Accuracy of Coronary Artery Disease Severity of Stenosis Between 640-slice Computed Tomography and Conventional Coronary Angiography at Phramongkutklao Hospital

Surangkana Duangsuwan, MD[1], Montri Charoenpanichsunti, MD[1], Kanintorn Soontorndhada, MD[1], Nakarin Sansanayudh, MD[1], Waraporn Tiyanon, MD[1], Pachum Tasukon, MD[1], Prasart Laothavorn, MD[1], Chumpol Piamsomboon, MD[1], Sopon Sanguanwong, MD[1], Charnnarong Naksawadi, MD[1], Preecha Uerojanaungkul, MD[1], Verapon Pinphanichakarn, MD[1], Thoranis Chantrarat, MD[1], Tanyarat Aramsaruwong, MD[1], Hutsay Prasitdumrong, MD[1]

[1]*Cardiovascular Division, Department of Internal Medicine Phramongkutklao Hospital*

Abstract

Background: Conventional coronary angiography is accepted as a gold standard to detect coronary artery stenosis. Accuracy of 640-slice coronary CTA, which is a new non-invasive technique to image the coronary arteries, should be assessed.

Objective: To compare the diagnostic accuracy for detection of significant coronary artery stenosis between the 640-slice computed tomography and the conventional coronary angiography.

Methods: Seventy-four consecutive patients who underwent both 640-slice coronary CTA and conventional coronary angiography between January 2012 and December 2012 were enrolled. Vessel-by-vessel and segment-by-segment analysis from both modalities, were compared in all patients. Lesion causing ≥ 50% narrowing and ≥ 70% narrowing were described as significant luminal stenosis. Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were analyzed.

Results: Fifty-eight males and 16 females, mean age 67±10 years were included. Mean heart rate prior to scan was 67±12 beats/min. Twenty-six segments of previous PCI and 31 grafts were recorded. In vessel-by-vessel analysis, sensitivity, specificity, PPV, and NPV of ≥ 50% narrowing were 100, 100, 81, and 100%, respectively. The vessel-by-vessel analysis, sensitivity, specificity, PPV, and NPV of ≥ 70% narrowing on 640-slice CT were 100, 99, 92 and 100%, respectively. Among patients with previous CABG, sensitivity, specificity, PPV, and NPV were 98, 100,100, and 100%, respectively.

Conclusion: 640-slice coronary CTA has high diagnostic accuracy when compared with conventional coronary angiography, especially in graft lesions.

Keyword: 640-slice coronary CTA

Thai Heart J 2017; 27 : 16-26
E-Journal : http://www.thaiheartjournal.org

Introduction

Coronary artery disease (CAD) is a leading cause of death in Thailand and the world. Early detection of coronary artery disease is important as timely treatment may significantly reduce morbidity and mortality. Although invasive coronary angiography (CAG) remains the gold standard for CAD evaluation, multidetector computed tomography coronary angiography (MDCT) has recently emerged as a non-invasive test to assess CAD. Coronary computed tomography angiography (CTA) offers accurate, rapid, and non-invasive delineation of the extent and severity of anatomic CAD. Single- and multicenter studies have demonstrated that coronary

CTA has high sensitivity and negative predictive value for excluding significant CAD[1,2,3].

Since 1999, Multi-Slice Computed Tomography (MSCT) has made significant technical advances allowing improvements in its temporal as well as its spatial resolution[(6)]. The acquisition time, detector number, and spatial and temporal resolution of MSCT have continuously improved with each new generation of scanners, resulting in excellent image quality and diagnostic accuracy in the detection of CAD[(5,6,,10,11,15)]. Previous 4-, 16-, and 64-slice MSCT systems used a helical scanning technique with retrospective ECG gating. Subsequently, dual-source CT was introduced with superior temporal resolution and excellent imaging quality as well as increased heart rates[(6,16)]. Simultaneously, developments in MSCT technology have focused on reduction of radiation dose. In particular, the availability of dose modulation and prospective ECG gating have drastically reduced patient radiation dose[(6,29,30)]. Recently, the 640-slice CTA systems were introduced allowing image acquisition. Continuous technological advances in hardware acquisition and software processing are steadily improving its accuracy in the detection of coronary artery obstruction.

Coronary artery bypass graft (CABG) is frequently performed in order to restore myocardial perfusion in patients with severe triple vessel disease (TVD) or left main coronary artery stenosis[(4,18)]. At present, CAD is the standard of reference for the detection of stenosis CAD in patients with prior CABG. However, CAG is associated with a small but non-negligible risk of complications, patient discomfort, and cost of hospital stay[(4,19)]. As a result, a non-invasive investigation to assess patient after CABG may be of clinical benefit in selected patient.

The diagnostic performance of CTA for the evaluation of patients with prior CABG has increased with each new generations of CT equipment[(4,20)]. When using older generation equipment such as the 16-slice CTA, high diagnostic accuracy was reported in the assessment of graft patency and significant stenosis [(4,21,22,23)], while the assessment of significant stenosis in native coronary arteries remained suboptimal[(4,24,25,26)]. When using the 64-slice CTA, the efficacy of CTA in the detection of significant stenosis in native coronary arteries and graft improved, with fair diagnostic accuracy in the detection of graft and native vessel stenosis, but still at the cost of high radiation and contrast doses[(4,5,27,28)]. The 320-slice CT accuracy was introduced for evaluation of CAD with reducing radiation burden, scan time, and contrast volume for previous CABG patients[(7,9)].

