Radiological Bronchopulmonary Manifestations of Mitral Valve Disease (MVD) in 225 cases.

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Mitral valve disease is the most common aftermath of rheumatic heart disease prevalent in this part of World[1]. Mitral valve disease is responsible for significant morbidity requiring emergency room admission and hospitalization. Apart from clinical assessment, simple chest x-ray is often helpful in the diagnosis of mitral valve disease. Chest X Ray is readily available in most centers. It is important to recognize common radiological features of mitral valve disease. This study is designed to find the prevalence of various parenchymal abnormalities in chest X-Ray in patients presenting with mitral valve disease confirmed on echocardiography. Chest X Ray of 225 echocardiographically confirmed patients of mitral valve disease presenting in out patients department and emergency room of this Institute were reviewed. The pattern of parenchymal findings in the chest X-Ray was studied in all patients.. A male to female ratio of 1:1.6 was observed. Pulmonary vascular cephalization was most common abnormality. It was seen in 90 % patients (203/225). Pulmonary edema of different grades was found in 79 % patients (178/225), Splaying of main stem bronchi was seen in 67.5 % (152/225). Other occasional findings in patients with MVD were pulmonary hemosiderosis (10%), alveolar hemorrhages (7.5%), pulmonary ossification (5.7%) and segmental collapse of right lower lobe (4.0%). Bronchopulmonary radiological changes are often seen in patients with mitral valve disease. Recognition of these abnormalities can facilitate the diagnosis of MVD.
Key Words: Mitral Valve, Pulmonary, Bronchopulmonary, edema.

Pulmonary parenchymal manifestations of mitral valve disease are the result of either pulmonary venous hypertension in mitral stenosis or abnormal regurgitant flow into pulmonary veins in mitral insufficiency. Splaying of the mainstem bronchi is due to left atrial enlargement. Peribronchial cuffing is due to peribronchial interstitial fluid collection. Bronchopulmonary radiographic findings in mitral stenosis include widening of subcarinal angle and raised left bronchus, pulmonary vascular cephalization; perivascular & peribronchial cuffing, interstitial edema; alveolar pulmonary edema and occasionally diffuse alveolar hemorrhage. Hemosiderosis and pulmonary ossification are pathognomonic for Chronic Mitral Valve Disease[2]. Signs of interstitial pulmonary edema are frequently visible and include septal lines. Radiographic findings in diffuse alveolar hemorrhage consist of diffuse, confluent acinar or ground-glass areas of increased opacity, often sparing the peripheral parenchyma and creating the so-called window frame effect[3]. Hemosiderosis is characterized by small, ill-defined nodules or by coarse reticular areas of increased opacity with a bias for the middle and lower lung regions[2]. Ossification manifests as densely calcified, 1–5-mm nodules, mainly in the middle and lower lungs, with a tendency for confluence and the occasional presence of trabeculae[5]. Imaging findings in mitral regurgitation depend on the acuteness of the disease. The most common Parenchymal manifestations of acute mitral regurgitation are acute left ventricular failure with pulmonary vascular engorgement and interstitial or alveolar pulmonary edema but limited cardiac enlargement. Chronic mitral regurgitation is characterized by marked left ventricular enlargement with massive left atrial dilatation and signs of left ventricular failure[5]. Familiarity with these manifestations can expedite diagnosis, particularly in rare cases of unsuspected mitral valve disease[3].

Material and method

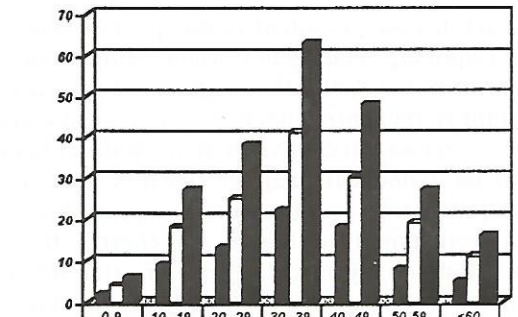
A total of 225 chest radiographs of the patients with Mitral Valve Disease (MVD) under treatment in Punjab Institute of cardiology Lahore were reviewed. Most of the patients were young adults. Age and sex were recorded.

All diagnosis of Mitral Valve Disease was confirmed either on ecchography. Radiologist and Cardiologist interpreted Postero anterior(PA) and lateral chest radiographs independently. Any discrepancy was settled by discussion in correlation with clinical findings. Chest films were evaluated for widening of subcarinal angle of main bronchi and Pulmonary Parenchymal changes (vascular cephalization, pulmonary edema, pulmonary alveolar hemorrhages, pulmonary haemosiderosis, pulmonary ossification and associated lung findings). Abnormal Parenchymal shadowing were categorized into seven pattern: upper lobe blood diversion, peribronchial & perivascular cuffing in hilae, interstitial –A & B lines and batwing appearance of pulmonary edema, diffuse alveolar hemorrhage, reticulonodular shadowing of increased density (Haemosiderosis), dense calcific nodule (ossification), and segmental collapse-consolidation.

