# Diagnostic Performance of High definition 64-slice MDCTA in Post Operative Cardiothoracic Complications in Patients after Open Heart Surgery

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**Abstract**

**Purpose**: To evaluate diagnostic value of HD 64-slice MDCTA in various post-operative cardiothoracic complications in patients after open heart surgery.

**Material and methods**: This study included 40 patients with post-operative cardiothoracic complications after open heart surgery (35 males and 5 females) with their ages ranged between 39-60 years (50 years mean age). Post operative symptoms form first to 60 days. All cases underwent HD 64-slice MDCTA. Invasive coronary angio (ICA) was performed only for post CABGS.

**Results**: The findings were nine patients (22.5 %) show total occlusion of CABGs at proximal anastomosis, two patients (5%) show total occlusion of CABGs at distal anastomosis, one patient (2.5%) cannot evaluated due to clip-artifacts and one patient (2.5%) native vessel cannot evaluated due to advanced atherosclerosis. Three patients (7.5%) show localized pericardial hematoma, two patients (5%) show pulmonary embolism, five patients (12.5 %) show pericardial effusion, seven patients (17.5 %) show pleural effusion, three patients (7.5%) show chest wall infection, four patients (10%) show pneumonia, one patient (2.5%) shows pseudoaneurism of left ventricle, one patient (2.5%) shows postoperative myocardial infarction and one patient (2.5%) shows aneurysm at the re-implanted coronary artery after Bentall procedure.

**Conclusion**: HD 64-slice MDCTA is non-invasive technique which shows to be effective in diagnosis most of the post operative cardiothoracic complications and gaining more grants in difficult clinical situations.

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**Key Words:** HD (High definition), MDCTA (Multidetector computed tomography angiography), Coronary artery bypass grafts (CABGs) and Invasive coronary angio (ICA).

## 1. Introduction:

Multidetector CT (MDCT), introduced into clinical practice in 2000, has demonstrated excellent detection of significant coronary lesions with a high degree of diagnostic accuracy. Also MDCT showed excellent capability of excluding coronary lesions, due to high negative predictive values, which ranges from 96 to 99% Russo V *et al.*, 2007 [1].

**Complications of open heart surgery can be categorized into two groups:**

**A. Complications of coronary artery bypass grafts (CABGs):** Graft thrombosis/stenosis, malposition or kinking and spasm. Iatrogenic complications of graft (retained clips, graft aneurysm and pseudoaneurism, ascending aorta dissecting aneurysm and pseudoaneurism, ostium stenosis and occlusion of the coronary arteries after Bentall procedure).

**B. Non graft related surgical complications:** Pleural/pericardial effusion, sternal/mediastinal infection and pulmonary embolism Aletta Ann Frazier *et al.*, 2005 [2].

**A. Complications related to (CABGs):-**

**1. Graft thrombosis/stenosis:-**

Graft occlusion from thrombosis at one month is a recognized complication in 10%–15% of cases Aletta Ann Frazier *et al.*, 2005 [2].

**2. Graft malposition or kinking:-**

Malposition or kinking of the graft can be a result of longer grafts and can lead to graft occlusion Ricci M *et al.*, 2000 [3].

**3. Graft spasm:-**

Graft spasm is more common with radial artery grafts; it is seen in early post-operative period Conant AR *et al.*, 2003 [4].

**4. Iatrogenic complications of graft:-**

**Graft aneurysm and pseudoaneurism:-**

Anastomotic aneurysm of CABGs more commonly occur at the distal anastomosis Sabri MN *et al.*, 1991[5]. The pseudoaneurism may arise at either proximal or distal ends of grafts. Aneurismal dilatation of graft >2 cm is considered significant, and will require surgery Aletta Ann Frazier *et al.*, 2005 [2].

**Ascending aorta dissecting aneurysm and pseudoaneurism:-**

Pseudoaneurism and dissecting aneurysm of the ascending aorta after cardiac surgery are uncommon but are considered serious complications Debbie Ann Charles *et al.,* 2010 [6].

**B. Non graft related surgical complications:-**

**1. Pericardial effusion:-**

Pericardial effusion is common after CABGs, occurring with a reported prevalence of 22%–85% Philippe Meurin *et al.,* 2004 [7]. Despite their frequency, postoperative pericardial effusion rarely progresses to become hemodynamically significant. Resultant cardiac tamponade has been reported in 0.8%–6% of patients Katara AN et al., 2003[8].

