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EDITORIAL COMMENT

The role of coronary CT angiography (CTA) for patients presenting with acute chest pain. Defining problem-specific, evidence-based indications of a novel imaging modality

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Abstract In the current issue, Stillman et al. (Int J Cardiovasc Imaging, 2007) discuss the role of coronary CTA in patients presenting with acute chest pain. The authors conclude, that CTA will provide novel information on the presence and significance of CAD in patients presenting with acute chest pain. Based on the lack of evidence-based data, specific recommendations for its appropriate use are incomplete. Most experts agree, that there is the need for large clinical trials to determine the accuracy and precision of MDCT for triage of patients with acute chest pain.

Keywords Coronary CTA · MDCT · Acute chest pain · ACS

Consensus guidelines describing the diagnostic approach to common clinical scenarios are based on published, evidence-based data reflecting extensive experience in different practice settings across continents. Such guidelines have been developed by major professional organizations for example for cardiac stress-testing, nuclear medicine, echocardiography, and coronary angiography. It is far more difficult to describe such standards for novel, emerging diagnostic modalities, for which clinical data is incomplete. Coronary CT angiography (CTA) is an example of a novel modality for which the excitement among both physicians and patients exceeds published data evaluating its benefit [1]. Providing guidance for these novel modalities is perhaps more important than for established methods in order to avoid inappropriate indications.

In this issue of the journal Stillman et al, representing an expert panel from the North American Society of Cardiovascular Imaging (NASCI) and European Society of Radiology (ESR), report guidelines for the use of multi-detector computed tomography (MDCT) in the work-up of patients with acute chest pain [2]. The authors conclude that CT has an established role in these patients, with standardized indications for the diagnosis of pulmonary embolism (PE) and acute aortic syndromes. If there is sufficient suspicion for one of these conditions after history, physical examination, and initial electrocardiographic and biochemical work-up, a targeted CT exam is recommended. In contrast, if a coronary etiology of chest pain is suspected the potential incremental value of dedicated CTA examinations remains unclear. The authors recommend further scientific evaluation in clinical studies.

The paper is an important contribution to the current debate about the appropriate use of CTA, in particular because of its approach to describe the potential and limitations of integrating CTA into

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standard diagnostic algorithms for patients with acute chest pain.

A practical concern is the necessary infrastructure required to integrate CTA into clinical routine. In many emergency departments, there is extensive experience with the performance, post-processing, and interpretation of PE and aortic CT examinations, available 24 h and 7 days a week. In contrast, the expertise for coronary CT acquisition and interpretation is more limited. Imaging for acute aortic syndromes and PE can be performed with most available scanner generations. In contrast, coronary imaging requires ECG-gated acquisition preferable with 64-slice scanners and expected rapid turnover of scanner generations with improving spatial and temporal resolution [3–5]. In addition, coronary imaging requires 3-D reconstruction on advanced, dedicated workstation with dedicated software. The introduction of CTA into routine clinical pathways would therefore require significant changes in the infrastructure.

It is also important to consider details of the protocols used for CTA in the patient with acute chest pain. One approach is the addition of a dedicated, separate CTA protocol to existing protocols for PE and acute aortic syndrome. These dedicated protocols provide the highest diagnostic accuracy. However, for practical purposes, these examinations are mutually exclusive, because each protocol requires the administration of contrast material. Therefore, these protocols support a clinical-driven diagnostic approach, where imaging is use to confirm or exclude a single, specific diagnosis. An alternative approach would be the use of a combined protocol (''triple rule-out'') with features allowing diagnostic evaluation of coronary disease, PE, and acute aortic syndromes in one study. However, these combined, examinations compromise the diagnostic value of each component to some extent and support an unfocused imaging-driven diagnostic approach. The information may frequently be clinically redundant, because situations in which an experienced physician if faced with clinical uncertainty of all three diagnostic considerations are likely few.

A critical aspect are the potential diagnostic criteria of a ''positive'' and ''negative'' CTA results and their clinical significance. In general, CTA can show absence of disease (no atherosclerotic plaque and no luminal stenosis), evidence of non-obstructive disease (calcified or non-calcified plaque in the vessel wall with estimated <50% stenosis), and suspected obstructive disease (>50% luminal stenosis). If CTA would be used to decide about early discharge (without awaiting serial negative enzyme results) the only potential CT criteria could be the absence of any disease. Recent epidemiologic studies in patient with stable coronary symptoms found absence of disease in about 1/3 of with suspected CAD [6]. However, the prevalence in patients presenting with acute chest pain is unknown and, as described by Stillman et al. it is unclear if CTA would provide incremental prognostic information over CT calcium scoring in these patients. Most importantly, there is almost complete lack of clinical prognostic data. While the absence of any disease may be associated with low risk of future events [7], the clinical significance of non-obstructive disease with calcified or non-calcified plaque of the vessel wall in the acute setting is unclear. It is likely that some unstable lesions present with such <50% stenosis (e.g. waxing and waning thrombus on a moderate lesions, ACS with reperfusion).

Current guidelines recommend the use of CTA to identify or exclude hemodynamically significant luminal stenosis after an ACS was ruled out by serial enzymes. Significant stenosis is typically defined as 50% luminal stenosis [8]. However, the assessment of stenosis severity with CT is not very accurate and characterized by a relatively high standard variation. This is related to the lower spatial resolution of CT in comparison to conventional angiography and the fact that vessel wall calcification lead to overestimation of percent stenosis or inability to assess luminal patency at all. In a recently published first CTA multicenter trial 29% of segment were non-evaluable by CT [9]. After censoring these non-evaluable segments as positive in a patient-based analysis, the sensitivity for detecting patients with at least 1 positive segment was 94%, and the negative predictive value 98%. However, specificity and positive predictive value were only 51% and 28%, respectively. These results were obtained with 16-detector scanners and would be expected to be better with 64-slice technology. However, these multi-center data, rather than results from selected, clinically stable patients in specialized, highly-experienced single centers, likely better reflect what could be achieved after widespread application of CTA in patients with chest pain. The relatively

low specificity would likely lead to further testing, including stress testing and cardiac catheterization, in a significant number of patients with hemodynamically insignificant atherosclerotic disease of the vessel wall. There is a need to perform randomized studies of chest pain workup with and without CTA using modern scanners in comparison to standard diagnostic strategies, including stress-testing [10, 11]. This comparison will also need to include a critical assessment of the relatively high radiation dose of CTA, which is higher than that of a coronary angiogram [12–14].

Stillman and colleagues conclude that MDCT will provide novel information on the presence and significance of CAD in patients presenting with acute chest pain. As expected based on the lack of evidence-based data, specific recommendations are incomplete and the guidelines will need to be updated over the next several years. Review of the recently published consensus guidelines of several professional organizations including the ACC and ACR provides similar recommendations for patient with acute chest pain [15]. These guidelines classify CTA as acceptable only in patients with intermediate pretest probability, no ECG changes, and *after* negative *serial* enzymes. In contrast, the use in patients with only initial negative enzymes as well as the value of ''triple rule out'' protocols is described as uncertain.

Most experts agree, that there is the need for large clinical trials to determine the accuracy and precision of MDCT for triage of patients with acute chest pain. Such randomized trials should be performed to evaluate if MDCT improves patient risk stratification, affects patient outcomes, and cost-effectiveness compared with the current standard of care.

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