

Role of different imaging modalities in assessment of Pericardial and Cardiac masses

Assay

Submitted in partial fulfilment of master in Radiodiagnosis

BY

*Naglaa Mohamed Fahmy
M.B.B.Ch.
Cairo University*

supervised by

*Dr. Sief EL-Din Abaza
Assistant Professor Of Radiology
Faculty Of Medicine, Cairo University*

*Dr. Noha Hossam-EL Din Behery
Lecturer Of Radiology, Faculty Of Medicine
Cairo University*

*Faculty of medicine
Cairo university*

٢٠٠٧

Acknowledgment

I would like to express my deepest appreciation to prof.Dr. Sief El-Din Abaza, assistant professor of Radiology, Faculty of medicine –Cairo university. And to Dr. Noha Hossam El-Din Beheiry, lecturer of radiology, faculty of medicine _ cairo university; for their great help and valuable guidance in finishing this work.

Abstract

Primary cardiac and pericardiac neoplasm are rare lesions and are less common than the secondary ones. They include both benign and malignant histologic types. Myxoma is the most frequent primary cardiac neoplasm in adult, while rhabdomyoma is the most common neoplasm in children. The pericardial tumors include benign teratom and malignant mesothlioma. However they can be early diagnosed with echocardiography, computed tomography (CT), and magnetic resonance imaging (MRI). Chest X-Ray may reflecting the location of the tumor., while Echocardiography is the preferred initial imaging modality, but CT and MRI add a very specific information in the evaluation of primary cardiac and pericardiac neoplasm as they detect the tumor location, morphologic features and tissue characterization, include the presence of calcification, fat, fibrous tissue, hemorrhage or cyctic changes. This help refine the differential diagnosis.

Key wards:

Cardiac masses/neoplasm, pericardiac masses/neoplasm, echocardiography, MRI heart, multislice CT heart.

Table of contents

	Page
List of figures	iv
Introduction and aim of study	viii
Review of literature	1
Anatomy of the heart	1
Radiographic anatomy	5
Anatomic evaluation with echocardiography	8
Conventional CT	14
Electron beam CT	14
Multislice CT	15
Magnetic resonance imaging	17
Different MR techniques for evaluation of cardiac lesions	17
Normal MRI appearance of the heart	54
MRI of normal pericardium	64
Radiological imaging of benign primary cardiac and pericardial masses	68
Radiological imaging of primary malignant cardiac and pericardial masses	118
Secondary metastatic cardiac tumors	137
Pathological classification of cardiac tumors	149
Case presentation	178
Summary	188
Conclusion	191
References	192
Arabic summary	209

List Of Figures

page

Fig 1	anatomy of the heart	4
Fig 2	chest X-Ray frontal projection	6
Fig 3	chest X-Ray lateral projection	7
Fig 4	short axis gradient echo view	27
Fig 5a	LVOT survey	29
Fig 5b	LVOT view	29
Fig 6a	coronal survey	29
Fig 6b	RVOT view	29
Fig 7a	transverse LV survey	30
Fig 7b	LV 2 chamber view	30
Fig 8a	transverse RV survey	31
Fig 8b	RV 2 chamber view	31
Fig 9a	aortic arch survey	31
Fig 9b	aortic arch view	31
Fig 10a	ascending arch survey	32
Fig 10b	ascending arch view	32
Fig 11a	LV 2 chamber view	33
Fig 11b	short axis view	33
Fig 12a	LVOT view	33
Fig 12b	short axis view	33
Fig 13a	coronal view	34
Fig 13b	sagittal view	34
Fig 13c	short axis view	34
Fig 14a	short axis view	35
Fig 14b	4 chamber view	35
Fig 15a	LV 2 chamber view	36
Fig 15b	4 chamber view	36
Fig 16a	coronal survey	37
Fig 16b	axial survey	37
Fig 16c	4 chamber view	37
Fig 17a	volumetric analysis of LV	46
Fig 17b	volumetric calculation of RV	46
Fig 18a	axial view level 1	56
Fig 18b	axial view level 2	56
Fig 19a	sagittal view level 1	58
Fig 19b	sagittal view level 2	58
Fig 20a,b,c	coronal view	59
Fig 21	short axis view	60
Fig 22	4 chamber view	61
Fig 23	2 chamber view	62
Fig 24a	short axis end systolic	62
Fig 24b	short axis during diastole	62
Fig 25a	out flow tract closed aortic valve	63
Fig 25b	out flow tract opened valve	63
Fig 26a,b	chest X-Ray PA (a)& lateral (b) in LA myxoma	72

