The Catheter and the CT Scanner

Invasive vs. Non-invasive Angiography

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In the past few years, catheter-based angiography has largely been displaced by CT angiography (CTA) and MR angiography (MRA) for diagnostic purposes, at least outside the coronary arteries. For those of us trained in earlier times, the conventional angiogram is still thought of as the "gold standard," with CTA and MRA seen as "angio light," done because they are less invasive rather than because they offer better information. In some cases, this may be true, as every technique has its limitations. CTA often requires substantially more contrast than an equivalent catheter-based study, and in densely calcified vessels, such as in the diabetic patient, CTA can struggle to distinguish opacified lumen from calcified plaque. MRA has neither of those problems, but is prone to exaggerate narrowings, and is thus less accurate in quantifying the degree of stenosis.

In certain situations, however, these noninvasive techniques offer advantages in the type and quality of information they can provide. A recent case illustrates the true diagnostic capability of CTA, which permits viewing the vessel of interest in any projection. Experienced angiographers know that "one view is no view" since every angiogram is a two-dimensional projection of a three-dimensional structure. Multiple views are therefore routinely obtained. But some views are impossible, such as viewing a renal artery in the head-to toe projection (craniocuadal) or end-on. The X-ray device simply can't be positioned around the patient to look in those views.

Fig 1. Standard antero-posterior view of the renal arteries on CTA, mimicking the view on a conventional angiogram. No stenosis can be seen.

The illustrative patient was a 42 year old female with accelerated hypertension, poorly controlled on multiple medications. A CTA was ordered to exclude renal artery stenosis as a cause of the hypertension. The conventional antero-posterior view (Fig. 1), which mimics the angiographic image, is entirely unremarkable. However, when the CTA data were manipulated by a computer to straighten the artery and view it from multiple projections (called curved-planar reformatting) (Fig.2), the stenosis caused by a soft plaque on the back wall of the artery (arrow) became apparent. The data could be further manipulated to view the vessel on end (Fig. 3 a&b) and accurately quantitate the degree of stenosis, either by the reduction in diameter or in luminal area, which is a more accurate reflection of the true degree of stenosis.

Fig. 2. A head-to-toe view of the renal arteries showing a posterior plaque in the proximal left renal artery (arrow).

Almost all recommendations in the literature about treatment for arterial stenoses have been based on the percent reduction in diameter, even though we

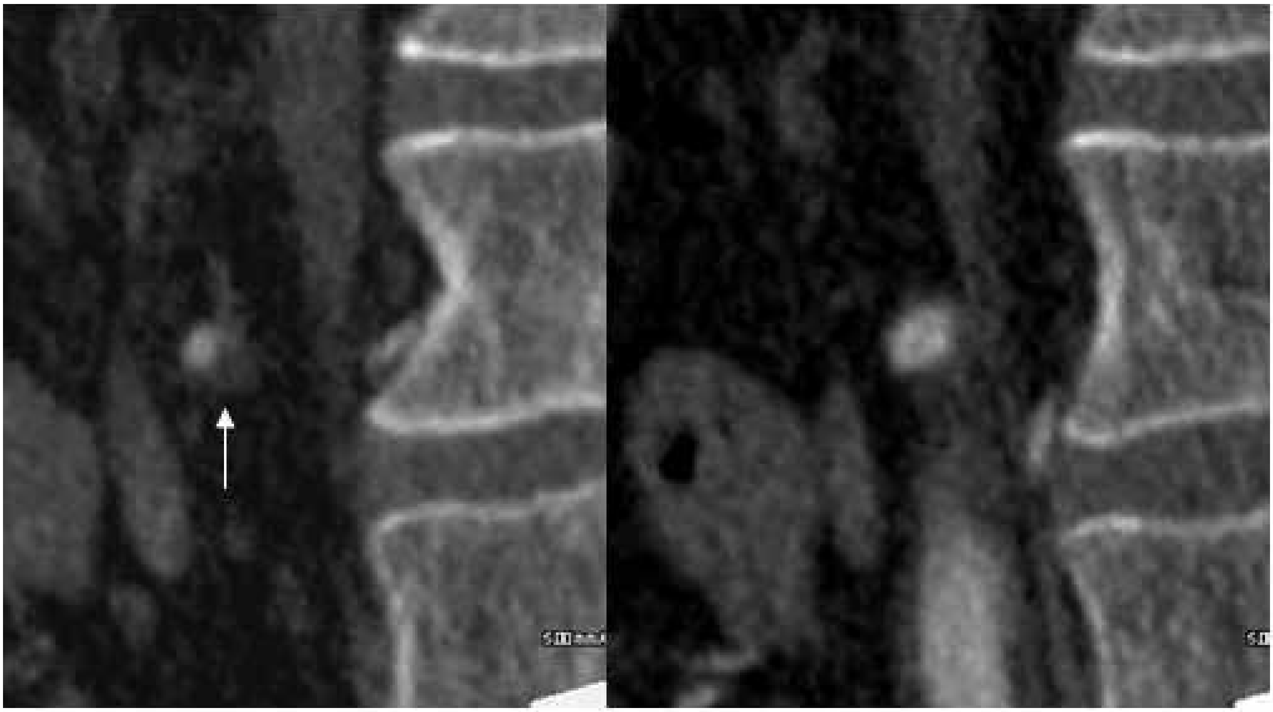

Fig. 3. The left image shows the minimum lumen of the left renal artery seen end-on, with the plaque and vessel wall seen faintly (arrow). The image on the right is one centimeter proximal to the first image, showing the normal lumen of the left renal artery.

know that physiologically it is the reduction in cross-sectional area that determines flow, and therefore ischemia. Unfortunately, reduction in diameter was all we could determine with a conventional angiogram. (Intravascular ultrasound can provide similar information, but is invasive and expensive.) Now we have a relatively non-invasive tool which provides the ability to get information about cross-sectional area, even in many small vessels such as the coronary arteries.

In the patient described, a diagnosis of significant stenosis was made and treatment with angioplasty or stenting is planned with the expectation of significant improvement in hypertension.

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