**2. Pleural Effusion:-**

Most patients who undergo CABGs develop pleural effusion. The prevalence is approximately 90% within the first week after surgery. These tend to be small, unilateral and left sided Vargas F et al., 1994 [9].

**3. Sternal Infection:-**

Approximately 2%–20% of CABGs are complicated by a surgical site infection Roy MC 1998[10]. Infections can be categorized as involving the presternal, sternal, or retrosternal compartments Li AE and Fishman EK 2003 [11].

**4. Pulmonary Embolism:-**

Pulmonary embolus occurred in 0.4 to 9.5% (average of 3.4%) of published studies after CABGs**.** It was fatal in 0.3 to 1.7% (average 0.5%) of cases Nicolos W. Shammas 2000[12].

**2. Patients and methods:**

During the period from Jun 2012 to October 2013, 40 patients were referred from cardiology and cardiothoracic surgery Departments on the bases of clinical suspected post-operative cardiothoracic complications. All patients underwent HD MDCT coronary angiography in Clinical Radiology Department, Co-Operation Union Cardiac Hospital, Kuwait City, Kuwait. Patients 35 males and 5 females, with their ages ranged from 39 to 60 years with mean age of 50 years. Patients with heart rate >70 beat/min received B-blocker, 100 mg Atenolol (Tenormin, AstraZeneca, Wedel, Germany) orally 1 hour before the scan. If heart rate was still >70 beat/min, 5 mg, metaprolol (Beloc, AstraZenica, Wedel, Germany) were administered IV. No adverse reactions to B-blocker were recorded. All patients gave written informed consent, and the study protocol was approved by the Institutional Review Board.

Exclusion criteria were patients with extensive myocardial infarcts, tachycardia (>80 beats/min), ICU, significant renal dysfunction (serum creatinine >2.5 mg/L), severe heart failure, unstable hemodynamics, and with allergic reaction to contrast media.

**A. HD MDCTA examination protocol:**

All examinations were performed by using a HD 64-slice MDCT scanner (GE Discovery CT750 HD, GE Medical Systems, and Milwaukee, USA). Monitoring of the electrocardiogram was performed continuously during the examinations, and all image acquisitions were performed during a single inspiratory breath-hold.

All patients were done using low dose technique, where an antero-posterior and lateral scout acquisition was obtained to determine the position of the heart and define the scan volume for further imaging (from clavicle level to the diaphragmatic face of the heart). For all examinations, 130 ml of iodinated contrast agent (Iodixanol, Visipaque 320 mgI/mL, GE Healthcare, Milwaukee, USA) was injected through an 18-gauge cannula positioned in an antecubital vein at a flow rate of 5 ml/s. Before the scan, each patient's individual circulation time was determined in the lumen of the ascending aorta using a test bolus of 30 ml of intravenous contrast agent at a flow rate of 5 ml/s. The time interval between the bolus injection and the maximal enhancement was measured, and the starting time of the enhanced scan was calculated as about 3 seconds after the transit time of contrast agent. In all patients, the standard built-in reconstruction algorithm was used for image reconstruction. The data sets were reconstructed (with a slice thickness of 0.625 mm and 0.4 mm increments) during the mid to end diastolic phase, 65% to 75% of the R-R interval. If image quality in this data set was not optimal, additional reconstructions (35% to 85%) were performed, and the data sets with optimal images were chosen for further evaluation.

All acquired data were transferred to a separate computer workstation (Advanced workstation 4.2, GE Healthcare, Milwaukee, USA) equipped with CardIQ software (GE Medical Systems). Depending on vessel morphology and quality of the MDCT data sets, different post-processing techniques such as maximum-intensity projection (MIP), curved multiplanar reconstruction (CPR), and three dimension volume rendering (3D VR) were applied to assess the origin and course of the coronary vessels. Prospectively gated coronary CT angiography software (Snap-shot Pulse, GE Health care, Milwaukee, USA) was used in all patients. We used an upper limit of heart rate of 70 beat per minute. Padding of the tube-on time was used to allow the reconstruction to adapt to minor heart rate variation. Padding was ranged from 40 msc to 80 msc.

