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RETROSPECTIVE CT CHEST EVALUATION OF COVID-19 POSITIVE CASES AT BPKIHS

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ABSTRACT

Background: Pulmonary involvement is the most common systemic involvement in covid infection. The objective of the study was to evaluate the thoracic manifestations of COVID-19 positive cases. **Methods:** Patient's record files who have undergone CT chest imaging in Radiology Department, BPKIHS during the period of the study was reviewed and relevant information was entered into SPSS and analysed. **Results:** Out of 80 patients, 7.5%(6) patients had completely normal CT finding. Out of 74 cases, 89.2 % (8) cases showed multiple lesions. Fifty percentage (37) of lesions were peripheral only, 4.1 % (3) central only and 45.9% (34) both central and peripheral. GGO and consolidation were noted in 98.6 % (73) and 60.8 %(45) respectively and both in 59.46% (44). Crazy paving, microvascular dilatation sign, vacuolar sign, subpleural line, subpleural transpatent line, halo sign, reverse halo sign, air bronchogram, bronchial dilatation and bronchial distortion were observed in 36.5% (27), 79.7%(59) 28.4% (21) ,33.8% (25) and 18.9 % (14), 17.6% (13),10.8% (8) , 60.8% (45), 29.7 % (22) and 16.2% (12) respectively. Pleural effusion, pleural retraction, pleural thickening, pericardial effusion, lymphadenopathy were noted in 14.9% (11), 9.5% (7), 12.2% (9), 4.1% (3) and14.9% (11) respectively. Mean CTSS was 8.62±5.96. Consolidation, crazy paving, microvascular dilatation sign, vacuolar sign,, air bronchogram, bronchial dilatation, bronchial distortion showed significant association with CTSS grading. Lower lobes were predominantly affected. **Conclusion:** Various pulmonary and extrapulmonary findings are seen in COVID pneumonia and evaluation of these findings helps in diagnosis and possibly management of the patients.

KEYWORDS: COVID-19 pneumonia, CT, pulmonary, sign, CTSS.

INTRODUCTION

COVID-19 pneumonia shares clinical similarities to Middle East Respiratory Syndrome and SARS identified in 2012 and 2003 respectively.[1] Pulmonary involvement is the most common systemic involvement in Covid infection and thus computed tomography (CT) has been recommended in suspected cases of Covid 19.[2] The sensitivity of Chest CT is proven to be greater than reverse transcription- polymerase chain reaction (rt-PCR) in some studies.[3] Further, PCR result may take time and dilemma may occur to initiate the treatment. But Fleischer society recommends no routine use or as screening purpose of CT for Covid pneumonia evaluation unless there is worsening of respiratory symptoms or suspicion of some other pathologies.[4]

The havoc created by the Covid pandemic has devastated the normal human lifestyle. In some countries the infection has overwhelmingly troubled the humans whereas in some countries the infection has presented in a subtle way. Nepal has also been unfortunate in the second wave of this pandemic though was able to restrict the mortality and morbidity in the first wave. Though various aspects of Covid have been discussed in literature in our context, radiological manifestations in our context has not been discussed yet. Thus through this study, we aimed to evaluate the CT chest manifestations of COVID-19 positive cases in our set up.

MATERIALS AND METHODS

After taking approval from institutional ethical committee, the medical record files of the patients who have undergone CT chest imaging in Radiology Department, BPKIHS during the period of the study were reviewed. Relevant findings were recorded in the predesigned proforma. The imaging findings were analysed. Ground glass opacity (GGO) was considered present if there is increased opacity with preservation of underlying bronchovascular markings, consolidation as dense homogeneous area obliterating underlying bronchovascular markings, ,crazy paving – GGO with interlobar and interlobar septal thickening, microvascular

dilatation sign – dilated small vessels within the lesion. Subpleural transparent line was defined as thin and transparent line between the areas GGO or consolidation and the visceral pleura. Subpleural lines were defined as a thin (1-3mm) curvilinear opacity lying parallel and within 1cm of pleural margin. Vacuolar sign was characterized as a small aircontaining space < 5 mm in length within the lung lesion. Halo sign referred to ground-glass haze surrounding a nodule whereas reverse halo referred to ground-glass haze surrounded by a complete or incomplete ring of consolidation. Air bronchogram was defined by air filled bronchi in area of consolidation or GGO. Mediastinal lymph nodes were said to be enlarged when the short axis diameter is 1 cm or more. CT severity score (CTSS) was calculated by visual inspection.

