CT chest manifestations in Egyptian patients with chronic viral hepatitis

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Aims and objectives

Egypt contains the highest prevalence of hepatitis C virus in the world (17.5%) and intermediate endemicity for hepatitis B virus infection (2-7%) [1,2], which are the primary causes of chronic liver diseases.

We aimed to determine the pulmonary parenchymal, vascular, pleural and mediastinal changes in Egyptian patients with chronic viral hepatitis using multi-slice Computed Tomography, and to assess the frequency of each complication in Egyptian patients with chronic viral hepatitis.
Methods and materials

This is a prospective study involved 175 Egyptian patients having chronic viral hepatitis. Cases were referred from the tropical medicine department to radiological department of Kasr AlAiny hospital for CT evaluation of the chest in the period between March 2013 to September 2014, with exclusion of patients with primary cardio-pulmonary disease, congestive heart failure, connective tissue disorders, chronic smoker with smoking related pulmonary complication, Drug addicts.

All patients were subjected to the following: proper history taking, relevant laboratory investigations, upper GIT endoscopy, abdominal ultrasound, MSCT chest examination was done, then CT evaluation and data analysis:

For each patient the following items were assessed:

1-Lung window settings evaluated for: consolidation (for infection, infarction or hemorrhage), collapse, metastasis, interstitial involvement (for interstitial pneumonia), vascular involvement; measuring peripheral pulmonary vasculature; for hepatopulmonary syndrome, others.

2-Mediastinal window settings will be used to: a) Measure the diameter of central pulmonary arteries to evaluate for pulmonary hypertension, b) Search for porto-systemic collaterals (esophageal and para-esophageal varices), c) Lymphadenopathy.
Results

From 175 Egyptian patients with chronic viral hepatitis and chest complain, after exclusion criteria, 100 patients were selected, 79 males, 21 females. Age range 20 -75 year-old (average 48.8 year-old), All cases were known to have chronic viral hepatitis, 82% of patients were hepatitis C virus only, 7% of patients were hepatitis B virus only and 11% of patients were both hepatitis B and C viruses, of which 96% of cases were known cirrhotics (of them 8% Child A, 44% Child B and 44% Child C). Cases were referred to radiological department of Cairo university hospital for CT Chest evaluation.

CT chest manifestations in chronic viral hepatitis, number of cases summarized in Figure 1:

1- PULMONARY VASCULAR COMPLICATIONS were in 67 patients:

a- Hepato-pulmonary syndrome (HPS) was in 43% of cases.

Types: Type 1 (minimal or diffuse) in 86% of HPS cases: Minimal in 23 cases or advanced patterns in 20 cases.

Computed tomography (CT) (Fig. 2, 3) demonstrated distal vascular dilatation, increased number of terminal branches that do not taper normally extending to the pleura bilaterally. Increased lower lobe segmental arterial diameter when compared with the adjacent bronchi. It predominates at both lower lobes, in minimal pattern, and reaches upper chest cuts at subpleural and subfissural regions in advanced pattern.

Type 2 (focal) was in 14% of cases: focal pattern, characterized by direct arterio-venous malformation (AVM), which are connected to a feeding artery and a draining vein on angiograms and nodular dilatation of peripheral pulmonary vessels on CT scans (Fig. 4) [3].

b- Pulmonary hypertension was in 22% of cases:

In CT, the diameter of the main pulmonary artery determined, measured in the scan plane of the bifurcation, at a right angle to its long axis and just lateral to the ascending aorta [4]. CT demonstrated changes of pulmonary hypertension: 1- The vascular changes, include enlargement of central pulmonary arteries, and abruptly diminished caliber of peripheral pulmonary vessels [4]. Pulmonary hypertension predicted when the diameter of the main pulmonary artery is greater than or equal to 29 mm accompanied by a segmental artery- to-bronchus ratio greater than 1:1 in three of four pulmonary lobes and the ratio of the main pulmonary artery diameter to the aortic diameter is greater than 1, particularly in patients less than 50 years of age [3], 2- Cardiac changes, causing right ventricular hypertrophy [3], 3- Pulmonary changes identified in high resolution computed tomography, causing the mosaic pattern of lung attenuation as the vascular cause for
the mosaic pattern is suggested when areas of high attenuation contain larger caliber vessels and areas of low attenuation contain vessels of diminished size [5].

In this study 15 cases pulmonary artery measures from 30 to 35 mm, 4 cases pulmonary artery measures from 35 to 40 mm and 3 cases pulmonary artery measures more than 40 mm (Fig. 5). 2 cases of them showed bilateral lung mosaic attenuation. 20% of patients had primary porto-pulmonary hypertension, however, in the other 2 patients the diagnosis of cor-pulmonale was raised as a complication to interstitial pulmonary fibrosis (IPF) and tuberculous fibrosis.

