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RESEARCH ARTICLE

CONTRIBUTION OF CARDIAC IMAGING (CT AND MRI) IN THEDIAGNOSIS OF CHRONIC CONSTRICTIVE PERICARDITIS: A SERIES OF 76 CASES

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Abstract

Background: Constrictive pericarditis (CP) is an uncommon disease that is usually difficult to diagnose. Transthoracic echocardiography can sometimes fail to establish its diagnosis. The aim of our study is to prove that both Computed tomography (CT) and magnetic resonance (MR) imaging offer distinct advantages to confirm the diagnosis of CP and make therapeutic decisions for patients with this condition.
Methods: Data of 76 patients who underwent MRI for a suspicion of CP from January 2009 to October 2021 were reviewed retrospectively
Results:MRI and CT scan confirmed the diagnosis; showing pericardial thickening in all cases, measuring 7.6 ± 3.2 mm on average; circumferential in 62,7 %, and localized in 37,3 %, pericardial calcification in 50 % of cases and inferior vena cava plethora in all cases. An abnormal septal motion was found in all patients. Imaging data; namely pericardial thickening, calcifications, as well as their topography, were confirmed by surgical exploration, and the results were consistent in 100% of cases.
Conclusion: Although cardiac CT and CMR are recommended as second-line tests in the diagnostic workup of constrictive pericarditis, they offer distinct advantages to not only confirm the diagnosis but also make therapeutic decisions for patients with this condition. Nowadays, many studies prove that a modern approach for the management of pericardial diseases should include the use of different imaging modalities.

Introduction:-

Constrictive pericarditis (CP) is the final stage of a chronic inflammatory process characterized by fibrous thickening and calcification of the pericardium[1], that impairs diastolic filling reduces cardiac output, and ultimately leads to heart failure[2].

Transthoracic echocardiography (TTE) is usually the first diagnostic investigation performed for suspected constrictive pericarditis and can be very useful in the presence of the typical findings [3].However, as CP is an uncommon disease, it is usually difficult to diagnose it.

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The aim of our study was to review the role of various imaging techniques used for the diagnosis, evaluation and decision-making process in patients with this condition.

In fact, Computed tomography (CT) and magnetic resonance (MR) imaging offer distinct advantages in the evaluation of the pericardiumand are presently the gold-standard methods for accurate measurement of pericardial thickness[4,5].

We report our experience concerning the contribution of MRI and CT-scan in the diagnosis of constrictive pericarditis.

Methods:-

From January 2009 to October 2021, we performed a retrospective analysis of all patients referred to our center for a confirmed or a suspiciousdiagnosis of CP. We enrolled in this study 76patients. They were recruited in 2 ways: patients hospitalized in Cardiology B and cardiothoracic surgery departments of Ibn Sina University Hospital of Rabat, and patients followed in internal medicine or cardiology consultations.

Clinical details were retrieved from hospital files and referring physicians.

Transthoracic echocardiography was performed using Vivid9 (Vivid-9, GE Healthcare, Milwaukee, WI, USA). Complete two-dimensional (Two-D) and Doppler examinations were done in all patients using parasternal, apical, and subcostal windows.

All patients underwent MRI (Siemens 1,5 T) with breath-hold and free-breathing respiratory-gatedimaging. This was performed using commercially available software along with an electrocardiographic triggering. The orthogonal planes (transverse, sagittal and coronal) were acquired in separate and contiguous acquisitions while maintaining adequate spatial resolution. Cine MR Images were taken using True-FISP sequences. Phase-sensitive inversion recovery (PSIR) sequences revealed a delayed hyperenhancement obtained five to ten minutes after the intravenous injection of gadolinium using an inversion recovery “spoiled” gradient-echo technique in the two-chamber, four-chamber, and short-axis planes.

Thicknessmeasurements and morphological assessment of the pericardium were obtained in end-diastole. An increased pericardial thickness (≥4mm) was considered abnormal.

CT-scan was performed in 15 patients with a suspicion of pericardial calcifications.