All the imaging acquisition was done in 16 slice Neusoft CT machine(120 kV, 110 mAs, pitch of 1.25 and section thickness of 1.25) in supine position in end-inspiratory phase.

The findings were entered into SPSS version 11 and analysed. Continuous variables were expressed as Mean±SD values. Frequency of CT signs was expressed as number (percentage) of occurrence. Chi-square was applied to see the association of frequency of CT findings with CTSS grade. P value <0.05 was considered statistically significant.

RESULTS

All the patients had symptoms of fever > 100ºC, at least one episode of shortness of breath and at least one episode of SpO2 < 90%.Two patients reported hemoptysis. Mean age of the study sample was 45 (43±15.24).Out of 80 patients, 58.8% (47) were male and 41.2% (33) were female. Out of 80 patients, only 74 patients were reported to have chest findings and six were completely normal. Out of 74 cases, 89.2 % (8) cases showed multiple lesions whereas 10.2% (66) had single lesion. Fifty percentage (37) of lesions were peripheral only, 4.1 % (3) were central only and 45.9% (34) showed both central and peripheral involvement. GGO was noted in 98.6 % (73), consolidation in 60.8 %(45) and both GGO and consolidation in 59.46% (44). Crazy paving was noted in 36.5% (27). Microvascular dilatation sign was observed in 79.7%(59). Vacuolar sign, subpleural line, and subpleural transparent line were observed in 28.4% (21) ,33.8% (25) and 18.9 % (14) respectively. Halo sign was observed in 17.6% (13) whereas reverse halo sign was observed in 10.8% (8) cases only. Air bronchogram, bronchial dilatation and bronchial distortion were detected in 60.8% (45), 29.7 % (22) and 16.2% (12) respectively. Pleural effusion was noted in 14.9% (11) whereas pleural retraction and pleural thickening were noted in 9.5% (7) and 12.2% (9). Pericardial effusion was also seen in 4.1% (3) and lymphadenopathy in 14.9% (11) (Table 1).

Table 1: Pulmonary and extra-pulmonary radiological findings in COVID (n=74).

CT findings	Male	Female	Total
1. GGO	43 (58.1%)	30 (40.5%)	73 (98.6%)
2. Consolidation	28 (37.8%)	17 (23.0%)	45 (60.8%)
3. Crazypaving	20 (27%)	7(9.5%)	27(36.5%)
4. Microvascular Dilatation sign	37(50%)	22(29.7%)	59(79.7%)
5. Vacuolar sign	13(17.6%)	8(10.8%)	21(28.4%)
6. Subpleural line	18(24.3%)	7(9.5%)	25(33.8%)
7. Subpleural transparent line	12(16.2%)	2(2.7%)	14(18.9%)
8. Halo sign	9(12.2%)	4(5.4%)	13(17.6%)
9. Reversehalo sign	7(9.5%)	1(1.4%)	8(10.8%)
10. Airbronchogram	30 (40.5%)	15(20.3%)	45(60.8%)
11. Bronchial dilatation	18(24.3%)	4(5.4%)	22(29.7%)
12. Bronchial distortion	10(13.5%)	2(2.7%)	12(16.2%)
13. Pleural effusion	6(8.1%)	5(6.8%)	11(14.9%)
14. Pleural thickening	3(4.1%)	6(8.1%)	9(12.2%)
15. Pleural retraction	5 (6.8%)	2(2.7%)	7(9.5%)
16. Pericardial effusion	2 (2.7%)	1(1.4%)	3(4.1%)
17. Mediastinal lymphadenopathy	6(8.1%)	5(6.8%)	11(14.9%)

