

64-Slice CT Scan in Kathmandu Medical College Teaching Hospital

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Abstract

64-slice CT scan is a versatile newly introduced imaging technology, which is capable of diagnosing various diseases from head to toe. The 64-slice CT coronary angiography has a negative predictive value of 100%. Virtual images of bronchi, stomach and colon can provide definite diagnosis. Coronary artery calcification score which predicts coronary artery disease can be calculated by 64-slice CT scan.

Key words: coronary angiography, coronary calcification

Sixty four slice Computed Tomography Scan (64-slice CT Scan) with its versatile imaging techniques can help in the diagnosis of diseases of various human organs and thus will be very useful in managing patients on the scientific basis. This recently introduced diagnostic imaging technology is very useful in the diagnosis of acute emergency condition like coronary artery disease, aortic dissection and pulmonary embolism¹.

Three dimensional reconstruction of images of the diseased organs is possible.

High quality HRCT (High resolution computed tomography) scan of the chest helps in diagnosing lung cancer, bronchiectasis, pulmonary fibrosis and many other diseases of the chest. Diseases of the brain, spine, kidney, ureter, bladder, limbs, bones and joints can be diagnosed by 64-slice CT scan (Fig 1). FNAC (fine needle aspiration cytology) aspiration and biopsy

can be performed with the help of the CT scan. Virtual images (Fig 2 and 3) of almost whole body from head to toe provide definite diagnosis. The sensitivity and specificity in the diagnosis of diseases of the brain, lung and all the organs of the abdomen are significantly high². Virtual images of the bronchi, stomach and colon can be obtained. The burden of the bronchoscopist and endoscopist is going to be less in future, though their help may still be required for taking biopsy from the suspected lesions². Apart from coronary bypass graft, it can assess left ventricular and right ventricular function.



Fig 1: Toshiba 64-slice CT

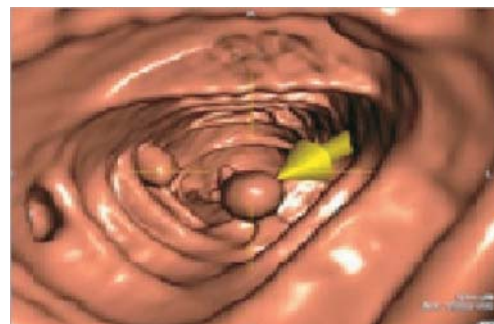


Fig 2: Virtual Colonoscopy showing polyp

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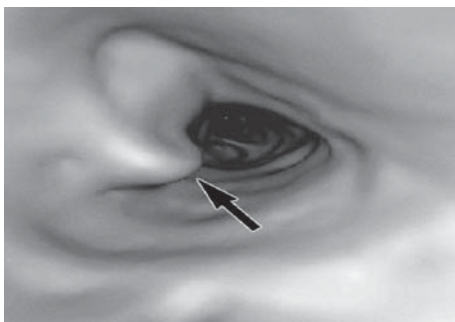


Fig 3: Virtual Broncoscopy showing tumor

Several hundred thousands negative coronary angiographies are still being performed in USA and around the world. One in thousand persons undergoing standard invasive coronary angiography can have serious complication and therefore should be advised only if it is absolutely necessary. CT angiography has high negative predictive value hence can be useful in patient with low risk coronary artery disease.

Four millions cardiac catheterizations are being performed annually in USA with normal coronary arteries in 27%¹. In spite of the positive non-invasive test like stress electrocardiography and echocardiography and myocardial scintigraphy, no evidence of coronary artery disease has been found in 20% of cases. Stress electrocardiography cannot be done in patients with left bundle branch block to rule out coronary artery disease. Patient with suspicious coronary artery disease undergoing major non cardiac surgery and valve replacement are usually advised coronary angiography. Sometimes patients consult doctors with chest pain but their cardiac enzymes and electrocardiogram may be normal. Such a group of patients cannot be allowed to go home and are admitted to CCU for observation. Most of these patients receive treatment for unstable angina. In all the above situations, a non- invasive 64 slice coronary angiography can be performed and patients assured accordingly³. CT angiography can exclude significant coronary artery disease (NPV 100%)². and its positive predictive value is 87%^{4,5}.

Invention of CT scan

Sir Godfrey Newbold Hounsfield (Fig 4), a British electrical engineer and Allan Cormack from USA (Fig 5) received a noble prize in medicine in the year 1979 for their invention of CT scan in 1972.

