

ROLE OF CT AND MRI IN DIAGNOSIS OF PERICARDIAL DISEASES

Essay

Submitted for partial fulfillment of M.Sc. degree
in Diagnostic Radiology

By

Mohamed Shaaban Mohamed Bayoumy Elsaawa

M.B.B.Ch

Faculty of Medicine - Ain Shams University

Supervised By

Dr. Sahar El Fiky

Professor of Diagnostic Radiology

Faculty of Medicine - Ain Shams University

Dr. Khaled Ahmed Mohamed Ali

Lecturer of Diagnostic radiology

Faculty of Medicine - Ain Shams University

**Faculty of Medicine
Ain Shams University**

2014

List of Contents

Title	Page No.
List of Abbreviations.....	ii
List of Tables	iv
List of Figures	v
Introduction	1
Aim of the work.....	4
Chapter (1): Anatomy	5
Chapter (2): PATHOLOGY.....	24
Chapter (3): X-Ray and Echocardiography.....	58
Chapter (4): CT & MRI	72
Summary	103
References	107
Arabic Summary	--

List of Abbreviations

2D	Two dimensional
AMI	Acute myocardial infarction
bSSFP	Balanced steady state free precession
BTFE	Balanced turbo field echo
CCT	Cardiac computed tomography
Cine	Cinema
CK	Creatine kinase
CMR	Cardiac magnetic resonance
CT	Computed tomography
CTR	Cardio-thoracic ratio
e.g.	For example
ECG	Electro-cardio-graphy (Electrocardiogram)
esp.	Especially
et al	And others
Fig.	Figure
Figs.	Figures
GRE	Gradient echo
HIV	Human immunodeficiency virus
i.e.	That is
IVC	Inferior vena cava
IVS	Inter-ventricular septum
LA	Left atrium
LV	Left ventricle
MFH	Malignant fibrous histiocytoma
MI	Myocardial infarction
ml	Milliliter
mm Hg	Millimeter mercury

List of Abbreviations_(Cont...)

MR	Magnetic resonance
MRI	Magnetic resonance imaging
MVP	Mitral valve prolapse
PA	Pulmonary artery
PA CXR	Postero-anterior chest x-ray
PMN	Poly-morph-nuclear white blood cells
PPD	Purified protein derivative
RA	Right atrium
RPA	Right pulmonary artery
RV	Right ventricle
SE	Spin echo
SLE	Systemic lupus erythematosus
SVC	Superior vena cava
T.B.	Tubercle bacillus
Tab.	Table
TNM	1ry tumor – lymph nodes – metastasis cancer staging system
TTE	Trans-thoracic echocardiography

List of Tables

Table No.	Title	Page No.
Table (1):	Constrictive pericarditis incidence rates	52
Table (2):	Summarizes the imaging findings in tamponade.	96
Table (3):	Imaging findings in constrictive pericarditis.....	99

List of Figures

Fig. No.	Title	Page No.
Fig. (1):	Position of the pericardium before the rotation.	18
Fig. (2):	Position of the pericardium after the rotation.	18
Fig. (3):	Posterior wall of the pericardial sac, showing the lines of reflection of the serous pericardium on the great vessels	21
Fig. (4):	Pericardial fluid.....	23
Fig. (5):	Normal pericardium.	25
Fig. (6):	Normal superior pericardial recess.	26
Fig. (7):	Drawing illustrates a cutaway view of the anterior aspect of the heart.	27
Fig. (8):	Drawing illustrates the pericardial sac with the heart removed.	28
Fig. (9):	Axial contrast-enhanced cardiac-gated images of the heart obtained at and inferior to the level of the right inferior pulmonary vein show areas of fluid attenuation anterior	29
Fig. (10):	Sagittal and coronal reformatted images from CT data show the relationship between the fluid in the pulmonic vein recess (arrowhead) and the pulmonary vein.	29
Fig. (11):	Axial contrast-enhanced CT scan shows fluid in the anterior portion of the superior aortic recess, a finding that can sometimes be mistaken for aortic dissection.....	32
Fig. (12):	Axial contrast-enhanced CT scan shows a small amount of fluid in the transverse sinus (<i>T</i>) posterior to the ascending aorta (<i>AA</i>).	33
Fig. (13):	Axial contrast-enhanced CT scan shows a small collection of fluid (arrow) in the posterior pericardial recess located below the level of the carina.	34
Fig. (14):	Echocardiography apical four-chamber end-diastolic view and parasternal long-axis view.....	35
Fig. (15):	Incidental finding of a partial left pericardial defect (arrow) with the left chest beyond.....	39

List of Figures_(Cont...)