	Page
Fig ٢٧a chest X-Ray PA in LA myxoma	٧٢
Fig ٢٧b chest X-Ray lateral view with barium in LA myxoma	٧٢
Fig ٢٨ chest X-Ray PA in biatrial myxoma	٧٣
Fig ٢٩ transverse transesophageal echo in LA myxoma	٧٥
Fig ٣٠ parasternal trasesophageal echo in RA myxoma	٧٥
Fig ٣١ trasesophageal echo in LA myxoma	٧٦
Fig ٣٢a,b non contrast CT in LA myxoma	٧٨
Fig ٣٣a,b CT chest with contrast	٧٨
Fig ٣٤a,b CT chest in RA myxoma	٧٨
Fig ٣٥a,b MRI coronal(a)& axial(b) in RA myxoma	٨٠
Fig ٣٦a,b MRI axial non contrast (a)& contrast(b) LV myxoma	٨٠
Fig ٣٧a,b MRI axial in intraatrial myxoma	٨٠
Fig ٣٨ trasesophageal echo in papillary fibroelastoma	٨٥
Fig ٣٩ trasthoracic ٤ chamber echo in papillary fibroelastoma	٨٥
Fig ٤٠ MRI in LA papillary fibroelastoma	٨٧
Fig ٤١ MRI axial cine in papillary fibroelastoma	٨٧
Fig ٤٢ trasesophageal echo in interventricular septum fibroma	٩٠
Fig ٤٣a,b CT chest non contrast(a)& contrast (b) in LV fibroma	٩١
Fig ٤٤a,b MRI axial (a)& sagittal(b) in RV fibroma	٩٢
Fig ٤٥ MRI axial in LV fibroma	٩٢
Fig ٤٦a,b,c,d MRI axial in LV fibroma	٩٣
Fig ٤٧ MRI coronal in cardiac rhabdomyoma	٩٦
Fig ٤٨ MRI axial T١ in cardiac hemangioma	٩٨
Fig ٤٩ MRI axial T٢ in LA hemangioma	٩٩
Fig ٥٠ trasesophageal echo in RA lipoma	١٠١
Fig ٥١ CT chest in RA lipoma	١٠٢
Fig ٥٢a,b MRI axial (a)& coronal(b) in intracardiac lipoma	١٠٣
Fig ٥٣ MRI axia T١ in RA lipoma	١٠٣
Fig ٥٤a,b MRI coronal T٢ (a)& contrast(b) in pericardial lipoma	١٠٤
Fig ٥٥ MRI axial lipomatous hypertrophy of the interatrial septum	١٠٥
Fig ٥٦ CT chest lipomatous hypertrophy of the interatrial septum	١٠٥
Fig ٥٧ transverse transesophageal echo in RA paraganglioma	١٠٩
Fig ٥٨ MIBG scan in RA paraganglioma	١١٠
Fig ٥٩a,b MRI axial T١(a)& PD(b) in cardiac paraganglioma	١١١
Fig ٦٠ MRI axial T١ in LA paraganglioma	١١٢
Fig ٦١ MRI coronal spin-echo in LA paraganglioma	١١٢
Fig ٦٢a,b chest X-Ray PA(a)& collimated PA(b) in teratoma	١١٥
Fig ٦٣a,b MRI axial T١(a)& sagittal T١(b) in pericardial teratoma	١١٥
Fig ٦٤ trasesophageal echo in cardiac lymphangioma	١١٧
Fig ٦٥a,b MRI axial T١(a)& coronal T١(b)pericardial lymphangioma	١١٨
Fig ٦٦ CT chest with contrast in cardiac angiosarcoma	١٢٤
Fig ٦٧ CT chest in cardiac angiosarcoma	١٢٤
Fig ٦٨ MRI coronal T٢ in RA angiosarcoma	١٢٥
Fig ٦٩ MRI axial T١ with contrast in RA angiosarcoma	١٢٥
Fig ٧٠a,b MRI axial T١(a)& cine(b) in angiosarcoma	١٢٥
Fig ٧١a,b,c,d MRI in LV angiosarcoma	١٢٦
Fig ٧٢ MRI sagittal T١ in LV rhabdomyosarcoma	١٢٩
Fig ٧٣ MRI axial T١ in cardiac leiomyosarcoma	١٣٠
Fig ٧٤a,b MRI sagittal T١(a)& axial T١(b) in cardiac liposarcoma	١٣٠

