SCIENTIFIC RESEARCH

DIAGNOSIS OF CORONARY ARTERY FISTULAS BY MULTI DETECTOR COMPUTED TOMOGRAPHY

Ngoc Phung Bao[1], Viet Nguyen Khoi[1], Hoa Hoang Van[1], Trang Nguyen Ngoc[1], Lien Le Thi Thuy[1], Thong Minh Pham[1,2], Luu Vu Dang[1,2]

SUMMARY

Objective: To evaluate the imaging characteristics of coronary artery fistulas (CAFs) by multidetector computed tomography (MDCT).

Materials and Methods: a prospective descriptivestudy from January 2019 to September 2020 enrolled 31 patients (11 males, mean age 56 years) detected CAFs on MDCT at Radiology Centre of Bach Mai hospital. The origin, size, and drainage site of CAFs were analyzed.

Results: 31 (0.93%) CAFs were detected with 3322 patients underwent CCTA. 18 (58.1%) patients had multiple fistulas and 13 (41.9%) patients had single communication. 6.5% originated from the right coronary, 35.5% from the left coronary artery system, and 58.5% from both the right and left coronary artery. 87.1% of fistulas drain to the right side of the circulation (74.2% drain to pulmonary artery). 1 patient (3.2%) had fistula drain to the left side of the circulation (bronchial artery). 3 patients (9.7%) had fistulas drain to both the right and left side of the circulation (pulmonary artery and bronchial artery). 10 patients had large fistulas (32.3%), 21 patients had small fistulas (67.7%). 19 (61.3%) patients had an asscociated aneurysm of fistulas . 38.7% of cases were diagnosed with CAFs by echocardiography (38.7%). 6 patients were examined by CAG: 2 patients were not detected origin of fistulas by CAG, 3 patients were not detected drainage of fistulas by CAG.

Conclusion: DSCT is a noninvasive and useful modality for the diagnosis of CAFs.

Keywords: *Coronary artery fistula, MDCT.*

[1] Radiology Center, Bachmai hospital, Hanoi, Vietnam

[2] Department of Radiology, Hanoi Medical University, Hanoi, Vietnam

INTRODUCTION

Coronary anomalies are rare findings among the general population and are classified according to the origin, course, and termination. Coronary artery fistulas (CAFs) consist of abnormal communications between a coronary with other vessels or cardiac chamber [1]. CAFs are observed in 0.002% of the general population but present in 0.05 – 0.25% of patients who undergo coronary angiography (CAG) for varying reasons [3]. CAG via cardiac catheterization remains the gold standard for imaging the coronary arteries; however, the relationship of CAFs to other structures and the origin and course of anomalous coronary arteries may not be apparent. Coronary computed tomography angiogram (CCTA), a non-invasive method, can provide the benefits of better imaging quality. Theaimed of this study was to evaluate the imaging characteristics of coronary artery fistulas by multidetector computed tomography (MDCT).

MATERIALS AND METHODS

Patient

A prospective descriptive study from January 2019 to September 2020 enrolled 31 patients detected CAFs from a total of 3322 patients underwent CCTA at Radiology Centre, Bach Mai hospital, Hanoi, Vietnam. Two experienced radiologists reviewed the axial, maximum intensity projection, and volume rendering technique images through the picture archiving and communication system. We excluded patients with poor image quality.

Protocol

CT data were acquired with retrospective ECG-gated cardiac CT scans by DSCT (Somatom® Definition; Siemens Healthcare, Forchheim, Germany) and Multidetector computed tomography 128 Slice, Scenaria, Hitachi. A single dose of 0.8 mg Nitroglycerin aerosol 3 minutes prior to scanning. Scan range: from the level of tracheal bifurcation to the diaphragm. Test bolus was performed in the ascending aorta: 12 mL of contrast material and 50 ml of saline flush. 50-80 ml of iohexol (Omnipaque 350 mg/mL) was injected at a flow rate of 6ml/s, followed by 50 ml saline chasing.

