CASE REPORT

A vulnerable plaque identified on CT coronary angiography: when should we act in stable coronary artery disease?

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SUMMARY

CT coronary angiography (CTCA) is increasingly being used to diagnose coronary artery disease (CAD). Recent technological advancements, including dual energy CT and improved gantry times, have led to the ability to image coronary arteries with excellent spatial resolution at low radiation doses. Atheromatous plaques can be identified using CTCA and assessed to establish the risk of acute coronary syndrome from each individual plaque. If CTCA identifies CAD, it should then be used in conjunction with functional testing or invasive angiography with physiological assessment to establish the significance of coronary disease in an individual patient. In this case, the patient was diagnosed with an acute coronary syndrome originating from an atheromatous plaque that had been identified on CTCA 15 months before the acute event. The patient had positive ischaemic testing on myocardial perfusion scan but no symptoms of angina prior to the acute event. This case highlights the increasing difficulties clinicians face when deciding on management for patients with high-risk plaques, as there are little guidelines beyond aggressive secondary prevention.

BACKGROUND

CT coronary angiography (CTCA) is increasingly being used to identify coronary artery disease (CAD). In addition to traditional luminal stenosis assessment, CTCA can accurately characterise individual coronary artery plaques. This has given way to the concept of the vulnerable or high-risk plaque.¹ These plaques are associated with a high prevalence of acute coronary syndrome.

Identifying high-risk features of CAD on CT may predict future coronary events. Lesions showing positive remodelling, low-attenuation and the 'napkin-ring sign' on CTCA are at high-risk of rupture.² Although evidence shows the benefits of medical therapy with aspirin and statins to decrease the plaque burden in CAD, consideration should be given to early invasive therapy, given the risk of acute events in patients with high-risk plaques. Difficulties arise in making decisions regarding management in patients who have high-risk plaques identified on CTCA, demonstrate ischaemia on functional testing but do not complain of angina.

This is a case of a patient in whom a high-risk lesion was detected on CTCA, a mildly positive myocardial perfusion (MIBI) scan, but who had no symptoms of angina. The patient was managed conservatively but went on to have an acute coronary syndrome (ACS). This highlights the difficulties faced by clinicians in deciding how to manage patients with confirmed CAD that is of unclear prognostic significance.

CASE PRESENTATION

A 59-year-old woman was followed up by cardiology as an outpatient, following ablation for an AV nodal re-entrant tachycardia. Her symptoms, which included chest pain, had resolved since the ablation; however, she complained that she was unable to get travel insurance because of a historical diagnosis of angina on her records. A CT coronary angiogram was arranged to rule out CAD.

INVESTIGATIONS

The CTCA showed a low-attenuation plaque in the mid left anterior descending artery (LAD) (figure 1). In this area of the vessel there was evidence of positive remodelling and a napkin-ring like sign, indicating a vulnerable plaque (figure 2). There was minimal luminal narrowing. The patient was started on aspirin and a statin for secondary

Figure 1 (A and B) Focal predominantly non-calcified plaque in LAD showing low attenuation characteristics in corresponding cross-sectional view and LAD plaque showing varying degrees of plaque progression in keeping with a heterogeneous high-risk plaque. The figure demonstrates minimal reduction in vessel lumen associated with the plaque. LAD, left anterior descending artery.

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Figure 2 LAD plaque showing high-risk features: (A) napkin-ring-like sign, (B) low attenuation plaque (37HU) with some degree of associative positive remodelling. LAD, left anterior descending artery.

prevention of CAD, and a MIBI scan was performed to look for inducible ischaemia. The MIBI scan showed a small area of subtle reduced perfusion to the apico-anterior myocardial wall and adequate perfusion elsewhere. Echocardiography showed good biventricular function. A strategy of medical therapy was pursued as the lesion had questionable prognostic significance.

OUTCOME AND FOLLOW-UP

Fifteen months following the identification of the plaque on CTCA, the patient was admitted to the emergency department with chest pain and T wave inversion in the anterior leads on ECG. Serial troponins were raised and treatment was started for a non-ST elevation myocardial infarction (MI). She had urgent percutaneous coronary intervention (PCI) to an LAD lesion identified on invasive angiography (figure 3). An echocardiogram following the episode showed akinetic apical and distal regions with moderately impaired LV systolic function.

