IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 15, Issue 4 Ver. XI (Apr. 2016), PP 12-23
www.iosrjournals.org

Analysis of Chest Imaging Findings and Correlation with Disease Severity in Patients with H1N1 Influenza Infection

Dr. Sundari Natarajan[1], Dr. Murali Nanjundan[2], Dr.P.P.Balamurugan[3], Dr. Naina Suresh[4]
[1,2,3,4]*(Department Of Radiodiagnosis, Coimbatore Medical College Hospital ,Tamilnadu, India)*

Abstract :
Aim : *To describe in detail the chest X-ray and CT findings in patients with H1N1 influenza infection and their frequency of occurrence and zonal predominance.The second aim of the study was to correlate the radiological features with the severity of illness in terms of the duration of hospital stay and ICU admission (ventilatory/circulatory support)*
Materials and methods: *The study population included patients admitted at CMCH with symptoms of flu , tested positive for the Influenza viral infection and undergone chest imaging. A total of 104 patients were included in the study out of which 96 patients underwent chest radiographs and 31 patients underwent chest CT examination. Patients were divided into group A and B depending upon the duration of hospital stay [more than 7 days and less than 7 days respectively). Opravil scoring was followed in chest radiographs. The CT images were analyzed and the radiological pattern was described in detail. The distribution was documented as follows- Peripheral/ Central/Focal/ Multifocal / Diffuse.*
Results: *Opravil score more than 12 has a 4.714 times higher chance of ending up in a longer hospital stay with increased rates of patient morbidity. In chest X-ray ground glass and consolidation type of opacities were the common type of opacities seen .CT findings were positive in all group A patients and 40% of group B patients. In the study multifocal, peripherally distributed ground glass opacities were the most common radiological appearance noted followed by the consolidation type of opacity. In CT Pleural effusion was seen in 7 patients , among which 6 patients belonged to Group A. Among ICU admission 5 patients had effusion*
Conclusion: *Predominant findings in our study were ground glass opacities and consolidation. Results of our study also suggest that findings in chest radiographs and CT chest can help patient triage and can predict severity of infection and outcome.*
Keywords : *Imaging in H1N1 influenza, CT findings in H1N1, OPRAVIL score*

I. Introduction

The H1N1 flu virus caused a world-wide pandemic in 2009. It is now a human seasonal flu virus. Every year there is a rise in the number of cases during winters as increased temperatures affect the longevity of the virus. During 2014-2015 winter the outbreak became widespread through India, which was at its peak during the month of February. The signs and symptoms are similar to flu except for the occurrence of gastrointestinal symptoms. Most important complications include lower respiratory track involvement, acute respiratory failure from acute lung injury or ARDS , secondary bacterial infection and septic shock.

II. Objectives

To review the chest x-ray and chest CT findings in swine flu patients and to describe in detail the radiological features and their frequency of occurrence and zonal predominance**.**The second aim of the study was to correlate the radiological features with the severity of illness in terms of the duration of hospital stay and predict the clinical outcome.

III. Materials And Methods

Our study was a retrospective study so informed consent was waived. Hospital ethical committee approval was obtained. The study period was between 31.12.2014 to 05.04.2015 and was conducted at Coimbatore Medical College Hospital (CMCH). The study population included patients admitted at CMCH with symptoms of flu and tested positive for the influenza viral infection and undergone chest imaging. A total of 104 patients were included in the study out of which 96 patients underwent chest radiographs and 31 patients underwent chest computed tomogram(CT) examination.Exclusion criteria included patients with features of pulmonary tuberculosis, mass lesions, massive cardiomegaly and other systemic illnesses.

Patients were divided into group A and B depending upon the duration of hospital stay.

- Group A included patients who had greater than seven days of hospital stay which included admission to the Intensive Care Unit.
- Group B included patients who had lesser than seven days of hospital stay.

Chest radiographs were taken in Prognosys digital radiography(DR) equipment or Meditronics CR 1000. Standardised technique was used. CT was done on a "Toshiba - Alexion Scanner" model TSX-033A in spiral mode and viewing was done in the mediastinal and lung windows.

The chest X-ray and CT were reviewed by two experienced radiologists. Each of them were analyzed and identified as normal or abnormal. The radiological appearances were characterized as ground glass pattern, consolidation, reticular opacities or nodular opacities. Patients with the above mentioned exclusion criteria were excluded from the study.

In chest radiographs each lung was divided into four regions with a total of eight regions in both lungs(Figure 1) OPRAVIL scoring was followed. Distribution of the lesions were described in detail. A chest x-ray scoring system was adapted. The radiological appearances were scored as follows:

0 - Normal
1 - Interstitial pattern
2 - Ground glass pattern
3 - Consolidation
(Figure 2,3)

The total maximum score was 24 and this was compared to the clinical severity of the illness in the form of duration of hospital stay and admission to the intensive care unit. The CT images were analyzed similarly and the radiological pattern was described in detail as mentioned above (Figure 4,5)

The distribution was documented as follows

- Peripheral
- Central
- Focal
- Multifocal
- Diffuse

The involved segments were also noted. Presence of pleural effusion was also documented.

