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Research Article

CT Angiography: Our Initial Experience on 128 Slice CT

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Abstract: CT (Computed tomography) angiography is a fast, noninvasive, affordable and reasonably accurate imaging investigation in the assessment of arteries. We report our institutional experience regarding CT angiography on 128 slice CT scanner. This is a hospital based retrospective study done in our department as per data collected during September 2014 to April 2015. All angiographies were done on 128 slice Toshiba Aquilion CXL CT scanner. Data was collected regarding the demographics, referring department, type of CT angiography, patient's operative status and result of the CT angiography procedure. Cardiovascular thoracic surgery department was most common referring department and CT angiography of postoperative patients were most commonly performed and advised procedure in our study. Despite of significant burden of ischemic heart disease patients, preoperative CT coronary angiographies were not being commonly advised by the cardiologists in our institute. Abnormal angiography results were noted in 59 cases. CT angiography is a valuable, noninvasive imaging investigation in the preoperative as well as postoperative patients for arterial assessment as it provides superior 3D (VR, MIP) and 2D (MPR) image display. Still catheter angiography is being preferred over CT angiography in coronary artery disease. We suggest CT angiography as initial imaging investigation in suspected cases of coronary artery disease and subsequent investigation/management should be done as per result of CT angiography.
Keywords: CT angiography, Preoperative, Postoperative, Department

INTRODUCTION

Ultrasound Doppler is an easily available modality to assess carotid, abdominal and peripheral arteries. But it has its own limitations. It is an operator dependent investigation, could not be used to assess intracranial arteries, expert hand is required [1]. MRA (Magnetic resonance angiography) is another noninvasive imaging modality can be use for vascular assessment. But it takes longer time, not easily available and contraindicated in patient with pacemaker and shrapnel in sensitive biological areas [1, 2]. It allows assessment of perfusion, function & viability in same study session without radiation exposure and use of iodinated contrast. MR contrast Gadolinium is required for perfusion & viability scan [2]. Catheter angiography is a gold standard investigation for arterial assessment. But it is invasive examination requiring arterial puncture and intra-arterial catheter manipulation. Associated risk of 1.5 to 2% morbidity & mortality has been reported with catheter angiography [1].

CT (Computed tomography) is noninvasive, fast, safe, affordable investigation with short examination time, hence preferred by most of the patients [1]. Disadvantages are radiation exposure, use of iodinated contrast and over-estimation of stenosis in heavily calcified artery. Single breath hold of 8-10 sec required in 64 slice and 6 sec in 128 slice CT for coronary angiography [2]. CT is capable of producing superior quality 3D angiographic images which are highly appreciated by clinicians and surgeons.

MATERIALS AND METHODS

This is a hospital based, retrospective study conducted in our radiology department. Data was collected from September 2014 to April 2015. Patients referred from various other departments (Cardiovascular thoracic surgery (CVTS), cardiology, chest medicine, gastroenterology etc.) of our institute to our radiology department for CT angiography in whom the requested study was performed were included in our study. Patient in whom CT angiography procedure was not done due to deranged kidney function were excluded from the study.

CT angiographies were done on Toshiba Aquilion CXL 128 slice CT scanner. CT angiography procedure was as follows. Patients were kept NBM for 4 hours before the study. Appropriate size intravenous cannulation was done. Patient positioning was done as per requested CT angiography protocol and contrast dose, rate were set according to patients weight. Desired protocol is selected and instructions were followed. Triggering HU (Hounsfield unit) value is inserted according to the type of angiography requested and ROI (Region of interest) was kept on desired artery. Scan was done by auto-triggering technique. After completion of scan 3D post-processing was done on the workstation. VR, MIP and MPR images were generated with the inbuilt software tools like vessel tools. Vessels were analyzed by the tools in analysis section. Images were saved by snapshot. Patient data was categories as per age, sex, complaints, referring department, operation status, abnormalities detected and subsequent analysis was done.

RESULTS

Total 99 patients were studied. Age distribution was 0-20 years: 4, 20-40 years: 9, 40-60 years: 40, >60: 46. 52 were males and 47 were females. The clinical complaints in our patients were chest pain (61), dyspnea (52), hemiplegia (5), headache (10), abdominal pain (4), claudication (7), malena/bleeding per-rectum (3).

Maximum patients were referred from CVTS department as compare to other departments (cardiology, chest medicine, neurosurgery, and gastroenterology) in our institution. The number of patients referred from various departments for CT angiography is shown in Fig. 1.

Most common angiography procedure done in our department was CT angiography of bypass grafts. Types of CT angiography procedures conducted in our department are shown in Fig. 2.