Operative information was obtained from operative report.

Concerning statistical analysis, all data were checked and analysed using SPSS software for windows version 18 (SPSS. Inc. Chicago; Illinois). Continuous variables were expressed as mean, standard deviation.

Results:-

Over the study period,76 patients were admitted to our center for cardiac MRI.

Patientcharacteristics data are summarized in (Table 1). The mean age of our patients was 41±17 years. In this study, the youngest patient was 6 years old and the oldest was 85 years. The majority were male patients; there were 30 (58.8%) males and 21 (41.2%) females; male to female ratio was 1.42. In our experience, the most common clinical presentation was right heart-failure symptoms (50%) followed by dyspnea (40%) (Figure A). Although CP was related to tuberculosis in 24% of cases, a significant proportion of cases (74%) did not have any identifiable aetiology. Prior cardiac surgery was found in 2% as a cause of CP.

TTE data of our patients are detailed in (Table II). On TTE, respiratory septal shift was present in 48 (63%), biatrial enlargement in 56 (73%), dilated IVC in 68(89%) and thickened pericardium in 18 (23%). Expiratory hepatic vein flow reversal was seen in 34(44%).

CardiacMRI data of our patients are detailed in Table III. On MRI, 72 patients had pericardial thickening (96%) which measured on average 7.6 ± 3.2 mm, with a maximum of 20 mm and a minimum of 4 mm (Figure B). Pericardial thickening was circumferential (Figure 1) in 62.7% (n = 32), and localized in 37.3% (n = 19) (Figure 2,3). This localized thickening was especially present near the LV free wall and the RV lateral wall in most patients. Pericardial effusion was present in 45% of cases (n = 23). The RA was dilated in 80% of cases (on average 44 ± 13 mm) ,the LA in 60% of cases (45 ± 13 mm on average).The RV was dilated to 34 ± 6 mm in 9% of cases, and the IVC was dilated (Figure 4) in all cases (100%) with a mean of 29 ± 5mm. TheLV was dilated in only one patient. The tagging sequences (Figure 5 showed adhesions of the pericardium to the myocardium in all patients. The study of late enhancement 5 to 10 minutes after injection of contrast product (Figure 6) showed sub-epicardial contrast enhancement in 72% of patients in whom we performed the injection (n = 36).Cine MRI sequences revealedan abnormal ventricular septum morphology in all patients Thus, MRI confirmed the diagnosis of CP in all cases.

On CT (Table III), 10 patients had pericardial thickening (83%), and 6 had calcifications (50%) (Figure 7, 8).Thus, in76patients, cross-sectional cardiac imaging (CT and MRI)confirmed the diagnosis of CP; as in 100% of cases.

32 (33%)Patients in our series were operated ; 30 had a subtotal pericardectomy. Two patients underwent pericardial drainage with biopsy by mini thoracotomy, due to active tuberculosis he was put under antibiotics. The other patients were not operated for several reasons; the refusal of the intervention by some patients, and the decision of a medical treatment by the surgical staff for a patient due to the technical difficulty of pericardial decortication. In addition to surgery, treatmentsfor heart failure (diuretics, anti-aldosterones) and tuberculosis wereinitiated before thesurgical intervention in 16 patients (presumed tuberculous CP), and postoperatively with a total treatment duration of 9 to 12 months.

The imaging data;namely pericardial thickening, calcifications, as well as their topography, were confirmed by surgical exploration, and results were consistent in 100% of cases.