Electron beam CT scan has many advantages but it is expensive. Spiral CT scan is also popular. The mechanical CT scan are of different types, single slice, 4 slice and 16 slice which were being used in the past and also are being used in many developing countries because they are less expensive. Recently mechanical CT scan with very high spatial and temporal resolution



Fig 4: Godfrey N. Hounsfield, UK



Fig 5: Allan M. Cormack, USA

has been introduced. 64 slice CT scan is a very useful and has already reached the premises of Kathmandu Medical College Teaching Hospital. More powerful and expensive 320 slice CT scan has been introduced in developed country like Japan.

CT Angiography (Fig 6 and 7)

A circular part of 64-slice scan called gantry moves around the patient with a speed of 3.2 cm per second. The height of the heart of about 12 cm is completed in less than 4 seconds. Because of short period taken to complete the study, the movement artifact is minimal. In order to avoid movement artifact and thus blurring of image, patient is advised to hold breath for a few seconds. The heart and its coronary arteries move with each heart beat and therefore heart image is taken with ECG gating. Preferably the heart beat should be less than 60 beats per minute to avoid artifact due to movement⁶. This can be done by using beta-blockers. The presence of atrial fibrillation precludes the use of CT coronary angiography⁷.

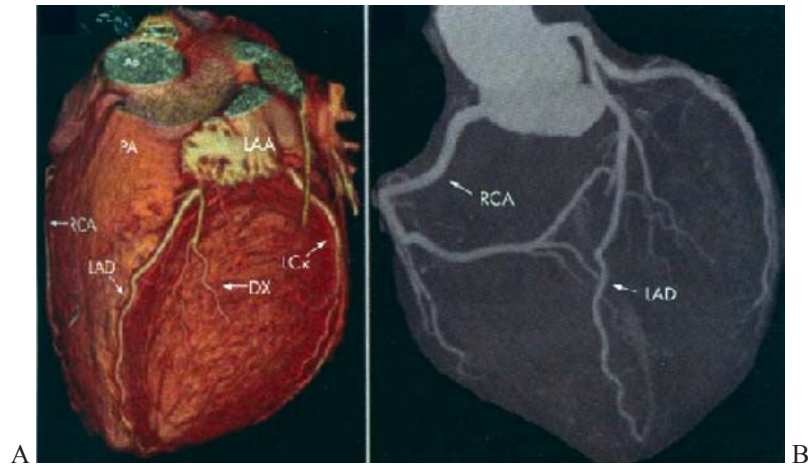


Fig 6: CT Angiography showing normal Coronary Arteries

As CT scan is an x-ray based technology and therefore there is a chance of radiation exposure to the patient. There are many ways by which radiation can be reduced⁸. Radiologist can take hundreds of images and apply pick up and choose technique in which good images are picked and blurred images are discarded. By doing this one can get clear images but the radiation hazard increases. On the other hand if limited images are taken, one may miss the clear images at the end of the study. Sublingual nitroglycerine a few minutes before the contrast is found to improve the image quality¹. Because of the similarity of the density of blood vessels and cardiac tissue, the capability of distinguishing coronary arteries from the adjacent cardiac tissue, in other word the spatial resolution becomes poor. Therefore intravenous contrast is necessary to make the coronary arteries distinct from the adjacent cardiac structures. The CT angiography creates a very clear image of coronary arteries and can make coronary luminal narrowing obvious. The diagnosis of coronary artery disease including soft coronary plaques and occlusion of graft arteries and veins has become very simple and non-invasive with the introduction of 64-slice CT scan.

Calcium Scoring of Coronary arteries

Different organs and tissues of the body have different Hounsfield number. This number for water = 0, air = -1000 and thousand for bone. CT numbers are divided into the following groups in order to calculate the Agatston calcium score of coronary arteries.

- 1= Hounsfield unit 130 – 199
- 2= Hounsfield unit 200 - 299
- 3= Hounsfield unit 300- 399
- 4= Hounsfield unit >400

CT scan measures the calcium area in square millimeter. This area is multiplied by either number 1, 2, 3, or 4 depending upon the CT number mentioned above. The resulting number thus obtain is called Agatston coronary artery calcium score^{9,10,11}.

According to Agatston (Fig 8) the calcium score of the coronary artery is divided into the following five categories⁹.