Imaging analysis

All images were evaluated by two independent radiologists who had 10 years of experience in cardiac imaging using specific workstations and software. The images were reconstructed with a slice thickness of 0.75mm and using a medium soft tissue convolution kernel (B26f). The characteristics of the CAFs on axial, multiplanar reformatted, and volume-rendered images assessed included the number and size (≥ 4mm in diameter is considered large), the original and the drainage vessels, the presence of an aneurysm (defined as dilatation 1.5 times the diameter of adjacent vessels), coexisting anomalies.

RESULT

CAFs were diagnosed with CCTA in 31 of 3322 (0.93%) patients (11 males; mean age, 56 years). Invasive CAG was performed in 6 patients, one of them was received surgical treatment.

Characteristics of coronary artery fistulas on MDCT

13 (41.9%) cases had a single fistula. The origin of CAFs from the right coronary artery (RCA) in 2 (6.5%) cases, from the left coronary artery (LCA) in 11 (35.5%) cases, and both LCA and RCA in 18 (58.1%) cases (Figure 1).

The right side cardiac structure is the most common drainage site of CAFs in 26 (87.1%) cases. Pulmonary artery was the the most common site (23/31, 74.2%) (Figure 1) and followed by the right ventricular (3/31, 9.9%) (Figure 2) and right atrium (1/31, 3.2%). Only 1 case (3.2%) drainage to the bronchial artery (Figure 3). 3 cases (9.7%) had drainage sites to both right and left side circulation arteries that included pulmonary artery and bronchial artery (Figure 4). Aneurysmal sac found in 19 (61.3%) cases with the mean diameter was 9.46 mm. And 14/19 (73.7%) aneurysms were adjacent to pulmonary artery. Besides, the contrast shunt sign presented in 18/19 (94.7%) in patients with an aneurysmal sac (Figure 5).

Compared with transthoracic echocardiography (TTE) and CAG

12/31 (38.7%) patients with CAFs were detected by TTE. And 9/12 (75%) CAFs cases had diameters ≥ 4 mm, only 3/12 (25%) CAFS had small size detected by TTE.

We had 6 patients underwent CAG but 2 patients could not detecte the origin of fistulas and 3 patients could not detect the drainage of fistulas (Figure 6).

DISCUSSION

The prevalence of CAFs determined with MDCT in our study is 0,93%; was similar to the study of Jae Jung Lim (0,9%) [1] and Le Duc Nam (0,92%) [2]. But, was higher than the reported prevalence of 0,05 - 0,25% on CAG examination. The prevalence of CAFs may have been underestimated with CAG due to some limitations for CAFs imaging include: cannulating all of the arteries with fistulous origins is technically difficult, and complex configurations of the anomalous vessels and their anatomic relations with adjacent structures can be obscured on 2D fluoroscopic images.

In the present study, we determined the most common origin site is both the RCA and LCA is (58.1%), which was similar to the study of K Zhou. Some studies report the prevalence of CAFs from both the RCA and LCA was only 5% [3]. Those studies were based on CAG, and could not evaluate exactly both RCA and LCA at the same time. The prevalence of multiple fistulae based on MDCT was higher than the reported based on CAG because small fistulas may be detected by MDCT but visualized less clearly by CAG.

MDCT images can be reconstructed in multiplanar with 2D and 3D views so that readers could see all the CAFs from the original site to the drainage site as well as coexisting abnormalities.

Another study (citation) found that the most common drainage site of CAFs was the right-side cardiac structure (90%); was similar to our study (87.1%), in which the majority (74.2%) to pulmonary artery which was similar to other studies from Jae JL et al. (93.8%) and K Zhou et al (75%) [1,3]. But, the most common drainage site of CAFs based on CAG was the right ventricle. The reason for this discrepancy may be the coronary to right ventricle type can be more clearly visualized than coronary to pulmonary type by CAG.