Discussion:-

The diagnosis of CP is quite challenging. Although echocardiography is considered the first-line imaging technique, it sometimes fails to establish the diagnosis of CP[6], and requires the use of other imaging modalities. In our study, some patients were addressed for a suspicion of CP, namely patients with localised forms and those with poorly exploitable aortic windows. Computed tomography (CT) and magnetic resonance imaging (MRI) are the two methods that allow direct visualization of the pericardium and are presently the gold-standard methods for accurate measurement of pericardial thickness[7]. MRIis recommended as a second-line test in the diagnostic workup ofpericarditis[7].Cardiac magnetic resonance imaging (MRI) is a non-invasive procedure that determines the anatomic and physiologic impact of an abnormal pericardium[8,9].In fact, the typical morphological presentation of constrictive pericarditis is a more or less generalized thickening of the pericardium this thickening is usually most pronounced over the right heart side[10].The normal pericardial thickness is 2 mm or less and a pericardial thickness greater than 4 mm is suggestive of pericardial constriction[11].Also,enhancement of the thickened pericardium after administration of gadolinium-based contrast material suggests pericardial inflammation but nonspecific to constrictive pericarditis which can inform response to anti-inflammatory therapy and the need for pericardiectomy[12,13].Another advantageof MRI istagging images that evaluate the adherence and immobility of the pericardial-myocardial interface[8,9].The MRI allows not only structural evaluation of the pericardium but also detection of the characteristic CP hemodynamic changes. Like echocardiography, Visual assessment of VSS is possible by free breathing cine CMR imaging with good sensitivity and specificity for CP diagnosis[14]. On CMR, combination of pericardial thickness and respiratory septal shift achieve a sensitivity of 100% and specificity of 90% in diagnosing CP[14].

In our study, adding MRI for patients with a suspicion of localized forms confirmed the diagnosis, VSS was seen in 100% on CMR and 48% on TTE and pericardial thickness increased was detected in by96 % CMR compared to 23 % by TTE.

Cardiac CT is also sensitive for detection of pericardial thickening andCT is the best imaging procedure to reveal pericardial calcifications. However, a calcified pericardium does not necessarily imply the presence of constrictive pericarditis[8]. Furthermore, the absence of calcifications does not rule out constriction[8].Tostudy the topography of calcifications in our cohort, cardiac CT was performed for only 12 patients and 6 of them had calcifications.

On the other hand, both CMR and CT are particularly helpful in planning surgical interventions[15].Different surgical approaches and techniques can be planned, especially median sternotomy versus lateral thoracotomy, partial versus total pericardiectomy[16,17]. Generally, the median sternotomy approach enables a more radical clearance of the pericardium overlying the right atrium and venae cavae[18]. The left anterolateral thoracotomy approach should be preferred in cases of purulent pericarditis and effusive-constricted pericarditis because of concomitant pyothorax and the risk of sternal infection[18]. The imaging data; namelypericardial thickening, calcifications, as well as their topography, were confirmed by surgical exploration, and results were consistent in 100% of cases.

Study Limitations:
Our research was limited to a single large academic center; the results may not be completely generalizable to other regions.

This was a retrospective observational study and no follow-up data was presented since our study was based on in-hospital records only.

Even if imaging datawere confirmed by surgical exploration, only 43% of patients were operated.

Conclusion:-

Although cardiac CT and CMR are recommended as second-line tests for the diagnostic workup of pericarditis, theyoffer distinct advantages to not only confirm the diagnosis of CP,but also make therapeutic decisions for patients with this condition. Nowadays, many studies prove that a modern approach for the management of pericardial diseases should include the use of different imaging modalities.

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Figures and tables

Total population	76(100%)
Mean age (years)	**41±17**
Symptoms	
Right heart-failure symptoms	**38(50%)**
Dyspnea	**30(40%)**
Palpitation	**7(10%)**
ETIOLOGY	
Tuberculosis	**18(24%)**
Prior cardiac surgery	**1(2%)**
Not identified	**56(74%)**

Table I:- Characteristics of our patients.