IV. Results And Statistical Analysis

Description of quantitative variables such as mean and standard deviation (SD) was done. The Chi square test was used for comparison among various qualitative variables. A significance level of $P < 0.05$ and a highly significant level of $P < 0.01$ were used in all tests. Comparison between groups was also done.

The study included sixty female and forty-four male patients (Table 1) with a total of 104 patients. Sixty seven patients were between the age group 21-60 years (Table 2)

4.1 Chest radiograph analysis

Chest radiographs showed positive findings in 43 patients (Table 3) Chest radiographs showed positive finding in 80.95% of the group A patients and 34.67% of the group B patients (Table 4)

OPRAVIL score value of 12 and above was taken as a severity measure and compared between group A and B patients(Table 5)

- A score of more than 12 was seen in 10 of the group A patients and none of the group B patients.
- A score of less than 12 was seen in 7 of the group A patients and 26 of the group B patients (Table 6)
- Opravil score more than 12 has a 4.714 times higher chance of ending up in a longer hospital stay with increased rates of patient morbidity (Table 7)

In chest x-ray ground glass and consolidation type of opacities were the common type of opacities seen. Score in the individual regions were added and total scores were compared.

- Consolidation and ground glass opacities occurred in 104 regions while interstitial opacities occurred in 85 regions (Table 8)
- Regions 3 and 4 were more involved than region 1 and 2 (Table 9)

4.2 CT analysis

CT findings were positive in all group A patients and 40% of group B patients (Table 10). In the study multifocal, peripherally distributed ground glass opacities were the most common radiological appearance noted followed by the consolidation type of opacity (Table 11,12) Pleural effusion was noted in 7 patients.

4.3 Intensive Care unit(ICU) patients data analysis

Among the group A patients, 9 were admitted in the ICU (Table 13). 5 patients had Opravil score of more than 12.

8 patients underwent chest CT. Among the 8 patients who underwent CT 'ground glass opacity' was the most common finding. Bilateral involvement was seen in 7 patients.

- Multifocal pattern in 4 patients
- Diffuse involvement in 3 patients
- Focal involvement in 1 patient

In CT pleural effusion was seen in 7 patients, among which 6 patients belonged to Group A. Among IMCU admission 5 patients had pleural effusion.

V. Discussion

In Influenza A H1N1 infection CXR is the first major modality for patients presenting with acute respiratory symptoms. Usually chest CT is indicated in patients with normal or suspicious findings in chest radiographs who have clinically pneumonia. CT chest is also useful in identifying complications and associated comorbid chest conditions in chest.

Our study suggested that chest radiographs play important role in predicting the clinical outcome and hospital stay in patients presenting with H1N1 infection. When the OPRAVIL score was more than 12 hospital stay was prolonged and few patients needed IMCU admission. Above finding was consistent with other studies [1,2, 6] in which severity of disease was greater in patients with high chest X ray score and multilobar involvement. In our study also ICU patients showed presence of diffuse involvement on CT[3,6]

In our study ground glass opacities were a common finding and basal segments were more commonly involved .These findings occured in many other studies [6,7,8] In these studies consolidation was also frequent and was accompanied by ground glass opacities. In our study also both types of opacities occurred in same patients frequently.

In our study young to middle aged patients were more commonly affected which always occured in novel influenza infection[1,2,10]

In a study about patients with H1N1pneumonia and acute respiratory failure[9] pleural effusion was present in 9 out of 10 with acute respiratory failure. Our study is comparable to the above mentioned study as pleural effusion was most commonly seen in IMCU patients.

VI. Figures And Tables

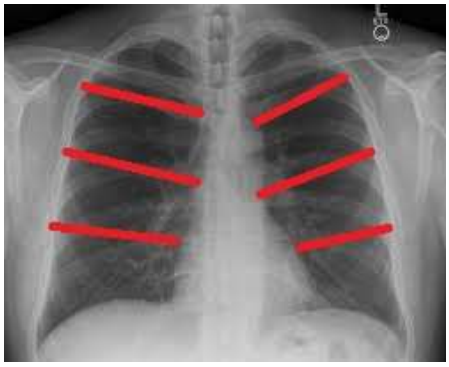


Figure 1 Chest X ray PA view demonstrating the zones used in the OPRAVIL scoring system