	Page
Fig ٧٥a,b MRI coronal T١(a)& SVCavography in cardiac lymphoma	١٣٣
Fig ٧٦a MRI axial T١ non contrast in cardiac lymphoma	١٣٣
Fig ٧٦b MRI axial with contrast in cardiac lymphoma	١٣٣
Fig ٧٧a MRI axial T١ atrial level in mediastinal lymphoma	١٣٤
Fig ٧٧b MRI axial T١ in ventricular level in mediastinal lymphoma	١٣٤
Fig ٧٨ CT chest in pericardial mesothelioma	١٣٦
Fig ٧٩ MRI axial T١ in secondary cardiac tumors	١٣٨
Fig ٨٠a MRI axial T١ in secondary metastatic cardiac tumors	١٣٩
Fig ٨٠b MRI cine in secondary metastatic cardiac tumors	١٣٩
Fig ٨١a,b MRI axial T١ in metastatic leiomyosarcoma	١٤٠
Fig ٨٢a,b MRI axial T١ in metastatic bronchogenic carcinoma	١٤٠
Fig ٨٣a CT chest scan in LV thrombous	١٤٣
Fig ٨٣b MRI axial T١ spin-echo in LV thrombous	١٤٣
Fig ٨٤a,b photograph of gross specimen of myxoma	١٥٤
Fig ٨٥a,b gross specimen of myxoma	١٥٥
Fig ٨٦a,b microscopic picture of cardiac myxoma	١٥٦
Fig ٨٧a,b microscopic picture of cardiac myxoma	١٥٦
Fig ٨٨ gross specimen of papillary fibroelastoma	١٥٨
Fig ٨٩ microscopic picture of papillary fibroelastoma	١٥٩
Fig ٩٠a resected specimen of LV fibroma	١٦٠
Fig ٩٠b intraoperative photograph of RV fibroma	١٦٠
Fig ٩١ microscopic picture of fibroma	١٦١
Fig ٩٢ cut specimen of cardiac rhabdomyoma	١٦٢
Fig ٩٣ microscopic picture of cardiac rhabdomyoma	١٦٣
Fig ٩٤ gross specimen of cardiac hemangioma	١٦٤
Fig ٩٥ microscopic picture of cardiac hemangioma	١٦٥
Fig ٩٦ gross specimen of cardiac lipoma	١٦٦
Fig ٩٧ resected specimen of RA paraganglioma	١٦٨
Fig ٩٨ microscopic picture of paraganglioma	١٦٨
Fig ٩٩ cut specimen of pericardial teratoma	١٦٩
Fig ١٠٠ microscopic picture of pericardial teratoma	١٧٠
Fig ١٠١ gross specimen of cardiac angiosarcoma	١٧١
Fig ١٠٢ microscopic picture of angiosarcoma	١٧٣
Fig ١٠٣ microscopic picture of rhabdomyosarcoma	١٧٤
Fig ١٠٤ specimen of heart in primary cardiac lymphoma	١٧٥
Fig ١٠٥ microscopic picture of cardiac lymphoma	١٧٥
Fig ١٠٦ cut specimen of pericardial mesothelioma	١٧٦
Fig ١٠٧ microscopic picture of pericardial mesothelioma	١٧٧
Fig ١٠٨a case ١: MRI brain axial T١WI Gd	١٧٨
Fig ١٠٨b case ١: chest X-Ray PA	١٧٩
Fig ١٠٨c case ١: Echocardiography	١٧٩
Fig ١٠٨d,e case ١: MRI axial T١WI(d)& axial T١WI Gd(e)	١٨٠
Fig ١٠٩ a,b case ٢: MRI Coronal T١WI(a)& Coronal T١WI Gd(b)	١٨١
Fig ١٠٩c case ٢: MRI Axial T١WI Gd	١٨١
Fig ١١٠a case ٣: MRI Axial T١WI Gd	١٨٢
Fig ١١٠b case ٣: MRI sagittal T١WI	١٨٣
Fig ١١٠c case ٣: MRI sagittal T١WI Gd	١٨٣
Fig ١١١a case ٤: MRI coronal T١WI	١٨٤
Fig ١١١b case ٤: MRI sagittal T١WI	١٨٥