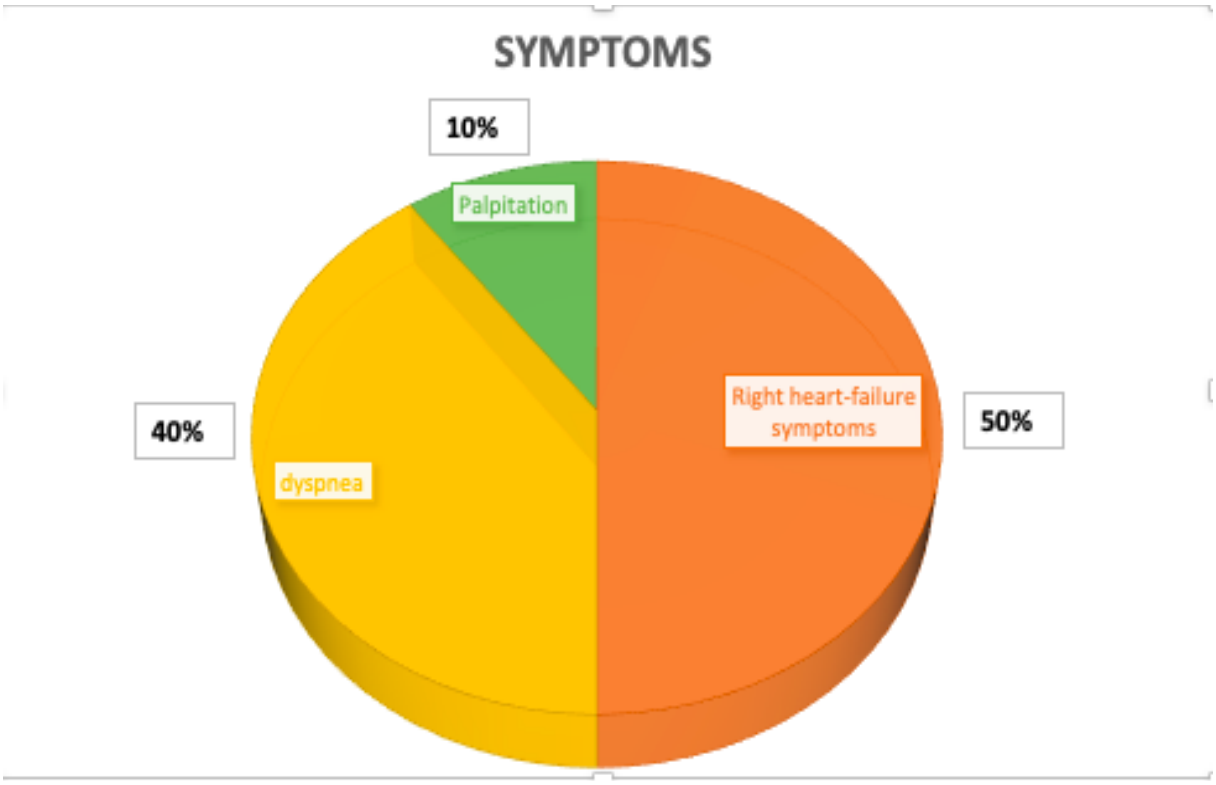


Figure A:- symptoms.

TransthoracicEchocardiogram	n(%)
Respiratory septal shift	48 (63%)
Dilate d'IVC	68(89%)
Thickenedpericardium	18 (23%)
Respiratory variation:	**69(91%)**
Septal e'>9	67(89%)
Annulusreversus:	53(70%)
Hepaticvein flow reversal:	34(44%)

Table II:- TransthoracicEchocardiogramdata of our patients.