All diseased grafts and coronary segments were classified as occluded and significantly

obstructed (50-100% luminal narrowing). Graft occlusion was defined as the absence of contrast material along the course of the graft, through the graft anastomosis to the native distal artery. Significant stenosis of the graft anastomosis in a patent graft was defined as ≥ 50% reduction of luminal diameter.

**B. Conventional coronary angiography in cases of CABGs:**

(ICA) was performed via a right femoral approach using a 4F catheter. Images were acquired at 12.5 frames per second. Selective imaging of bypass grafts was performed in 30 degree right anterior oblique and 60 degree left anterior oblique views. An experienced cardiologist, who was unaware of the CT results, described the angiographic findings. Using quantitative coronary angiography (QCA) evaluation (CAAS, Pie Medical Systems, Maastricht, The Netherlands), maximum diameter stenosis was determined out of at least two (orthogonal) projections. Graft occlusion was defined as the absence of contrast material along the course of the graft, through the graft anastomosis to the native distal artery. Native coronary artery occlusion was defined as the absence of contrast material along the course of the artery. Significant stenosis of the graft, graft anastomosis, or native coronary artery was determined if there was ≥ 50% reduction in the mean diameter.

**3. Results:**

Forty patients were submitted for HD MDCTA in our study. The patient characteristics are seen in Table1.

**Table1.Patient characteristics (NO.of patients 40).**

| | |
|---|---|
| Males | 35 patients |
| Females | 5 patients |
| Age (years) | 39 to 60y |
| Time post operative symptoms | First to 60 days |
| Diabetes | 15 patients |
| Hypertension | 30 patients |
| Hypercholesterolemia | 29 patients |
| Increased serum triglyceride | 20 patients |
| Atherosclerosis | 18 patients |
| Obesity | 10 patients |
| Smokers | 15 patients |
| Previous myocardial infarction | 1 patients |

A total of sixty grafts were available for evaluation (20 arterial grafts and 40 venous grafts). Graft characteristics are seen in Table 2.

**Table 2. Graft characteristics.**

| | |
|---|---|
| Total number of grafts | 60 grafts |
| Single arterial grafts | 12 (20%) |
| Sequential arterial grafts | 8 (13%) |
| Single venous grafts | 22 (37%) |
| Sequential venous grafts | 18 (30%) |
| Total number of nongrafted vessels | 12 |
| Left anterior descending coronary artery (LAD) | 2 (17%) |
| Left circumflex coronary artery (LCx) | 3 (25%) |
| Right coronary artery (RCA) | 7 (58%) |

The commonest age group in this study was 55-60 years (18/40 patients, 45 %), followed by 45-50 years (13/40 patients, 32.5%) and 39-40 years (9/40 patients, 22.5%).

Distributions of patients regarding complaint are seen in Table 3.

**Table 3. Patient complaint.**

| Patients complaint | Number of patients |
|---|---|
| Chest pain | 40 (100%) |
| Respiratory distress | 40 (100%) |
| Fever | 8 (20%) |
| Dry cough | 2 (5%) |
| Productive cough | 2 (5%) |

Regarding patients complaint forty patients 100% were presented by chest pain which the most common symptom. The distributions of patients according to type of pain there are ten patients presented by squeezing chest pain, ten patients presented by chest fullness, five patients presented by painful feeling, two patients presented by chest heaviness, one patient presented by chest discomfort, one patient presented by burning pain, two patients presented by burning chest pain and nine patients presented by vague chest pain.

Regarding patients presentation by respiratory distress. The distributions of patients according to different grades of respiratory distress there are thirty four patients presented by tachypnea (grade I mild distress), four patients presented by chest retraction (grade II moderate distress), one patient presented by grunting (grade III sever distress) and one patients presented by cyanosis and disturbed consciousness (grade IV).

Regarding patients presentation by fever there are (7/40 patients 15%) complaint from low grade fever and (1/40 patient, 2.5%) complaint from with high grade hectic fever.

Regarding patients presentation by dry cough there are (2/40 patients, 5%).

Regarding patients presentation by productive cough there are (2/40 patients, 5%).