Postoperative CT angiographies were most commonly performed investigation on our 128 slice CT scanner (Fig. 3). Total 60 postoperative angiography studies were done which includes coronary bypass angiography (49), postoperative aortic (9), carotid (1) and cerebral (1) angiographies. Preoperative CT angiographies were less accounting only 39 (Fig. 3). Preoperative CT angiographies were includes pulmonary angiography (10), aortic angiography (9), peripheral angiography (7), coronary angiography (6), carotid angiography (4) and cerebral angiography (3).

Abnormalities were detected in 59 cases (Fig. 4). Normal angiogram was found in 40 cases of which 36 were of normal coronary bypass graft and four were of other postoperative procedures.

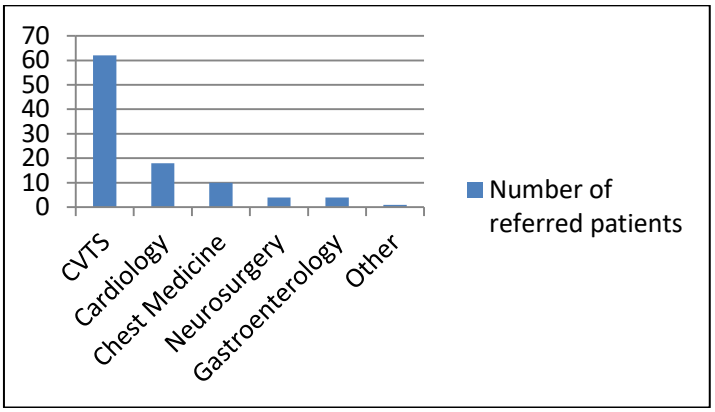

Fig. 1: Bar diagram showing number of department-wise referrals for CTA

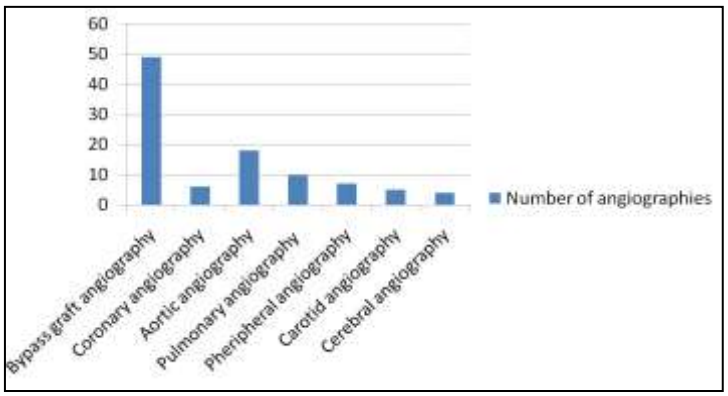

Fig. 2: Bar diagram showing number of different type of CT angiographies performed in our institute

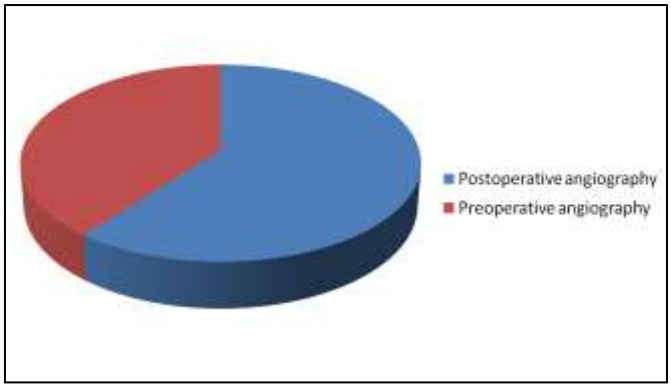

Fig. 3: Pie chart showing preoperative and postoperative CTA

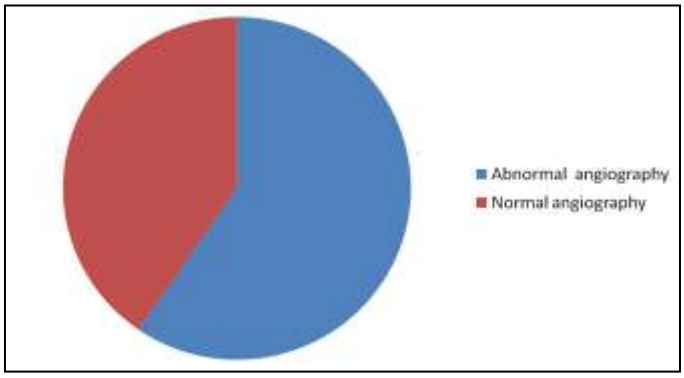

Fig. 4: Pie chart showing abnormal and normal CTA

Fig. 5: A) VR image on right side showing multiple stenotic segments in the RCA. Corresponding MPR image is shown on left side showing stenosis and calcifications. B) VR image of heart showing the LIMA-LAD, SV-OM, SV-PDA grafts. C) MIP image of operated case of ascending aortic aneurysm with coarctation of aorta. Image shows reconstructed ascending aorta with patent graft between left subclavian artery and descending aorta.

