

An Evaluation of CT Chest Features and its Association with Severity of Illness in H1N1 Influenza-Infected Patients

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Abstract

Aim: To analyze in detail the CT chest features in H1N1 influenza-infected patients and their frequency of CT changes and lobar distribution. Also, to relate the radiological findings with the extent of hospital admission and ICU requirement.

Materials and Methods: The study participants included patients hospitalized at Coimbatore Medical College Hospital with signs of flu, laboratory proven test for the Influenza viral infection, and undertaken CT chest. A total of 200 patients were involved in the study among which 62 patients undertook chest CT. Study participants were separated into two groups based on the duration of hospital stay with a cut-off of seven days. The CT images were examined and the radiological configuration was evaluated. The findings were designated as follows – Peripheral/Central/Focal/ Multifocal /Diffuse.

Results: CT chest findings were present in all patients with more than 7 days duration of admission and 40 percent in patients with less than 7 days hospital stay. In our study multifocal, peripherally distributed ground glass opacities were the most frequent radiological feature noted followed by the opacity due to consolidation. In our study, pleural effusion was present in 14 patients, among which 12 patients needed more than 7 days of hospital stay.

Conclusion: Major discoveries in our study were ground glass opacities and consolidation. Outcomes of our study also recommend that in CT chest features will help in triage of patients and to foresee the severity of the infection and further consequences.

Keywords: H1N1 Influenza, CT-Chest, Consolidation, Opacity.

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Introduction

The H1N1 flu virus initiated a global pandemic in 2009. It is now traversed into a human seasonal flu virus. Each year there is an increase in the amount of cases during seasonal change as reduced temperatures

affect the durability of the virus. During 2014-2015 the outbreak became prevalent throughout India, during the month of February it was at its peak. The signs and symptoms are comparable to flu except for

the manifestation of GI symptoms. The utmost common clinical findings in the presentation of H1N1 infection are fever, cough, dyspnea, myalgia, and headache. Gastrointestinal symptoms, such as nausea, vomiting, and diarrhea, have also been reported. In most cases, the symptoms are mild and run a self-limiting course; however, a small proportion of individuals develop a severe course, which can result in respiratory failure and death. Most significant problems include lower respiratory track association, acute respiratory failure from acute lung injury or ARDS, secondary bacterial sepsis and septic shock. X-ray chest provides adequate information for defining the approach in most of the affected patients [1]. However, CT often becomes an important tool for determining the extent of pulmonary involvement, as well as being useful in the evaluation of complications and in the clarification of suspected mixed infections or failure to respond to therapy [2-4]. Although the diagnosis of viral infection is based on the clinical profile and on the identification of the virus, the recognition of some imaging features of the disease can become useful, especially in patients with atypical clinical manifestations [5]. Therefore, understanding the imaging features of the disease becomes important in clinical practice [6]. The objectives of this study are to analyze in detail the CT chest features in H1N1 influenza-infected patients and their frequency of CT changes and lobar distribution. Also, to relate the radiological findings with the extent of hospital admission and ICU requirement.

Materials and Methods

Our study was done as a hospital based retrospective study so informed consent was no required and waiver of consent was obtained. Hospital ethical committee authorization was acquired before start of the study. The study period was six months and was undertaken at radiology department at

Coimbatore Medical College Hospital. The study participants included patients admitted in hospital with signs and symptoms of flu and microbiologically tested positive for the influenza virus and underwent chest imaging. A total of 200 patients were included in the study out of which 62 undertook chest CT. Patients with features of pulmonary TB, mass lesions, massive cardiomegaly, and other comorbidities were excluded. Patients were distributed into two groups based on hospital stay duration. One group of patients included greater than seven days of hospital stay duration while another group included patients who had lesser than seven days of hospital stay.

CT was done on a "Toshiba - Alexion Scanner" model TSX-033A in spiral mode and observing was done in the mediastinal and lung windows. The CT was studied by two skilled radiologists. Each of them were evaluated and recognized as normal or abnormal. The radiological appearances were categorized as ground glass pattern, consolidation, reticular opacities or nodular opacities. The distribution was acknowledged as follows-Peripheral, Central, Focal, and Multifocal, diffuse. The involved segments were also identified. Pleural effusion presence was also noted.

Results and Statistical Analysis

Description of quantitative variables such as mean and standard deviation (SD) was done. The Chi-square test was used for evaluation among qualitative variables. A significance level of $P < 0.05$ was used. Comparison between groups was also done.