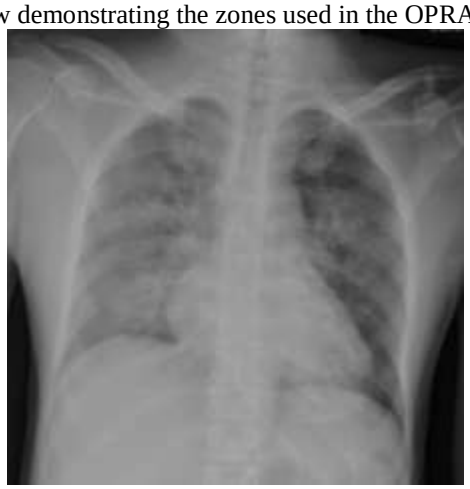
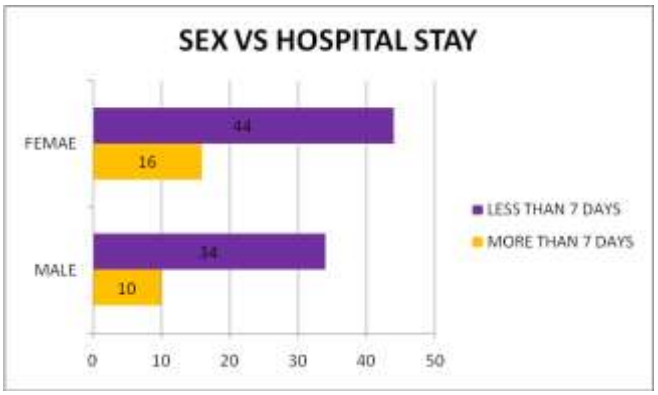


Fig 2 Chest radiograph showing bilateral ground glass opacities.