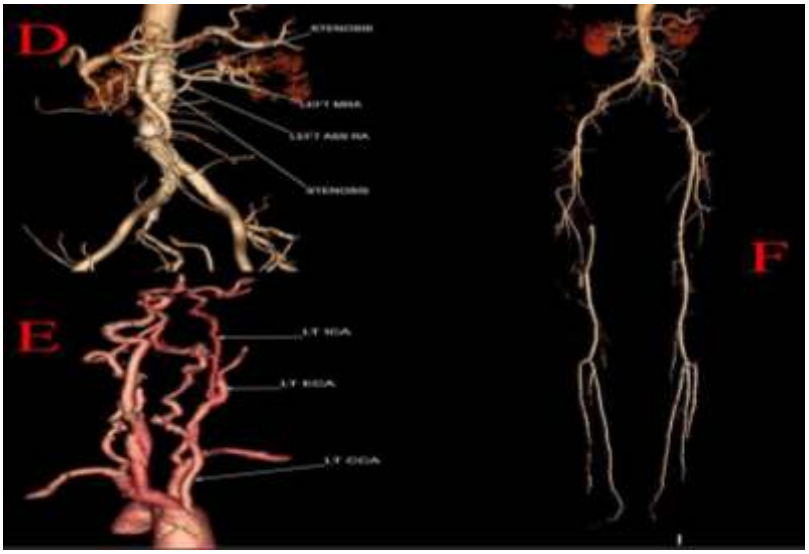

Fig-6: D) VR image of CT abdominal angiography showing ostial stenosis of left main and accessory renal artery. E) VR image of CT carotid angiography showing severe degree long segment stenosis of left internal carotid artery. F) VR image of CT lower limb angiography showing total occlusion of right proximal superficial femoral artery, mid and lower part of left anterior tibial artery and bilateral dorsalis pedis artery.

DISCUSSION

In our study we found >60 year as most common age group because of risk of getting cardiovascular disease with increasing age. CTA (Computed tomography angiography) is also particularly beneficial in older age group as atheromatous and calcific changes in the arterial wall may lead to increase in vascular complications in catheter angiography. Most common clinical complaint was chest pain. Our study group was largely composed of patients with coronary artery disease to whom CTA was advised to detect native artery or graft stenosis. In our study group, most of the patients were postoperative cases of whom largest were coronary artery bypass graft patients.

Initial promising results in the imaging of coronary bypass grafts were reported with the availability of 4 or 16 slice CT scanner and addition of electrocardiography (ECG) gating leading to rapid scanning of the area of interest [3,4]. Thereafter with the introduction of 64 slice multidetector CT (MDCT) scanner with improved temporal & spatial resolution had reported in improved assessment of coronary artery bypass graft stenosis and occlusion [5,6]. Multiple studies on 64 slice MDCT scanner had reported excellent results in the assessment of graft occlusion & high grade stenosis (Table-1). CTA was done in our cases to detect graft stenosis, graft complication and to check distal vasculature. Abnormalities were observed in grafts of 18 coronary artery bypass graft patients.

Table 1: Studies showing sensitivity and specificity of CTA in assessment of graft occlusion and high grade stenosis

Sl. No.	Study	Sensitivity (%)	Specificity (%)
1	Tochii *et al*. (2010) [7]	100	93
2	Dikker *et al*. (2007) [8]	100	99

Higher spatial resolution, shorter examination time, patient preference with higher diagnostic performance CTA is preferred over MRA for patients having low to intermediate probability of coronary artery disease [2]. Also in patients with high likelihood of coronary artery disease, CT angiography is helpful in differentiation of patient requiring or not requiring revascularization [9]. Hence CTA has potential to limit the patients without any obstructive coronary artery disease from undergoing an invasive procedure of catheter angiography.

