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Questions in Cardiovascular CT

How much calcium is too much calcium for coronary computerized tomographic angiography?

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Abstract. The coronary artery calcium (CAC) score above which it is recommended that coronary computerized tomographic angiography (CTA) not be performed has been steadily increasing. Currently, calcium scores > 1000 are thought to prohibit CTA accurate interpretation. However, a reasoned approach suggests that there is no absolute upper limit that applies to all patients and imaging centers. To anticipate the problems posed by calcium, a CAC scan must be obtained before CTA. Understanding the clinical goals of the CTA and the source and recognition of CAC-based imaging artifacts can enable accurate clinical CTA examinations even in the setting of high calcium scores.

Introduction

The coronary artery calcium (CAC) score above which it is recommended that coronary computerized tomographic angiography (CTA) not be performed has been steadily increasing. Currently, calcium scores > 1000 are thought to prohibit CTA accurate interpretation. However, a reasoned approach suggests that there is no absolute upper limit that applies to all patients and imaging centers.

To anticipate the problems posed by calcium, a CAC scan must be obtained before CTA. Most centers perform CAC scanning before CTA; many do so only on request. Although routine CAC scanning is advisable, for centers in which is not the clinical routine, heavy calcification will be apparent on the scout chest scan performed before contrast injection and should alert personnel to the potential problem.

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General considerations

CTA objectives

There are 2 broad goals of CTA. The first goal is detection of obstructive disease. The quantitative approach to stenosis measurement depends on the ability to clearly separate contrast from calcified plaque, whether lesion severity is determined from qualitatively "eyeballing," or a quantitative measurement, or from cross-sectional analysis and derivation of minimum luminal area. However, it is critical to realize that a clinically effective CTA scan result does not require the ability to accurately analyze every millimeter of the vessel. Rather, the crucial issue is to arrive at the appropriate clinical recommendation. Consequently, if in most cases there is readily detectible significant obstructive disease secondary to evaluable, less-calcified plaque, the inability to evaluate heavily calcified areas is rendered irrelevant. For example, in Figure 1, an 88-year-old man with a CAC score of 4253 underwent CTA. There was clearly significant left main and right coronary stenosis secondary to almost entirely noncalcified plaque, in addition to a significant left anterior descending stenosis resulting from mixed plaque. The presence of adjacent densely calcified non-evaluable areas did not interfere with arriving at the correct diagnosis.

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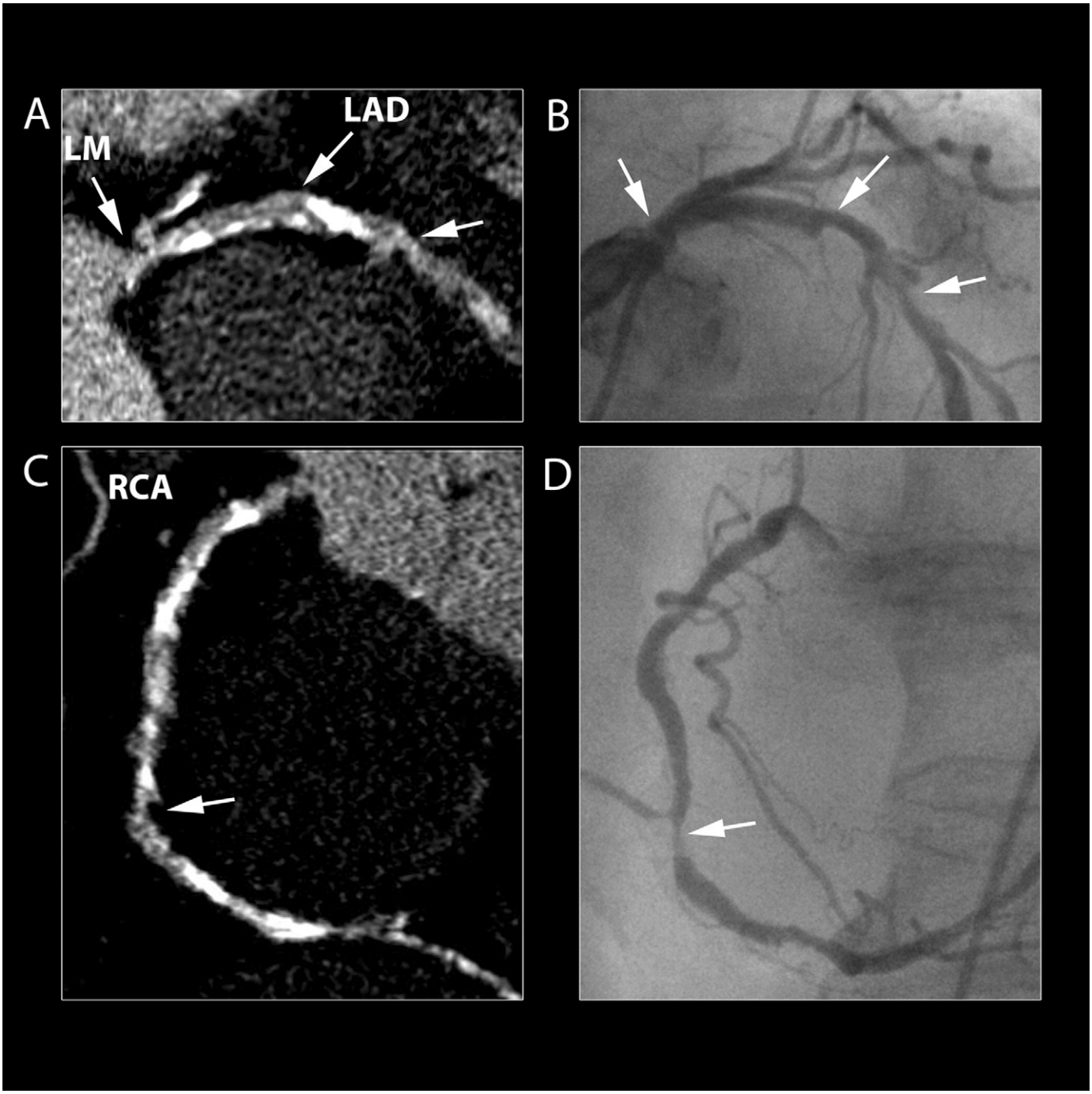

Figure 1 An 88-year-old man presented with chest pain. The CAC score was 4253 with extensive calcified plaque in all vessels. CTA showed readily apparent, significant left main (LM) (**A**) and right coronary artery (RCA) (**C**) stenoses associated with almost exclusively noncalcified plaque, as well as significant left anterior descending (LAD) coronary artery lesions secondary to mixed calcified and noncalcified plaque. The findings were confirmed by invasive angiography (**B** and **D**).

In addition, data suggest that the more severe stenoses are associated with less-calcified plaques, minimizing the importance of the densely calcified areas.[1] The increased positive remodeling associated with extensively calcified plaque preserves the lumen, despite the large plaque burden. Nonetheless, there will be cases with extensive calcified plaque that will prevent evaluation of those sites, without clear obstructive disease elsewhere. In these situations, it is appropriate to state in the report that "There is extensive calcified plaque at which location significant stenosis cannot be excluded".

The second goal is assessment of plaque burden. Characterization and quantitation of both noncalcified and calcified plaque offers a more complete assessment of risk than does the calcified component alone. In general, the degree of vulnerability is thought to be directly related to the noncalcified component. A quantitative assessment of calcified plaque and a semiquantitative evaluation of noncalcified plaque enable stratification of the extent of atherosclerosis, which in some centers is considered of equal or greater importance than evaluation of obstructive dis-