Fig 3 Chest radiograph showing predominantly consolidation

Fig 4 Chest CT showing ground glass opacity

Fig 5 Chest CT showing consolidation



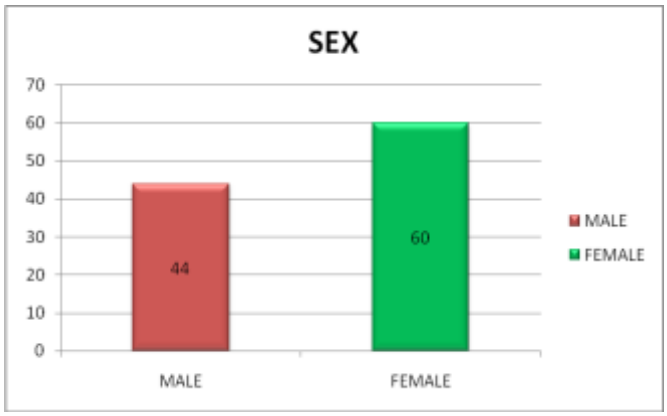


Table 1 Sex wise distribution of H1N1 infection

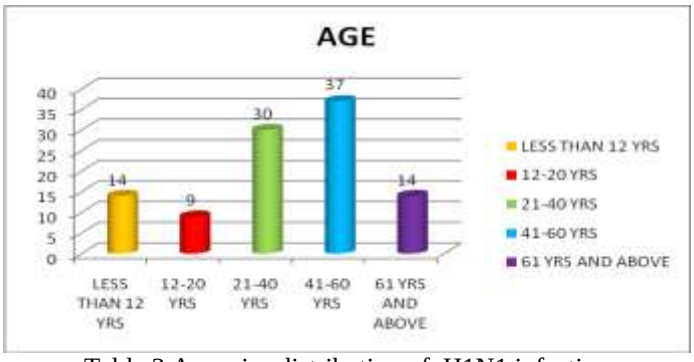


Table 2 Age wise distribution of H1N1 infection

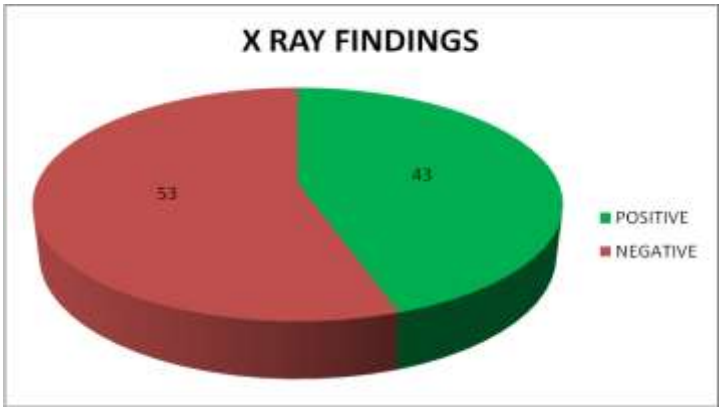
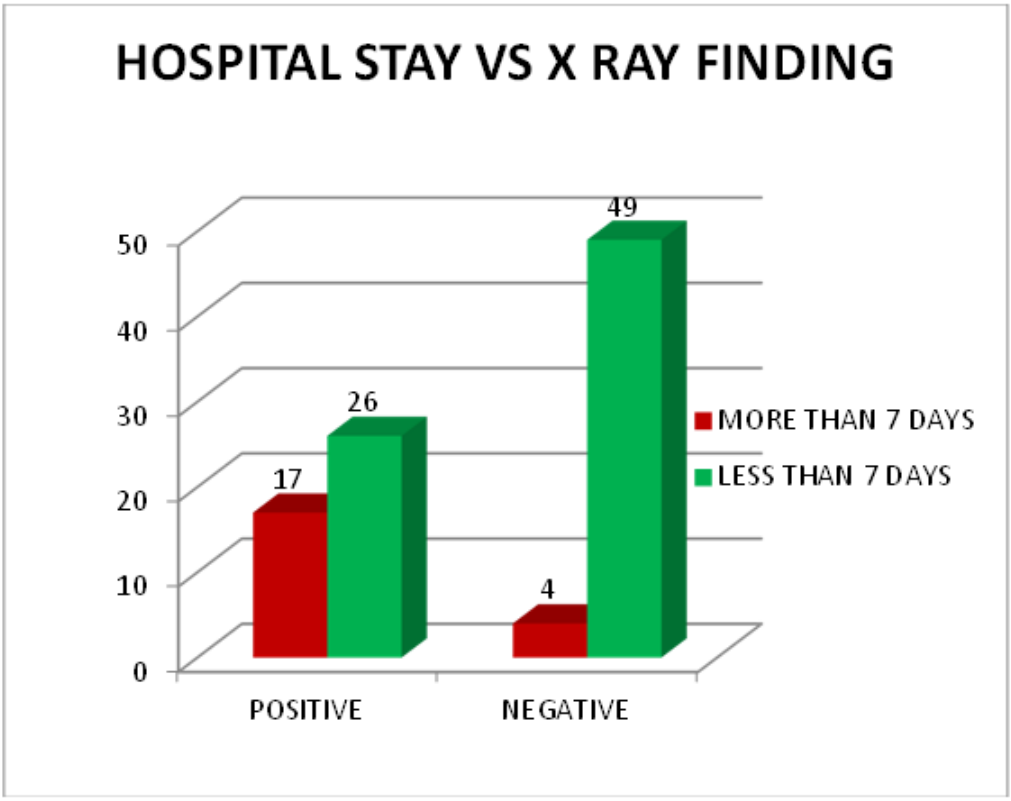


Table 3 Presence or absence of X ray findings

*** XRAY FINDING**

		XRAY FINDING		
		POSITIVE	NEGATIVE	Total
HOSPITAL STAY	GROUP A MORE THAN 7 DAYS	17	4	21
		80.95 %	19.05 %	100 %
		39.53 %	7.55 %	21.88 %
	GROUP B LESS THAN 7 DAYS	26	49	75
		34.67 %	65.33 %	100 %
		60.47 %	92.45 %	78.12 %
Total		43	53	96
		44.8 %	55.2 %	100 %
		100 %	100 %	100 %



Chi-Square Tests

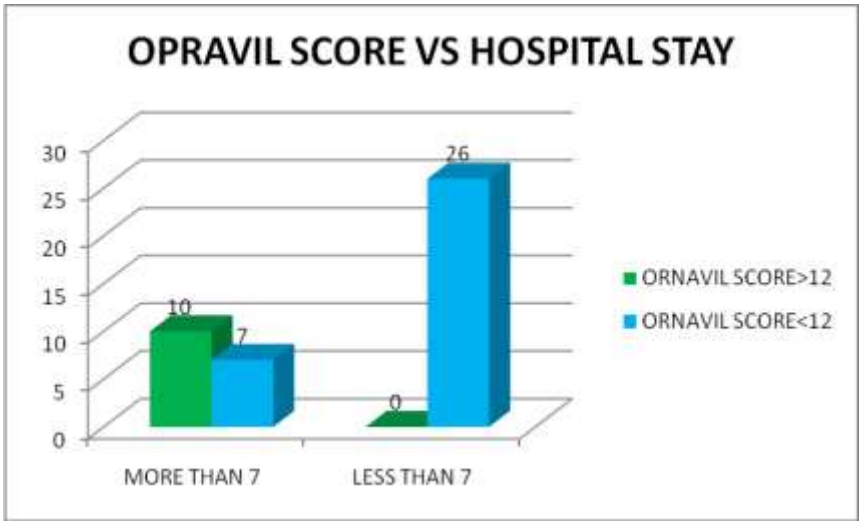
	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	14.214	1	.000		
Continuity Correction[b]	12.40	1	.000		
Likelihood Ratio	14.78	1	.000		
Fisher's Exact Test				.000	.000
N of Valid Cases	96				

Risk Estimate			
	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for MORE THAN LESS THAN 7 (1 / 2)	**8.010**	2.440	26.288
For cohort XRAY FINDING	2.335	1.607	3.393
For cohort XRAY FINDING	.292	.119	.715
N of Valid Cases	96		

From the above results it's clear that there is statistically significant(p=0.000) impact on number of days of hospital stay by presence of positive x ray findings in swine flu patients, with odds ratio of 8.01 patient with positive x ray findings have 8.01 times higher chance of ending up in more than 7 days of hospital stay.