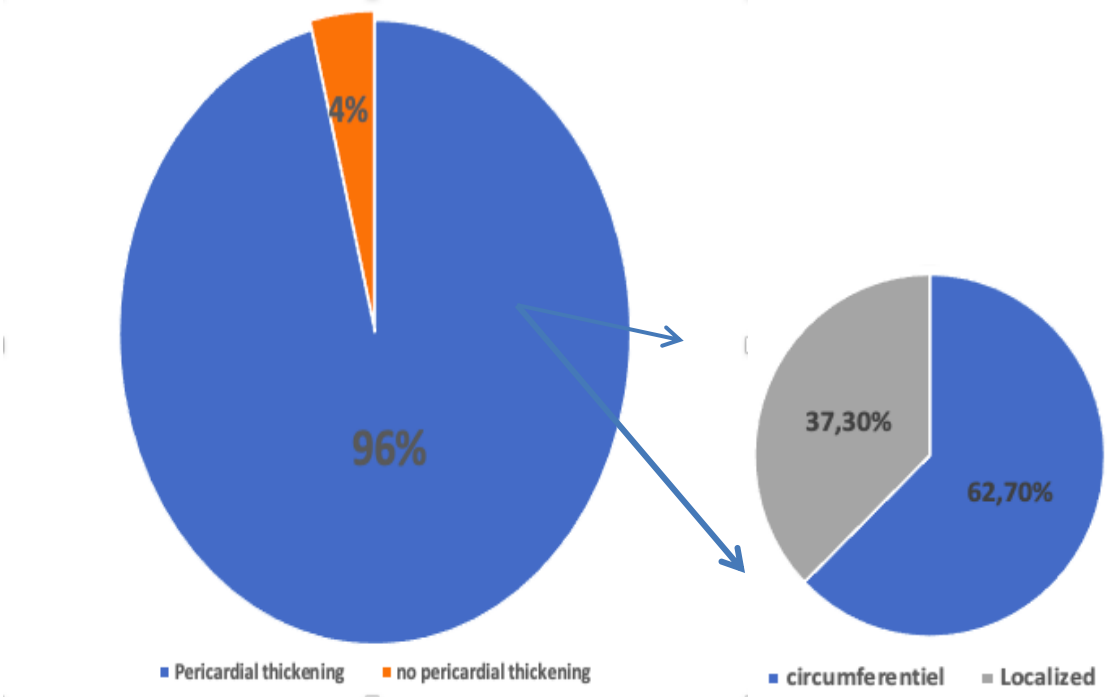


Figure B:- Pericardial thickening.

Pericardial thickening	72(96%)
Pericardial thickening localization Circumferential Localized	 47(62.7%) 25(37.3%)
Pericardial effusion	34(45%)
RA	60(80%)
LA	45(60%)
RV	6(9%)
IVC	76(100%)
Late enhancement	54(72%)
VSS	76(100%)

RA: Right Atrium, LA: Left Atrium, RV: Right Ventricle, IVC: Inferior Vena Cava

Table II :-Cardiac MRI data of our patients.

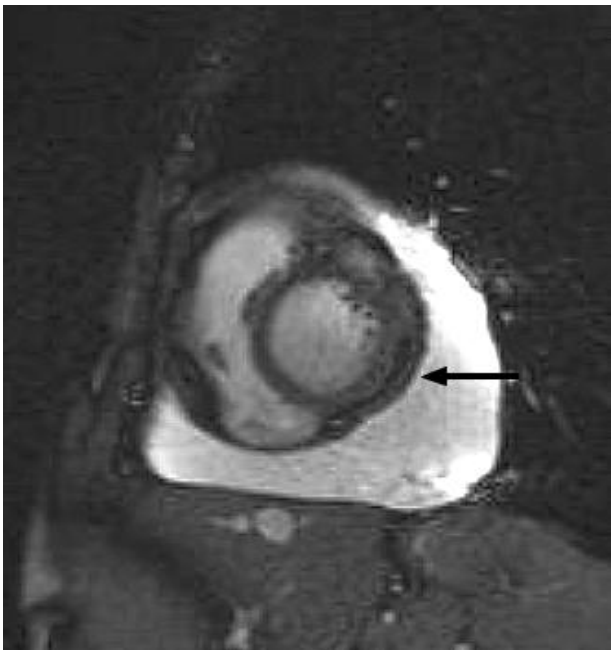


Figure 1:- Small axis section showing circumferential pericardial thickening with abundant pericardial effusion.

Figure 2:- Small axis section showing a thickened pericardium and encysted effusion opposite to the infero-lateral wall of the RV.