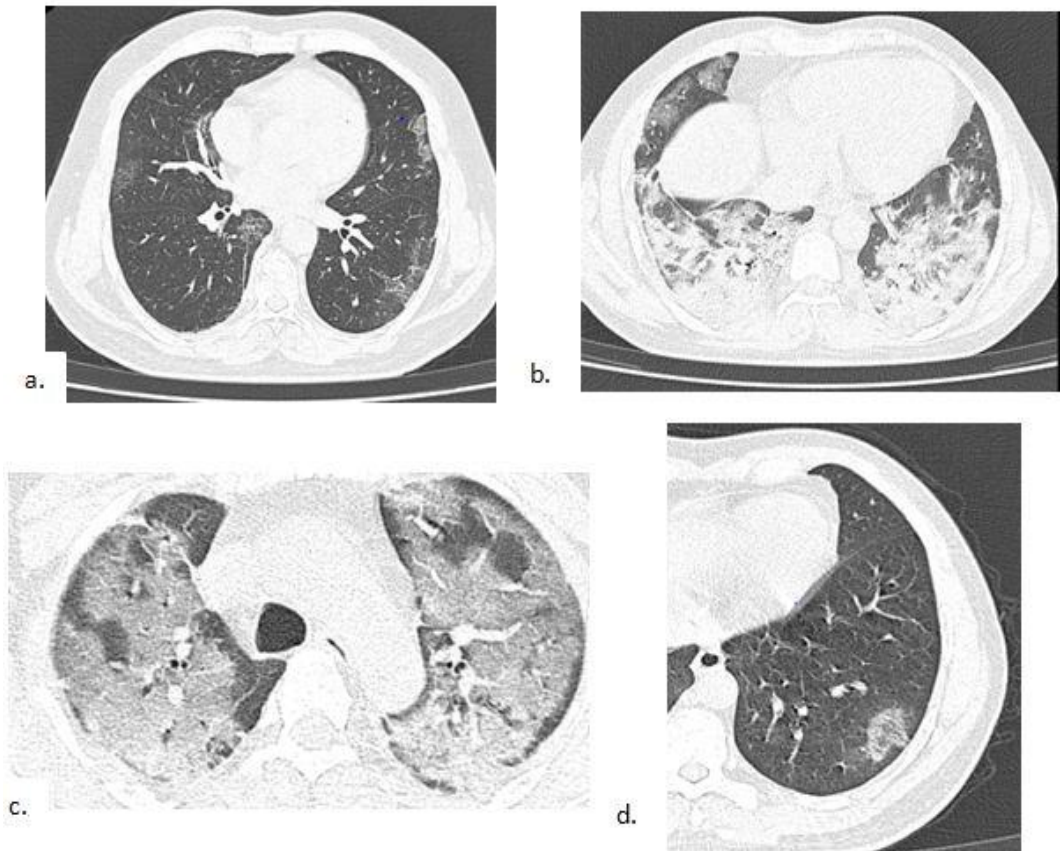

Figure-1: Pulmonary findings a. peripheral GGO b. bilateral lower lobe consolidation c. crazy paving appearance d. atoll sign.