	Page
Fig ١١١c case ٤: MRI axial T١WI	١٨٥
Fig ١١٢a case ٥: Echocardiography	١٨٦
Fig ١١٢b case ٥: MRI axial T١WI	١٨٧
Fig ١١٢c case ٥: MRI axial T١WI Gd	١٨٧
Fig ١١٢d case ٥: MRI coronal T١WI	١٨٧

Introduction

Primary cardiac neoplasm are rare lesions that affect patients of all ages. It is estimated that primary cardiac neoplasm are 100-1000 times less prevalent than secondary neoplasm of the heart. The benign primary neoplasm are more common than the malignant ones although benign neoplasm don not metastasize may lead to significant morbidity and mortality by affecting blood flow and causing arrhythmias and emboli before the advent of cross sectional image. (*Sawage et. al., 2000*)

The most common primary cardiac neoplasm is myxoma that account for half of all the cases other primary cardiac tumors include papillary fibroelastoma which is the most common valvular tumor, rhabdomyoma, fibroma, lipoma, hemangioma & paraganglioma. While the malignant cardiac tumors include sarcoma which represent the second most common primary cardiac neoplasm and lymphoma which is rarely manifest as primary cardiac tumor. (*Shapiro et. al., 2001*)

The pericardial tumors also affect the heart mimic cardiac neoplasms the most common pericardial tumors are teratoma and malignant mesothelioma. (*Schvartzman et. al., 2000*)

Benign neoplasms are classified according to their histological features and cellular differentiation into that arising from fibrous tissue as (fibroma), vascular as (hemangioma), fat as (lipoma) & nervous as (pheochromocytoma) or ectopic as (teratoma).

Introduction and aim of study

While the malignant neoplasms are histological classified by tissue type into as mesenchymal (sarcoma), lymphoid (lymphoma) and mesothelial as (mesothelioma). (*Zissin et.al., 1999*)

Patients with primary cardiac neoplasms present with wide range of symptoms that are commonly cardiovascular in nature that may mimic cardiopulmonary diseases as coronary artery diseases, cardiomyopathy, pericarditis or valvular dysfunction.

The most common clinical presentation is heart failure as dyspnea, orthopnea, peripheral edema, followed by symptoms of peripheral emboli to the cerebral or the coronary arterial circulation. The clinical presentation is determined by the tumor location, size, rate of growth, friability with the its tendency for emmobilization and the degree of invasiveness. (*Perchinsky et.al., 1997*)

The intra cavitory tumors tend to obstruct the cardiac valves or the major vascular structures or produce emboli, while the myocardial lesions may affect the conduction system of the heart resulting in arrhythmia, the pericardial neoplasms lead to pericardial tamponad. (*Roberts et.al., 1997*)

Radiological evaluation usually begin with chest X-Ray which reveals abnormal findings including cardiomegaly, abnormal contour, sign of heart failure and plural effusion. Specific chamber enlargement may result from various intracavitary tumors, whereas the mural lesions produce abnormal contour or cardiac enlargement. Pericardial neoplasm usually produce a rapid developing pericardial effusion. (*Rachmani et.al., 1999*)

Echocardiography is the primary modality of imaging intracardiac disease as it provide high resolution and real time images through trasesophageal echocardiography, it is the initial

Introduction and aim of study

evaluation of suspected cardiac tumors and it is frequently required for more accurate assessment.