According to ESC guideline 2011, coronary CTA is considered as Class IIa (LOE B) recommendation in low to intermediate likelihood of CAD patients suspected of acute coronary syndrome but inconclusive of cardiac enzyme and ECG, alternative to CAG.

Recently, the 640-slice computed tomography angiography emerged as a non-invasive modality. It has technological advances for evaluation of CAD. With high spiral and temporal resolution, the 640-slice CTA is proposed as an alternative modality for ACS diagnosis. The purpose of the present study is to evaluate the diagnostic accuracy of the 640-slice CTA for detecting angiographically significant CAD and compare the result with conventional coronary angiography, which is recognized as a standard of reference.

Methods

Patient population

The patient population consisted of 74 consecutive patients (58 males and 16 females with a mean age of 6710 years) who received both the 640-slice CTA and the conventional coronary angiography at Phramongkutklao Hospital. Among 74 patients, 11 patients had previous CABG and 11 patients had previous percutaneous coronary intervention (PCI). Inclusion criteria were age ≥20 years. Table 1 presents baseline characteristics of the study population.

Computed tomography coronary angiography acquisition

CTA studies were performed by ECG gate volumetric 640-slice CTA scanner (Aquilion ONE, Toshiba Medical System, Otawara, Japan) with 320 detector rows, each 0.5

mm wide. Metoprolol, 50 to 100 mg orally, was prescribed prior to acquisition if baseline patient's heart rate exceed 65 bpm, unless contraindication. In addition, nitroglycerine oral spray (1.25 mg Isoket®) just before CTA acquisition, if tolerated. The entire heart was imaged within single heart beat, with maximum of 16 cm craniocaudal coverage. Prospective scan mode was used in most of the cases. Phase window was set at 70 to 80% of R-R interval. Retrospective scan mode was performed in patients who required LV function measurement.

Tube voltage was set at 100 kv and maximal tube current was 400 to 580 mA (depending on body weight and thoracic anatomy). A bi-phasic contrast injection protocol was used and the average total amount of non-ionic contrast media (Ultravist 370, Bayer UK) was 45 mL, which was injected into the antecubital vein with flow rate 5.0 mL/s then immediately followed by a saline flush of 40 mL injected with a dual syringe injector. In order to synchronize the arrival of the contrast media and the scan, bolus arrival was detected using automated peak enhancement detection at the descending aorta using a threshold of +300 Hounsfield units. All images were performed during an inspiratory breath-hold. A data set was initially reconstructed at 75% of R-R interval, with 0.5 mm of slice thickness and a reconstruction interval of 0.25 mm. For processing and evaluation, images were transferred at remote workstation with dedicated software (Vitrea fx 1.0, Vital Images, MN, USA). During the CTA examination, mean HR (+SD) was 6712 bpm. Radiation dose was quantified with a dose–length product conversion factor of 0.014.

In both venous grafts and arterial grafts, CTA was performed with graft protocol; the coverage was extended to proximal of origin of internal mammary aterial graft from subclavian artery.

Computed tomography coronary angiography images analysis

CTA images analysis was performed by one CTA experienced cardiologist who was blinded to the invasive coronary angiography result. Firstly, three-dimensional volume rendered reconstructions were used to obtain general information regarding the status and anatomy of coronary arteries and grafts. Subsequently, axial slices and multiplanar curred reconstruction were visually examined for the presence of significant luminal narrowing of ≥ 50% and ≥ 70% reduction of luminal diameter as recommended by the SCCT guidelines for the interpretation and reporting of CTA[29]. Coronary anatomy was assessed in a standardized manner by dividing the coronary artery tree into 17 segments according to a modified American Heart Association classification[30]. Degree of luminal stenosis was assessed according to Goldstein et al[31]. It is described as minimal = 1 to 25% luminal stenosis, mild = 25 to 50% luminal stenosis, moderate = 51 to 70% luminal stenosis, severe = 71 to 99% luminal stenosis, and total occlusion = 100% luminal stenosis. Bypass graft luminal stenosis were analyzed as native vessel. Calcium score were recorded in all patients except in CABG. Plaque types was also recorded as calcified, non-calcified, and mixed plaque. Of note, the presence of in-stent stenosis was identified by reduced or complete absence of contrast within the stent as well as reduced or absent runoff of contrast distally to the stented segment.

Conventional coronary angiography analysis

Invasive coronary angiography was performed according to standard techniques. Angiograms were assessed by an experienced interventionists blinded to the results of CTA data. The available coronary segments were identified on the basis of the American Heart Association guidelines. The same segmental model was used in both coronary angiography and CTA analysis. Subsequently, all segments were visually classified as no luminal stenosis, less than 50% luminal narrowing, 50 to 70% luminal narrowing, and more than70% luminal stenosis. Each segment was described as significant luminal stenosis if presence of more than 50% and more than 70% luminal diameter reduction.

Statistical analysis

CTA results were compared with CAG analyses, segment-by-segment, and vessel–by-vessel. Sensitivity, specificity, PPV NPV, including 95% confidence intervals (CI), for the detection of greater than 50% and greater than 70% luminal narrowing each segment were calculated. Continuous data were expressed as mean+SD. Statistical analyses were performed using SPSS software version 17 (SPSS, Inc., Chicago, IL, USA). A value of P< 0.05 was considered statistically significant and all reported P-values were two-sided.

