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imaging update

CORONARY ARTERY CALCIFICATION SCORING



Queensland
Diagnostic Imaging

THE NEED FOR A NON-INVASIVE SCREENING TEST

Coronary heart disease is the single biggest cause of premature death in Australia, claiming 30,000 lives per year. For many people, the first and only symptom of coronary heart disease is a fatal heart attack. Up to 50% of myocardial infarctions occur in patients who have average or unremarkable cholesterol levels, normal stress or exercise treadmill tests and few, if any, of the major risk factors. The earlier atherosclerosis is detected, the greater the chance it can be slowed, stopped, or possibly even reversed.

About 50% of men aged 50 will have some calcium detected in their coronary vessels while women usually take 10 years longer than men to achieve similar calcium scores. With increasing age, progressively higher calcium scores are seen, correlating with increased cardiac mortality with advancing age. The higher the calcium score, the greater the likelihood that an individual has a significant (>70%) coronary stenosis. Clinical correlation is required to complete a diagnosis of significant coronary stenoses. (The calcium score is not a substitute for a coronary angiogram.)

PATHOPHYSIOLOGY OF CORONARY ATHEROSCLEROSIS

Coronary arterial calcification is a well-accepted marker of coronary atherosclerosis. A number of studies including Rumberger et.al (1995), report that the calcific plaque represents approximately twenty percent (20%) of the total plaque burden along the vessel and therefore coronary calcification can be regarded as a reliable correlate of total coronary atherosclerosis. Arguments against coronary artery calcification scoring mainly revolve around the fact that non-calcified plaque is not imaged. It is commonly believed that small fatty plaques are the usual plaques that rupture to cause an acute ischemic syndrome such as acute myocardial infarction, unstable angina pectoris, or sudden cardiac death. A number of studies however, have suggested that the most common site for atherosclerotic plaque rupture is the junction of soft and hard plaque. This junction creates a demarcation line that may lead to inconstant mechanical factors; a so called "hinge point" explaining the actual site of rupture. Non calcified plaque is almost always accompanied by the more advanced calcified plaque and, therefore, detection of calcification is representative of the amount of soft plaque and, hence, the extent of the atherosclerotic burden.

EQUIPMENT - THE NEED FOR SPEED

CT is extremely sensitive in detecting coronary calcification because of the ability of calcium to attenuate the x-ray beam. Calcific deposits are seen as bright, white areas along the course of the coronary arteries. Calcium scoring programs have been historically developed and validated with electron beam CT, a form of ultra-fast CT. Until recently, helical CT has not been fast enough to successfully image the heart without blurring of the images caused by cardiac motion. A number of investigators have reported that calcific deposits imaged with one second scan times (which is common for many helical scanners) are often blurred because of cardiac motion. A number of studies have shown extremely good correlation in calcification scores when faster helical CT scanners have been compared with electron beam CT, particularly with ECG triggering. The latest sub-second multi-slice CT scanners allow partial scans in only 300 milliseconds, which combined with prospective and retrospective ECG gating, allows imaging of the heart with no motion artifact.

Fig 1

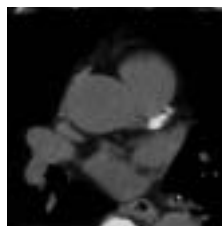


Fig 2



The 300ms gated multislice CT (Fig 1) gives a much more accurate assessment of the extent of coronary calcification compared to a 1 second non-cardiac gated CT (Fig 2) in the same patient.

Fig 3

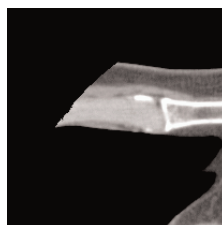
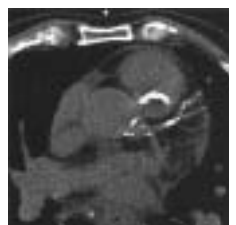
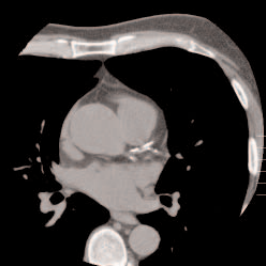


Fig 4



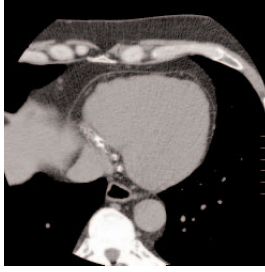
Comparison of EBCT (Fig 3) to gated multislice CT (Fig 4).