However the image acquisition with computed tomography adequately demonstrate the morphology, location and extent of cardiac neoplasms, and its main advantages over the echocardiography is its depiction of the pericardium, great vessels and surrounding structures to look for the associated metastasis (Shaparo et.al., 1999)

The soft tissue contrast by CT imaging is superior to that of echocardiography and is capable of detection of calcification which is important variable in the differential diagnosis of cardiac neoplasm.

Magnetic resonance imaging has a higher soft tissue contrast than CT images and allows much greater flexibility in selection of imaging planes. MRI is utilized in preoperative evaluation of cardiac neoplasm. The main advantage of MRI is high contrast and spatial resolution, wide field of view, multiplaner imaging and capabilities of precise demonstration of the masses include its anatomical relation to the pericardium, myocardium or any contiguous structures. In some cases the use of gadolinium increase the conspicuity of the tumor by showing the differential enhancement with respect the surrounding normal myocardium. (Smith et.al., 1998)

Aim of study

To compare the capability of different imaging modalities in diagnosis of cardiac tumors.

Anatomy of the heart

The heart base is facing upward with its apex is pointing downward forward and to the left . Two third of the heart lies to the left ,and one third lies to the right of the median plain .

The heart has two surfaces: the anterior surface , that is anterior superior ,and the posterior surface that is posterior inferior it also has two borders: A blunted left border and a sharp right border.

The anterior surface of the heart is made mainly of the anterior surface of the right ventricle with a small strip of the left ventricle to the left and the anterior aspect of the right atrium to the right.

The posterior surface of the heart is divided into the diaphragmatic, and the vertebral surfaces.

The diaphragmatic surface is formed of the ventricles separated by the posterior inter ventricular sulcus. The left ventricle forms the left two third of this surface. The vertebral surface that form the base of the heart is formed by the atria, mainly the left . The base is separated from the diaphragmatic surface by the posterior part of the coronary sulcus. .(*Abaza et al*, ١٩٩٥)

Review of literature

Right atrium :

The right atrium consists of smooth walled posterior part which receive the superior and inferior vena cava and the coronary sinus and an anterior part which is ridged by muscle bundles (muscle pectinati). The two parts are separated on the right by an external groove(sulcus terminalis) and a corresponding internal vertical ridge (crista terminalis) . The fossa ovalis lies on the posteromedial wall of the right atrium . the left border of the right atrium is largely formed by the tricuspid valve.

Left atrium:

The left atrium is an ovoid shaped chamber. The four pulmonary veins enter through its posterior wall. The mitral valve occupies the left anteroposterior aspect of the chamber, while the atrial septum forms its right anteroposterior wall. (*Abaza et al., 1990*)

Right ventricle:

The right ventricle lies anterior and to the right of the left ventricle, its cavity is approximately triangular in shape when seen from the anterior surface and crescent in shape in transverse section . The normal chamber can be divided into two identifiable segments :an outflow portion or infundibulum leading to the pulmonary valve. The remainder of the ventricle has irregular muscular ridge (trabeculae carneae) projecting from its internal surface.

There are usually 3 papillary muscles . Large posterior and anterior papillary muscles and several small septal papillary muscles. Each of these papillary muscles is inserted into the

margins and ventricular surface of the two adjacent cups of the tricuspid valve by tendinous strands (chordae tendinae).

The crista supra ventricularis is a muscular sheet that extends between the tricuspid and the pulmonary valves and forms the right posterior wall of the infundibulum.

Septomarginal trabecula or moderator band is one of the trabeculae crossing the cavity of the ventricle from the septum to the anterior papillary muscle .