Results

Study population

Seventy-four patients were enrolled in this study. The clinical baseline characteristics of patient population are shown in ***Table 1***. Most of the patients were male and mean age was 6710 years. Most underlying disease were dyslipidemia, hypertension, diabetes, and ESRD. Seven percent of the patients were still smoking. Eleven patients had previous PCI and 11 patients were previous CABG. Average HR during image acquisition was 68±12 bpm.

Detection of significant coronary arteries and grafts stenosis

Sixty-three patients had 641 vessels and 2,564 segments evaluated. Interpretation of main branches vessels were described as left main coronary artery (LM), left anterior descending artery (LAD), left circumflex artery (LCX), and right coronary artery (RCA). Subsequently, branches were described as diagonal branches (DG), obtuse marginal branches (OM), ramus intermediate (ramus), posteriolateral branches (PL), and posterior descending artery (PDA). Among 11 patients with previous CABG, 31 grafts were assessed. Most bypass grafts were saphenous vein graft connected to OM or PDA and most arterial grafts were left internal mammary artery (LIMA) connected to LAD or DG.

Calcium score was investigated in all patients except CABG patients. They were varying in calcium scoring between 0 to 6,317. Intracoronary plaque types were categorized as calcified, non-calcified, and mixed plaque. Calcium scoring and intracoronary plaque types were shown in ***supplementary appendix.***

Table 1 Baseline characteristics of patients (n = 74)

Characteristics	Value
Men/women	58/16
Age (years)	67±10
DM, n(%)	31 (41.9%)
HT, n(%)	69 (93.2)
DLP, n(%)	74 (100%)
ESRD, n(%)	5 (6.8%)
Smoking, n(%) Current	7 (9.5%)
Family history of CAD	3 (4.1%)
Previous PCI	18 (24.3%)
Previous CABG	11 (14.9%)
PPM or ICD	1 (1.4%)

Primary and secondary effectiveness end points

Out of 63 patients with CTA examination, 65 segments were excluded from the study due to densely calcified coronary vessels and motion artifact from extra-systole during image acquisition. Importantly, on patient basis, no patient with significant coronary artery stenosis was missed by CTA when compared with CAG. Because of the overall accuracy of detection luminal stenosis, the sensitivity and specificity of detection of the greater than 50% luminal narrowing were 100% and 100% respectively. In addition, the PPV and NPV were 81% and 100% respectively. In the detection of greater than 70% luminal narrowing, sensitivity, specificity, PPV,and NPV were 100%, 99%, 92%, and 100%, respectively. An overview of diagnostic accuracy of the greater than 50% and greater than 70% luminal stenosis were shown in ***Figure 1***. According to main vessels and branches analysis, results for the detection of luminal narrowing were shown in ***Figure 2 and Figure 3***.

Furthermore, the sensitivity, specificity, PPV and NPV among bypass graft were 98%, 100%, 100%, and 100% , respectively, as shown in ***Figure 4 and Figure 5***.

Figure 1.

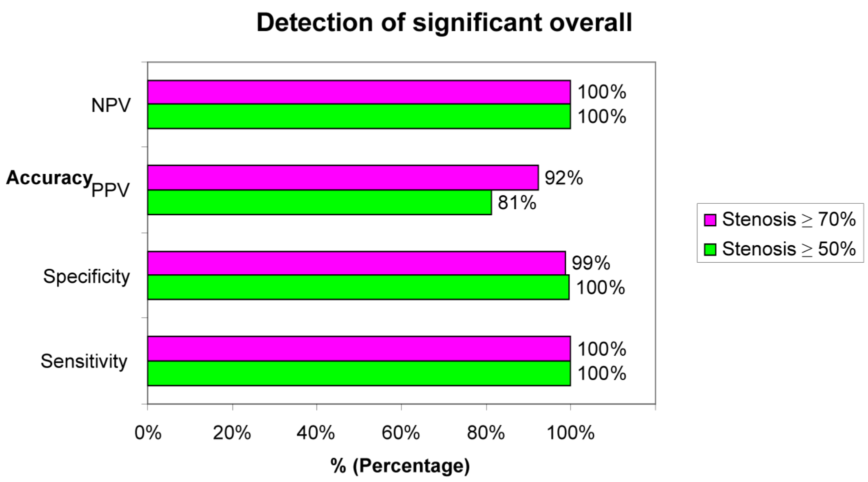


Figure 2.