Regarding post CABGs complications nine patients (22.5%) show total occlusion of CABGs at proximal anastomosis, two patients (5%) show total occlusion of CABGs at distal anastomosis. One patient cannot evaluate due to clip artifacts, also in one patient native vessel cannot evaluated due to advanced atherosclerosis. All cases are confirmed by invasive coronary angiography (ICA).

Three patients (7.5%) show localized pericardial hematoma discovered during CT cardiac examination but missed by Echo.

Two patients (5%) show pulmonary embolism.

Five patients (12.5%) show pericardial effusion incidentally discovered during cardiac examination which diagnosed by Echo.

Seven patients (17.5%) show pleural effusion incidentally discovered during cardiac examination which diagnosed previously by plain chest radiography.

Three patients (7.5%) revealed chest wall infection by clinical examination but CT is used to confirm diagnosis and to determine possibility of retrosternal extension and associated mediastinitis.

Four patients (10%) show pneumonia, diagnosed by CT but the plain chest radiography normal.

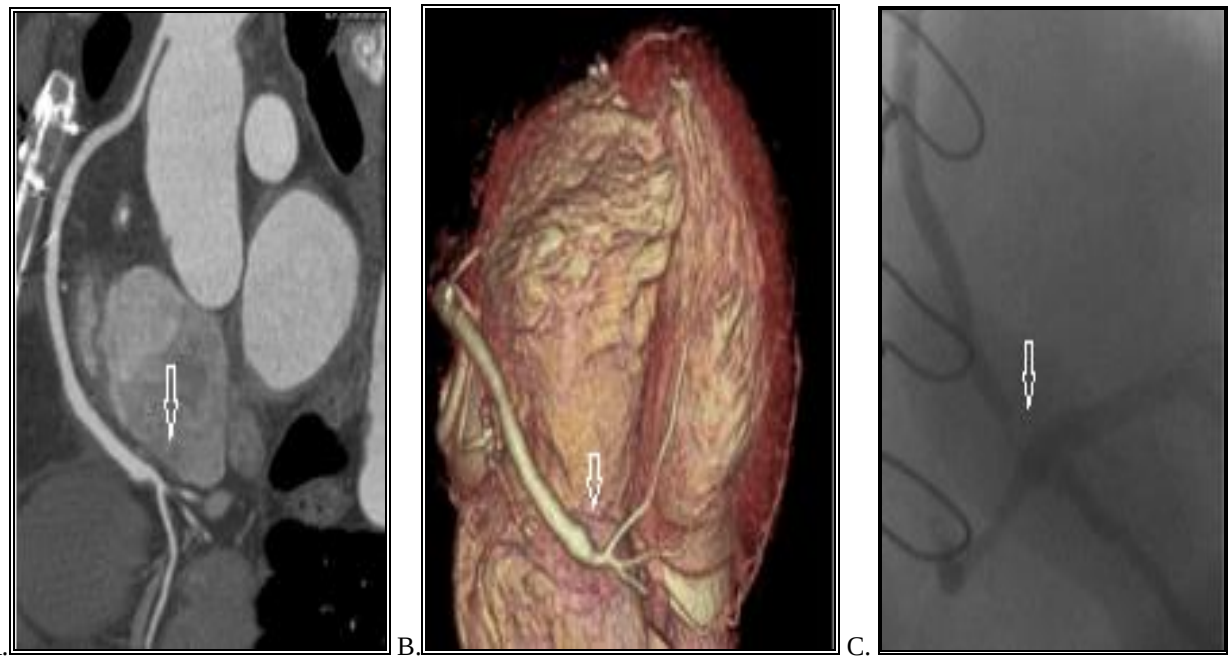
One patient (2.5%) shows pseudoaneurism of left ventricle Echo revealed possibility of diagnosis but CT is used to confirm diagnosis and determined type of aneurysm.

One patient (2.5%) shows postoperative myocardial infarction.

One patient (2.5%) shows aneurysm at the site of re-implanted coronary artery after Bentall procedure. The Postoperative cardiothoracic complications are seen in Table 4.