Dewy et al had reported sensitivity of 97%, specificity of 87% for CTA & sensitivity of 87% & specificity of 70% for MRA in detection of coronary artery stenosis [2]. Ozgun *et al*. had reported sensitivity, specificity and accuracy of 96%, 96%, 96% respectively for CTA & 85%, 88%, 87% respectively for MRA [10]. Not only postoperative patients, but also in preoperative cases CTA can help the treating physician in accurate diagnosis and follow up. Most of the patients of suspected coronary artery disease (CAD) were evaluated by the catheter angiographies in the cardiology department of our institute. Hence the

referral of the patients from cardiology department is less. Only six CAD cases were referred for preoperative CT coronary angiography (CTCA). CTCA can help the cardiologist to reduce the excessive burden of catheter angiography. CTCA can be done as screening test in suspected cases of CTA and based on the findings of CTCA further management should be done. Because of noninvasive nature of the procedure patients were cooperative for the CTCA. Vascular complications which can occur in catheter angiography were not happened in CTA. Contrast related complications were expected in CTA but no such complications were reported in our study. MRA should be done for imaging in coronary artery disease in heavily calcified arteries [2].

Hurst *et al*. had reported higher sensitivity of CTA (76% & 64%) compare to MRA (52% & 48%) in cases of pulmonary embolism. Specificity was reported to be high for both modalities (98.8%-99.6%) [11]. Four cases of pulmonary thrombosis/embolism were detected in our study.

Peripheral angiographies were referred from CVTS and cardiology department having history of claudication and abnormality on doppler. In our study arterial stenosis/occlusion were noted with collateral formations in all cases of peripheral angiographies. According to Collins et al, for significant stenosis in whole leg CTA showed sensitivity of 89-99% & specificity of 83-97%, whereas contrast enhanced MRA (CEMRA) showed sensitivity of 92-99.5% & specificity of 64-99%. They also reported catheter angiography as most uncomfortable investigation followed by CEMRA. CTA was reported to be least uncomfortable [12].

Patient referred from neurosurgery were of subarachnoid hemorrhage with suspected aneurysm. CTA provides details about location, size of aneurysm and circle of Willis. Out of total 4 cases of cerebral angiographies 3 preoperative cases showed aneurysm and one postoperative case showed obliteration of previous aneurysm. White et al had showed CTA sensitivity of 57% for <5mm aneurysm & 94% for >5mm aneurysm. MRA showed sensitivity of 35% for <5mm aneurysm & 86% for >5mm aneurysm. Overall accuracy was 73% for CTA & 67% for MRA [13]. There is a significant role of 3D rotational CTA in detection of aneurysm not completely occluded by surgical clipping & in follow up of size of aneurysm remnant.

Excellent correlation of CTA has been observed with catheter angiography in the differentiation between total and near total occlusion of internal carotid artery (ICA) [14]. Chen et al had suggested CTA as a substitute to catheter angiography in differentiation between total and near total occlusion of ICA [14]. CTA is also as important investigation to assess postoperative status of carotid arteries. Out of 5 cases of carotid angiographies, one was postoperative showing the no abnormality and 4 were preoperative showing carotid stenosis.

Patients from gastroenterology departments were of gastrointestinal bleed where cause was not found on endoscopy and patients of portal hypertension with suspected aneurysm on doppler. Renal angiography patients were referred from cardiology department in whom there is suspicion of renal artery stenosis on doppler. Continuing advances in CT scanner with facility of ECG gating has improved the image quality & overall assessment (including measurement) of pre & postoperative aorta [15]. In our study we evaluated 18 patients of aortic angiography of them 9 patients were preoperative showing abnormalities like coarctation of aorta, aneurysm, takayashu arteritis, renal artery stenosis, other aortic branches thrombosis/stenosis. Rest 9 postoperative patients showed patency of grafts.

MPR (Multiplaner reformation) provides 2D image display with structural details. Quantitative analysis, simplified image interpretation are advantages of MPR. But disadvantage is that it has limited spatial resolution [16]. VR (Volume rendered) & MIP (Maximum intensity projection) both has 3D angiographic display. MIP has improved depiction of small caliber & poorly enhanced arteries. Visualization in MIP is degraded by high density structure. VR has accurate spatial resolution but it dependent on opacity transfer function [16].

CONCLUSION

CTA is an important, safe, affordable, noninvasive, reliable, fast, reasonably sensitive and specific imaging investigation in assessment of arteries in both preoperative & postoperative patients. Postoperative angiographies were common in our study as it does coronary graft evaluation noninvasively. The cardiologists are still doing catheter angiographies in the most of the suspected cases of CAD. We hope the cardiologist could understand the importance of CTCA in CAD so that unnecessary catheter angiographies could be reduced. We recommend CTCA should be used as initial screening modality in all CAD patients. CTA is not only important for the CVTS surgeons and cardiologist but also for neurosurgeon & gastroenterologist for detecting various vascular abnormalities. CTA also provides superior quality images in MIP, VR and MPR format giving the clear picture of the disease.