Fig 5



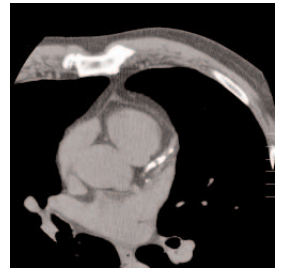
Calcified plaque in left coronary artery and in the LAD and circumflex arteries.

Fig 6



Calcification in the right coronary artery and circumflex artery.

Fig 7



Dense calcification in the LAD.

A multislice scan of the heart can be obtained in several minutes and a calcification score is generated. With the software QDI is using (Sclmage Workstation), the calcification score is compared with a patient database from the University of Illinois, Chicago of 19,000 patients. This large database gives the most statistically significant results available.

The sensitivity of multislice CT calcification scoring to detect obstructive coronary atherosclerotic disease ranges between 82% and 100%. Specificity has been reported to range from 56% –88 % when compared to angiographic disease severity. This is because coronary angiography only detects late luminal disease and not early mural coronary atherosclerosis, which is the real advantage of high speed gated coronary computed tomography.

INDICATIONS FOR CACS

Any person aged between 40 and 70 years concerned about their risk of coronary heart disease is a suitable candidate for coronary artery calcification assessment (particularly men over 40 and women over 50). Persons with known risk factors for coronary heart disease such as elevated cholesterol or blood lipids, smokers, those with a family history of

heart disease, those who are overweight, have diabetes or high blood pressure should also consider having a cardiac risk assessment.

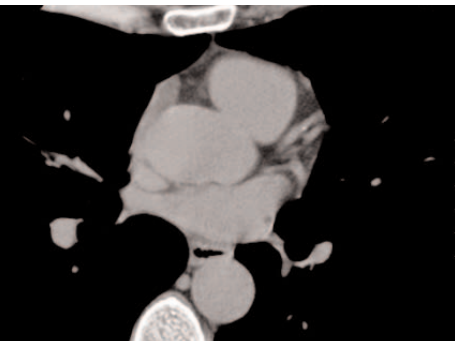
CONTRAINDICATIONS FOR CACS

People who have been identified as having documented coronary artery disease, for example, heart attack, coronary artery bypass, angioplasty, positive history or stress test, should not have this test.

INTERPRETING THE RESULTS

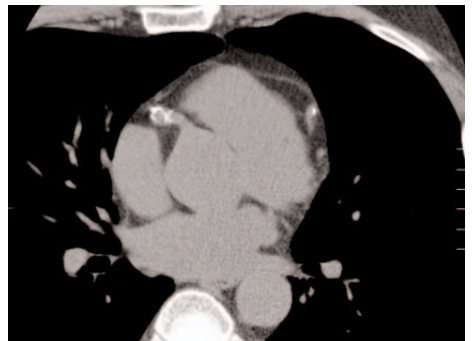
A calcium score of zero in a person over 40 years of age indicates a 90-95% absence of significant coronary artery disease. A score of 1 to 10 is in keeping with a minimum plaque burden. A score of 11 to 100 is in keeping with a mild plaque burden; 100-400 moderate plaque burden and over 400 extensive plaque burden with a very high likelihood of at least one significant coronary stenosis (greater than 50% diameter). These coronary calcification scores should be interpreted in association with the patients blood lipid profile and cardiovascular risk factors. High calcium scores are more predictive than traditional risk factors in identifying people at future risk of symptomatic coronary artery disease.

Fig 8



Coronary Artery Calcification Score = 0.

Fig 9



Calcification in the right coronary artery and in the LAD.

ADVANTAGES OF CACS

The advantages of coronary artery calcification scoring performed with a sub-second multislice CT scanner and ECG gating are:

It is a non-invasive screening test for the early detection of coronary atherosclerosis. Although it only assesses the calcified plaque, a large number of studies show that this is a good indication of the total plaque burden. Coronary heart disease remains the single biggest cause of premature death in Australia.

Early detection of coronary atherosclerosis in asymptomatic patients is important from the point of implementing risk modification strategies, including the initiation of dietary and lipid lowering therapy, before a cardiac event has occurred. Calcium scores appear highest in individuals with increased coronary risk factors.

There appears to be an increased likelihood of cardiac events in individuals with higher calcification scores. Calcification scores are not predictive of significant stenosis at the site of the calcification, but high scores often correlate well with the presence of a stenosis somewhere within the artery.