Our study participants included 120 female and 80 male patients with a total of 200 patients. 134 patients in our study were between the age group 21-60 years. In this study among those patients who underwent CT around 32 patients was under admission for more than seven days and rest 30 patients were under admission for less than 7 days.

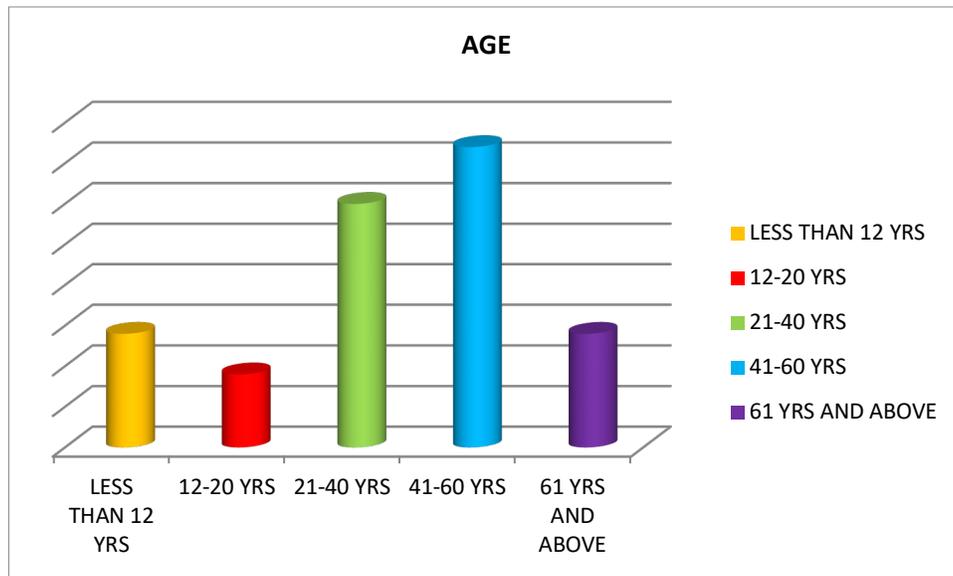


Chart 1: Age distribution of HIN1 infection

CT analysis

The radiological features were described as ground glass pattern, consolidation, reticular opacities and nodular opacities. In our study, frequent radiographic features were unilateral or bilateral multifocal asymmetric ground-glass opacities, trailed by unilateral or bilateral consolidation, more in subpleural location and basal predominance.

CT findings were positive for swine flu in all patients who were in the hospital for more than 7 days and 40% in patients who were on admission for less than 7 days. In this study multifocal, peripherally distributed ground glass opacities were the most frequently encountered radiological feature seen followed by the opacity with consolidation. Pleural effusion was identified radiologically in 14 patients. Acinar nodules were seen in one patient.

