Electron beam CT scanning: finding more than calcium

See page 1748 for the article to which this Editorial refers

There is nothing quite like the prospect of getting something for nothing to arouse interest. The article by Hunold et al.\(^{(1)}\) therefore deserves close scrutiny.

The first prototype computed tomography scanner was installed in 1972, at the Atkinson Morley Hospital in London, developed by Sir Godfrey Hounsfield. This machine started an era of imaging that now allows high-resolution three-dimensional data from humans to be analysed in exquisite detail.

Cardiac imaging requires short exposure times to avoid motion artefact, and the electron beam tomography scanner was developed with this in mind. A magnetically steered electron beam generates a fan of X-rays that sweep rapidly around a patient. Acquisition of data at 50 or 100 ms per slice, coupled with ECG-gating results in high-resolution cardiac images free from motion artefact.

Because of the frequently unheralded nature of acute coronary syndromes, the detection of coronary plaque that is not flow limiting, but is vulnerable to rupture or erosion is an important but as yet unattainable goal. Detection and quantification of calcified coronary atheroma may be a first step, for while such atheroma may be stable and less prone to acute change than a lipid-laden, thin-capped plaque, calcified atheroma may act as a marker for other more active lesions.

A patient having an electron beam tomography scan for coronary calcium simply lies in the scanner, and scans are triggered by the patient’s electrocardiogram. Intravenous contrast is not given. The scanner acquires a series of 3 mm thick datasets sequentially from the level of the left pulmonary artery down to the diaphragm. This dataset can be reconstructed to give tomograms of a range of diameters. When assessing coronary calcium a 26 cm field of view is employed, but the raw data can be used to generate a larger diameter image to encompass the entire lower two thirds of the thorax with no additional scanning required. In order to optimally visualize the coronary arteries and calcification (and the rest of the mediastinum) it is usual to review the images on a fairly narrow window setting (e.g. a level of 0 or 50

---


Hounsfield Units (HU) and a width of 450HU). However, it is a simple matter to alter these window settings on the viewing console to parameters more suited for reviewing the lung parenchyma or chest wall. If such a strategy provided important information, then it could be argued that such an analysis should always be performed to maximize the patient’s potential benefit from an examination that involves exposure to ionizing radiation.

What sort of additional findings might one expect in the typical population referred for coronary calcium scans? Atheroma in other arteries is likely to be found, and indeed this was the case in the present study, although in only one case (that of aortic dissection), were there important early therapeutic consequences. Most of the cardiac abnormalities were probably clinically irrelevant, but for filling defects including one atrial myxoma. However, intravenous contrast was required to visualize the defects in many of these scans, and over half of these abnormalities would not have been picked up by a simple scan for coronary calcification.

Smoking is a risk factor for both coronary atheroma and malignant disease, and it might be expected that this would be the most fruitful source of incidental findings. Coronary calcification, however, is so prevalent in patients over the age of 70\(^2\), that the technique tends to be used in younger cohorts. This is reflected in the mean age of 59 years in this study. Two lung tumours were identified and resected, and one inoperable oesophageal tumour identified. How does this compare with lung cancer screening studies? The most recent was the Early Lung Cancer Action Project\(^3\) and as expected the age of the population studied was greater (median 67 years) with a detection of malignant disease of 2.7%, but there are likely to be other important demographic differences that make true comparison impossible. Detection rate in an earlier study of younger people was lower\(^4\).

The relative sensitivity of CT in detecting pulmonary nodules is at the cost of relatively low specificity. This is particularly important in areas where fungal granulomatous diseases such as histoplasmosis are common\(^5\). However, even in areas where fungal disease of the chest is rare, non-calciﬁed, presumed tuberculous pulmonary granulomas are common enough to cause confusion\(^6\). The ELCAP had a speciﬁc protocol built into the study to try to reduce the potentially high number of inappropriate nodule biopsies. Perhaps this needs to be considered with electron beam tomography.

Ten mediastinal lymph nodes were said to be enlarged, and therefore suspicious of malignancy, but we are not given information regarding their later progress. It is important to note that intrathoracic lymph node enlargement has many benign causes, and even in patients with known lung cancer, in excess of one third of signiﬁcantly enlarged lymph nodes are hyperplastic and free of tumour\(^7\).

Thus, while the authors were concerned that 53% of the scans revealed other findings, the vast majority were of no clinical signiﬁcance. Mitral valve calciﬁcation, for example, in the absence of clinical signs or symptoms of mitral valve disease, is not of any importance to the patient. Moreover, the incidentally discovered abdominal abnormalities were all virtually of no signiﬁcance, and that three benign hepatic cysts were punctured for further assessment is a source of concern. This raises the issue of how many of the additional investigations that were performed were actually necessary.

Availability of electron beam tomography is limited, but there is increasing interest in the use of multislice CT and MRI for imaging the heart and these too acquire whole body data which if appropriately interrogated will produce incidental findings. There are clearly important consequences of such findings. On the one hand, the patient may be subjected to unnecessary and potentially harmful further investigation, as well as experience unnecessary anxiety over an insignificant ﬁnding; on the other hand, the incidental finding of an early cancer is of undoubted beneﬁt.

Hunold and his colleagues ask two important questions. Firstly should patients undergoing electron beam tomography for suspected coronary disease have the entire thorax scanned despite the additional irradiation, and secondly should high risk populations such as heavy smokers undergo different scanning protocols more targeted to their perceived risks? The answer to these must surely be ‘No’, until the longer-term outcome of studies such as ELCAP are known. The other issue that they raise is about interpretation of the scans, and on this we have to agree that it is in the best interest of the patient that there is close cooperation between the cardiologist and the radiologist.

P. F. LUDMAN\(^1\)
M. B. RUBENS\(^2\)

\(^1\)Birmingham Heartlands Hospital, Birmingham, U.K.
\(^2\)Royal Brompton Hospital, London, U.K.

References