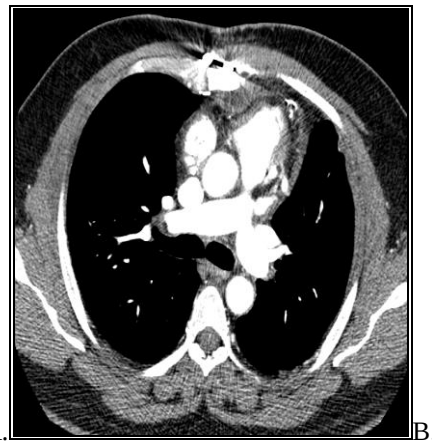
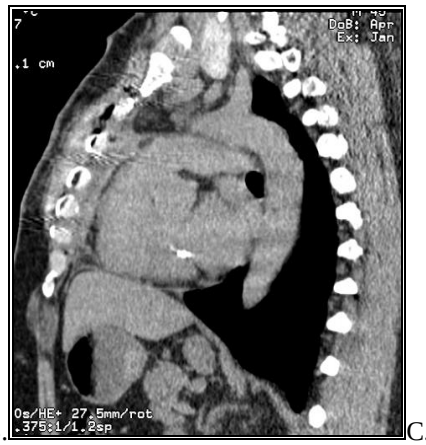
**Table 4. Postoperative complications.**

| Post operative cardiothoracic complications in patients after open heart surgery | Number of patients |
|---|---|
| Occlusion CABGs | 13 (42.5%) |
| Localized pericardial hematoma | 3 (7.5%) |
| Pulmonary embolism | 2 (5%) |
| Pericardial effusion | 5 (12.5%) |
| Pleural effusion | 7 (17.5%) |
| Chest wall infection | 3 (7.5%) |
| Pneumonia | 4(10%) |
| Pseudoaneurism of left ventricle | 1(2.5%) |
| Myocardial infarction | 1(2.5%) |
| Aneurysm at the re-implanted coronary artery after Bentall procedure | 1(2.5%) |



A. B. C.

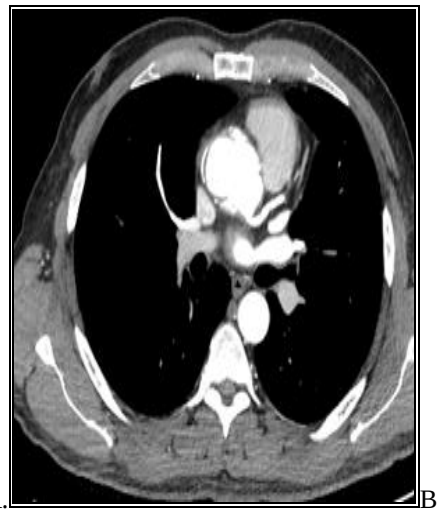
Case NO.1. CT coronary angiography (curved multiplanar reformation, three dimensional volume rendered and invasive coronary angiography images) after CABGs surgery show moderate distal anastomotic stenosis of arterial bypass graft to the distal right coronary artery.

A.  B.  C. 

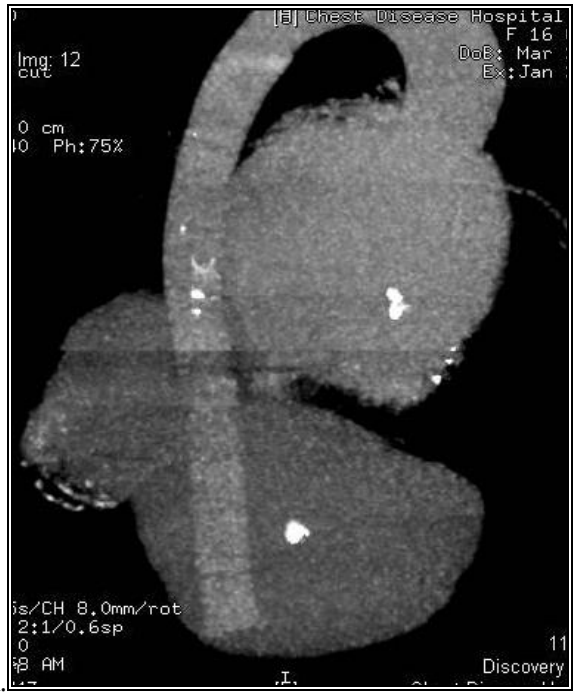
Case NO.2. CT chest with contrast axial and sagittal reconstruction in soft and bone window reformation images after CABGs surgery show post operative sternal infection appears as retrosternal fluid collection and presternal air locules.