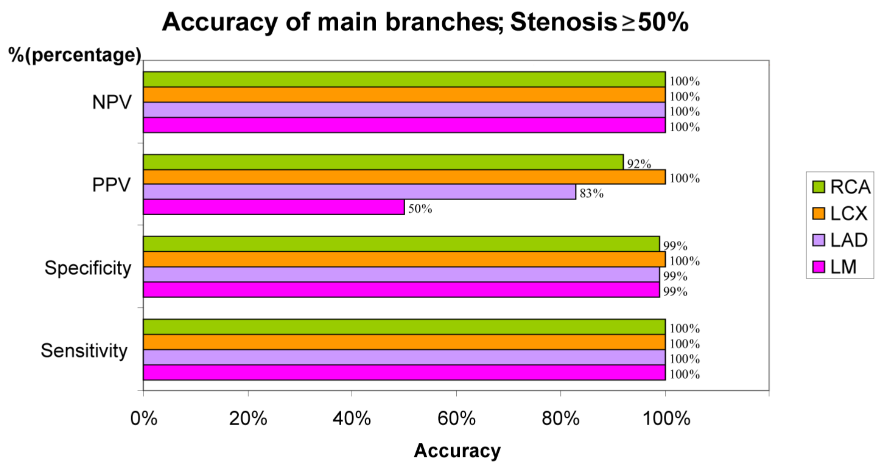


Figure 3.

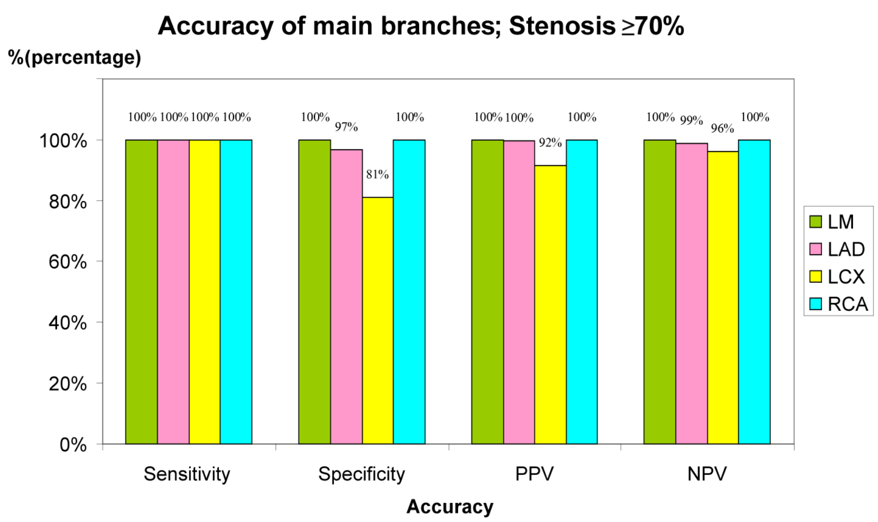


Figure 4.

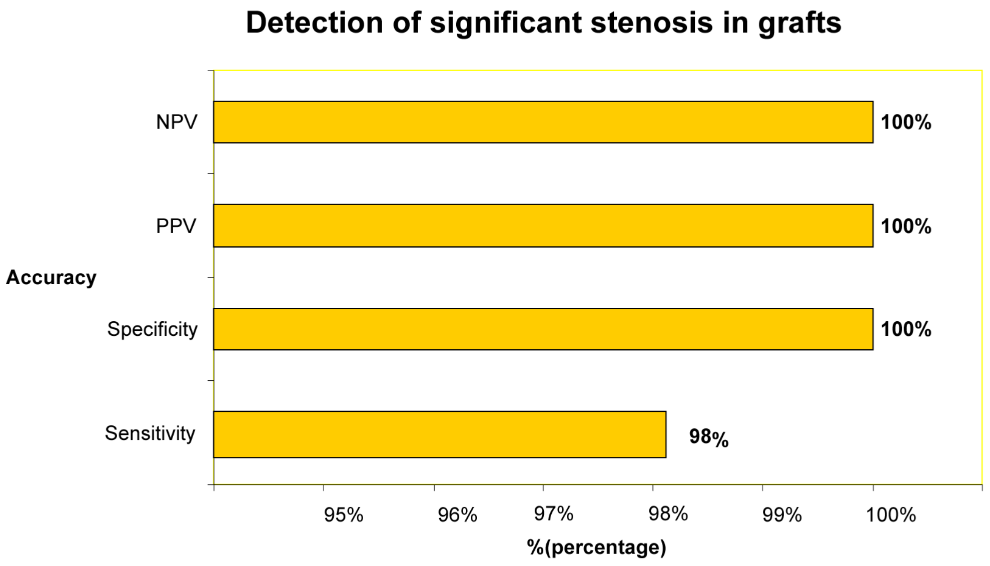
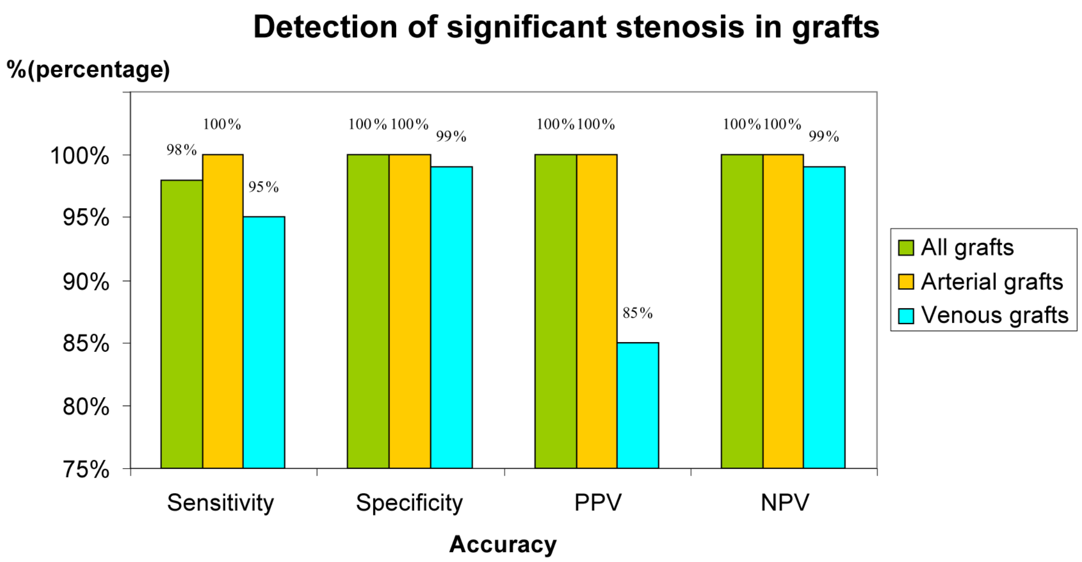