Aneurysm of the fistula is an important complication. We found that the aneurysm of the fistula was significantly related to drainage site (pulmonary artery) and contrast shunt sign. The prevalence of aneurysmal CAFs in our study was higher than in other studies, because most of our patients were old with chronic CAFs for a long time leading to an aneurysm.

In our study, the prevalence of CAFs seen by TTE is 38.7%, which was higher than the prevalence in Dao Si Nghiep’s study (18,75%) [5]. The reason for this discrepancy is this reported prevalence based on a small fistulous tract (<4mm) – one of the limitations of TTE. Le Anh Minh reported this prevalence was 87.4% [4], higher than our study because this reported based on patients were examined by CAG with single, large, and not too tortuous fistulous tract, so TTE demonstrated CAFs.

6 patients were examined by CAG and all of them were detected CAFs by CAG, so the overall sensitivity of MDCT was 100% in patients with CAFs. Fehmi K reported the sensitivity of MDCT in patients having CAFs is 73% [6], the reason for this discrepancy may be this study used a 16–slice MDCT with lower diagnostic accuracy than 128-slice MDCT and 256-slice DSCT in our study. 2 patients were not detected small origin site from the conus branch by CAG because CAG can not evaluate exactly both RCA and LCA at the same time. 3 patients were not detected coronary to the bronchial artery by CAG, because all of them were complicated fistula with multiple origin sites, multiple and tortuous fistulous tract. The course and drainage site of the CAF are visualized less clearly by CAG because of its two-dimensional imaging pattern. MDCT provides excellent spatial resolution, which allows showing not only an accurate anatomic relationship of CAF with adjacent structures but also the drainage site as well.

CONCLUSION

The prevalence of CAFs by MDCT is 0.93%. Both the RCA and LCA is the most common origin site of CAFs (58%), the most common drainage site of CAFs is pulmonary artery (74,2%). Aneurysm of the fistula was significantly related to drainage site (pulmonary artery) and contrast shunt sign. MDCT is a non-invasive and useful imaging modality to depict the CAFs from the original site to the drainage site as well as coexisting abnormalities.

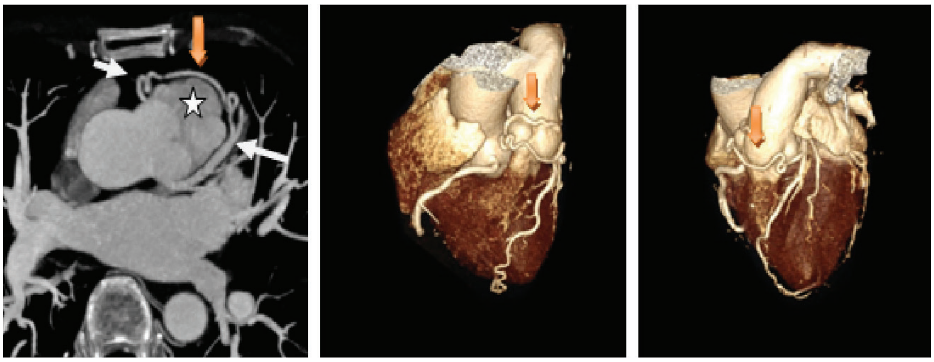

Fig.1 A 73-year-old man with CAFs originating from the conus branch and LAD (white arrow), draining into the pulmonary artery (star)

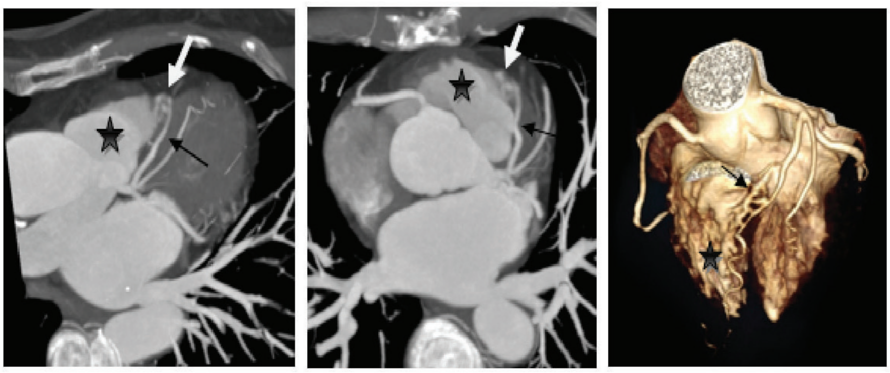

Fig.2 A 63-year-old woman with the left anterior descending artery (black arrow) to right ventricle fistula (star)