Table 4 A,B,C,D Hospital stay and X ray finding

Opravil Score Vs Hospital Stay				
		Hospital Stay		Total
		More Than 7 Days	Less Than 7 Days	
Opravil Score	More Than 12	10	0	10
		100 %	0 %	100 %
		58.82 %	0 %	23.26 %
	Less Than 12	7	26	33
		21.21 %	78.79 %	100 %
		41.18 %	100 %	76.74 %
Total		17	26	43
		39.53 %	60.47 %	100 %
		100 %	100 %	100 %



Chi-Square Tests					
	Value	Df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	19.929[a]	1	**.000**		
Continuity Correction[b]	16.769	1	.000		
Likelihood Ratio	23.607	1	.000		
Fisher's Exact Test				.000	.000
N of Valid Cases	43				

Risk Estimate			
	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for MORE THAN LESS THAN 7 (1 / 2)	**4.714**	2.443	9.099
For cohort ORNAVIL SCORE = 1	2.696	1.519	4.785
For cohort ORNAVIL SCORE = 2	.196	.053	.732
N of Valid Cases	43		

From the above results it's clear that there is statistically significant(p=0.000) impact on number of days of hospital stay by OPRAVIL score in X ray in swine flu patients, with odds ratio of 4.714 patient with OPRAVIL score more than 12 have 4.714 times higher chance of ending up in more than 7 days of hospital stay which is very high rate.

Table 5 A,B,C,D OPRAVIL score and hospital stay

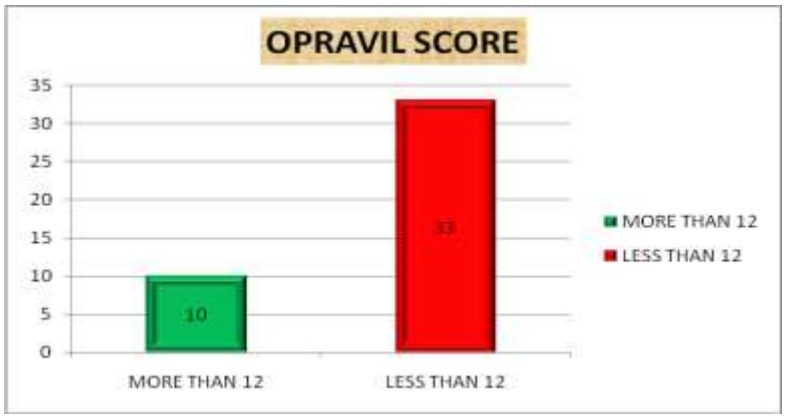


Table 6 Distribution of cases based on OPRAVIL score

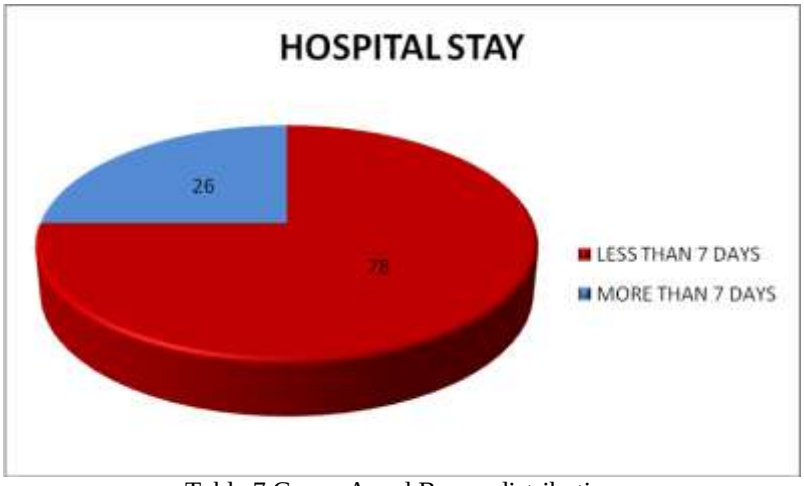
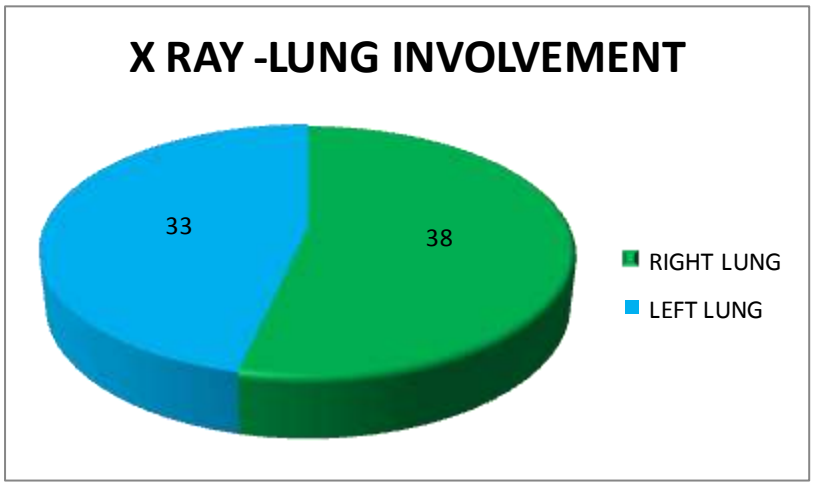