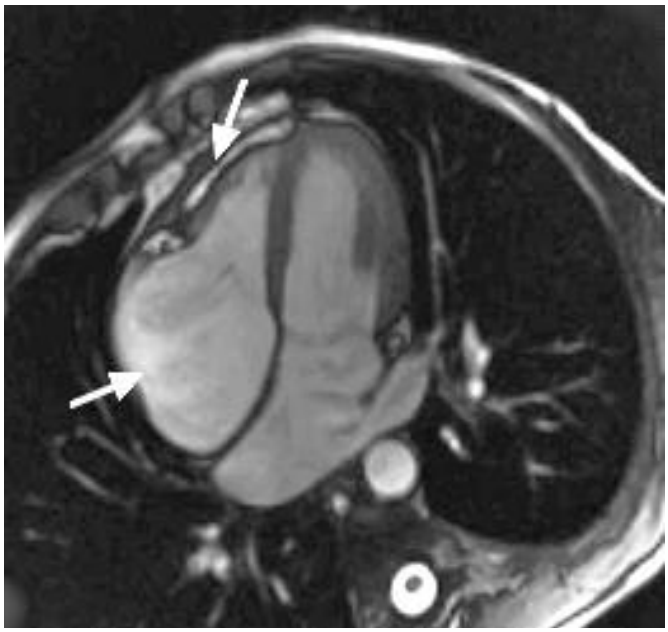


Figure 3:- Cine MRI showing pericardial thickening localized at the level of the lateral wall of the RV with an encysted effusion in one patient.

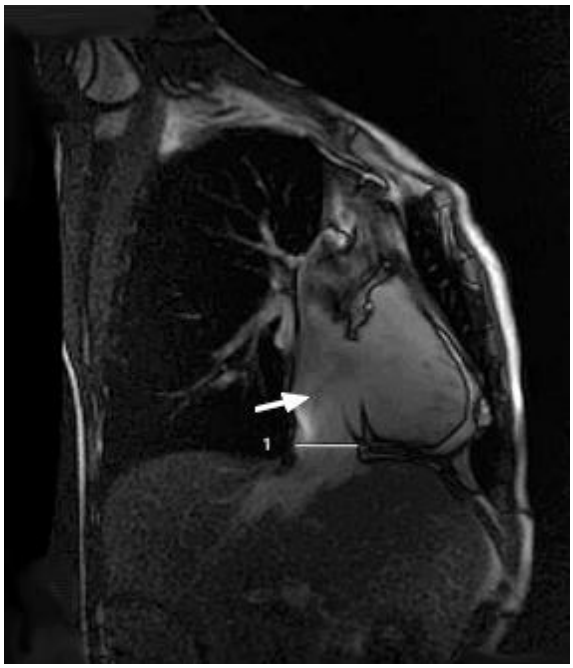


Figure 4:- Long RV axis section in Cine MRI showing significant IVC dilation, circumferential pericardial thickening with adhesions at the base of the lower and anterior wall.

Figure 5:- Short axis section in Cine MRI showing a sequence of myocardial tagging. Note the pericardial thickening opposite the lateral wall of the LV as well as the grip at this level.

Figure 6:- 4-Cavity MRI section 10 minutes after gadolinium injection showinganenhancement in the pericardium indicating progressive inflammation.

Total population	12 (100%)
Pericardial thickening	10 (83%)
Calcifications	6 (50%)

Table III:- Cardiac CT data of our patients.