More than one pattern could be visualized for a given film. The radiographs used in our study were presenting radiographs on the first visit to hospital.

Results

Among the 225 patients, 140 were female and 85 males. A female to male ratio of 1.6: 1 was observed. Six (4 %) patients were under 10 years and twenty (8 %) above 60 years. Remaining (88 %) was in the age group of 20 to 50 years. (Fig.1)



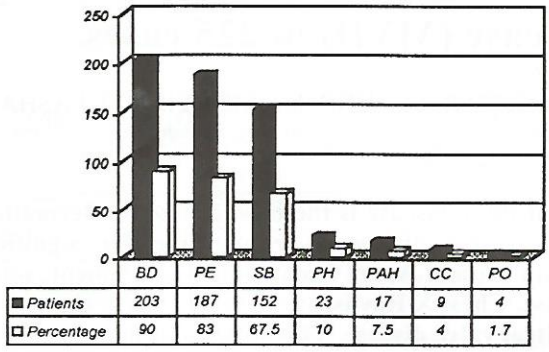
	0-9	10--19	20--29	30--39	40--49	50-59	<60
Male	2	9	13	22	18	8	5
Female	4	18	25	41	30	19	11
Total	6	27	38	63	48	27	16

Figure 1.Demographic patient data of 225 cases of MVD.

Parenchymal involvement was observed in 218 patients and nine patients showed almost normal chest X-Ray. Majority of these patients 208 (90%) had definite upper lobe blood diversion and splaying of main stem bronchi in 152 patients (67.5%). Pulmonary edema of different grades and pattern were seen in 187 patients (83%)- Peribronchial & perivascular cuffing with haze in hilae (Grade 1) in 30 patients (13%), Septal lines (grade II) in 57 patients (25%), Batwing alveolar edema (grade III) in 39 patients (17%) and Mixed pattern of all grades and pleural effusion (Grade IV) in 61 patients (27%). 23 patients (10.0%) had Pulmonary hemosiderosis. Pulmonary alveolar hemorrhage was present in 17(7.5%) and 9(4.0%) had Right lower lobe segmental collapse-consolidation. Pulmonary Ossification was present in 4 (1.7 %). The most frequent findings of the patients were upper lobe diversion (90 %), pulmonary edema (83 %)and splaying of main stem bronchi (67.5 %) (Table.1 & Fig.2).

Table 1. Demographic chart (n=225)

Parenchymal Lesion	n=	%age
Upper lobe blood diversion(BD)	203	90.0
Pulmonary edema(PE)	187	83.0
-Peribronchial & perivascular cuffing	30	13.3
Septal edema	57	25.0
-Batwing Alveolar edema	39	17.3
-Mixed pattern & Pl. Effusion	49	21.8
Splaying of mainstem bronchi (SB)	152	67.5
Pulmonary Hemosiderosis (PH)	23	10.0
Pulmonary alveolar hemorrhage (PAH)	17	7.5
Rt. Lower Lobe segmental Collapse-Consolidation (CC)	9	4.0
Pulmonary Ossification (PO)	4	1.7



	BD	PE	SB	PH	PAH	CC	PO
Patients	203	187	152	23	17	9	4
Percentage	90	83	67.5	10	7.5	4	1.7

Figure 2. BD-Blood Diversion, SB-Splaying of Bronchi, PE-Pulmonary Edema, PAH-Pul. Alveolar Hemorrhage, PH-Pul. Hemosiderosis, PO-Pul. Ossification and Collapse-consolidation (CC).

Discussion

The cardiac radiographic features of mitral valve disease are well known. The hallmark of mitral valve disease is pulmonary venous hypertension, which frequently leads to clinical findings of left ventricular failure. Chest radiography is an important part of the evaluation of patients with this disease. Medical and surgical treatment of mitral valve disease is particularly successful early in the course of the disease; therefore, detection at initial presentation is of considerable importance. Characteristic changes in cardiac contour, particularly in long-standing mitral stenosis, are helpful in confirming the radiographic diagnosis in affected patients. The pulmonary Parenchymal manifestations of mitral valve disease are less well known and relate to pulmonary vascular engorgement. These findings are frequently nonspecific but can have a characteristic appearance that facilitates recognition of unsuspected cases of mitral valve disease.

