SUMMARY AND CONCLUSION

Ischemic heart disease (IHD) is the generic designation for a group of closely related clinical presentations, resulting from myocardial ischemia; an imbalance between the blood supply (perfusion) and demands of the myocardium for oxygenated blood. In most cases, the cause of myocardial ischemia is reduced blood supply because of atherosclerotic coronary artery disease.

Multislice CT is a recent development in the spiral CT. The MSCT scanners are equipped with multiple and thinner detector rows, and has a faster tube rotation speed creating two major advantages; high spatial resolution and short acquisition time that enable high-quality examinations. It is only with this immense increase in the data acquisition volume per unit time, that CT assessment of the coronary arteries has become possible.

High and consistent vascular enhancement within the vessel lumen is a prerequisite for successful CT angiography. Adequate enhancement is needed to visualize the vessel wall and the small side branches of the coronary tree. In addition, high and homogenous enhancement serves as the basis for threshold-dependent three-dimensional (3D) visualization techniques.

For CTCA, the chest is scanned from above the left main coronary artery to below the diaphragmatic surface of the heart. The acquired CT and ECG data are to be sent to a separate advanced workstation with dedicated cardiac reconstruction software used to reconstruct the images.

The initial and most important step in the interpretation of CT coronary angiography is the careful review of the axial images that necessitate thorough knowledge of the coronary anatomy including the origin, course, caliber and branches of each coronary artery and experience in CT analysis. This also allows recognition of coronary calcifications and possibly significant stenotic lesions and image artifacts related to cardiac motion.

The evaluation of MDCT coronary angiograms has been performed interactively on off-line workstations, by using a combination of transverse, MPR, MIP, and 3D VR images.

Challenges in evaluating the coronary arteries at CT are the small size and tortuous courses of the vessels and their continuous movements being intimately related to the cardiac chambers. Controlled heart rate and good breath-holding help to reduce cardiac and respiratory motion artifacts respectively. Retrospective ECG gating and proper choice of the reconstruction window would significantly improve the examination quality.

Since introduction of the MSCT as a non-invasive tool for depiction of the CAD, the clinical value of CT coronary angiography has been subjected for research work. Several comparative studies for evaluation of MSCT angiography as a diagnostic tool for coronary artery disease have been published. Initial results with four-detector CT scanner were limited by motion artifacts, the presence of significant coronary calcium, the need for long breath holds, and less-than optimal spatial resolution.

Improvements of the recently developed 64-channel CT scanners, including the improved spatial and temporal resolutions and considerably reduced acquisition times were reflected on the image quality leading to better results. The current results shows that MSCT angiography is a good non-invasive coronary imaging modality that is able to evaluate the coronary anatomy and early detect and grade coronary lesions competing with other noninvasive examinations used to detect CAD, such as exercise stress testing. Because of its high negative predictive value, CT angiography might be employed to exclude significant CAD and thus avoid unnecessary coronary angiograms in certain groups of patients.

Various artifacts associated with data creation and reformation, post-processing methods, and image interpretation can hamper accurate diagnosis. These artifacts can be related to cardiac or respiratory motions, partial volume averaging, high attenuation entities (e.g. stents and surgical clips), inappropriate scan pitch and patient body state. Some artifacts have already been resolved with technical advances, whereas others represent partially inherent limitations for coronary CT angiography.

Problems and limitations remain, as always, and will trigger scientific and technical innovation. Conceivable strategies to improve scanner performance include evaluation of the electron beam CT (EBCT) detectors to allow simultaneous acquisition of multiple sections and trial of the dual-source computed tomography (DSCT) aiming at improvement of the temporal resolution

The potential role for the CT angiography as a non-invasive modality in evaluating the coronary arteries:

An appropriateness review was conducted at 2006 under American College of Cardiology Foundation (ACCF), revised lately and directed a review as following:

"Appropriate" clinical indications for coronary CTA

1. Exclusion of CAD in patients with low to intermediate pretest likelihood.

With CTCA:

- High negative predictive value of CT.
- Noninvasive CT is highly accepted by patients.