Figure 5.



Discussion

The present study demonstrated excellent diagnostic accuracy of 640-slice CTA for detection of significant coronary stenosis and graft occlusion.

Detection of coronary arteries and graft vessel stenosis

Only 2.5% of vessels were uninterpretable due to heavy calcification and artifact. Overall graft vessels were good imaging for evaluation.

Our study results are better than prior data, obtained from previous generation scanner, including 64-slice CTA and 320-slice CTA[2,8]. Importantly, no patients with significant CAD were missed when using 640-slice CTA. Our study also showed the great result of main branches analysis, the excellent sensitivity for detection of greater than 50% luminal stenosis was 100% and 100% negative predictive value. Furthermore, sensitivity detection of greater than 70% luminal stenosis was 100% and 96% of negative predictive value. Compared with previous study from

64-slice CTA, in all vessels, sensitivity was 94.9% and negative predictive value was 99%(8). Similar to the diagnostic accuracy of 320-slice CTA, the detection of greater than 50% luminal stenosis was 100% in sensitivity and 100% in negative predictive. However, when using the 320-slice CTA the detection of Greater than 70% luminal stenosis was only 94% in sensitivity and 98% negative predictive value, little difference from our study.

In grafts analysis, although evaluation was good, in present study, the assessment of native vessels was not recorded for interpretation.Slightly higher diagnostic accuracy for detection of grafts and native vessels has been reported when using other novel CTA technologies.

Weustink et al., using dual-source CTA in 52 patients with prior CABG, reported excellent accuracy in 100% in evaluation of graft stenosis on a segment basis [32].

From previous study, the diagnostic performance of the 320-slice multidetector CTA on CABG patients, sensitivity, specificity, PPV, and NPV were 96%, 92%, 83%, and 98%, respectively. Our study showed that 640-slice CTA has high resolution and technical processing imaging, so the results in detection of grafts stenosis were also excellent, with 98% sensitivity, 100% of specificity, 100% PPV, and 100% NPV.

Clinical implication

Invasive coronary angiography remains gold standard for diagnosis of CAD in native vessels and grafts[17]. However, from previous CABG patients whom only graft visualization is required, CTA may omit the need for repeat of coronary angiography. CTA may be considered as a useful alternative investigation in patients that ICA should be avoided due to a higher risk of procedural complications. In addition, in patients with a history of CABG, CTA may provide anatomical information prior to PCI. CTA may also be useful for pre-surgical evaluation in patients undergoing re-operative cardiac surgery. Moreover, CTA is a rapid and comprehensive representation of complex anatomy and can be used in patients with incomplete surgical history, in whom precise graft anatomy is unknown. In clinical practice, CTA is used as a non-invasive alternative to coronary angiography in carefully selected patients with suspected ACS and to rule out CAD[12,13,14,17].

Study limitations

From initial results, the limitations of the present study should be considered. First, this is a descriptive observational study with retrospective data. Secondly, data was recorded and analyzed from patients who were both investigated with 640-slice CTA and Conventional CAG so high calcium score was recorded. If vessels or segments were high calcium score, the interpretation by CTA was difficult from heavy calcification and artifact. Thirdly, because it is a retrospective study, data correction was recorded from OPD and IPD information and might be missed. Fourthly, as a single-center study, the generalizability of the present results is limited. Fifthly, as CTA and invasive coronary angiography analysis were performed blinded, differences in segment and small vessel allocation may have occurred. Lastly, in the retrospective study, patients who had negative result with the 640-CTA were not futher investigated with conventional CAG.

Conclusion

The present study demonstrated an excellent diagnostic accuracy of the 640-slice CTA as a non-invasive modality for detection luminal narrowing of coronary artery and grafts when compared with invasive coronary angiography. High negative predictive value is suggested to be used for exclusion of CAD.

Acknowledgments

I would like to thank all those participating patients who made this study possible. I thank my advisor and co-investigators, Hutsaya Prasitdumrong, MD. for her invaluable suggestion and encouragement in all parts of this study. I also thank my co-advisors; Pachum Tasukon MD., Prasart Laothavorn MD.MRCP., associate professor Chumpol Piamsomboon MD.FACC., assistant professor Sopon Sanguanwong MD., Charnnarong Naksawadi MD.

FACC., Preecha Uerojanaungkul MD., assistant professor Nakarin Sansanayudh MD., Verapon Pinphanichakarn MD., Thoranis Chantrarat MD.MRCP., Waraporn Tiyanon MD., and Tanyarat Aramsaruwong, MD. for their suggestions and support.