Table 7 Group A and B case distribution



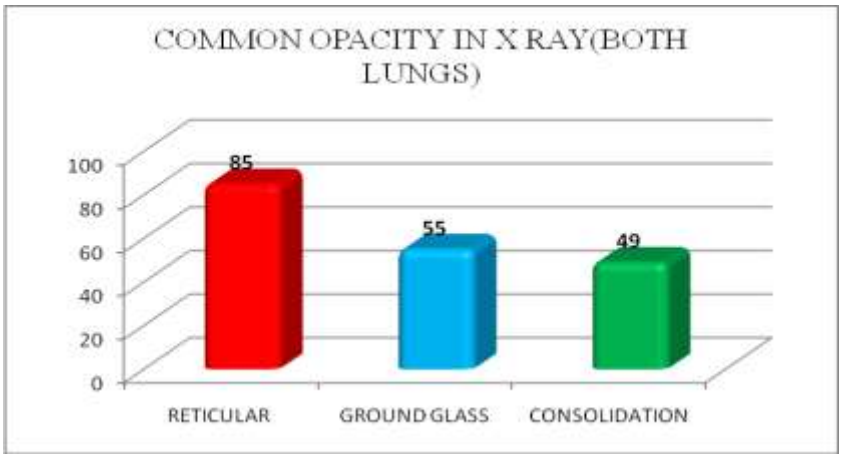
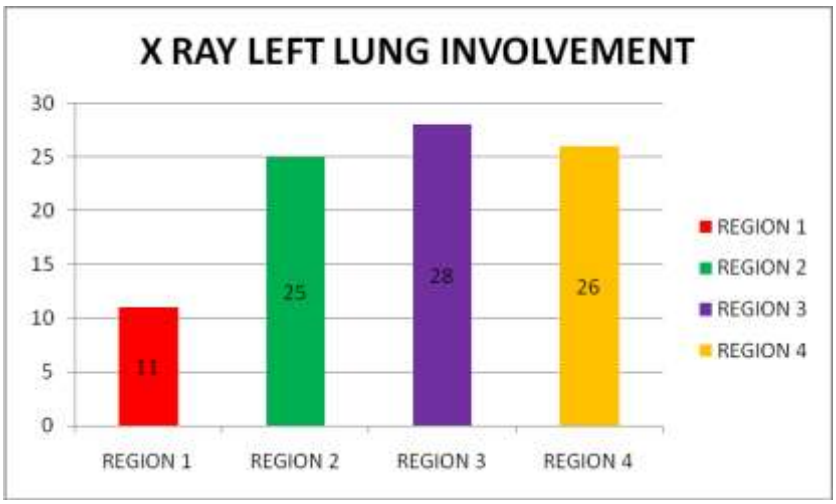