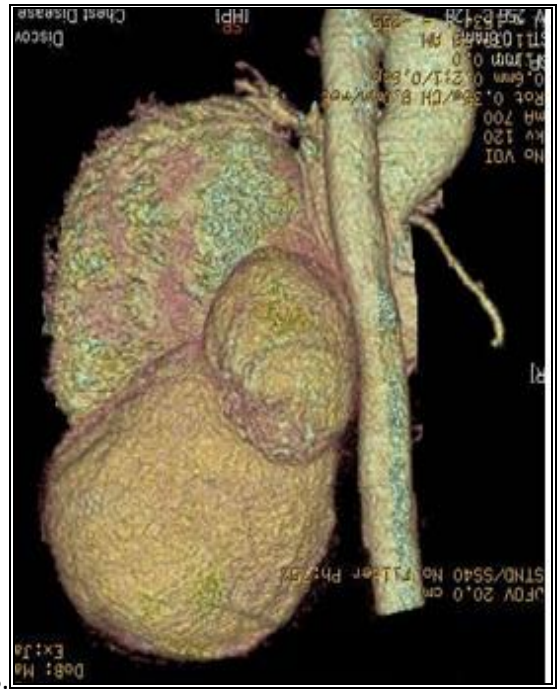
A.  B. 

Case NO.3. CT heart with contrast (curved multiplanar reformation and three dimensional volume rendered images) after Bentall procedure show aneurysmal dilatation of proximal segment of right coronary artery.

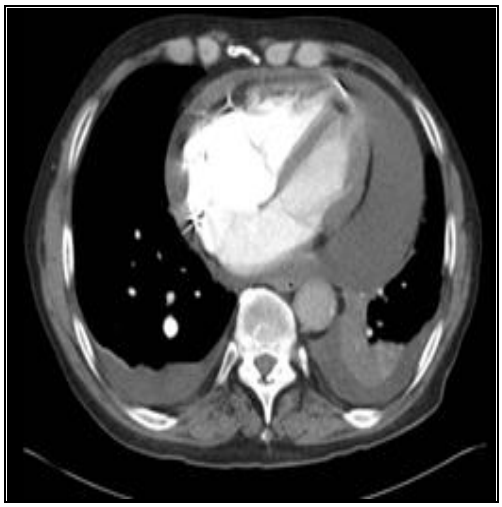
A.  B.  C. 

Case NO. 4. CT chest and heart with contrast (axail, coronal and sagittal reformation images) after CABGs surgery show dissection of the ascending aorta (type A dissection) with intimal flap reaching to aortic branches.

A. 

B. 

Case NO.5. CT heart with contrast (curved multiplanar reformation and three dimensional volume rendered images) after CABGs surgery show left ventricular pseudoaneurism with spared coronary ostium.



Case NO.6. CT chest with contrast axial image after CABGs surgery shows simple large pericardial and bilateral pleural effusions with left lower lobe segmental collapse.


Case NO.7. CT coronary angiography after CABGs surgery (curved multiplanar reformation image) shows filling defect artifact resulting from clips of the graft.

**4. Discussion:**

The all grafs, recipient vessels and nongrafted vessels were visually classified as abnormal if ≥ 50% luminal narrowing and vessel occlusion. In my study the diagnostic accuracy in the detection native vessels stenosis was 92 % due to advanced atherosclerosis in patient if compared with preoperative study, on other hand the accuracy was 92% in diagnosis graft stenosis/occlusion due to one patient with arterial graft was rendered non-diagnostic due to clip-artifacts. This case is considered positive for the presence of significant stenosis or occlusion. Stein PD *et al.*, 2005 [13] reported that surgical vascular clips in the proximity of bypass grafts have frequently caused beam hardening and partial volume artifact that hamper exact assessment of the graft. This