We thank all coordinators, Miss Dollapas Punpanich and Miss Salinee Samthong (statistical consultant), echocardiography unit staff, cardiology outpatient clinic staff, coronary angiography unit staff, and computed tomography unit staff for their work in completing the study.

Supplementary appendix

Table 2 Calcium scoring (Agatston Score)

	N	%	Mean	SD.	Median	Min	Max
Ca_score_LM	63	85.1%	56.13	96.42	0	0	409
Ca_score_LAD	63	85.1%	221.16	304.61	141	0	1558
Ca_score_DG1	63	85.1%	8.89	50.43	0	0	386
Ca_score_DG2	63	85.1%	0.4	1.8	0	0	9
Ca_score_LCX	63	85.1%	177.56	351.57	46	0	1803
Ca_score_OM1	63	85.1%	0.11	0.88	0	0	7
Ca_score_OM2	63	85.1%	0.11	0.88	0	0	7
Ca_score_Ramus	10	13.5%	46.1	71.34	0	0	195
Ca_score_RCA	63	85.1%	279.16	620.48	65	0	3883
Ca_score_PL	63	85.1%	0.14	1.13	0	0	9
Ca_score_PDA	63	85.1%	1.29	9.12	0	0	72
Ca_score_Total	63	85.1%	759.81	1162.21	383	0	6317

Table 3 Plaque types

Variables	Mixed		Calcified		Non-calcified	
	Yes, n (%)	No, n (%)	Yes, n (%)	No, n (%)	Yes, n (%)	No, n (%)
Plaque_LM	6 (8.5%)	65 (91.5%)	22 (31%)	49 (69%)	7 (9.9%)	64 (90.1%)
Plaque_LAD	30 (42.3%)	41 (57.7%)	33 (46.5%)	38 (53.5%)	12 (16.9%)	59 (83.1%)
Plaque_DG1	6 (8.5%)	65 (91.5%)	13 (18.3%)	58 (81.7%)	4 (5.6%)	67 (94.4%)
Plaque_DG2	1 (1.4%)	70 (98.6%)	2 (2.8%)	69 (97.2%)	1 (1.4%)	70 (98.6%)
Plaque_LCX	19 (26.8%)	52 (73.2%)	31 (43.7%)	40 (56.3%)	4 (5.6%)	67 (94.4%)
Plaque_OM1	3 (4.2%)	68 (95.8%)	7 (9.9%)	64 (90.1%)	0 (0%)	71 (100%)
Plaque_OM2	0 (0%)	71 (100%)	3 (4.2%)	68 (95.8%)	0 (0%)	71 (100%)
Plaque_Ramus	0 (0%)	14 (100%)	5 (35.7%)	9 (64.3%)	1 (7.1%)	13 (92.9%)
Plaque_RCA	23 (32.4%)	48 (67.6%)	33 (46.5%)	38 (53.5%)	14 (19.7%)	57 (80.3%)
Plaque_PL	0 (0%)	71 (100%)	2 (2.8%)	69 (97.2%)	2 (2.8%)	69 (97.2%)
Plaque_PDA	2 (2.8%)	69 (97.2%)	2 (2.8%)	69 (97.2%)	2 (2.8%)	69 (97.2%)

References

1. Pierre A, Ruthmarie S, P. Charbel A, et al. Diagnostic accuracy of non-invasive coronary angiography by multi-slice computed tomography. Rochester medical center, Rochester, MI.
2. MasanoNaya, Venkatesh L. Murthy, Ron Blankstein, et al. Quantitative relationship between the /extent and morphology of coronary atherosclerotic plaque and downstream myocardial perfusion. Journal of the American College of Cardiology. 2011;58:1807-1816.
3. Blankstein R, Di Carli MF. Integration of coronary anatomy and myocardial perfusion imaging. NatureReveiwsCardiology. 2010;7226-7236.
4. Fleur R. de Graaf, Jölla E. van Velzen, Agnieszka J. Witkowska, et al. Diagnostic performance of 320-slice multidetector computedtomography coronary angiography in patients after coronary artery bypass grafting. European Radiology. 2011;21:2285–2296.
5. Paul D. Stein, Abdo Y. Yaekoub, FadiMatta, et al. 64-Slice CT for diagnosis of coronary artery disease: A systematic review. The American Journal of Medicine. 2008;121:715-725.
6. F.R. de Graaf, J.D. Schuijf, V. Delgado, et al.Clinical application of CT coronary angiography: State of the art. Heart Lung and Circulation. 2010;19:107–116.
7. Qin J, Zhu KS, Liu LY, et al. Initial application of coronary images from 320-slice dynamic volume MDCT.Journal of the Chinese Medical Association. 2010;90(7):478-81.
8. G Mowatt,E Cummins, N Waugh, et al. Systematic review of the clinical effectiveness and cost-effectiveness of 64-slice or higher computed tomography angiography as an alternative to invasive coronary angiography in the investigation of coronary artery disease. Health Technology Assessment. 2008;12:17.
9. Edward M. Hsiao, Frank J.Rybicki, Michael Steigner. CT coronary angiography: 256-slice and 320-detector row scanners. Current Cardiology Reports. 2010;12:68–75.
10. D. Muenzel, P. B. Noel, F. Dorn, et al. Step and shoot coronary CT angiography using 256-slice CT: effect of heart rate and heart rate variability on image quality. EuropeanRadiology. 2011 ;21:2277–2284.
11. Wang Z, Ding ZX, DI XB, Yuan JH, et al. Initial experience of 640-slice CTcoronary angiography in pacemaker patients. Journal of the Chinese Medical Association.2011;39(8):721-724.