Left ventricle:

The left ventricle is an elliptic shaped chamber with a flattened base formed by the aortic valve . It is round in cross section , having thick wall and fine trabeculations . The aortic and mitral valves insert in a common on the fibrous skeleton of the heart . The mitral valve is situated along the most posterior and superior aspect of the left ventricle , just below the posterior margin of the aortic valve . The mitral valve is tethered by two finger like papillary muscles , one arising from the anterior lateral aspect of the left ventricle wall near the cardiac apex and the other from the posterior medial portion of the ventricle. .(Abaza et al., 1990)

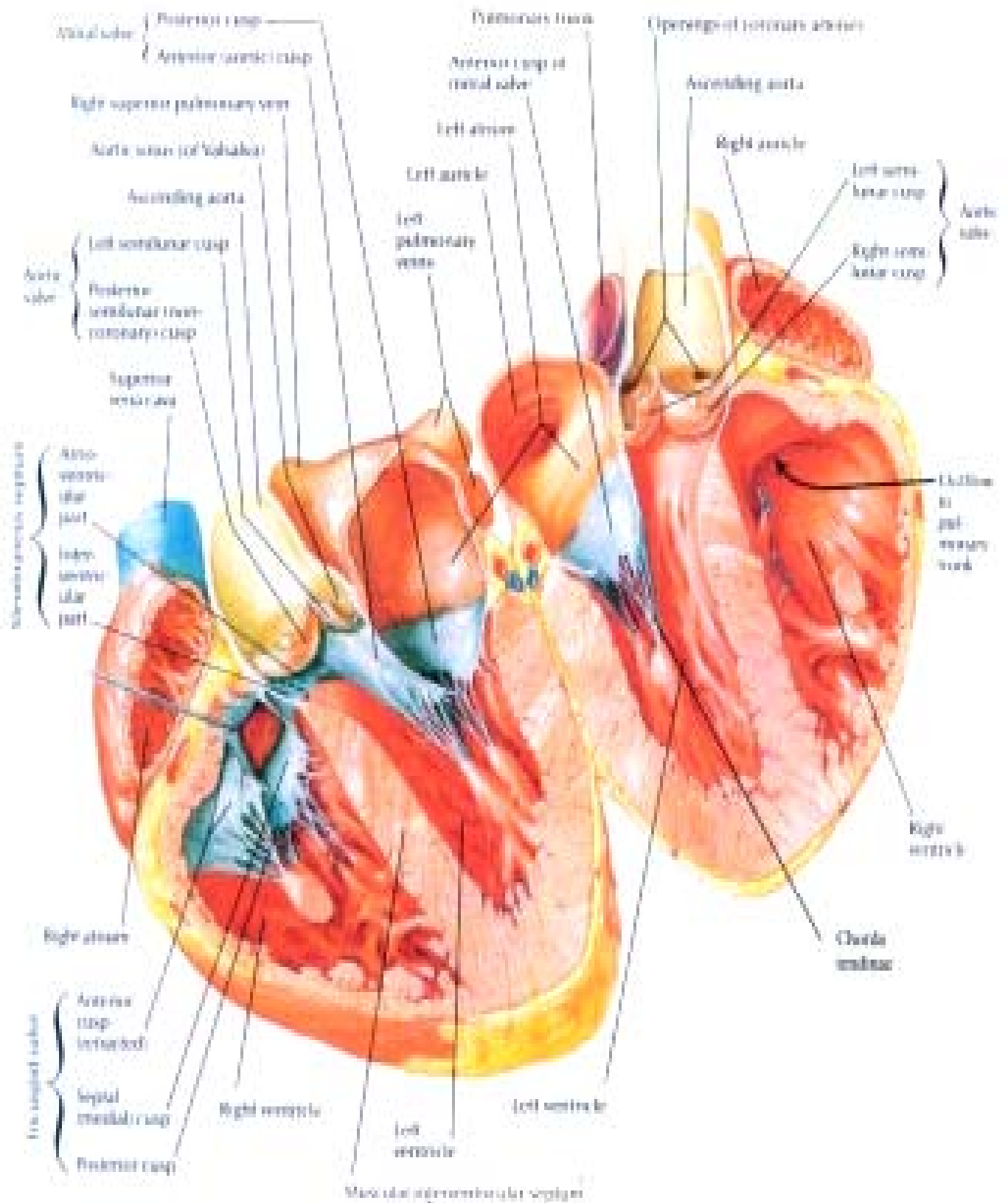


Fig (1) anatomy of the heart (Netter 1990)