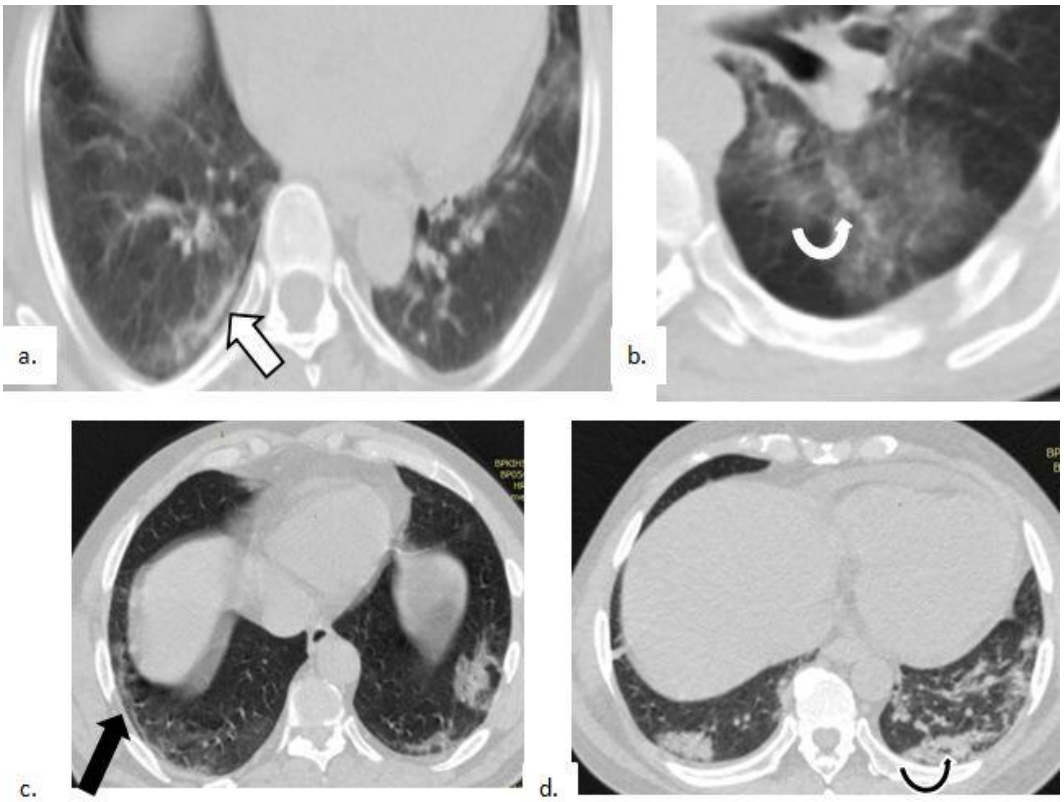

Figure-2: Pulmonary findings a. subpleural transparent line (straight white arrow) b. vascular dilatation sign (curved white arrow) c. subpleural line (straight black arrow) d. vacuolar sign (curved black arrow)