In this article, we discuss and illustrate the imaging appearances of a variety of bronchopulmonary manifestations of mitral valve disease including pulmonary vascular cephalization, pulmonary edema, diffuse alveolar hemorrhage, hemosiderosis, segmental collapse and occasionally pulmonary ossification.

Mitral valve disease has prevalence in developing countries and typically result from rheumatic heart disease although it may occasionally be congenital[1]. It is still common in Pakistan among the low socioeconomic population and our study group belongs to same group. Mitral valve disease affect women more than man and typically manifest in 10-15 years with peak in 30-40 years[3]. In our study onset is early onset (5-10 years) with peak in (30-40 years). This is because of low socioeconomic status and poor medical management by general practitioners and quacks. The roentgenoghraphic appearance is highly suggestive of mitral valve disease but may resemble any other disease of the lungs[4].

Pulmonary vascular cephalization

The most frequent radiographic finding seen in our patients 203 (90 %) was upper lobe blood diversion. In rest of the patients the chest film was either normal or has been obscured by the florid pulmonary edema. This pulmonary vascular cephalization result from the chronically raised left atrial pressure and brought into prominence by the lower lobe vascular constriction indicating pulmonary arterial hypertension in mitral valve disease[5].

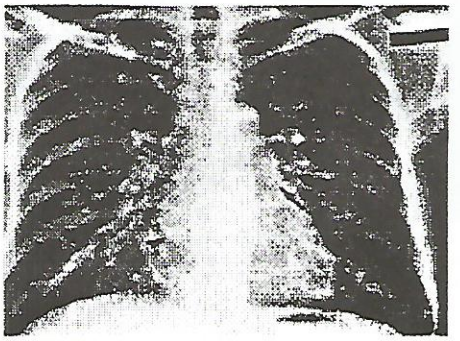


Figure 3. Upper lobe blood diversion, double density shadow (arrowhead), pulmonary trunk (arrow).

Splaying of mainstem bronchi

Splaying of bronchi is another commonly seen feature of mitral valve disease. This is due to enlarged left atrium causing widening of the subcarinal angle and double density shadow along left heart border more conspicuously seen in mitral regurgitation[6]. Similar findings are seen in our study in 152 patients (67.5%) along with other pulmonary Parenchymal changes of MVD. Even when present alone is highly suggestive of MVD[5]..

Pulmonary edema

Pulmonary edema, nonspecific feature, particularly those related to left ventricular failure are the most common lung parenchymal manifestation of MVD manifested in 187 patients (83%) similar to other reports[3,7,8]. Interstitial pulmonary edema including peribronchial and perivascular cuffing signs of early pulmonary edema was found in 30 patients (13.3%), septal lines including A & B-lines in 48 patients (26.6 %), alveolar edema in 39 patients (17%) and mixed pattern of pulmonary edema with minimal effusion are seen in majority of these patients 61(27%). This advanced disease at the time of presentation may be either due to delayed diagnosis, volume overload e.g intraoperative infusion of liquids, during pregnancy and delivery, poor health and nutrition due to low socioeconomic status. An unusual but pathognomonic manifestation of acute mitral regurgitation is asymmetric right upper lobe pulmonary edema[8,9]. In a historical study of 131 patients admitted with a primary diagnosis of mitral regurgitation, 12 patients (9%) had asymmetric right upper lobe edema[8]. The predilection of edema

Formation for the right upper lobe is explained by the anatomy of the pulmonary veins in relation to the mitral valve apparatus. The plane of the mitral valve is inclined postero-superiorly and to the right, and the regurgitant jet penetrates the origin of the pulmonary vein in the right upper lobe. Preferential flow of the regurgitant jet has been confirmed in an echocardiographic study of 40 patients with mitral regurgitation[10], and a single case report of a regurgitant jet oriented toward the origin of the right pulmonary veins has been documented by transesophageal echocardiography in a patient with asymmetric right upper lobe edema[11].

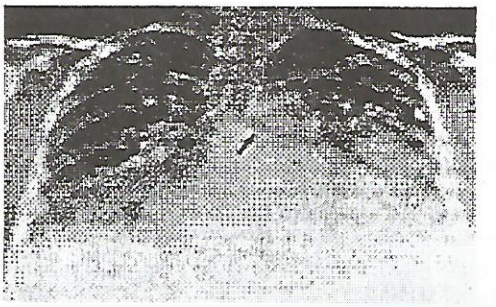


Figure 4. Splaying of mainstem bronchi (thin arrow) and pulmonary edema both sides in MVD.