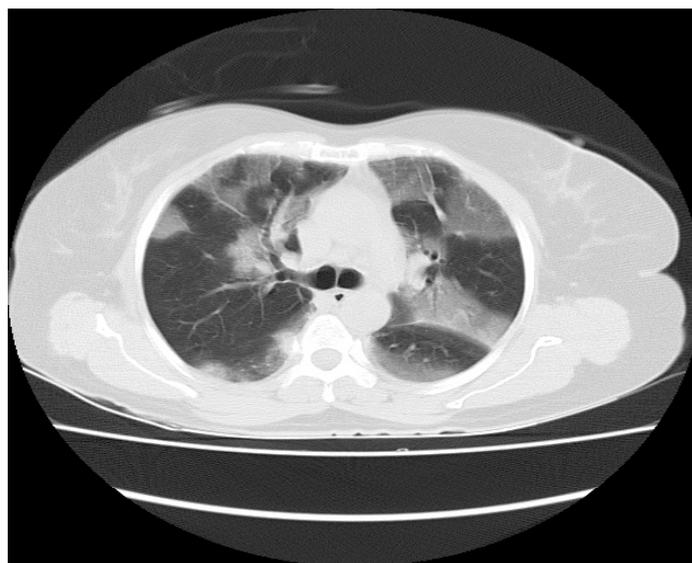


Figure 1: CT Chest- ground glass opacity

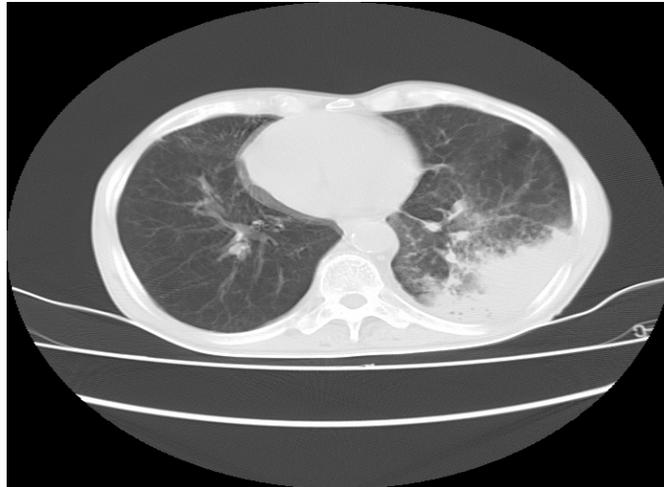


Figure 2: CT-Chest - Consolidation



Figure 3: Ground glass opacities with consolidation

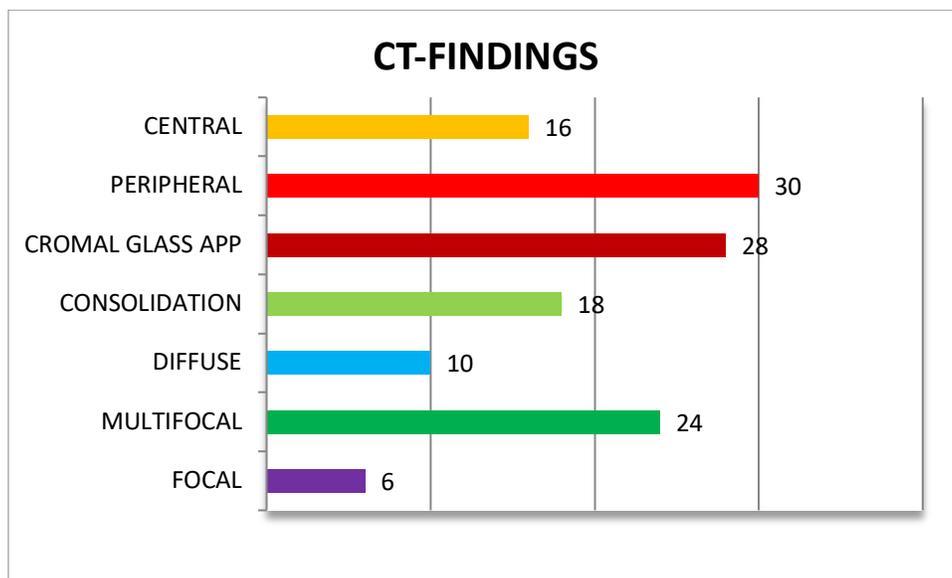


Chart 2: Distribution of CT Finding the gs

Coming to lobe wise distribution, findings were most commonly seen in right and left lower lobe followed by right middle lobe and right upper lobe.

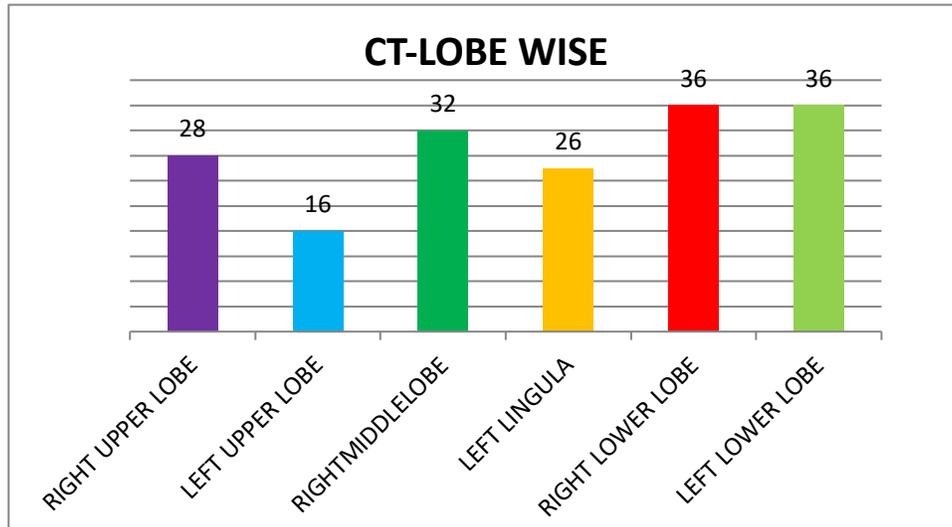


Chart 3: Lobe wise distribution

Next, we analyzed the relation between hospital stay and CT scan findings, where all patients who had hospital stay more than 7 days had positive CT finding while among the rest only 12 had positive CT findings.