REFERENCES

1. Alam A, Chander BN; Spiral CT angiography: Applications in neurovascular imaging Medical Journal Armed Forces India, 2006; 62(1): 16–19.

2. Dewey M; Coronary CT versus MR angiography: pro CT--the role of CT angiography. Radiology, 2011; 258(2): 329-339.
3. Marano R, Storto ML, Merlino B, Maddestra N, Di Giammarco G, Bonomo L; A pictorial review of coronary artery bypass grafts at multidetector row CT. Chest, 2005; 127(4): 1371-1377.
4. Ueyama K, Ohashi H, Tsutsumi Y, Kawai T, Ueda T, Ohnaka M; Evaluation of coronary artery bypass grafts using helical scan computed tomography. Catheterization and Cardiovascular Interventions, 1999; 46(3): 322-326.
5. Frazier AA, Qureshi F, Read KM, Gilkeson RC, Poston RS, White CS; Coronary artery bypass grafts: assessment with multidetector CT in the early and late postoperative settings. Radiographics, 2005; 25(4): 881-896.
6. Lee R, Lim J, Kaw G, Wan G, Ng K, Ho KT; Comprehensive noninvasive evaluation of bypass grafts and native coronary arteries in patients after coronary bypass surgery: accuracy of 64-slice multidetector computed tomography compared to invasive coronary angiography. Journal of Cardiovascular Medicine (Hagerstown), 2010; 11(2): 81-90.
7. Tochii M, Takagi Y, Anno H, Hoshino R, Akita K, Kondo H *et al*.; Accuracy of 64-slice multidetector computed tomography for diseased coronary artery graft detection. Annals of Thoracic Surgery, 2010; 89(6): 1906- 1911.
8. Dikkers R, Willems TP, Tio RA, Anthonio RL, Zijlstra F, Oudkerk M; The benefit of 64-MDCT prior to invasive coronary angiography in symptomatic post- CABG patients. International Journal of Cardiovascular Imaging, 2007; 23(3): 369-377.
9. Moscariello A, Vliegenthart R, Schoepf UJ, Nance JW, Zwerner PL, Meyer M *et al*.; Coronary CT Angiography versus Conventional Cardiac Angiography for Therapeutic Decision Making in Patients with High Likelihood of Coronary Artery Disease, RSNA 2012; 265(2): 385-392
10. Ozgun M, Rink M, Hoffmeier A, Botnar RM, Heindel W, Fischbach R *et al*.; Intraindividual comparison of 3D coronary MR angiography and coronary CT angiography. Acad Radiol, 2007; 14(8): 910-916.
11. Hurst DR, Kazerooni EA, Stafford-Johnson D, Williams DM, Platt JF, Cascade PN *et al*.; Diagnosis of pulmonary embolism: comparison of CT angiography and MR angiography in canines. J Vasc Interv Radiol, 1999; 10(3): 309-318.
12. Collins R , Cranny G, Burch J, Aguiar-Ibáñez R, Craig D, Wright K *et al*.; A systematic review of duplex ultrasound, magnetic resonance angiography and computed tomography angiography for the diagnosis and assessment of symptomatic, lower limb peripheral arterial disease. Health Technol Assess, 2007; 11(20): 1-184.
13. White PM, Teasdale EM, Wardlaw JM, Easton V; Intracranial Aneurysms: CT Angiography and MR Angiography for Detection—Prospective Blinded Comparison in a Large Patient Cohort1. Radiology, 2001; 219(3): 739-749.
14. Chen CJ, Lee TH, Hsu HL, Tseng YC, Lin SK, Wang LJ *et al*.; Multi-Slice CT angiography in diagnosing total versus near occlusions of the internal carotid artery: comparison with catheter angiography. Stroke, 2004; 35(1): 83-85.
15. Prescott-Focht JA, Martinez-Jimenez S, Hurwitz LM, Hoang JK, Christensen JD, Ghoshhajra BB Abbara S; Ascending Thoracic Aorta: Postoperative Imaging Evaluation. Radiographics: A Review Publication of the Radiological Society of North America, 2013; 33(1): 73-85.
16. Hellinger JC, Pena A, Poon M, Epelmas M; Paediatric CT Angiography: Imaging the cardiovascular system gently. Radiol Clin North, 2010; 48(2): 439-467.