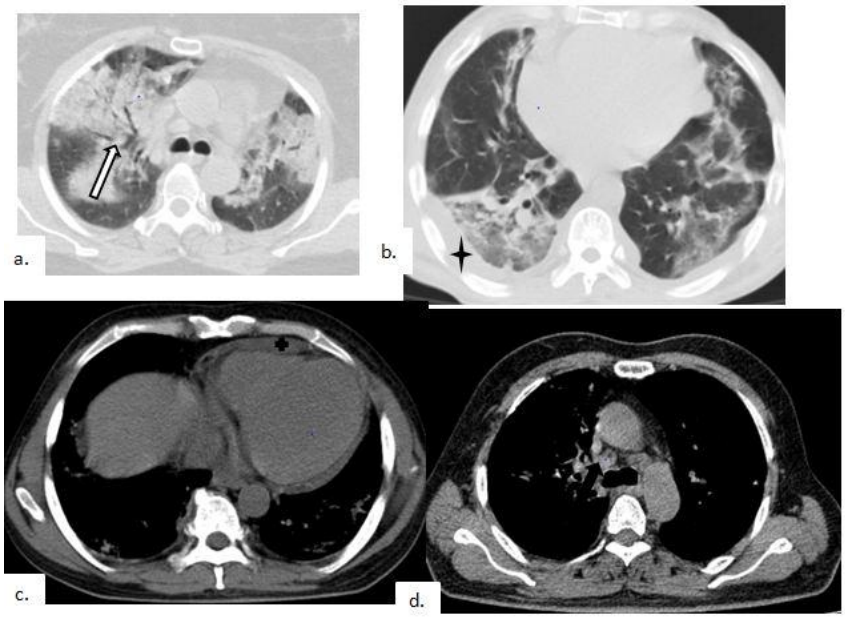

Figure-3: Pulmonary and extra-pulmonary findings a. air-bronchogram sign (straight white arrow) b. pleural effusion (asterisk) c. pericardial effusion (plus) d. mediastinal lymph node (straight black arrow)

Mean CTSS was calculated to be 8.62±5.96 (1-24) in our study sample. Consolidation, crazy paving, microvascular dilatation sign, vacuolar sign,, air bronchogram, bronchial dilatation, bronchial distortion showed significant association with CTSS grading (Table 2).

Predominantly affected lobes were as: 43.2% (32) in RLL, 39.2 % (29) in LLL, 12.2% (9) in RUL, 4.1% (3) in LUL and 1.4 %(1) in RML. Three cases of mortality were reported out of 80 cases who had undergone CT.

Table 2: Radiological findings distribution according to CTSS grading (n=74).

CT findings		CTSS			p-value
		Mild (<7)	moderate(8-14)	severity(15-25)	
1. GGO	+	36	26	11	0.602
	-	1	0	0	
2. Consolidation	+	16	21	8	0.007
	-	21	5	3	
3. Crazypaving	+	8	12	7	0.018
	-	29	14	4	
4. Microvascular Dilatation sign	+	22	26	11	0.00
	-	15	0	0	
5. Vacuolar sign	+	5	9	7	0.004
	-	32	17	4	
6. Subpleural line	+	10	11	4	0.442
	-	27	15	7	
7. Subpleural transparent line	+	5	5	4	0.236
	-	32	21	7	
8. Halo sign	+	3	7	3	0.102
	-	34	19	8	
9. Reversehalo sign	+	2	3	3	0.121
	-	35	23	8	
10. Airbronchogram	+	14	21	10	0.000
	-	23	5	1	
11. Bronchial dilatation	+	4	10	8	0.000
	-	33	16	3	
12. Bronchial distortion	+	1	7	4	0.005
	-	36	19	7	
13. Pleural effusion	+	3	4	4	0.069

	-	34	22	7	
14. Pleural thickening	+	3	3	3	0.231
	-	34	23	8	
15. Pleural retraction	+	3	3	1	0.899
	-	34	23	10	
16. Pericardial effusion	+	1	1	1	0.640
	-	36	25	10	
17. Mediastinal lymphadenopathy	+	4	4	3	0.402
	-	33	22	8	

+ denotes present and – denotes absent.

DISCUSSION

The devastating Covid-19 has not left any part of the world uninfluenced. The impact created by the pandemic may depend upon the number of factors including the health status of the state or the country. In the country like Nepal with limited health infrastructure and medical supplies, it was a dreadful challenge to all health workers.[5] BPKIHS couldn't remain unaffected from this which is a tertiary level health centre in Nepal with limited health infrastructure. In our institute, we had only one working CT scanner machine where we continued to do emergency, routine OPD and ward services at the day time and needful Covid patients imaging during the evening hours with safety protocols as designed by the institute covid management team.

All the patients who had undergone CT in the institute had experienced fever, shortness of breath with saturation < 90% for at least one episode and was advised for CT scan by the covid management team for further management. We tried to investigate the various radiological findings of those patients in our set up. Broadly, the pulmonary findings were divided into lung changes and pleural changes; extrapulmonary findings were pericardial effusion and mediastinal lymphadenopathy.