**c- Intrathoracic Portosystemic Collateral Vessels (PSCV) was in 38% of cases. All were known to be cirrhotic and with portal hypertension:**

The porto-systemic collateral channels can develop by the way of the coronary vein into esophageal, occurred in 92% of PSCV cases and para-esophageal varices in 18% of them and 10.5% of them showed both esophageal and para-esophageal varices, with detection rate of CT was 81% as endoscopy revealed varices in 47 cases.

CT shows nodular thickening of the esophageal wall and enhancing nodular lesions protruding into the esophageal lumen (Fig. 6a) [6]. CT also differentiates the large esophageal varices from small varices with a criterion of 3-mm-or larger diameter on CT for large varices could be useful in identifying high-risk patients who would benefit most from selective endoscopy [7]. In para-esophageal varices CT shows dilated collateral vessels surrounding the esophagus and descending thoracic aorta (Fig. 6a, 7).

**2- PULMONARY PARENCHYMAL LESIONS:**

*a. Compression atelectasis,* was in 38% of cases, in CT Chest 22% of patients showed segmental or sub-segmental atelectasis, and 16% of patients showed linear atelectasis (Fig. 6b). 66% of them were secondary to pleural effusion.

*b. Pulmonary consolidation* was in 13% of cases,

Inflammation was in 28% of consolidation cases:

- Pneumonia; was seen in 39.3% of inflammatory cases, CT showed pneumonic patches, ground glass or alveolar opacities (Fig. 8).
- Tuberculous infection with tuberculin test positive; in 39.3% of them. CT in 7 cases showed apical reticulo-nodular opacities, 4 cases showed granulomatous nodules, 1 case showed cavitary lesion and 5 cases showed calcified lymph nodes.
- Aspiration approved pyo-pneumothorax; was in 14.3%. Three of these cases were left sided and one case was right sided,
- Fungal infection; was in 3.6% of them with disseminated abscess cavities (Fig. 9), on follow up, patient died shortly after.
c. Acute respiratory distress syndrome: in 1% of cases. Typical CT features include diffuse bilateral ground-glass opacities and more extensive dependent consolidation [3].

c. Lung metastasis in cases of hepatocellular carcinoma was in 3% of cases known to have hepatitis C virus, cirrhosis and hepato-cellular carcinoma (HCC). In CT the thoracic manifestations of metastatic HCC are:

- Multiple pulmonary nodules 1%; occurs due to hematogenous metastases that commonly noted at bilateral lung lobes with the lower lung zones were involved more frequently than the upper lung zones (Fig.10) [8].
- Mediastinal lymphadenopathy 1%, CT showed large irregular shape lymph node with heterogeneous attenuation (Fig. 11).
- Tumor extension into the IVC or right atrium 1% [3] Contrast- enhanced CT clearly demonstrates a low attenuation mass extending from the liver into the hepatic vein, IVC, and right atrium and emboli of low attenuation in the pulmonary arteries [9] (Fig. 12).

d. Interstitial pulmonary disease was in 1% of cases:

HRCT demonstrates bilateral fairly symmetrical basal sub-pleural ground glass opacification, reticulations with prominent inter and intra-lobular interstitium, traction bronchiolectasis and mounting to honey combing (Fig. 13).

3. PLEURAL LESIONS were in 34% of cases:

a. Hepatic hydrothorax were in 22 cases (65% of pleural lesions):

All of cases were associated with cirrhosis and ascites. Pleural fluid aspiration approved its exudative nature. 19 cases of them were free and 3 cases were loculated. Diaphragmatic defects found in 10 cases and they were right sided (Fig. 14).

b. Other pleural lesions as pleural thickening were in 32% of them and aspiration approved pyo-pneumothorax were in 11.8 % of them, CT showed visceral pleural thickening and enhancement (Fig. 15).

4. Mediastinal lymphadenopathy were in 12% of cases:

a- HCV associated lymphoma were in 25% of lymphadenopathy cases: They were associated with generalized lymphadenopathy (mainly abdominal, axillary and inguinal lymph nodes). They presented with prevascular, retrocaval and paratracheal lymph nodes. All of these cases were hepatitis C virus, these cases were biopsy proved B-cell lymphoma.

b. Inflammatory lymph nodes were in 66.7% of lymphadenopathy cases, with 41.7% of them post-granulomatous in etiology.
c. Neoplastic lymph nodes was in 8.3% of lymphadenopathy cases.
Fig. 5: 22 year-old male patient, known case with liver cirrhosis and portal hypertension coming complaining of exertional dyspnea. (a) CT chest mediastinal window showed widened pulmonary trunk with a diameter greater than that of the ascending aorta, (b) Lower chest cut showed dilated right sided heart with right ventricular hypertrophy, picture impressive of isolated porto-pulmonary hypertension.