Coronary artery calcification scoring can be useful for the evaluation of atypical chest pains. A calcification score of zero in a person over 40 years old has a high correlation with the absence of significant and geographical narrowing (greater than 50% stenosis).

Multislice calcification scoring can also be used to monitor the progress of coronary atherosclerosis over time.

IN SUMMARY

The coronary artery calcification score, in combination with the patient's blood lipid profile and coronary artery risk factors can give a good indication of the patient's risk of coronary heart disease.

With QDI's recent purchase of a Toshiba Aquilion Multislice CT (with ECG gating) and ScImage workstation at the Holy Spirit Hospital, QDI is able to offer the most accurate and statistically significant coronary artery calcification scores available.

Dr. John McGuire. MBBS, FRANZCR.
Queensland Diagnostic Imaging

References:

1. Rumberger JA et al. (1995). "Coronary Artery Calcium Areas by EBCT and Coronary Atherosclerotic plaque area: Histopathologic Correlative Study". *Circulation*; 92: 2157-2162
2. Stamford W, Thompson BH. "Imaging of Coronary Artery Calcification: It's importance in assessing atherosclerotic disease." *Radiol Clin Nth Am*; 37: 257-272
3. *Journal of the American College of Cardiology* 2001; 37:451-57.



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QDI remains privately owned and committed to providing a clinically independent choice for radiology services. QDI continues to invest in improving the service provided to our referring doctors and patients. Our commitment to bringing you the best technology, better levels of service in terms of faster reporting times, delivery of results and providing services sensitive to the needs of our patients and doctors is further demonstrated in this edition of QDI News.

CARDIAC SCORING ON THE WORLD'S FASTEST CT MACHINE

QDI Holy Spirit Hospital has been the centre of attention over the last month with the introduction of cardiac scoring. The new multislice CT with the Scimage cardiac scoring package is the state of the art technology when it comes to imaging calcium deposits in the coronary arteries. As a screening procedure, the examination is not rebatable by Medicare and a fee of \$250 applies. Any questions regarding this service may be directed to QDI HSH on 38396161 or for bookings call 3832 8838.

QDI INDOOROOPILLY

QDI is building a comprehensive medical imaging practice in Coonan Street, Indooroopilly. Multi Slice CT, Ultrasound, General X-ray, Screening (Fluoroscopy) and a dedicated Women's Imaging Centre are all earmarked for the site planned to open February 2002. Plenty of patient parking, a convenient location, electronic delivery of results and a full time radiologist make this site the leading medical imaging centre in the Western Suburbs.

CT MACHINE UPGRADES FOR STRATHPINE AND GOODNA

Strathpine is installing a Toshiba Asteion multislice CT machine in June. With sub second scanning it can produce scans with excellent resolution, anatomic detail and improved diagnostic capabilities. Goodna is also installing a new spiral CT scanner in June. The GE ProSpeed introduces spiral scanning to the Goodna region, this will allow improved diagnostic capabilities including CT angiography and multi planar and 3D reconstructions.

SECURE EMAIL

QDI's investment in it's computer system allows us to send your radiology reports via secure email. Military grade encryption ensures privacy and makes for easier administration for your reception staff. QDI is the only group in Brisbane with this capability so if you have any questions at all, call Michelle Ryan on 3222 1910.

CHERMSIDE REGION

QDI HolySpirit Northside is progressing to plan. The recruitment drive is well and truly underway, the state of the art, digital capable equipment is ordered and the builders are frantically working on the fitout. All is well for a July 30 2001 kick off.

QDI Chermisde will continue to operate business as usual, offering a great alternative for most outpatient imaging requirements.

FASTER REPORT TURNAROUNDS

QDI is pleased to announce a significant upgrade to our Teleradiology service. Kedron, Taringa and Inala branches are now being serviced by Teleradiology, which will result in a significant reduction in reporting time. In addition, with the upgrading of our Teleradiology send stations generally and the installation of new software and monitors at our Sherwood rooms, turn around time for Teleradiology images from other tele sites will also be significantly improved.

WHO WANTS TO BE A MILLIONAIRE?

QDI radiologist, Dr David Robertson will not commit on a guess, which is a great trait in a radiologist, but not in a game show contestant. The guess would have sent him on his way to fame and fortune. What composer had 4 children who all went on to be famous composers themselves? Who cares! Glad to see you back at work Robbo.

Enquiries should be directed in the first instance to **QDI Information Officer**
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