Fig. No.	Title	Page No.
Fig. (16):	Hemopericardium: Gross, an excellent in situ view	43
Fig. (17):	Fibrinous pericarditis: Gross, natural color, an excellent example.....	46
Fig. (18):	Mature teratoma, microscopic features. Low-power photomicrograph (original magnification, 75.....	57
Fig. (19):	Mature teratoma in a 1-month-old girl with heart failure. Photograph of a cut specimen of the tumor shows a firm, white lobular, multilocular cystic mass	58
Fig. (20):	Pericardial fibroma, microscopic features.....	58
Fig. (21):	Mesothelioma, microscopic features.....	61
Fig. (22):	Pericardial mesothelioma in a 36-year-old woman with fatigue, malaise, and dyspnea	61
Fig. (23):	Intraoperative photograph shows a cyst filling up almost the entire anterior mediastinum, overlying SVC	66
Fig. (24):	Congenital defect in the pericardium.....	71
Fig. (25):	Transthoracic echocardiogram.....	72
Fig. (26):	Transthoracic echocardiogram.....	72
Fig. (27):	Posteroanterior chest X -ray of a straight back syndrome patient	73
Fig. (28):	Transthoracic echocardiogram of a straight back syndrome patient in apical 4- chamber view that has abnormal view	74
Fig. (29):	M-mode transthoracic echocardiography of a straight back syndrome patient in parasternal short axis view that shows paradoxical septal motion.....	75
Fig. (30):	Patient recently underwent a valve replacement. There is a large cardiac silhouette, which could be the result of cardiomegaly.	76
Fig. (31):	Pericardial effusion	76
Fig. (32):	A very large pericardial effusion as seen on cardiac ultrasound.....	77

List of Figures_(Cont...)

Fig. No.	Title	Page No.
Fig. (33):	Constrictive pericarditis with small bilateral pleural effusion and upper lobe venous diversion.....	78
Fig. (34):	Chest x-ray (lateral view) showing extensive pericardial calcifications. L indicates lateral	79
Fig. (35):	Large circumferential pericardial effusion with diastolic RV inversion	81
Fig. (36):	Reduced mitral inflow on inspiration	81
Fig. (37):	Physiology of ventricular interdependence highlighting the change in transvalvular flow throughout the respiratory cycle.....	83
Fig. (38):	Chronic pericarditis with thickening of the pericardium.....	84
Fig. (39):	CMR of Normal Pericardium The CMR bSSFP sequence in short-axis (left) and 4-chamber view (right) showing the normal pericardial outline and the epicardial fat layer (arrowhead).....	86
Fig. (40):	Congenital absence of the pericardium.....	87
Fig. (41):	Cardiac computed tomography scan demonstrating superior and lateral displacement of the apex without identifiable pericardium over the apex of the heart consistent with congenital absence of the pericardium.	88
Fig. (42):	Pericardial effusion in a 40-year-old woman with shortness of breath. Axial contrast-enhanced CT scan shows an effusion	89
Fig. (43):	Pericardial effusion in a 46-year-old man with shortness of breath.	90
Fig. (44):	Loculated pericardial effusion in a 65-yearold man with recent thoracotomy	90
Fig. (45):	Pericardial effusion in a 34-year-old woman with nephrotic syndrome.....	91
Fig. (46):	Pericardial effusion in a 68-year-old woman with a recent history of myocardial infarction.....	92

List of Figures_(Cont...)

Fig. No.	Title	Page No.
Fig. (47):	Spiral thoracic post-contrast computed tomography scan at the level of the superior pulmonary vein entrance to the left atrium.....	94
Fig. (48):	Delayed Enhancement of the Pericardium.....	94
Fig. (49):	CMR using bSSFP in a short-axis view demonstrating a circumferential pericardial effusion.....	96
Fig. (50):	Cardiac computed tomography findings of pericardial calcification clustered around the atrioventricular grooves.....	97
Fig. (51):	Persistent continuity of tag lines on CMR tagging sequence throughout the cardiac cycle is diagnostic of pericardial adhesions	100
Fig. (52):	Short axis MRI showing early diastolic flattening of the interventricular septum.....	100
Fig. (53):	MR appearances of constrictive pericarditis.	101
Fig. (54):	Axial T1-weighted MR image shows the large, heterogeneous, lobular multicystic pericardial mass	102
Fig. (55):	Mature teratoma in a 1-month-old girl with heart failure.....	102
Fig. (56):	MRI demonstrating huge right sided pericardial fibroma.	103
Fig. (57):	Pericardial mesothelioma in a 36-year-old woman with fatigue, malaise, and dyspnea	104
Fig. (58):	Unclassified sarcoma in a 29-year-old man with cough, fever, and weight loss who underwent heart transplantation.	105
Fig. (59):	Angiosarcoma in a 28-year-old woman who presented with mitral valve obstruction	106
Fig. (60):	Coronal T2-weighted (3,780/57) MR image demonstrates extensive circumferential cardiac involvement by the nodular, heterogeneous, hyperintense tumor.....	107

List of Figures_(Cont...)

