The Continuing Value of Invasive Coronary Angiography

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In 1975, Gofredo Gensini stated, “The primary goal of coronary arteriography is the identification, localization, and assessment of obstructive lesions present within the arteries of the heart.” The operative word here is assessment. I interpret assessment to mean determining the pathophysiologic significance (ischemia versus no ischemia) of the coronary stenosis in question.

Key words: invasive coronary angiography

Introduction

In my view, coronary angiography is going to be with us for a long time. I suggest that we get as much information as possible from this diagnostic technique.

I guess I'm getting somewhat tired and perhaps a little bored listening to presentations and reading papers about multislice computed tomographic coronary angiography. Not much has been said in recent years about the value of catheter-based x-ray coronary angiography. As one reads the literature on this subject, it is obvious that cardiac catheterization and angiography, as well as other imaging techniques performed during cardiac catheterization, remain the standard of reference for coronary, noninvasive imaging techniques.

Diagnostic Cardiac Catheterization with Contrast Angiography

A proper cardiac catheterization and angiography can yield a great deal of information that is important for the management of the individual patient. What follows is a long list of that information:

1. Stenosis percent narrowing, location, morphology, and condition of the distal vessel.
2. Stenosis number in the same vessel.
3. Number of vessels containing stenoses.
4. Thrombolysis in myocardial infarction (TIMI) flow to assess epicardial blood flow.
5. Provide access for other studies, for example, intra-coronary ultrasound, ocular coherence tomography (OCT), coronary flow reserve (CFR), and fractionated flow reserve (FFR).
6. Identify minimal irregularities (possible plaques prone to rupture) sometimes associated with coronary artery spasm.
7. Identify myocardial bridges.
8. Identify collateral blood flow.

9. Identify ectopic coronary arteries.
10. Assess the microcirculation by blush of contrast (TIMI myocardial perfusion grade) and assessment of CFR.
11. Assessment of regional myocardial viability by assessing collateral blood flow, microcirculation and TIMI flow, and improved contraction after nitrate or dopamine infusion and post extra-systolic potentiation (PESP).
12. Visualize the coronary venous circulation, which may be important to define the anatomy for potential biventricular pacing.
13. At the time of cardiac catheterization, fluoroscopy can be done to assess the presence or absence of calcium in the coronary circulation.
14. Precise measurements of systolic and diastolic pressure on the left side of the heart.
15. The physiologic significance of coronary stenoses can be determined by evaluating coronary FFR.
16. Regional and global ventricular function, particularly if right anterior oblique (RAO) and left anterior oblique (LAO) ventriculography is performed (wall motion can be correlated with proximal coronary stenoses and distal target vessels, microcirculation, collateral, and antegrade TIMI flow at baseline and after nitrate infusion).

No other noninvasive studies that I know of can accomplish all of what I have just outlined.

Noninvasive Assessment of the Coronary Arteries by Computed Tomographic Angiography and Invasive Angiography

I share the enthusiasm that many have expressed about the use of computed tomographic coronary angiography.¹ There is no doubt in my mind that whatever we have now

will be better in the next 5–10 y, and what we have now is quite good.²

What follows is a comparison of catheter-based x-ray contrast coronary angiography and multislice computed tomographic content angiography related to important information necessary for clinical decision-making:

1. Left ventricular (LV) function: there is no question that cardiac catheterization and angiography can provide important information about ejection fraction and regional wall motion. Multislice computed tomography (MSCT) with contrast is also beginning to provide this information, but I don't believe it's quite as good.
2. Myocardial perfusion: very little is being done to assess myocardial perfusion with MSCT, but this is easily accomplished with coronary angiography assessing TIMI flow and TIMI blush scores.
3. Coronary pathology: both techniques can estimate coronary pathology even if the stenoses are not flow limiting, although MSCT is not quite as good in distal circulation.
4. Myocardial viability is easily assessed with cardiac catheterization and contrast angiography by assessing TIMI blush, collaterals, improved ventricular contraction after nitrates, postextrasystolic potentiation (PESP), or dobutamine.
5. Valve function is still best assessed with cardiac catheterization, and of course, cardiac and vascular pressures can only be measured at the time of cardiac catheterization.
6. Peripheral artery disease: both techniques can assess peripheral arterial disease.
7. Coronary arterial wall: although MSCT can give some estimate of the coronary arterial wall non-invasively, techniques done at the time of cardiac catheterization including intravascular ultrasound, ocular coherence tomography, and perhaps many others can do a much better job of assessing the vascular wall.
8. I have not seen any data with MSCT assessing the microcirculation and, of course, at the time of cardiac catheterization one can assess CFR, TIMI blush, presence or absence of collaterals, and FFR.
9. Multislice computed tomography does not provide any way to perform therapeutic procedures, whereas cardiac catheterization allows the performance of percutaneous coronary intervention (PCI)/stent and diagnostic intravascular studies.
10. Calcium in the coronaries: calcium can be easily detected by MSCT, but it can also be detected at the time of cardiac catheterization using fluoroscopy, and, in addition, one can assess the degree of stenosis at the site of the coronary calcium. At the moment, this is not being done with MSCT.
11. Radiation dose: the average radiation dose for a diagnostic study using MSCT, depending on the source, is in the neighborhood of 10 to 15 millisieverts, whereas diagnostic cardiac catheterization is much lower, perhaps 2 to 5 millisieverts. I have no doubt that both techniques will improve and decrease the radiation dose in the future, but the future is not now.
12. Contrast nephropathy: both techniques put the patient at risk for contrast induced nephropathy.

Summary

In summary, properly done diagnostic cardiac catheterization with contrast angiography can really be a one-stop shop for diagnostic imaging of the cardiovascular system, and the radiation dose is acceptable.³ Of course, percutaneous treatment of coronary artery disease can only be done during cardiac catheterization.

References

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