- 1. Zero calcium score – No calcium
- 2. Calcium score less than 100 – Mild calcification
- 3. Calcium score 100-399 – Moderate calcification
- 4. Calcium score 400-999 – Severe calcification
- 5. Calcium score more than 1000 –Extensive calcification

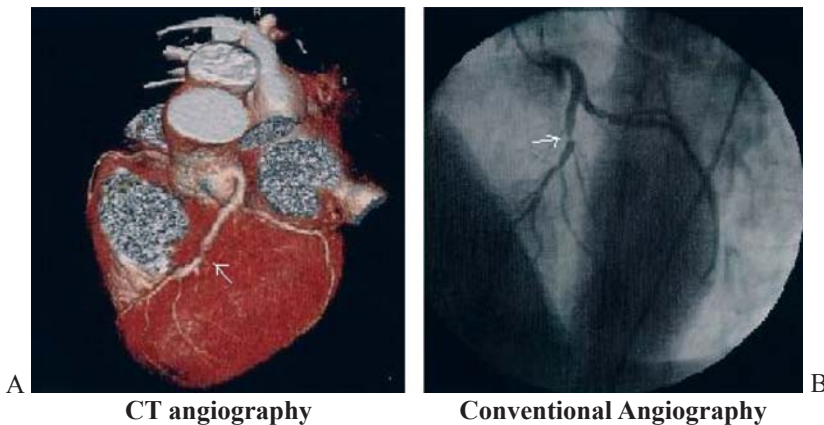


Fig 7: Stenosis of proximal left anterior descending coronary artery



Fig 8: Arthur Agatston

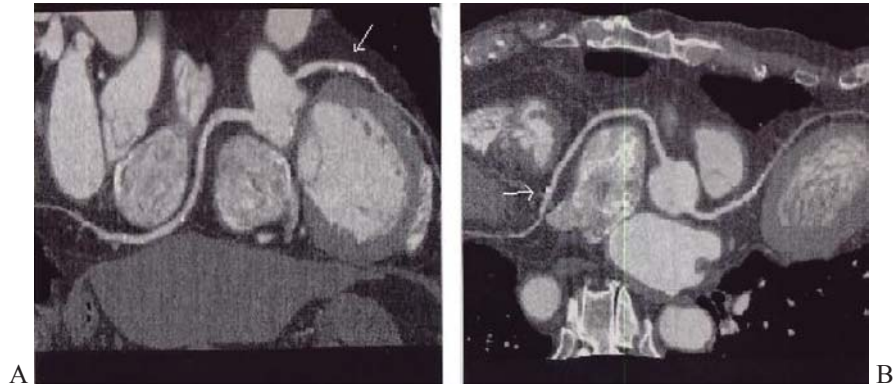


Fig 9: Coronary artery calcification

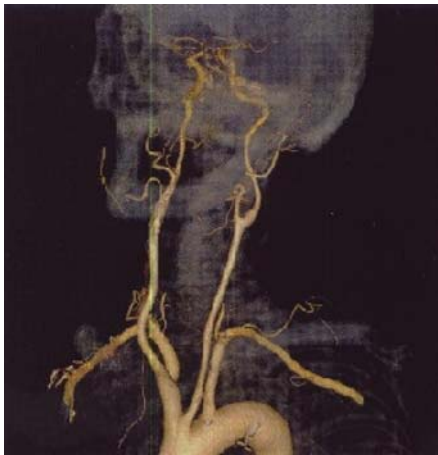


Fig 10: Carotid Arterial System

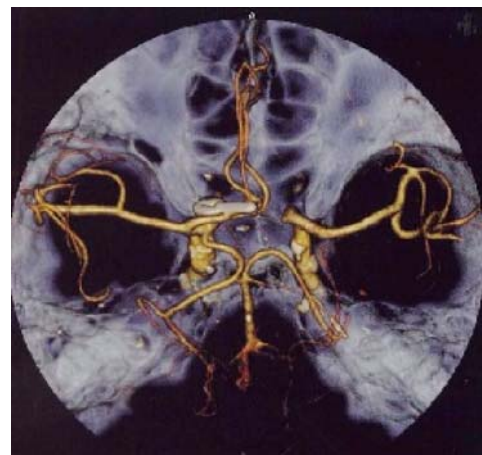


Fig 11: Clipping of Anterior communicating artery Aneurysm

The incidence of cardiovascular death or myocardial infarction is found to increase proportionately with calcium score. In subjects with an increase in coronary artery calcium progression above 15% per year, a higher rate of myocardial infarction has been found. All male and 92.8% female with coronary artery disease are found to have coronary calcification⁹. The frequency and extend of coronary artery calcium increase with age. In spite of extensive coronary calcification, there may be no coronary luminal narrowing. According to St. Francis Heart study, statin does not attenuate coronary artery calcium progression⁹ (Fig 9, 10 and 11).

Imaging of cerebral arteries

Arch of aorta, cerebral arteries and arteries of limbs are clearly visualized by 64 slice CT scan

Conclusion

Introduction of 64 slice CT scan in Nepal is going to be patient's friendly investigation, which will help doctors in the diagnosis of diseases of human body. Because of inconvenience and life threatening complications of invasive procedure patients and doctors should prefer non-invasive diagnostic aid like 64 slice CT Scan.

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