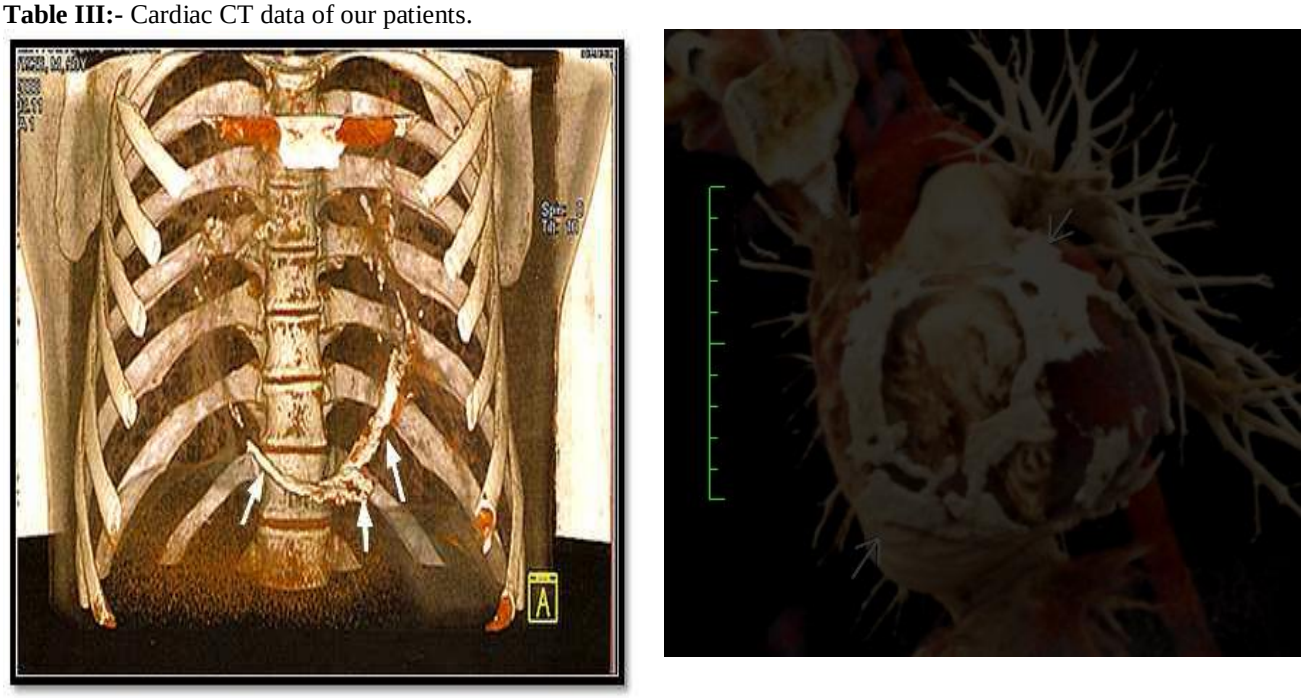
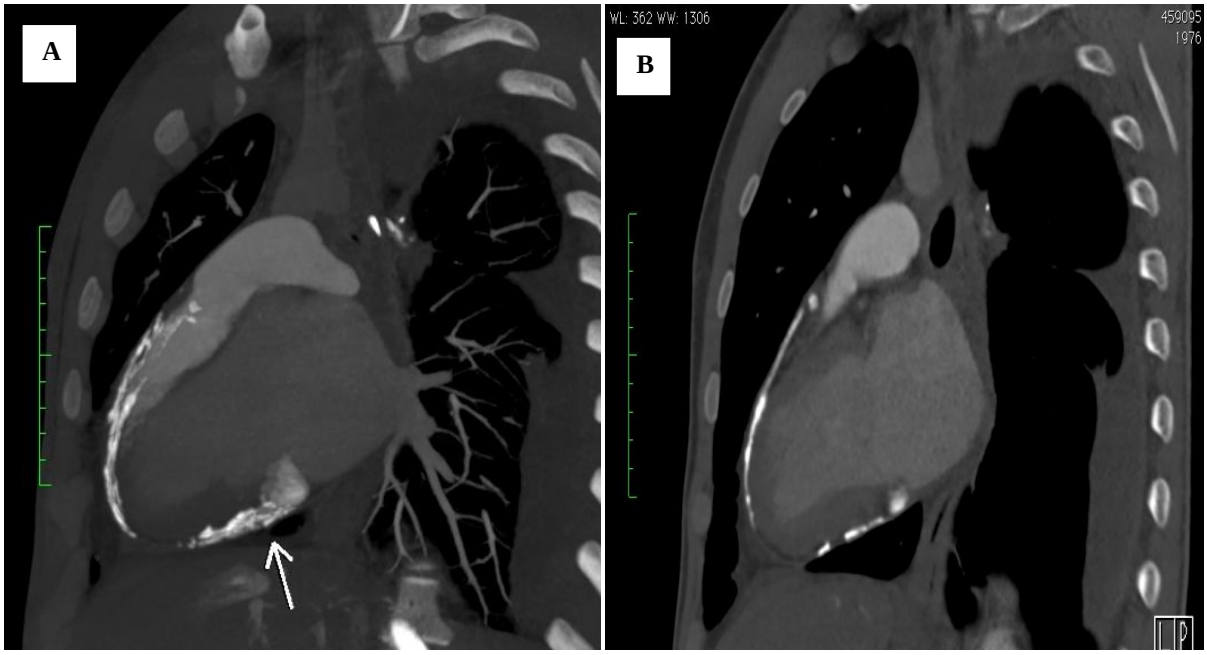