Like previous studies, GGO was the most common manifestation.[6,7]Other lung changes consolidation, subpleural line, subpleural transparent line, crazy paving, halo or reverse halo were also noted in various proportions. The initial GGO pattern is usually followed by consolidation in the progressive stage where we can see mixed pattern. Later in the peak or consolidative phase there is extensive consolidation along with subpleural line, subpleural transparent line.[8] Our study comprised of mixed patterns as most of the patients presenting to the institute showed up only after they had severe symptoms, after which their PCR was confirmed in hospital laboratory. So the accurate time couldn't be calculated in many cases.

Most of the lesions were predominantly peripheral followed by both peripheral and central involvement as seen in earlier study.[9] Vacuolar sign or air bubble sign reflects the early sign of resorption.[10] Crazy paving is usually seen around the eighth day of infection.[11] Some authors have reported atoll sign or reverse halo sign late in the progressive phase whereas others have also reported them in early stage with a variable incidence.[13]Halo-sign is non-specific and usually represents alveolar edema and hemorrhage. It is thought to be due to consequence of thrombotic damage of pulmonary microcirculation.[13]Microvascular dilatation sign which is thought to be due to the congestion of alveolar septal capillaries is seen in 79.7% of cases.[14] This sign is seen much more common in Covid pneumonia than influenza pneumonia.[15]These signs were seen in variable incidence in our study and proportion may vary depending on the stage of the infection.

Airway changes are also noted in Covid pneumonia. Air bronchogram has variable incidence in different reports ranging from 28 to 80% of patients. Air bronchogram is usually a sign of advanced disease, usually seen after the second week from the onset of symptoms.[10]Bronchial dilatation and distortion are the result of bronchial inflammation and has been in reported in some previous studies.[16]

Pleural changes are the rare findings in Covid pneumonia. In our case, pleural effusion was observed more than pleural thickening. A study by Carroti et al showed that pleural thickening is the most common finding than pleural effusion.[16] Pleural effusion is said to be bad prognostic factor associated with increased severity of disease and mortality compared with patients without pleural effusion.[17]Pericardial effusion is also a rare finding seen in 4.1% of our cases. This is supposed to develop due to insult to myocardium or pericardium and sometimes often leads to cardiac tamponade necessitating pericardiocentesis.[18]

The predominant lobe involvement was seen in bilateral lower lobes, right slightly greater than the left and right middle lobe was the least affected as seen in previous studies.[19]Mediastinal lymphadenopathy was observed in 14.9% of cases. Mediastinal lymphadenopathy was found in 0%-66% of the cases with COVID-19 infection in various studies and is noted to be present especially in critically ill patients.[20]

Various CT severity score has been formulated with percentage of lobar or segmental involvement. Here we divided the lungs into 5 anatomical lobes with involvement of 0-5%, 5-25%, 25-50%, 50-75%, &>75% assigned with a score of 1,2,3,4 and 5 respectively and

added for each lobes. CTSS was graded as mild (0-7), moderate (8-14) and severe (15-25).[21] Consolidation, crazy paving, microvascular dilatation sign, vacuolar sign,, air bronchogram, bronchial dilatation, bronchial distortion showed significant association with CTSS grading. With increase in percentage of lung involvement or severity of the disease, these radiological findings were more prevalent. A study by performed by Hafez MA also showed that consolidation, bronchial dilatation, crazy paving, halo, reverse halo and mediastinal lymphadenopathy significantly correlated with disease severity but the grading of CTSS was different from our study.[22]

Of the 80 cases, three cases of mortality were reported. Two cases had severe CTSS whereas one case had completely normal pulmonary finding and died within 24 hour of admission.

The pulmonary and extrapulmonary findings observed in our study was not so different from the study done in other countries, as observed with this limited sample size in our set up. On one hand, this study discusses about the various imaging finding in covid pneumonia patients in our set up, whereas on the other hand it emphasizes the need of CT for patient management and care which our national policy makers seems to be unaware of.

CONCLUSION

In conclusion, the role of CT is not just limited to the diagnosis of the Covid pneumonia but also in the prognosis and further management of the patients.

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