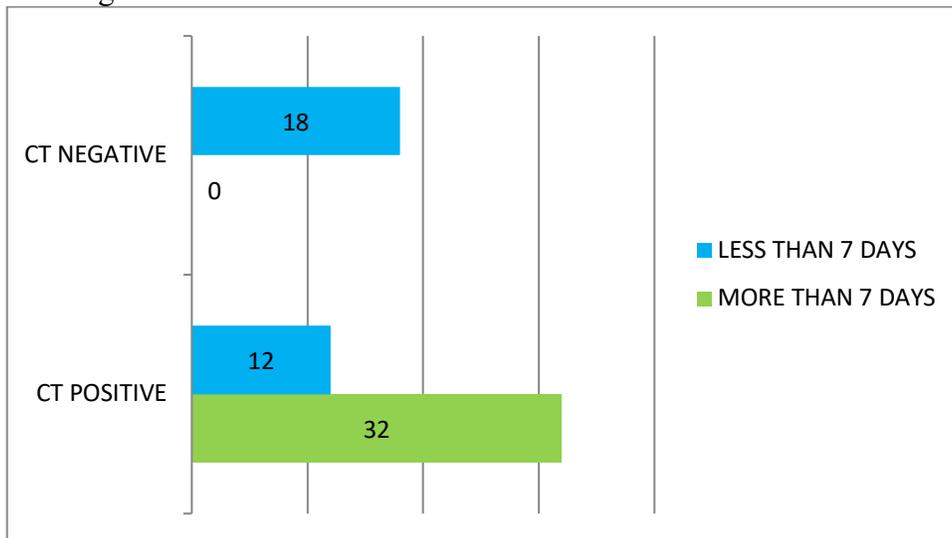


Chart 4: CT-Chest findings VS Number of days stay in hospital

Table 1: CT-Chest findings VS Number of days stay in hospital

		CT-Scan		Total
		Positive	Negative	
Hospital Stay	More Than 7	32	0	32
	Less Than 7	12	18	30
Total		44	18	62

In our study based on the above results, it's clear that there is a statistically significant relation between positive CT chest findings and the number of days stayed in the hospital in swine flu patients. With an odds ratio of 2.5, patients with positive CT chest findings have more chance of ending up in more than 7 days of hospital stay.

Discussion

In Influenza A H1N1 infection Chest X-ray is the first major investigative method for patients who present with acute respiratory symptoms. Generally, CT chest is specified in patients with normal or doubtful features in chest x-ray who have clinically proven pneumonia. CT chest is also beneficial in recognizing complications and concomitant comorbid conditions in the lungs.

Computed tomography (CT) is an excellent method to evaluate pulmonary diseases with greater accuracy as compared with radiography [7]. Currently, an increasing number of patients are being submitted to CT in cases where there is high clinical suspicion of viral infection and chest radiography is normal or dubious [8].

In our study, common radiographic findings were unilateral or bilateral multifocal asymmetric ground-glass opacity followed by unilateral or bilateral consolidation, more in subpleural location and Basal predominance.

Heussel *et al* [9] have developed a study with febrile neutropenia patients and observed that in 48% of cases where chest radiographs were normal, there were findings suggestive of pneumonia at CT. CT is also useful in evaluating complications in patients with known pneumonia who do not respond to appropriate therapy. Main CT features in patients affected by the H1N1 virus include ground-glass opacities, consolidation or both ground-glass opacity and consolidation. The dissemination of such variations is primarily subpleural and peri-broncho vascular. There is a predilection for the lung base.

In our study patients who were more commonly affected was younger to middle age group which always happened in novel influenza infection.

In a previous study about patients with H1N1 pneumonia and acute respiratory failure, pleural effusion was existing in 18 out of 20 with acute respiratory failure. Our study is similar to the above study as pleural effusion was most frequently seen in IMCU patients.

Li *et al* [10] carried out a similar study of HRCT findings in 70 patients clinically infected by the influenza A (H1N1) virus. The authors separated the patients into two groups as follows: group 1 comprised severe cases which required admission to ICU or mechanical ventilation; and group 2 comprised patients who were admitted for a short period, with no need for mechanical ventilation.

