Summary

✓ Multislice computed tomography (MSCT) and spiral (or helical) computed tomography (CT) are designed to provide faster images with better resolution than conventional CT scanning. MSCT and spiral CT have been used to quantify calcification in the coronary arteries, in an effort to link this to coronary artery disease.

✓ Long-term studies on clinical outcomes of people screened with MSCT or spiral CT are lacking, as are comparisons with established screening modalities like risk factor algorithms. Low specificity gives rise to concern over false positive results. False positives may cause harm (and expense) due to inappropriate and invasive follow-up.

✓ One study was identified in which spiral CT was compared with electron beam CT (EBCT) to evaluate coronary calcifications in 33 asymptomatic individuals, giving a sensitivity of 74% and a specificity of 70%.

✓ There is insufficient evidence at this time to suggest that asymptomatic people derive clinical benefit from undergoing coronary calcification screening using MSCT or spiral CT scanning.

The Technology

Computed tomography (CT) images are generated by X-rays. An X-ray tube and detector array rotate around a patient, gathering information from which a computer can generate axial images (slices) of internal structures. In conventional CT the patient is moved after each rotation. Slip-ring technology, introduced in 1988, allows continuous rotation and as the patient is moved, a spiral or helical scan is obtained, hence the name 'spiral' or 'helical' CT. A further technological advance, multislice CT (MSCT) or multirow detector CT, uses multiple rows of detector arrays to obtain multiple slices (commonly four slices) with one pass.1,2 MSCT scanners allow narrower slices with increased spatial resolution and faster (sub-second) scanning times. Patient movement artifacts are reduced and cardiac imaging is more feasible, particularly when ECG-gating is done to synchronize image acquisition with cardiac diastole (when the heart is moving least).2 MSCT differs from electron beam CT (EBCT), in which an electron beam is magnetically steered along stationary tungsten rings to produce a rotating X-ray beam. In EBCT, also known as Ultrafast CT, there are no moving parts and scans are faster than with MSCT. EBCT scanners are not as versatile for general imaging applications as MSCT scanners.2

This bulletin looks at the use of MSCT and spiral CT for the screening of asymptomatic people for coronary calcification, as a marker for coronary artery disease (CAD). Coronary calcium indicates atherosclerosis, but presence of calcification alone is not enough: quantification provides more clinically useful information.3 EBCT has been considered the 'gold standard' for evaluation of coronary calcification.4 The standard method of quantifying coronary calcium, the Agatston calcium score, was developed using EBCT5 but is also used with MSCT and spiral CT. Agatston total calcium scores are calculated.
based on the number, areas and peak computed tomographic density [measured in Hounsfield units (HU)] of the calcific lesions detected.5

**Regulatory Status**

Various MSCT and spiral scanners and the Imatron EBCT have been granted Class III licenses for use in Canada.6 Class III diagnostic and therapeutic devices are defined as being potentially hazardous or representing an immediate danger if they fail.

**Patient Group**

Ischemic heart disease (IHD) accounts for 20% of deaths in Canada (44,000 deaths in 1997).7 The age-adjusted mortality rate from IHD is declining, but it is unclear if this is due to decreasing incidence or increased survivorship.7 Cardiovascular disease (heart disease and stroke) remains a leading cause of death and hospitalization for men and women.7 Premature death from cardiovascular disease is responsible for an estimated 289,000 years of life lost and is third after injuries and cancer.7

**Current Practice**

When CAD is identified at an early stage in patients, this 'silent killer' is manageable through risk factor modification, pharmaceutical therapy and surgical intervention. In primary prevention, targeted screening of high-risk groups is more appealing than costly mass screening.8 Risk factor screening is followed by subsequent testing for CAD in high-risk people. Algorithms based on risk factors have been developed to predict the risk of CAD in people without overt disease.9

Direct assessment of CAD may be carried out with coronary angiography (the gold standard), but this is too invasive and expensive to be used for screening. Screening for coronary calcification as a marker for CAD is a non-invasive modality that has become more feasible as CT technology has progressed.

Some literature exists on the use of EBCT (introduced in the mid-1980s) for detection of coronary calcium, more than can be found on MSCT. A 1999 systematic review for the UK NHS found no evidence to support the use of EBCT in an asymptomatic population for predicting subsequent coronary events.10 The 2000 American College of Cardiology/American Heart Association consensus was that the published literature did not answer the question of whether EBCT calcium score is additive to the Framingham score for the definition of CAD risk in asymptomatic patients. It was recommended that EBCT screening should not be available to the general public without a physician's request.11

**The Evidence**

Long-term studies on clinical outcomes of people who have received coronary calcification screening with MSCT or spiral CT are lacking. No comparisons of MSCT calcium scoring screening with established modalities like risk factor algorithms were found.

One study was found that addressed the use of spiral CT scanning of asymptomatic people for CAD in terms of specificity and sensitivity. Spiral CT was compared against EBCT to evaluate coronary calcification in 33 asymptomatic people of mean age 52 years (standard deviation 9 years) with an average of 1.6 cardiac risk factors, who were referred for calcium scans. Spiral CT had a sensitivity of 74%, a specificity of 70%, overall accuracy of 73%, and positive and negative predictive values (PPV and NPV) of 85% and 54% respectively. Agatston scoring was done with a threshold for detection of 130 HU, which was derived for EBCT scoring. The authors commented that no studies had evaluated the proper thresholds to use with spiral CT.4 CCOHTA’s search did find a published abstract reporting Agatston score percentiles for a threshold of 130 HU in 749 healthy men using multi-row spiral CT;12 the authors suggested that the data could be used to establish a 'normal range' of coronary calcification determined by multi-row spiral CT in apparently healthy subjects.
Adverse Effects

Ionizing radiation doses from CT examination are among the highest of those for any diagnostic imaging modality. MSCT can potentially deliver less radiation than conventional CT because of its shortened scan time. However, an increased dose is necessary to maintain image quality when obtaining the thin slices of which MSCT is capable. Automatic dose-control mechanisms are available on many scanners. Coronary calcification scanning does not require intravenous contrast, so there is no risk of reactions from contrast media.

Given the low specificity of MSCT and spiral CT with respect to coronary calcification detection in asymptomatic subjects, false positives may give rise to harm from inappropriate and invasive follow-up. Furthermore, there will be a cost to the public health care system when otherwise well people are 'medicalized' by a false positive finding. Such false positives are not limited to coronary calcification: if screening detects indeterminate nodules in the lung fields, further investigation and invasive procedures may be carried out for what is likely to be a benign nodule.

Administration and Cost

Acquisition costs for a new MSCT scanner range from US$1.2 million to US$1.5 million. This is at least US$500,000 more than a single-slice scanner. An EBCT system costs from US$1.8 million to over US$2 million.

Concurrent Developments

Multislice systems capable of acquiring 16 or 32 slices have been introduced recently, which promise faster image acquisition and improved image quality.

Rate of Technology Diffusion

The main concern in assessing this technology application is the potential for unproven screening to lead to unnecessary anxiety and an increased burden on the public healthcare system with respect to management of false positive results.

Implementation Issues

At this time, evidence could not be identified to suggest that asymptomatic people would derive clinical benefit from undergoing coronary calcification screening using MSCT or spiral CT scanning.

References


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The Canadian Coordinating Office for Health Technology Assessment (CCOHTA) is a non-profit organization funded by the federal, provincial and territorial governments. (www.ccohta.ca)