Table 8 Distribution of X ray findings



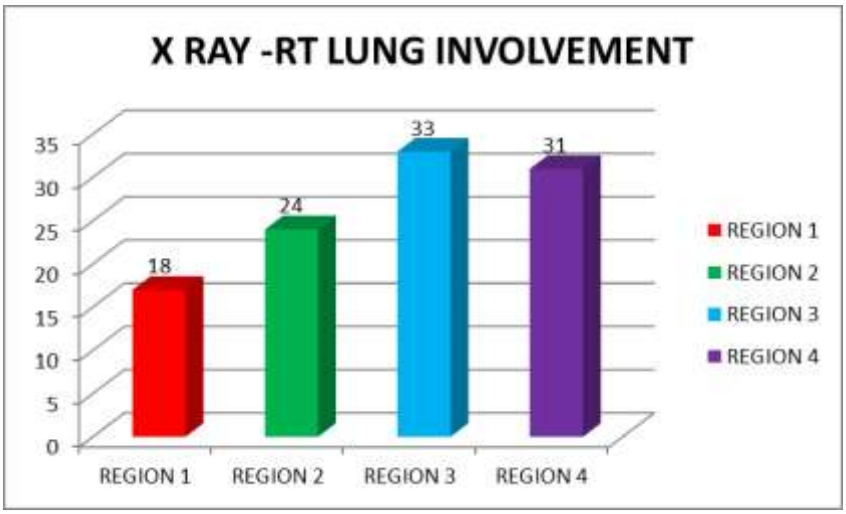
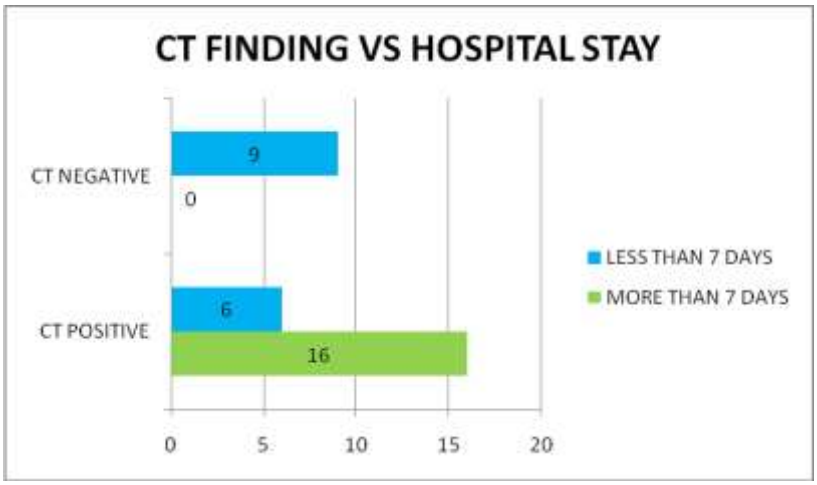


Table 9 Region wise distribution of findings

		CT SCAN		Total
		POSITIVE	NEGATIVE	
GROUP A		16	0	16
		100 %	0 %	100 %
		72.73 %	0 %	51.61 %
	GROUP B	6	9	15
		40 %	60 %	100 %
		27.27 %	100 %	48.39 %
Total		22	9	31
		71 %	29 %	100 %
		100 %	100 %	100 %

Chi-Square Tests					
	Value	Df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	13.527[a]	1	**.000**		
Continuity Correction[b]	10.772	1	.001		
Likelihood Ratio	17.161	1	.000		
Fisher's Exact Test				.000	.000
N of Valid Cases	31				



Risk Estimate			
	Value	95% Confidence Interval	
		Lower	Upper
For cohort ctscanpositive = 1	**2.500**	1.345	4.646
N of Valid Cases	31		

From the above results it's clear that there is statistically significant(p=0.000) impact on number of days of hospital stay by positive findings in CT scan in swine flu patients,with odds ratio of 2.5 patient with positive CT scan findings have 2.5 times higher chance of ending up in more than 7 days of hospital stay.