Figure 7:- Chest CT scan without contrast media injection with 3D reconstruction: calcified circumferential matrix predominant in the lateral and lower wall of the LV.



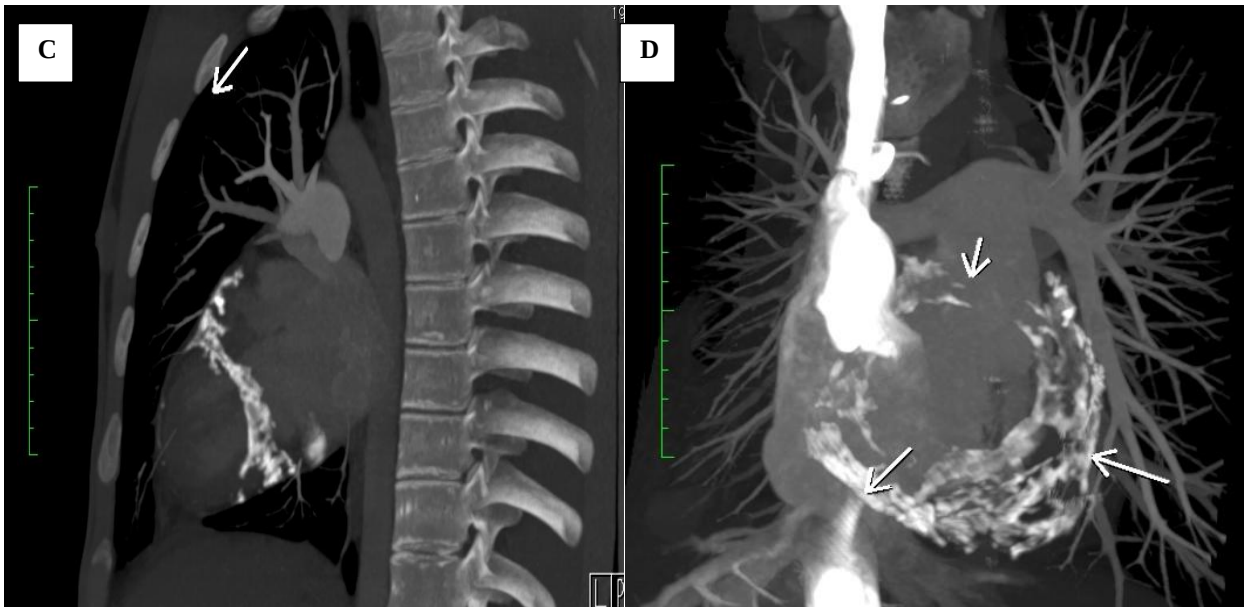


Figure 8:- Chest CT scan without ECG synchronization, with contrast media: A+B : Calcifications in Anterior and Inferior wall- C: Calcifications in Mitral Ring- D: circumferentialcalfications.

Conflict of interest:
The Authors declare that there is no conflict of interest.

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