Our experience using coronary computed tomography angiography in patients with low-risk chest pain: Post procedural outcomes

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Abstract

Background: Chest pain is the second most frequent cause of presentation for management .Selection of the proper technique for chest pain diagnosis is crucial. Coronary computed tomography angiography (CCTA) is considered an early chest pain diagnostic procedure.

Aim: To evaluate outcomes of early use of CCTA in our Jordanian group of patients.

Methods: Our retrospective investigation included 485 patients, aged 18–74 years, of both sexes, with low-risk chest pain but no history of coronary artery disease. All patients were assigned to CCTA at King Hussein Hospital, King Hussein Medical Center, Amman, Jordan, during the 2017–2018 period. The primary outcome was secondary cardiac catheterization. The secondary outcome was cardiovascular hazards. Correlation between sex, age, and body mass index, was recorded using the χ^2 or Fisher's exact test. Correlation between chest pain and cardiovascular findings was recorded using the χ^2 or Fisher's exact test. P-values of less than 0.05 were recorded as significant.

Results: Normal CCTA was recorded in 324 patients (66.8%). Secondary cardiac catheterization was performed in 161 patients (33.2%), of whom 68 patients (68/485 = 14.02%) had percutaneous coronary interventions. There were 17 (17/485 = 3.5%) cardiovascular hazards within a median of one year after CCTA.

Conclusions: To treat a patient with heart disease, the first step is to determine whether he or she has coronary artery disease. The second step is to determine whether the coronary artery disease is remarkable, requiring choosing between conservative management or revascularization. If the patient has remarkable coronary artery disease, the third step is to determine whether the patient requires percutaneous intervention or CABG, taking into consideration the clinical characteristics of the patient such as age, comorbidity, and individual risk.

Keywords: low-risk chest pain; coronary computed tomography angiography; outcome: primary, secondary.

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Introduction

Cardiovascular-disease-induced mortality is remarkably more than any other cause such as cancer. The most important cause is coronary artery disease [(1)]. Chest pain is the second most frequent cause of presentation for management in the United States. Angina and acute coronary syndrome are the first diagnostic items followed by noninvasive cardiac investigations [(1)]. Fast discharge of most patients with chest pain induced by benign states is an important issue. The selection of a proper technique for chest pain evaluation is also important. Early coronary computed tomography angiography (CCTA) decreases the length of stay [(2)]. CCTA is the only suitable early evaluation system for patients with normal troponin levels [(3)].

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CCTA use is increasing, whereas functional investigation use is decreasing. Coronary stenosis intensity is an anticipator of outcomes in coronary artery disease. CCTA is a noninvasive procedure that makes anatomical recognition of coronary artery disease easy. CCTA permits a full diagnostic and prognostic evaluation of low-intermediate patients. CCTA measures the total plaque size, differentiates plaque subtypes, and recognizes high-risk plaque.

Angina-like retrosternal chest pain may originate from cardiovascular or noncardiovascular causes because of the common sensory innervation of the heart, pleura, aorta and esophagus by fibers from the same spinal segments. Nowadays, in low-to-intermediate risk patients, CCTA can exclude coronary origin of chest pain. This permits many patients with nonsignificant coronary artery disease at CCTA to avoid conventional coronary angiography [(4)].

The aim of our investigation was to evaluate outcome of early use of CCTA in our Jordanian group of patients.

Methods

Our retrospective investigation included 485 patients, aged 18–74 years, of both sexes, with low-risk chest pain but with no history of coronary artery disease. All patients were assigned to CCTA at King Hussein Hospital, King Hussein Medical Center (KHMC), Amman, Jordan, during the 2017–2018 period after obtaining approval from the local ethical and research board review committee of JRMS(Jordanian royal medical services), KHMC, Amman, Jordan. Inclusion criteria were as follows: negative serum troponin level 6 h after onset of clinical features and consequent disappearance of chest pain. Exclusion criteria were as follows: increased serum troponin T, electrocardiogram changes of acute ischemia or myocardial infarction, persistent chest pain, renal insufficiency, active asthma, and CCTA performed during the past six months.

All participants were scheduled according to low-risk chest pain for CCTA. The patients imaged via SIMENS CT (Somatom Force) 256-slice in the Radiology department, All patients were examined by two Radiology specialist in two separate sessions and the results were analyzed by simple statistical methods. Patients with positive findings were assigned to cardiac catheterization. Patients were divided according to invasive therapy in revascularization and no revascularization groups. The primary outcome was secondary cardiac catheterization. The secondary outcome was cardiovascular hazards (myocardial infarction and cerebrovascular accident), including severe hazards for the revascularization group. Outcomes were assessed at one month and one year.

Statistics

Correlation between sex, age, and BMI was recorded using the χ^2 or Fisher's exact test. Correlation between chest pain and cardiovascular findings was recorded using the χ^2 or Fisher's exact test. P values of less than 0.05 were recorded as significant.