Table 10 CT scan and hospital stay

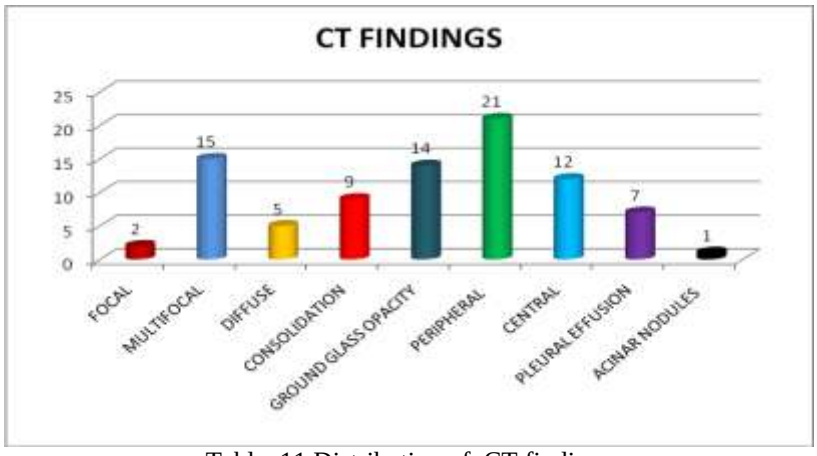


Table 11 Distribution of CT findings

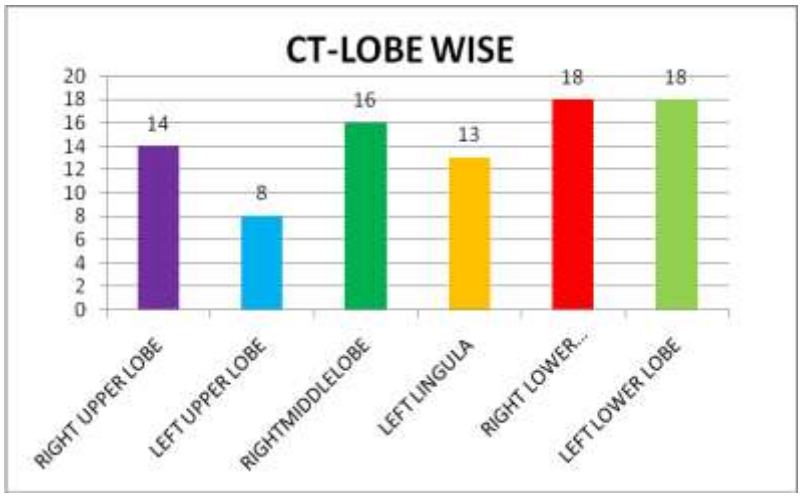


Table 12 Lobe wise distribution details

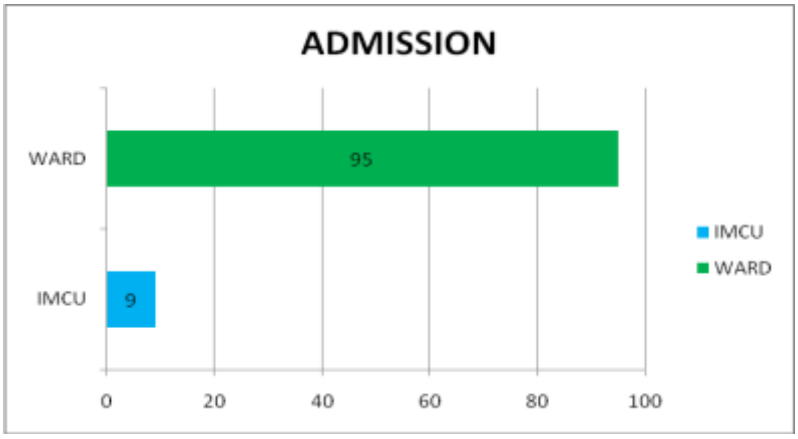


Table 13 Distribution of cases based on admission to various wards

VII. Conclusion

Chest radiographs were normal in more than 50% of patients with H1N1 infection. The predominant findings in chest imaging of patients with H1N1 infection was ground glass opacities followed by consolidation and mixed pattern. Lower and mid zone are more commonly involved than upper zone. OPRAVIL score of more than 12 was associated with increased days of hospital stay and at times ICU admission and ventilatory support.

Results of our study also suggested that findings in chest radiographs and CT chest can help patient triage and can predict severity of infection.

References

[1]. Chest radiological findings of influenza H1N1 pneumonia; A Nicolini,LFerrara,Rao,R,M Ferrari Bravo Revisita Portuguesea de pneumologia, Volume 18,issue 3,May 2012 page 120 -127

[2]. Imaging findings in patients with H1N1 influenzaA 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 doi:10.1016/j.ejcdt.2015.07.001. 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.[PubMed][DOI: 10.1056/NEJMoa0904252]

[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. [PubMed][DOI: 10.1056/NEJMoa0903810].

[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.). December 2009, Volume 193, Number 6

[7]. Chest radiography findings in adults with pandemic H1N1 2009 influenza 2010 The British Institute of Radiology; R E McEwen, J E Scriven, C A Green, M S Bailey, A K Banerjee

[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]. Imaging features of patients with H1N1 virus pneumonia and acute respiratory failure; Acad Radiol, 2010 Jun;17(6):681-5 doi:10.1016/j.acra.2010.03.013: Henzler T, Meyer M, Kalenka A, Alb M, Schmid-Bindert G, Bartling S, Schoepf JU, Schoenberg SO, Fink c.

[10]. Cardiopulmonary Imaging, Chest Radiographic and CT Findings in Novel Swine-Origin Influenza A (H1N1) Virus (S-OIV) InfectionPrachi P. Agarwal, Sandro Cinti and Ella A. Kazerooni

[11]. Opravil M,Marincek B, Fuchs WA, Weber R, Speich R, Battegay M, et al. Shortcomings of chest radiography in detecting Pneumocystis carinii pmeumonia. J Acquir Immune Defic Syndr. 1994;7:39-45

[12]. Chowell G, Bertozzi SM, Colchero Ma, Lopez-Gatell H, Alpuche-Aranda C, Hernandez M et al. Severe respiratory diasease concurrent with circultion of H1N1 influenza. N Engl J Med 2009;361:674-9

[13]. Gomez-Gomez A, Martinez-martinez R, Gotway MB. Oraganizing pneumonia associated with swine-oeigin influenza A H1NI 2009 vial pneumonia. AJR. 2011;196:103-4

[14]. Yun TJ, Kwon GJ, Oh MK, Woo SK, Choi SH, Lee HJ, et al. Radiological and clinical characteristics of a military out break of pandemic H1N1 influenza virus infection. Korean J Radiol.2010;11:417-24

[15]. Cho WH, Kim YS, Jeon DS, kim JE, kim KI, Seol HY, et al. Outcome of pandemic H1N1 pneumonia: clinical and radiological findings for severity assessment, Korean J Intern Med. 2011;26:160-7