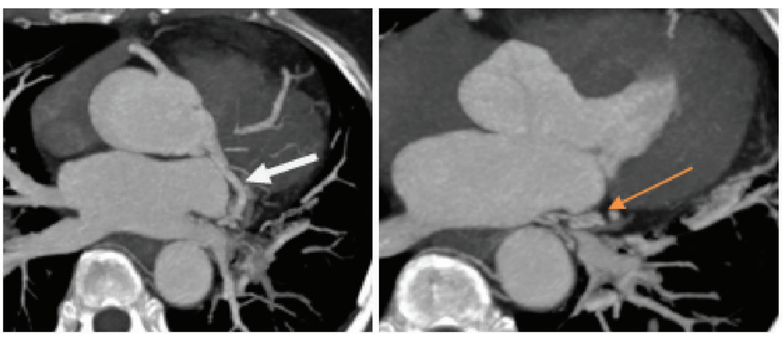

Fig.3 A 63-year-old woman with the LCx artery (white arrow) to left bronchial artery (yellow arrow)

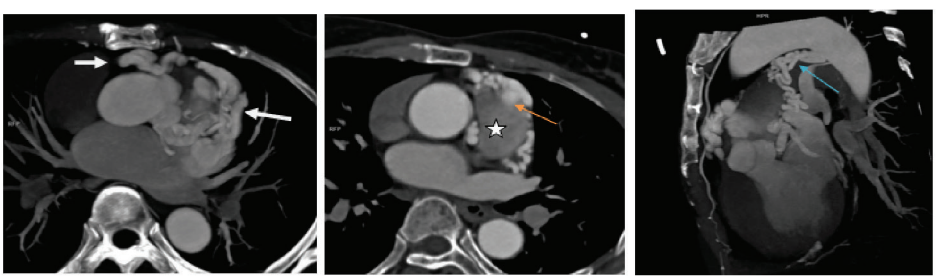

Fig.4 A 60-year-old woman with CAFs originating from the conus branch and LAD (white arrow), draining into the bronchial (blue arrow) and pulmonary artery (star) with the contrast shunt sign (yellow arrow).