This patient had known CAD with a high-risk plaque identified on the CTCA 15 months prior to an acute event. After commencing secondary prevention, she was asymptomatic in the

15 months leading up to an acute event which has left her with left ventricular dysfunction. This highlights a question of what is the optimum treatment for high-risk plaque identified on CTCA.

DISCUSSION

High-risk features in individuals can help to characterise potential lesions at risk of plaque rupture and subsequent ACS. In this case, the evidence of positive remodelling and a low attenuation plaque highlighted the high-risk nature of the lesion. High-risk plaques and significant stenosis identified on CTCA are independent predictors of ACS.² Currently, there is no agreed strategy for management of high-risk plaques beyond traditional secondary prevention.³

If a coronary plaque is stenotic and proven to be causing ischaemia, there may be a mandate to treat with PCI. The presence of ischaemia is an independent predictor of outcomes.⁴ Even in the absence of symptoms, patients may benefit from revascularisation simply because of a reduction in ischaemic burden.⁵ In our case the lesion was of questionable prognostic significance with minimal ischaemic burden. It was therefore treated conservatively. However, the significance of the lesion based on the location of the ischaemia is likely to be an oversimplification. This highlights the additional value of ischaemic burden, estimated from CTCA. CTCA may be useful in terms of determining the presence of CAD and should be used with functional testing to establish risk of coronary events. There was no mandate to stent this lesion and the patient was treated according to guidelines.

A recent study demonstrated that patients who have a CTCA rather than a functional test to look for CAD are more likely to then undergo invasive angiography.⁶ This may be an advantage due to higher rates of revascularisation at an earlier time-point. Visual assessment of the degree of plaque disease may be inaccurate and a substantial proportion of non-stenotic CAD are significant lesions when measured with invasive pressure wire.⁷ This supports the case for early invasive therapy, given the inaccuracy of imaging in estimating stenosis severity.

In a recent review of the utility of imaging high-risk plaques, Arbab-Zadeh *et al* suggested that there is no conclusive evidence for independent risk prediction associated with high-risk plaque features and therefore overall atherosclerotic disease burden is a better marker of the risk of acute coronary syndromes.⁸ In contradiction to this review, this case suggests that even without a high atherosclerotic disease burden, a high-risk plaque can rupture with devastating consequences to the individual.

Statins and aspirin have both been shown to reduce coronary events and plaque burden in stenotic and non-stenotic disease.^{9 10} However, adverse plaque characteristics are often present in patients undergoing CTCA testing. Such plaques are associated with the presence of ischaemia and increased risk.^{2 11}

Ongoing studies are investigating interventional treatment of stable CAD observed on CTCA, assessing subsequent rates of acute events. However, the risk of PCI must be considered together with the risk of future ACS. Physicians face difficulties in decision-making for such patients because of the increased information provided by numerous investigations performed on a single patient. In this case, the echocardiogram, CTCA and MIBI scan had to be interpreted together with the clinical history from the patient. Ideally, these difficult clinical scenarios should be discussed in a multidisciplinary forum where revascularisation decisions can be made objectively and without individual clinician bias. Further studies are needed to identify the high-risk patients and understand management that will improve outcomes.

Figure 3 (A and B) Diagnostic angiogram showing the culprit lesion in the mid LAD prior to PCI (arrow) and angiographic result following stenting of LAD lesion (arrow head). LAD, left anterior descending artery; PCI, percutaneous coronary intervention.

Learning points

- ▶ Together with functional testing, CT coronary angiography (CTCA) provides useful information about ischaemic burden and individual plaque feature that can be used to estimate risk of future coronary events.
- ▶ Early invasive management could be beneficial in patients with high-risk features on CTCA and ischaemia on non-invasive testing but the risk of PCI should be considered. Difficult cases such as this should be discussed in an MDT setting to establish a consensus management plan regarding revascularisation.
- ▶ Further research is required to quantify the risk of acute coronary syndromes in such patients and clear guidance should be developed.

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