sort of artifact is often aggravated by cardiac motion. Ability to evaluate the proximal anastomotic site and the body of grafts is very good with 16-slice MDCT. However, evaluation of distal anastomotic site may be more difficult and time consuming. Hausleiter J *et al.*, 2006 [14] founded that post bypass surgery evaluation should include assessment of the native coronary arteries which is difficult in these patients because of severe calcification and diffusely narrowed arteries associated with advanced atherosclerotic disease. In study by FR de Graaf *et al.*, 2011 [15] demonstrated that diagnostic accuracy in the assessment of recipient and nongrafted vessels was considerably lower (85% and 73% respectively) as compared to the performance in grafts (96%). Also Weustink *et al.*, 2009 [16] mentioned that using dual-source CTA in 52 patients with prior CABG, reported excellent diagnostic accuracy in the evaluation of patients with a history of CABG, with a diagnostic accuracy of 100% in the evaluation of graft stenosis. Moreover Aysel Türkvatan *et al.*, 2009 [17] stated that use of 16-slice MDCT angiography allows very accurate evaluation of CABG patency and has high diagnostic accuracy in detecting graft stenosis. But evaluation of native coronary artery stenosis is limited, particularly in patients with advanced coronary artery disease with severe calcification. Galit Aviram *et al.*, 2009 [18] demonstrated that patency and proximity of patent grafts to the sternum are well demonstrated by MDCT and may provide the surgeon with an important roadmap to avoid potential graft injury. Stauder NI *et al.*, 2006 [19] show that using older generations such as 16-row CTA, high diagnostic accuracy was reported in the assessment of graft patency and significant stenosis. Andreini D *et al.*, 2007 [20] stated that assessment of significant stenosis in native coronary arteries remained suboptimal. Nazeri I *et al.*, 2009 [21] reported that using 64-row CTA, the efficacy of CTA in the detection of significant stenosis in native coronary arteries and grafts 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. Susanna Prat-Gonzalez *et al.*, 2008 [22] show that other potential indications of cardiac CT include the evaluation of bypass grafts. Grafted vessels have larger calibers and are less prone to motion artifacts than native coronary arteries. However, accuracy for the evaluation of distal anastomoses is lower. Metallic artifacts caused by surgical clips may limit the assessment of segments of internal thoracic grafts. Analysis of native vessels is often more difficult in patients who have received coronary artery bypass grafts because of poor distal vessel opacification, more extensive calcification, and smaller lumen size. Malagutti P *et al.*, 2007 [23] stated that the clinical applications of cardiac CT after CABGs are symptoms shortly after CABGs, contraindications to invasive angiography (aortic disease, aortic valve endocarditis), unknown graft anatomy, or failure to selectively inject the graft during surgery, atypical symptoms or decreased left ventricular function after CABG and graft localization prior to thoracic surgery. Pim J de Feyter *et al.*, 2008 [24] founded that accuracy of CT angiography to detect obstructive graft disease is almost 100%. Comprehensive post-bypass surgery evaluation should also include the assessment of the native coronary arteries, which may prove challenging as a result of advanced, diffuse coronary artery disease.

We had 7 patients (17.5%) show pleural effusion six at the left and one at the right side and patient complaint from chest pain, heaviness and fullness. Lawrence H. Cohan 2008 [25] mentioned that pleural effusion is common after cardiac surgery particularly one the left side and patient complaint from chest pain or heaviness, shortness of breath and hypoxia.

In our study the pulmonary embolism was presented in two patients (5%) and patient complaint from chest pain and respiratory distress (grade III and IV). Zain L. Khalpey *et al.*, 2008 [26] reported that incidence of pulmonary embolism ranges from (0.5 to 3.5%) and patient complaint from shortness of breath or reduced exercise tolerance.

In the present study there are four patients (10%) show pneumonia and presented by productive cough and low grade fever. Lawrence H. Cohan 2008 [25] mentioned that most common cause of pneumonia is ventilator associated pneumonia and patient complaint from cough, expectoration and fever.

Current study shows seven patients (17.5%) complaint from low grade fever due to post pericardiotomy syndrome and pneumonia and one patient (2.5%) complaint from high grade hectic fever due to chest wall infection with fistulous tract. Zain L. Khalpey *et al.*, 2008 [26] reported that causes of fever in post open heart surgery is non infectious causes include myocardial infarction, post pericardiotomy syndrome, and drug fever. Infectious causes include wound infection, urinary tract infection, pneumonia, catheter sepsis, and loculated areas of contaminated blood accumulation (e.g., pericardial and pleural).