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Fig. 6: 59 year-old male patient known case of hepatitis C and B viruses and liver cirrhosis coming complaining of dyspnea. (a) Mediastinal window showed esophageal and para-esophageal varices in the form of esophageal wall thickening and enhancement, luminal narrowing and dilated para-esophageal veins. (b) CT chest lung window coronal plane, revealed right basal linear parenchymal bands.

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Fig. 7: 35 year-old male patient known case with HCV and liver cirrhosis coming complaining of hemoptysis attack with chest pain and dyspnea. (a) CT Chest mediastinal window shows hugely dilated para-esophageal varices. (b) Lung window in the same patient revealed right peripheral wedge shape consolidation diagnosed as pulmonary infarction, likely post embolization.

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Fig. 8: 37 year-old male patient known with hepatitis C virus, complaining of cough with expectoration, dyspnea and fever. CT chest lung window (a) axial and (b) coronal planes revealed bilateral moderate pleural effusion with right upper and lower lobar patchy areas of consolidation.

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**Fig. 9:** 56 year-old immunocompromized female patient. CT chest (a) axial cut and (b) coronal cut, revealed bilateral multiple disseminated nodular and cavitary lesions picture of disseminated fungal infection with abscess formation. On follow up, she died shortly after.

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**Fig. 10:** 59 year-old female patient, known of hepato-cellular carcinoma. Contrast enhanced CT Chest mediastinal window revealed right moderate pleural effusion and sub-pleural enhancing nodule in a known case of HCC, proved case of right metastatic nodule.

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**Fig. 11:** 42 year-old male patient, known with hepato-cellular carcinoma (HCC). (a) CT Chest revealed a metastatic anterior mediastinal lymph nodes. (b) Upper abdominal cut showed the right hepatic lobe irregular ill defined lesion.

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**Fig. 12:** 50 year-old male patient, known with hepatocellular carcinoma (HCC) coming complaining of vague chest pain and dyspnea. CT chest with IV contrast. mediastinal windows revealed that the known HCC with direct trans-diaphragmatic invasion into the adjacent portion of the peri and myo-cardium and posterior mediastinum. Right moderate pleural effusion and underlying lung compression noted.

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Fig. 13: 35 year-old, known female patient of chronic hepatitis C virus. HRCT Chest revealed bilateral fairly symmetrical predominantly basal sub-pleural coarse reticulations mounting to honey combing associated with bronchiolectasis picture of interstitial pneumonia.

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Fig. 14: 59 year-old male patient known case of hepatitis C and B viruses with the main chest complain was dyspnea. (a) CT chest revealed right moderate free pleural effusion with underlying lower lobe compression collapse. (b) Upper abdominal cut showed the focal defect in the right posterior diaphragm (arrow). Pleural effusion cytology shows reactive exudative smear.

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**Fig. 15**: 60 year-old female patient known with hepatitis C virus coming complaining of chest pain and cough and expectoration. CT chest revealed right sided marked loculated hydro-pneumothorax associated with visceral pleural thickening and compression collapse mainly of the right lower lobe. Pleural fluid aspiration and pathology showed bloody suppurative smear.

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**Fig. 1**: Show the number of cases in each thoracic complication in patients with chronic viral hepatitis. IPF: interstitial pulmonary fibrosis, M.HCC: metastatic hepatocellular

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Fig. 2: 50 year-old male patient, known with HCV and liver cirrhosis coming complaining of progressive dyspnea. CT chest axial cut lung window revealed bilateral abnormally dilated peripheral pulmonary vessels with an abnormally large number of visible terminal artery branches extending to the pleural and fissural surfaces (blue arrow). The ratio of the diameter of the segmental arteries to the diameter of the accompanying bronchi is increased (white arrow), picture of HPS type 1.

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Fig. 3: 41 year-old male patient known with hepatitis C virus and liver cirrhosis, coming complaining of progressive dyspnea. CT chest axial cuts lung window, showed picture of
type 1 HPS with dilated terminal vascular branches as well as sub-pleural telangiectasia, blue arrows.

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Fig. 4: 60 year-old male patient known case of HCV and liver cirrhosis with shortness of breath and progressive dyspnea. CT chest (a) lung and (b) mediastinal windows showed bilateral peripheral nodular, dilatation of peripheral pulmonary vessels, with evidence of early venous filling, arrows, impressive of HPS type 2.

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Conclusion

Hepatitis viral infection is etiologically involved in the development of several pulmonary abnormalities which have a significant impact on morbidity and mortality, summarized in (Figure 16), so multi-slice CT chest is mandatory for any patients with chronic viral hepatitis presenting with any chest complain.

Awareness of the various thoracic lesions and their various CT chest manifestations in patients with chronic viral hepatitis can be helpful for making a differential diagnosis and planning proper management.
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**Fig. 16:** Shows the summary of CT chest manifestations in Egyptian patients with chronic viral hepatitis.

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