

Editorial

Why the controversy about electron beam computed tomographic screening for coronary atherosclerosis?

Electron beam cardiac computed tomography is being used to screen for occult coronary atherosclerosis. This procedure, which can detect small amounts of calcium phosphate in atherosclerotic vessels, is now available at 48 centres throughout the world.

Advocates of this type of screening state that coronary calcium signifies atherosclerosis, that detection of this deadly disease is important, and that a positive screen justifies aggressive management of risk factors or further evaluation by exercise testing or angiography. Others who are less convinced of its value do not think that it should be used to screen for coronary artery disease.¹

This editorial summarises the strength of the evidence linking coronary calcium with atherosclerosis and coronary events and proposes a model for the future development of this technique.

Evidence linking coronary calcium to atherosclerosis in dead and symptomatic study groups

Necropsy studies support the contention that coronary calcium almost always signifies atherosclerosis.²⁻⁷ In 1961, Blankenhorn performed radiographic and histopathological studies of 89 randomly selected hearts.⁶ Thirty years later, Simons *et al* used electron beam tomography and careful histopathological sectioning to examine 13 hearts for coronary calcium deposits.⁷ Neither study found one calcified radio-opaque lesion that was not atherosclerotic.

Angiographic studies also support an association between calcium and stenoses in study groups with symptoms. Gianrossi *et al* performed a meta-analysis of the relation between fluoroscopically detectable coronary calcium and angiographic disease.⁸ The studies they reviewed used conventional image intensifier fluoroscopy in patients with symptoms who had angiography for clinical indications. They found that cardiac fluoroscopy was almost as accurate as exercise electrocardiography and exercise thallium scintigraphy. When electron beam tomography was compared with coronary angiography in patients with symptoms the sensitivity of electron beam tomography was about 100% but the specificity was lower than in fluoroscopic studies.⁹⁻¹¹ Loecker *et al* performed a prospective fluoroscopic evaluation of 613 aircrewmembers undergoing conventional fluoroscopy and angiography.¹² The prevalence of angiographic narrowing in this healthy young cohort was about 17%. This report is unique because these men had no symptoms. Loecker *et al* found a sensitivity of 66% and a specificity of 78% for the prediction of at least one angiographic luminal narrowing of at least 50%.

Coronary calcium as a predictor of events in symptom free groups

The prevalence of coronary artery calcium detected by electron beam computed tomography is high and rises dramatically with age: more than 60% of symptom free women and 80% of symptom free men aged more than 60 have detectable calcium.^{13 14} Because clinical coronary events will develop in only a small proportion of these individuals risk stratification depends on a defined amount of calcium being regarded as high risk. Because the amount of disease present when any calcification whatever is detected is so small the predictive value of the detection of coronary calcium is limited. Very few data link coronary artery calcium to an increased incidence of coronary events in those who are symptom free.^{15 16} These studies do show an increased risk of events in those with coronary calcium detected by fluoroscopy or by ultrafast computed tomography but the predictive values are no better than those independently reported for the exercise electrocardiogram.^{17 18}

A model for future research

The problem of oversensitivity can be resolved if:

- Electron beam computed tomography accurately measures the mass of calcium precipitated in coronary arteries
 - The mass of calcium corresponds with the amount of atherosclerosis
 - The amount of atherosclerosis correlates with risk.
- If these three conditions are met, reliable thresholds for a positive test can be set such that specificity and predictive value may be high enough to be useful.

ACCURACY IN QUANTITATING CALCIUM MASS

Though little work has been done to validate calcium measurements in coronary arteries an arbitrary scoring system has been proposed.¹⁹ More accurate methods are being developed and preliminary results are encouraging.²⁰⁻²³

RELATION OF CALCIUM MASS WITH PATHOLOGY

The best studies show an imperfect relation between the amount of calcium and the total atherosclerotic volume.^{7 24} Indeed, speculations that the mass of calcium may track the progression and regression of atherosclerosis are exciting²⁵ but they have not been proved and more importantly the relation between clinical plaque stability and amount, morphology, or changes in coronary calcium is not clear.

RELATION BETWEEN PATHOLOGY AND RISK

Though it is plausible that the amount of atherosclerosis is strongly related to risk this too is not proved. Nor is it known whether atherosclerosis is more or less malignant when it is calcified.²⁶⁻³⁰

Coronary calcium and patients with symptoms

In contrast to the symptom free individual, the usefulness of detecting coronary calcium in the patient with atypical angina is more firmly grounded. There are several well conducted studies using fluoroscopy and computed tomography.^{8-11,19} When electron beam studies are negative in those with symptoms the probability of obstructive disease is low and such a result strongly suggests a non-cardiac cause. Electron beam computed tomography may also be helpful in symptom free patients with abnormal exercise electrocardiograms. The absence of calcium in such patients suggests that the exercise result is a consequence of hyperventilation,³¹ medication, or an oestrogen effect.³²

Reasons for the controversy

On the one hand, a non-invasive tool is available which can detect even small amounts of a deadly pathology, coronary atherosclerosis. On the other, this tool is so sensitive that it detects atherosclerosis in many individuals who will never suffer its clinical consequences. This is not the only example of the dilemma of widespread potentially life threatening pathology which if it remains unrecognised usually runs a benign course. Clinically, thyroid carcinoma is rare; but Harach *et al* estimated that it would be diagnosed in nearly everyone aged over 50 if biopsies were sufficiently thorough.³³ Fortunately, routine biopsy of the entire population has not been seriously proposed. Nor should the entire population be examined by electron beam computed tomography, which also would uncover pathology that is unlikely to become manifest.

Though it would be helpful to know whether calcium is present in those at intermediate risk of coronary disease (that is, with atypical angina or non-diagnostic exercise electrocardiograms), in those who are symptom free few clinical decisions can be based on these results. The presence of coronary calcium may alert a symptom free individual to a potential emerging problem, this supposed beneficial effect must be balanced against the detrimental effects of being labelled as ill, of anxiety, and of unwarranted invasive interventions.

ROBERT C DETRANO

St Johns Cardiovascular Research Center,
Harbor-UCLA Medical Center,
Building RB2, 1124 Carson Street, Torrance,
California 90502, USA

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