We found three patients (7.5%) show chest wall infection two revealed superficial wound infection but the third one demonstrated deep sternal wound infection with sinus formation. Samuel Jerome Durham and Jeffrey Philip Gold 2008 [27] stated that incidence of deep sternal wound infection varies from (0.4 to 5%).

We had 15 patients (37.5%) were diabetic. Shirani S and M Soleymanzadeh 2010 [28] mentioned

that obesity, diabetes and bilateral internal mammary grafting increase the risk of sternal infection.

In our study there are three patients (7.5%) show localized pericardial hematoma post Bentall procedure and following CABGs. Aditya kapoor *et al.*, 2011 [29] reported case of delayed complications related to retained pericardial pacing wires left in situ with consequent organized pericardial hematoma around wires presenting three months following aortic valve replacement surgery especially in patients on long term oral anticoagulants.

In current study there are five patients (12.5%) show pericardial effusion. Elena A. Ashikhmina *et al.*, 2010 [30] mentioned that pericardial effusion occurred in 1.5% of patients, and symptoms were nonspecific. Several factors, mainly related to preoperative characteristics and type of operation, predispose patients to effusion. Also Bernhard Floerchinger *et al.*, 2013 [31] stated that pericardial effusion is common in patients after open heart surgery due to postoperative bleeding or postcardiotomy syndrome. Patients after open heart surgery represent pericardial effusion up to more than 60%. Moreover, majority of pericardial effusion after cardiac surgery is localized and frequently placed in the posterior pericardium or near the right atrium and ventricle with limited assessability by Echo, then even more challenging to be detected. Diagnostic accuracy of Echo is limited in patients after open heart surgery, since sensitivity and specificity for detection of cardiac tamponade are limited. Therefore CT is reasonable for supplemental diagnostic imaging to assess suspected delayed cardiac tamponade in high risk patients after open heart surgery.

In our study there is one patient (2.5%) proved to be pseudoaneurism of left ventricle Echo revealed possibility of diagnosis. This patient has past history of myocardial infarction in left ventricle. The MDCT demonstrated the aneurism is involving the posterior wall and communicate with the left ventricular cavity through a narrow neck and was pulsating, expanding during diastole and collapsing during systole. These characterizations consistent with pseudoaneurism of left ventricle only. ECG gated cardiac MDCT is valuable in the coronary angiography, detailed anatomical information of the heart chambers and pericardium and accurate dynamic evaluation of myocardial function, perfusion and integrity as well as non invasive for diagnosis left ventricle pseudoaneurism. Chun Tai Mao *et al.*, 2012 [32] mentioned that pseudoaneurism of left ventricle originated form basal inferoposterior wall of the left ventricle and the incidence is a rare. Premraj Makkuni *et al.*, 2010 [33] stated that causes of pseudoaneurism include myocardial infarction, cardiac surgery, infectious endocarditis and chest trauma.

In our study there is one patient (2.5%) shows aneurysm at the re-implanted coronary artery after Bentall procedure. Zile Singh Meherwal *et al.*, 2011 [34] mention that late complications of the Bentall procedure are false or true aneurysm of the arterial button, coronary artery or both may occur.

One patient (2.5%) shows postoperative myocardial infarction. Zain L. Khalpey *et al.*, 2008 [26] reported incidences postoperative myocardial ischemia and infarction.

Our findings demonstrated 10 obese patients (12.5%) had more than one complication. Demir A *et al.*, 2012 [35] mentioned that obesity does not increase short term mortality for open heart surgery, however, it increases the risk of post operative pulmonary complications and discharge with morbidity.

Our study had 15 patients (37.5%) were currently smokers. Zain L. Khalpey *et al.*, 2008 [26] reported that smokers patients have a higher incidence of pneumonia (15.3% versus 3.6% in controls).

**5. Study limitations:**

There are some limitations to the present study. We included post CABGs patients with clip-artifacts and with advanced atherosclerosis. Invasive coronary angio is still the golden standard in the evaluation of both coronary artery and graft status, but its use is restricted by the invasive nature of the procedure.

**6. Conclusion:**

HD 64-slice MDCTA is non-invasive technique which shows to be effective in diagnosis most of the post-operative cardiothoracic complications and gaining more grants in difficult clinical situations.

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