Ground-glass opacity was the predominant finding in the first week after the symptom's onset (95% of the patients), either in association or not with consolidation, with reduced frequency on the subsequent weeks. Air trapping was observed in only 18 of the patients who were submitted to mechanical ventilation.

As regards to the extent of the pulmonary involvement by the disease, such it was greater in the second week after the onset of the symptoms in both groups, with slow resolution in the following weeks. Greater pulmonary involvement was observed in group 1. CT findings in the patients at presentation were unilateral or bilateral multifocal asymmetric ground-glass opacity alone, with unilateral or bilateral consolidation. The consolidation had peri-broncho vascular and sub pleural predominance. The areas of consolidation were found mainly in the posterior, middle and lower regions of the lungs. In our study to all above findings were similar.

Conclusion

Results of our study also proposed that CT chest features can help in triaging patients and also in predicting infection severity. Viral pneumonia caused by influenza A (H1N1) virus complicated by bacterial co-infection presents a diagnostic challenge for the radiologist and physician, as extensive consolidation may manifest in such cases of pneumonia. In such cases, and depending on of clinical and laboratory test results, the possibility of secondary bacterial infection or the pulmonary manifestation of ARDS should be considered [11].

We found that results from our study participants with H1N1 influenza is reliable with previous studies as the most common radiological features were unilateral or bilateral multifocal asymmetric ground-glass opacity, unilateral or bilateral consolidation, nodular opacities or reticular opacities, Mostly seen in sub pleural location and Basal predominance. Becoming familiar with the clinical and radiographic presentations of this very infectious disease helps in early diagnosis, treatment and isolation of patients.

References

1. Chest radiological findings of influenza H1N1 pneumonia; A Nicolini, L Ferrara, Rao R, M Ferrari Bravo Revisita Portuguesa de pneumologia, May 2012; 18(3):120 -127.
2. Imaging findings in patients with H1N1 influenza A infection Group: 2011 Subgroup: Volume 8 Issue 4, December 2011iranjradiol.com/4554.by B Mehrdad - 2011
3. Radiological findings in patients with H1N1 influenza pneumoniaMagdy Abdelsalam, Haytham Samy Diab, Yasser Ragab. The Egyptian Society of Chest Diseases and Tuberculosis
4. Pneumonia and respiratory failure from swine-origin influenza A (H1N1) in Mexico. Perez-Padilla R, de la Rosa-Zamboni D, Ponce de Leon S, Hernandez M, Quinones-Falconi F, Bautista E, *et al.* N Engl J Med. 2009;361(7):680-9.
5. Emergence of a novel swine-origin influenza A (H1N1) virus in humans. Dawood F, S Jain S, Finelli L, Shaw M W, Lindstrom S, Garten RJ, *et al.* N Engl J Med. 2009;360(25):2605-15.
6. H1N1 Influenza: Initial Chest Radiographic Findings in Helping Predict Patient Outcome.Galit Aviram, Amir Bar-Shai Jacob Sosna, Ori Rogowski, Galia Rosen, Iuliana Weinstein, Arie Steinvil, and Ofer Zimmerman, (J.S.). December2009; 193(6).
7. R E McEwen, J E Scriven, C A Green, M S Bailey, A K Banerjee. Chest radiography findings in adults with pandemic H1N1 2009 influenza 2010 The British Institute of Radiology; 2010.
8. Ajlan AM, Quiney B, Nicolaou S, Muller NL. Swine origin influenza A (H1N1) viral infection: radiographic and CT findings. AJR Am J Roentgenol. 2009;193(6):1494-1499.
9. Heussel CP, Kauczor HU, Heussel GE, Fischer B, Begrich M, Mildenerger P, Thelen M. Pneumonia in febrile neutropenic patients and in bone marrow and blood stem-cell transplant recipients: use of high-resolution computed tomography. J Clin Oncol. 1999 Mar; 17(3):796-805.
10. Li P, Zhang JF, Xia XD, Su DJ, Liu BL, Zhao DL, *et al.* Serial evaluation of high-resolution CT findings in patients with pneumonia in novel swine-origin influenza A (H1N1) virus infection. Br J Radiol. 2012;85(1014):729–735.
11. Marchiori E, Zanetti G, Fontes CA, *et al.* Influenza A (H1N1) virus-associated pneumonia: high-resolution computed tomography-pathologic correlation. Eur J Radiol. 2011;80: e500–4