Against CTCA:

- Only little data available on possible advantages of CT over other modalities such as stress ECG, and on possible advantages for patient management.

2. Patients with suspected CAD and inconclusive noninvasive test results.

With CTCA:

- High negative predictive value of CT.
- Noninvasive CT is highly accepted by patients.

Against CTCA:

- Only little data available on possible advantages for patient management.

3. Follow-up of symptomatic patients with coronary artery bypasses.

With CTCA:

- Reliable visualization of the entire bypass, including the proximal and distal anastomoses.
- Noninvasive CT is highly accepted by patients.

Against CTCA:

- Numerous studies, but in small patient populations.

4. Exclusion of coronary artery anomalies and aneurysms.

With CTCA:

- Excellent evaluation of the course of anomalous coronaries (malignant vs. benign).
- Unlike MRI, CT allows reliable visualization of the entire course of the vessel.

Against CTCA:

- Its competitor, MRI, is to be preferred, in younger patients, because it does not involve radiation exposure.

"Potential" clinical indications for coronary CTA:

1. Acute chest pain without ST segment elevation.

With CTCA:

- Reliable exclusion of CAD in these patients.
- Patient is discharged at once and may be referred for bypass surgery.

Against CTCA:

- There are as yet no results from studies in larger patient populations.
- Unclear outcome benefit over established tests.

2. Ruling out CAD prior to noncoronary cardiac Surgery.

With CTCA:

- Reliable exclusion of CAD in these patients.
- Conventional coronary angiography may be avoided.

Against CTCA:

- There are as yet no results from studies in larger patient populations.
- Unclear outcome benefit over established tests.

3. Follow-up of patients with coronary artery stents.

With CTCA:

- High negative predictive value for some stents
- Can be used for noninvasive follow-up

Against CTCA:

- Evaluation of stents with an internal diameter < 3.5 mm is still limited
- Current CT technology does not provide functional information on blood flow direction.

4. Prior to re-operative cardiac surgery.

With CTCA:

- Important pathology (such as sternal wire near bypasses) and dimensions (e.g., distance of sternum to bypass) can be detected prior to operation.

Against CTCA:

- No results from studies in larger patient population.

5. Suspected pericardial disease.

With CTCA:

- Excellent depiction of calcified pericarditis ("armored heart") and pericardial effusion.

Against CTCA:

- CT provides only limited functional information.
- MRI and echocardiography yield good results without radiation exposure

"Inappropriate" clinical indications for coronary CTA:

1. Screening of asymptomatic individuals without abnormal findings in other noninvasive tests.

With CTCA:

- May conceivably be more accurate than other noninvasive modalities in reliably excluding disease

Against CTCA:

- The positive predictive value is unacceptably low in screening patients with a very low pretest likelihood of CAD. Study results are not yet available

2. High pretest likelihood of CAD based on typical symptoms or positive results of other noninvasive tests

With CTCA:

- High negative predictive value

Against CTCA:

- The negative predictive value is unacceptably low in patients with high pretest likelihood of CAD. Study results are not yet available.
- PCI is probably required for such group.

3. Triple rule-out (to exclude coronary stenoses, pulmonary embolism, and aortic dissection)

With CTCA:

- Comprehensive examination.
- Generally accepted scanning protocols

Against CTCA:

- The target population remain to be defined.
- No outcome studies.

4. Analysis of myocardial viability and perfusion

With CTCA:

- CT has higher spatial resolution than MRI

Against CTCA:

- Stress echocardiography and MRI have good clinical accuracy without involving radiation exposure
- Analysis of myocardial vitality and perfusion by CT requires an additional scan after coronary angiography.

The following model summarizes chest pain management pathway that incorporates coronary CTA.