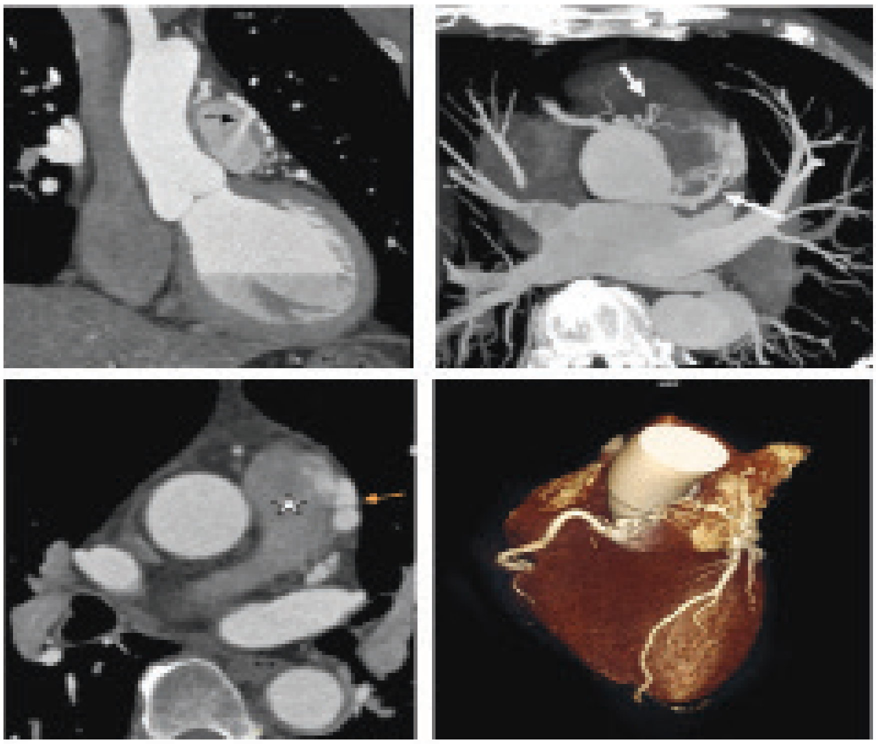

Fig.5 A 62-year-old man with CAFs originating from the conus branch and LAD (white arrow), draining into the pulmonary artery (star) with the contrast shunt sign (black arrow) and two aneurysmal sac (yellow sac).

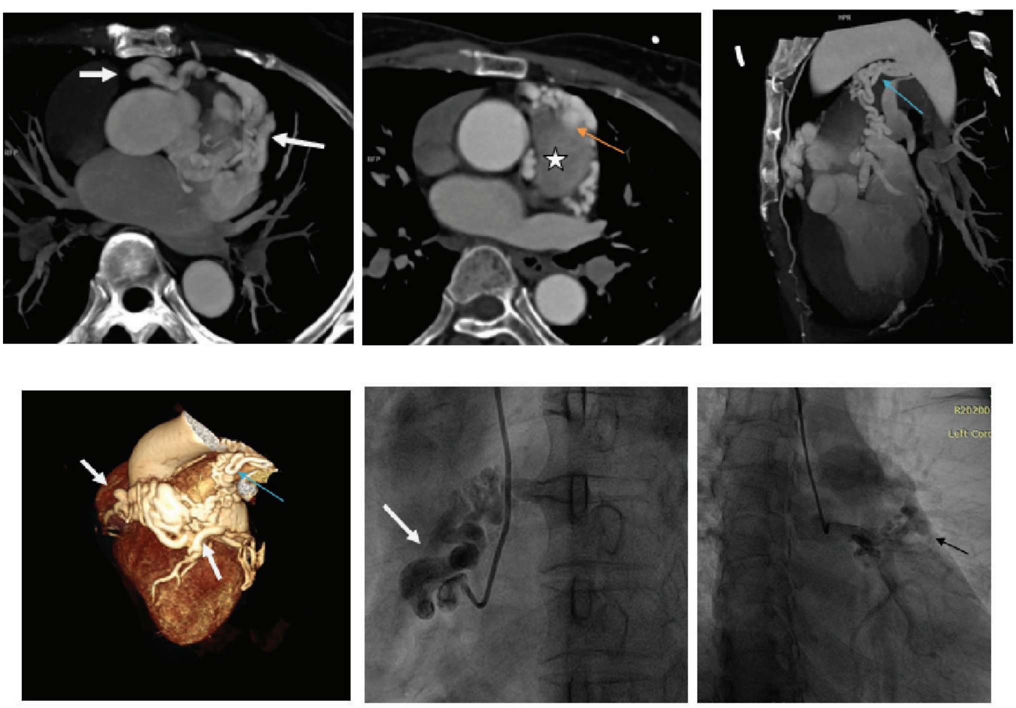

Fig.6 A 60-year-old woman with CAFs originating from the conus branch and LAD (white arrow), draining into the bronchial (blue arrow) and pulmonary artery (star) with the contrast shunt sign (yellow arrow). CAG image only shows communication between the conus branch (white arrow) and pulmonary artery (black arrow).

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Correspondent: Phung Ngoc Bao. Email: trando0801@yahoo.com

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