12. G. Koulaouzidis, A. Powell, K. Wong, et al. The use of CT coronary angiography in a community rapid access chest pain clinic. European Heart Journal. 2011. Abstract Supplement.
13. Udo Hoffmann, Quynh A. Truong, David A Schoenfeld, et al. Coronary CT angiography versus standard evaluation in acute chest pain. New England Journal of Medicine. 2012;367:299-308.
14. Fleur R. de Graaf, Joanne D. Schuijf, Joella E. van Velzen, et al. Diagnostic accuracy of 320-rowmultidetector computed tomography coronary angiography in the non-invasive evaluation of significant coronary artery disease. European Heart Journal. 2010;31:1908–1915.
15. Roberts WT, Bax JJ, Davies LC, et al. Cardiac CT coronary angiograghy: technology and application. Heart. 2008;94(6): 781-792.
16. Achenbach S, Ropers D, Kuettner A, et al. Contrast-enhanced coronary artery visualization by dual-source computed tomography-initial experience. European Journal of Radiology. 2006;57(3):331-335.
17. Eduard G, Diana L, Robert D. 16-MDCT Coronary angiography versus invasive coronary angiography in acute chest pain syndrome. American Journal of Roentgenology.2006;186:177–184.
18. Serruys PW, Morice MC, Kappetein AP, et al. Percutaneouscoronary intervention versus coronary-artery bypassgrafting for severe coronary artery disease. New England Journal of Medicine. 360;961–972.
19. Elhendy A, van Domburg RT, Bax JJ, et al. Dobutamine-atropine stress myocardial perfusionSPECT imaging in the diagnosis of graft stenosis after coronaryartery bypass grafting. Journal of Nuclear Cardiology. 1998;5:491–497.
20. Stein PD, Beemath A, Skaf E, et al. Usefulness of 4-, 8-, and 16-slice computed tomographyfor detection of graft occlusion or patency after coronaryartery bypass grafting. American Journalof Cardiology. 2009;96:1669–1673.
21. Stauder NI, Kuttner A, Schroder S, et al. Coronary arterybypass grafts: assessment of graft patency and native coronaryartery lesions using 16-slice MDCT. European Radiology. 2006;16: 2512–2520.
22. Schlosser T, Konorza T, Hunold P, et al. Noninvasive visualization of coronary arterybypass grafts using 16-detector row computed tomography. Journal of the American Collegeof Cardiology. 2004;44:1224–1229.
23. Martuscelli E, Romagnoli A, D'Eliseo A, et al.Evaluation of venous and arterial conduit patency by 16-slicespiral computed tomography. Circulation.2004;110:3234–3238.
24. Khan MF, Herzog C, Landenberger K, et al. Visualisation of noninvasivecoronary bypass imaging: 4-row vs 16-row multidetectorcomputed tomography. European Radiology. 2005;15:118–126.
25. Andreini D, Pontone G, Ballerini G, et al. Bypass graft and native postanastomoticcoronary artery patency: assessment with computed tomography. The Annalsof Thoracic Surgery. 2011;83:1672–1678.
26. Salm LP, Bax JJ, Jukema JW, et al. Comprehensive assessment of patients after coronary artery bypass grafting by 16-detector-rowcomputed tomography. American Heart Journal. 2011;150: 775–781.
27. Hamon M, Lepage O, Malagutti P, et al. Diagnostic performance of 16-and 64-section spiral CT for coronary artery bypass graftassessment: meta-analysis. Radiology.2008;247:679–686.
28. Nazeri I, Shahabi P, Tehrai M, et al. Assessment of patients after coronary artery bypass grafting using64-slice computed tomography. American Journal of Cardiology. 2009;103:667–673.
29. Raff GL, Abidov A, Achenbach S, et al. SCCT guidelines for the interpretationand reporting of coronary computed tomographic angiography. Journal Cardiovascular Computed Tomography. 2009;3:122–136.
30. Austen WG, Edwards JE, Frye RL, et al. A reporting system on patients evaluated for coronaryartery disease. Report of the Ad Hoc Committee for Grading of Coronary Artery Disease. Circulation. 1975;51:5–40.
31. Goldstein, Michael, et al. A randomized controlled trial of multi-slice coronary computed tomography for evaluation of acute chest pain.Journal of the American Collegeof Cardiology. 2007;49:863-871.
32. Weustink AC, Nieman K, Pugliese F, et al. Diagnostic accuracy of computed tomography angiographyin patients after bypass grafting: comparison with invasivecoronary angiography. JACC: Cardiovascular Imaging. 2009;2:816-824.

