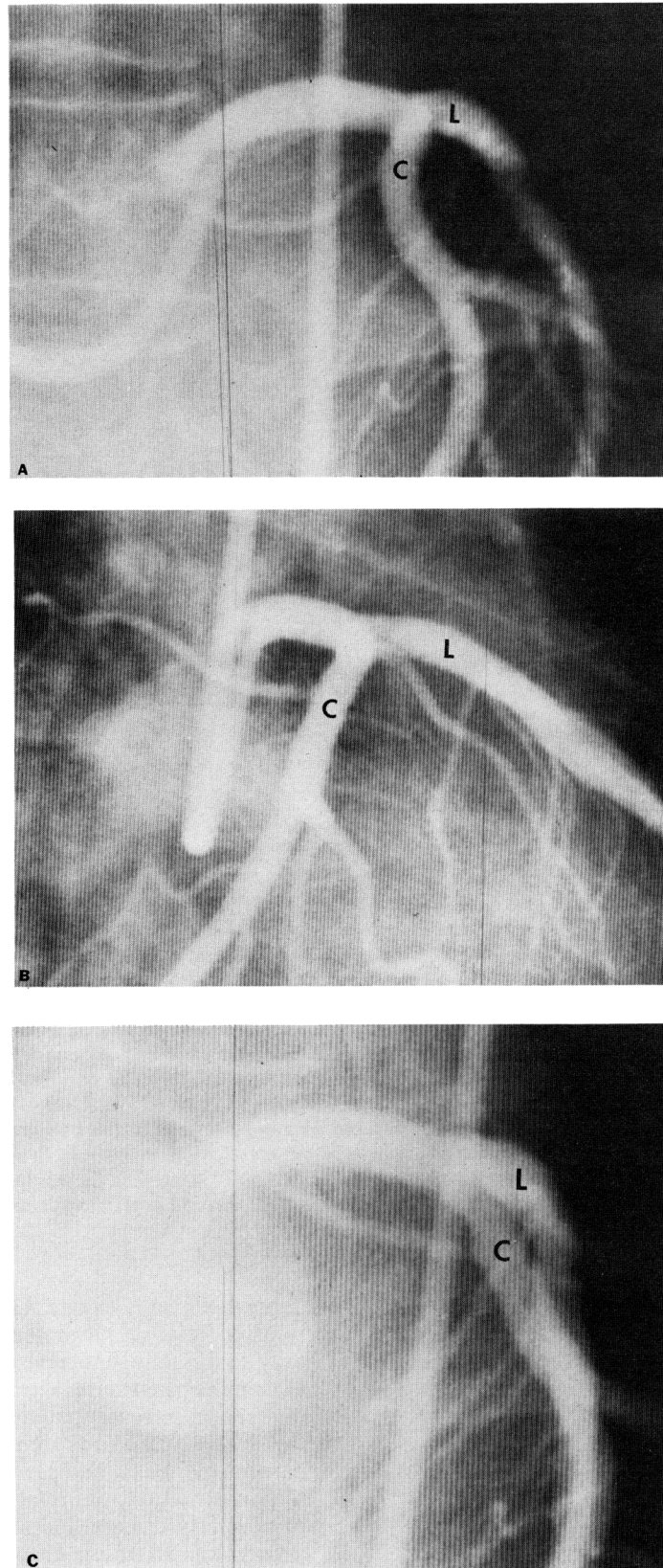


FIGURE 9. A) Anteroposterior view of left coronary artery. Notice that the origin of the anterior descending branch (L) is obscured by the circumflex artery (C). B) Shallow right anterior oblique view of the same angiogram. In this patient the main coronary artery is significantly foreshortened. C) Shallow left anterior oblique view from the same study. The main coronary artery is displayed in its entire length. Origin of anterior descending branch is clearly shown.

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Quantitative Coronary Angiography: Measurement of the "Critical" Stenosis in Patients with Unstable Angina and Single-Vessel Disease Without Collaterals

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SUMMARY Quantitative angiographic assessment of proximal coronary artery stenosis was performed in 15 patients with consecutive presentations in two categories defined by clinical and angiographic criteria. Group 1 consisted of 10 patients who had new onset of refractory rest angina and ischemic ST-T changes, but no infarction, single-vessel coronary disease without collateralization, and normal left ventricular (LV) angiograms. Group 2 consisted of five patients who were similar to patients in group 1, but had subendocardial infarction (SEI). Quantitative coronary arteriography, using paired perpendicular angiographic views and digital computation, yielded statistically different lesion dimensions and hemodynamic predictions for the two groups. Minimum stenosis diameters were 0.88 ± 0.14 (SD) and 0.64 ± 0.08 mm, respectively, for groups 1 and 2. This corresponded to 72% and 78% diameter reduction and 92% and 95% cross-sectional area reduction for the two groups. These small dimensional differences among lesions in the two groups resulted in large differences in their hemodynamic impact as predicted from classic fluid mechanics theory. We conclude that there are characteristic lesion dimensions for the isolated "critical" stenosis in these selected patients with rest angina. Further small increases in lesion severity result in SEI. Certain practical applications and limitations of these observations are discussed.

THE TERM "CRITICAL LESION" is commonly used but poorly defined in human disease. Are there, in fact, identifiable characteristics of the "critical" human coronary stenosis? A critical lesion may be

defined clinically as one that results in ischemic symptoms at rest, or physiologically as one that permits only marginally sufficient levels of myocardial perfusion in the basal state. Various clinical and experimental reports have contributed to our understanding of the degree of coronary constriction necessary to impair normal basal myocardial perfusion.¹⁻¹⁸ In spite of this information, the relationship between symptoms of coronary disease and the magnitude of stenosis is widely known to be inconsistent.¹⁹⁻²¹ For example, patients with total obstruction of a large coronary branch sometimes have enough collateral development to preserve both ventricular function and the asymptomatic state. Conversely, patients with variant angina²² may have only minimal atherosclerosis.²³ Thus, one might anticipate similar inconsistencies in

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