Results

Median age of patients was 46 years, with 199 females (41.03%) (Table I). Normal CCTA was recorded in 324 patients (66.8%). Secondary cardiac catheterization was performed in 161 patients (33.2%), out of whom 68 patients (68/485 = 14.02%) had percutaneous coronary interventions. Ten patients (2.1%) had CABG(coronary artery bypass graft). There were 17 (17/485 = 3.5%) cardiovascular hazards within a median of one year after CCTA. There were significant differences between incidences of myocardial infarction and cerebrovascular accidents ($P < 0.005$).

Twelve CCTA patients (2.5%) experienced severe hazards of coronary revascularization (Table II). Eight-three CCTA patients (17.1%) did not have revascularization. There were no significant difference between percentage of revascularization and no revascularization during cardiac catheterization ($P > 0.05$) (Table II). One hundred and forty CCTA patients (28.9%) had persistent chest pain or shortness of breath. There were no significant differences regarding incidences of severe hazards of revascularization between types of chest pain ($P > 0.05$) (Table III).

Table I. Patient demographics.

Item	**No (%)**
Age (yrs.) median (range)	46 (18-74)
Body mass index (kg/m^2) median	27
Sex M **F**	286 (58.97) 199 (41.03)
Postmenopausal	130 (26.8)
Coronary artery disease family history	170 (35.1)
Medical history Hypertension **Diabetes mellitus**	250 (51.5) 150 (30.9)
Smoking	120 (24.7)
Sedentarism	350 (72.2)
Acetylsalicylic acid	120 (24.7)
Chest pain By effort **Retrosternal** **Relieved by rest or nitroglycerin**	90 (18.6) 380 (78.4) 240 (49.5)

Table II. Postprocedural hazards and secondary procedures.

Hazards	**No (%)**
Cardiovascular myocardial infarction **Cerebrovascular accident**	14 (2.9) 3 (0.6)
Secondary procedures	
Cardiac catheterization **Revascularization** **CABG** **PCI** **No revascularization**	161 (33.2) 78 (16.1) 10 (2.1) 68 (14.2) 83 (17.1)
Severe hazards	
Revascularization	12(2.5)

Table III. Correlation between chest pain and investigation findings.

Chest pain	By effort (n = 90)	Retrosternal (n = 380)	Relieved by GTN (n = 240)
Myocardial infarction (n = 14)	2	7	5
CABG (n = 10)	3	3	4
PCI (n = 68)	36	10	22
No revascularization (n = 83)	23	41	19
Severe hazards of revascularization (n = 12)	4	4	4

Discussion

The diagnosis of cardiac and coronary diseases is being influenced by the application of new radiological methods. CCTA allows direct anatomical recognition of atherosclerotic stenosis in the epicardial coronary arteries, with low radiation exposure. Increased heart rate, dysrhythmia, obesity and increased coronary calcium size can limit total assessment. CCTA has an increased diagnostic precision compared with invasive coronary angiography.

We conducted an assessment of CCTA in low-risk chest pain patients. In our investigation, CCTA was conducted earlier and at the same moment in the diagnostic work-up. Cardiac catheterization was performed late in patients in CCTA [5]. We showed that most catheterized patients did not undergo a coronary procedure. Although a previous study demonstrated a slight reduction in catheterizations without procedures with CCTA, it also demonstrated increased total percentage of catheterization, percutaneous intervention, and bypass surgery [6]. Increased revascularization in CCTA patients was found in other patients [4].

There were more aspirin prescriptions in CCTA because of the greater percentage of patients with coronary artery disease [7]. There was also a significant reduction in myocardial infarction in patients undergoing CCTA due to the availability of enhanced medical therapy guidelines [8,9].

This investigation was a single-center investigation, which limited generalization. Therefore, the application of the results of this investigation in other centers will rely on the availability of imaging techniques. Our investigation was not intended to detect cardiovascular hazards [6].The potential reduction in imaging relies on the multiple triage system used [10]. The proper management method to improve outcomes of patients with low troponin levels is still being debated [11]. We did not evaluate the effects of advances in CCTA, especially procedures for detection of stenosis significance. Pretest probability of severe coronary disease was detected [12].

Our investigation focused on low-risk patients, and this fact must be taken into account before applying the results to high-risk patients.

CCTA is the only diagnostic method that can recognize nonobstructive coronary plaque disease. Standard noninvasive ischemia testing methods have poor sensitivity for obstructive coronary disease and cannot differentiate patients with normal coronary arteries from those with nonobstructive plaque disease. Recognition of nonobstructive coronary disease is the key for prophylactic treatments in patients undergoing CCTA.

Conclusions

To treat a patient with heart disease, the first step is to determine whether he or she has coronary artery disease. The second step is to determine whether the coronary artery disease is remarkable, requiring choosing between conservative management and revascularization. If the patient has remarkable coronary artery disease, the third step is to determine whether the patient requires percutaneous intervention or CABG, taking into consideration the clinical characteristics of the patient such as age, comorbidity, and individual risk.

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