การศึกษาความแม่นยำในการวินิจฉัยโรคหลอดเลือดหัวใจโคโรนารี่ตีบหรืออุดตัน จากการตรวจด้วยเครื่องเอ็กซเรย์คอมพิวเตอร์ 640 สไลด์ เปรียบเทียบกับวิธีมาตรฐาน คือการสวนหลอดเลือดหัวใจโคโรนารี่

สุรางคนา ดวงสุวรรณ, พบ.[1], มนตรี เจริญพานิชสันติ, พบ.[1], ฆนินทร สุนทรธาดา, พบ.[1], นครินทร์ ศันสนยุทธ, พบ.[1], ปชุม ทาสุคนธ์, พบ.[1], ประสาท เหล่าถาวร, พบ.[1], ชุมพล เปี่ยมสมบูรณ์, พบ.[1], โสภณ สงวนวงษ์, พบ.[1], ชาญณรงค์ นาคสวัสดิ์, พบ.[1], ปรีชา เอื้อโรจน์อังกูร, พบ.[1], วราภรณ์ ติยานนท์, พบ.[1], ธรณิศ จันทรารัตน์, พบ.[1], วีรพร ปิ่นพานิชการ, พบ.[1], ธัญรัตน์ อร่ามเสรีวงศ์, พบ.[1], หัสยา ประสิทธิ์ดำรง, พบ.[1]

[1]ศูนย์หัวใจสิรินธร หน่วยโรคหัวใจและหลอดเลือด กองอายุรกรรม โรงพยาบาลพระมงกุฎเกล้า

บทคัดย่อ

วัตถุประสงค์การศึกษา: เพื่อศึกษาความไว ความจำเพาะและความแม่นยำในการวินิจฉัยโรคหลอดเลือดหัวใจโคโรนารี่ตีบหรืออุดตันโดยการตรวจด้วยเครื่องเอ็กซเรย์คอมพิวเตอร์ 640 สไลด์ เปรียบเทียบกับการสวนหลอดเลือดหัวใจโคโรนารี่ในโรงพยาบาลพระมงกุฎเกล้า

ความสำคัญของปัญหา: แม้ว่าการสวนหลอดเลือดหัวใจโคโรนารี่ได้รับการยอมรับว่าเป็นวิธีมาตรฐานในการวินิจฉัยหลอดเลือดหัวใจโคโรนารี่ตีบหรืออุดตัน ปัจจุบันมีการใช้เอ็กซเรย์คอมพิวเตอร์ในการตรวจหลอดเลือดหัวใจแพร่หลายมากขึ้นและสามารถตรวจได้โดยผู้ป่วยไม่ต้องนอนโรงพยาบาล

วิธีการศึกษาวิจัย: การศึกษานี้เป็นการศึกษาแบบเก็บข้อมูลย้อนหลัง มีจำนวนผู้ป่วยทั้งหมด 74 คนโดยทุกคนได้รับทั้งการตรวจด้วยเอ็กซเรย์คอมพิวเตอร์แบบ 640 สไลด์ และการสวนหลอดเลือดหัวใจโคโรนารี่ในช่วงระหว่างเดือนมกราคม พ.ศ.2555 และเดือนธันวาคม พ.ศ.2555 โดยนำผลการตีบหรืออุดตันของหลอดเลือดหัวใจแต่ละส่วนและแต่ละเส้นหลักมาวิเคราะห์เทียบกันในทั้งสองวิธี โดยมีการสวนหลอดเลือดหัวใจโคโรนารี่เป็นวิธีมาตรฐานในการเปรียบเทียบ รอยโรคที่ตีบหรืออุดตันจะประเมินความแม่นยำที่ ≥ ร้อยละ 50 และ ≥ ร้อยละ 70

ผลการวิจัย: จากผู้ป่วยทั้งสิ้น 74 คน ผู้ชาย 58 คนและผู้หญิง 16 คน อัตราการเต้นของชีพจรระหว่างการตรวจด้วยเครื่องเอ็กซเรย์อยู่ที่ 67±12 ครั้งต่อนาที 11 รายได้รับการใส่ขดลวดขยายหลอดเลือดหัวใจและ 11 รายได้รับการผ่าตัดบายพาส ในการประเมินความแม่นยำโดยการตรวจด้วยเอ็กซเรย์คอมพิวเตอร์แบบ 640 สไลด์ พบว่าที่การตีบของหลอดเลือดหัวใจมากกว่าร้อยละ 50 มีความไว ความจำเพาะ PPV และ NPV 100%, 100%, 81% และ 100% ตามลำดับ ส่วนการตีบของหลอดเลือดหัวใจมากกว่าร้อยละ 70 มีความไว ความจำเพาะ PPV และ NPV 100%, 99%, 92% และ 100% ผู้ป่วยที่ได้รับการผ่าตัดหลอดเลือหัวใจบายพาสพบว่ามีความแม่นยำคือความไว ความจำเพาะ PPV และ NPV 98%, 100%, 100% และ 100% ตามลำดับ

สรุปผลการวิจัย: การตรวจวินิจฉัยโรคหลอดเลือดหัวใจโคโรนารี่ตีบหรืออุดตันด้วยเครื่องเอ็กซเรย์คอมพิวเตอร์แบบ 640 สไลด์ ก็เป็นเครื่องมือใหม่ที่มีความแม่นยำสูงเมื่อเทียบกับวิธีมาตรฐานคือการสวนหลอดเลือดหัวใจโคโรนารี่

คำสำคัญ: เอ็กซเรย์คอมพิวเตอร์แบบ 640 สไลด์