Fig. No.	Title	Page No.
Fig. (61):	Primary cardiac lymphoma in a 75-year-old woman with progressive dyspnea, superior vena cava syndrome, and atrial fibrillation	108
Fig. (62):	Biopsy-proved primary pericardial lymphoma in a 45-year-old man with shortness of breath.....	108
Fig. (63):	Metastatic pericardial lymphoma in a 36- year-old man	110
Fig. (64):	Direct extension in a 65-year-old woman with bronchogenic carcinoma	111
Fig. (65):	Direct invasion in a patient with sarcoma.	111
Fig. (66):	Placement of a small-bore catheter into the pericardium for drainage of a pericardial effusion or administration of a sclerosing agent.	112
Fig. (67):	CT Scan of the thorax showing the pericardial cyst.....	113
Fig. (68):	MR scan demonstrating a large cystic mass in right anterior hemithorax.....	114
Fig. (69):	An axial CT scan through the lower thorax shows an accumulation of fat (arrow) in the space anterior to the heart and the right hemidiaphragm.....	114
Fig. (70):	Computed tomography confirmed the highly calcified pericarditis with maximal thickness measured at 19 mm and only a small antero-apical region free of calcification.....	115
Fig. (71):	Computed tomographic findings demonstrate post-traumatic pneumopericardium, with no associated pericardial effusion	115

ABSTRACT

Pericardial diseases are important causes of morbidity and mortality in cardiovascular diseases. CT & MRI are more than adjuncts to echocardiography in pericardial diseases assessment, as they provide an excellent pericardial anatomy delineation and precise pericardial lesions evaluation including; effusion, constrictive pericarditis, thickening, masses and congenital anomalies. Ideal management needs the proper imaging modality choosing ability.

Keywords: Pericardial diseases - CT - MRI.

INTRODUCTION

Pericardial disease is an important cause of morbidity and mortality in patients with cardiovascular disease. Inflammatory diseases of the pericardium constitute a spectrum ranging from acute pericarditis to chronic constrictive pericarditis. Other important entities that involve the pericardium include benign and malignant pericardial masses, pericardial cysts, and diverticula, as well as congenital absence of the pericardium (*Kibar et al., 2010*).

Echocardiography is the method of choice for evaluating most pericardial diseases. When competently performed in patients with good acoustic windows, echocardiography accurately detects all pericardial effusions and provides clinically relevant information about their size and hemodynamic importance. The technique is less reliable than magnetic resonance imaging (MRI) and computed tomography (CT) in detecting pericardial thickening/constriction and calcification as well as small loculated effusions, but is still extremely useful in these conditions (*Elyse et al., 2011*).

In the evaluation of pericardial disease, computed tomography (CT) and magnetic resonance (MR) imaging traditionally have been used as adjuncts to echocardiography. However, CT and MR imaging are particularly useful as sensitive and noninvasive methods for evaluating loculated or hemorrhagic pericardial effusion, constrictive pericarditis, and pericardial masses. Both CT and MR imaging provide excellent delineation of the pericardial anatomy and can aid in the precise localization and characterization of various pericardial lesions, including effusion, constrictive pericarditis and pericardial thickening, pericardial masses, and congenital anomalies such as partial or complete absence of the pericardium. Both modalities provide a larger field of view than does echocardiography, allowing the examination of the entire chest and detection of associated abnormalities in the mediastinum and lungs. Soft-tissue contrast on CT scans and MR images also is superior to that on echocardiograms. Given the many potential applications of these modalities in the evaluation of pericardial diseases, familiarity with the CT and MR imaging features of these diseases is important (*Zhen et al., 2003*).

Constrictive pericarditis is characterized by a thickened and adherent pericardium that restricts diastolic filling of the

heart. Tagged cine MRI is a noninvasive imaging technique for labeling and monitoring specific regions of the heart; the patterns of regional displacement accurately reflect the intervening motion within a cardiac cycle. It can successfully identify adhesion of the thickened pericardium to the myocardium, which is the essential feature of constrictive pericarditis (*Sunao et al., 1999*).

The pericardium, consisting of a fibroserous sac that encloses the heart, is routinely imaged on CT. Multidetector technology, in allowing rapid acquisition of volumetric data in high resolution and multiplanar reformation, has improved anatomic imaging. Imaging with narrow collimation results in improved delineation of cardiovascular anatomy and routine visualization of the pericardial recesses. The pericardial space normally contains a small amount of fluid (15–20 ml), and the fluid-filled recesses and sinuses can be misinterpreted as adenopathy or abnormality of an adjacent mediastinal structure. In oncologic imaging, staging and prognostic implications of fluid in a pericardial recess misinterpreted as adenopathy can significantly alter management and therapy. We review the anatomy of the pericardium with emphasis on the pericardial recesses that can potentially be misinterpreted as adenopathy. (*Mylene et al., 2003*).

Optimal management of the patient with suspected pericardial disease requires familiarity with the key imaging modalities and the ability to choose the appropriate imaging tests for each patient (*Kibar et al., 2010*).