Pulmonary alveolar hemorrhage

Patients with mitral stenosis may present with hemoptysis and diffuse alveolar hemorrhage. Hemorrhage early in the

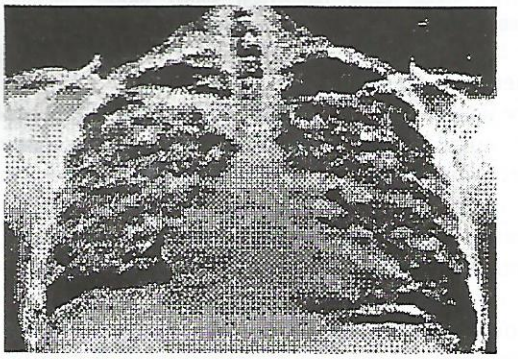


Figure 5. Pulmonary hemorrhage in a 33-year-old man with mitral and aortic stenosis who presented with hemoptysis. Chest radiograph demonstrates extensive bilateral diffuse pulmonary consolidation with sparing of the periphery of the lungs, creating the window frame effect that is suggestive of pulmonary hemorrhage.

course of the disease may be related to rupture of the microvasculature. As postcapillary pulmonary arterial hypertension develop, intimal hyperplasia may protect the microvasculature. However at this stage may relate to abnormally engorged submucosal bronchial veins that are exposed to elevated pressure through anostomosis with pulmonary veins[2]. Radiographic findings consist of diffuse, confluent aciner or ground glass areas of increased opacity, often sparing the peripheral parenchyma in 17 patients (7.5%). Radiographic differentiation of diffuse

alveolar hemorrhage from hydrostatic pulmonary edema can be difficult, although the presence of hemoptysis and air bronchogram may help.

Pulmonary hemosiderosis

Hemosiderosis is regularly found at pathologic analysis in chronic mitral stenosis but is less conspicuous radiographically. At pathologic analysis, hemosiderosis is characterized by the accumulation of hemosiderin in the alveolar, lobular, and perivascular interstitium, filling of the alveoli with hemosiderin-laden macrophages, and fibrosis. Pulmonary hemosiderosis is characterized by small (1-3 mm) ill-defined nodules or by course reticular areas of increased opacity with a bias for the middle and lower lung region[2]. It is seen in 23 patients (10%) in our study that is similar to the study of Steiner RE & et al[6].

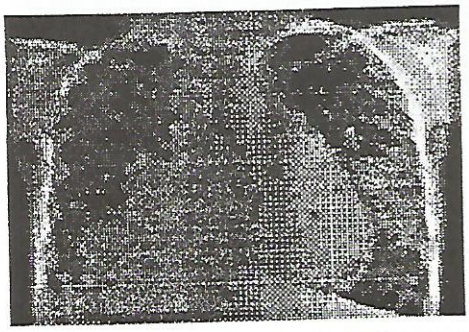


Figure 7. Frontal chest radiograph shows diffuse micronodules of pulmonary hemosiderosis scattered throughout the lungs in MVD.

Segmental collapse

A very large or aneurysm left atrium (one which reaches to within an inch of the chest wall) may be associated with segmental or lobar collapse-consolidation on the right. Consolidation of infarct may occur[5]. This was seen in 9 patients (4.0%) in our study because of late presentation of patients. Most of these patients were in 30-40 age group.

Pulmonary ossification

A rare, late sequels that is virtually pathognomonic for chronic mitral stenosis is parenchymal ossification, which manifests radiographically as densely calcified, 1–5-mm nodules, mainly in the middle and lower lungs, with a tendency for confluence and the occasional presence of trabeculae[2]. The prevalence of bone formation ranges from 3% to 13% in reported series[7] and found in 4 patients (1.7%) in our study. This lower ratio in our study is possibly due to high mortality rate in our patients

Conclusions

Lung parenchymal changes are frequently seen in patients with mitral valve disease. These changes usually facilitate the diagnosis of mitral valve disease but can occasionally hinder such a diagnosis. Familiarity with the gamut of pulmonary findings in patients with mitral valve disease is crucial for rapid diagnosis and optimal patient care.

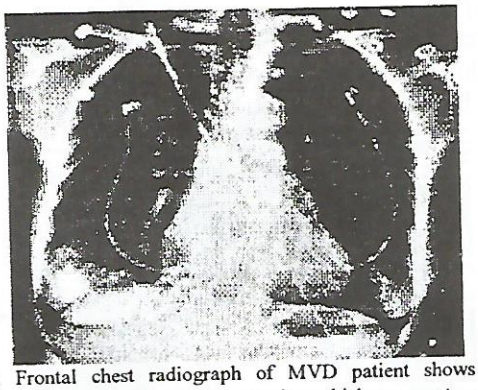


Figure 8. Frontal chest radiograph of MVD patient shows bibasilar confluent calcific areas of increased opacity, which are most conspicuous at the right lung base.

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