IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 16, Issue 3 Ver. X (March. 2017), PP 24-28
www.iosrjournals.org

Imaging Evaluation of Pulmonary Infections in A Tertiary Care Centre of North Western India

Dr. Eram Fatima[1],Dr. Sameer R. Verma[2],Dr. Mukta Mital[3],Dr. Prakhar Sharma[4],Dr. Prashant K.Gupta[5],Dr. Neeru Choudhary[6],Dr. Ankita Malik[7]

[1]*Resident, Dept. Of Radiodiagnosis, Subharti Medical College, Meerut, India*
[2]*Professor, Dept of Radiodiagnosis, Subharti Medical College, Meerut, India*
[3]*Associate Professor, Dept of Radiodiagnosis, Subharti Medical College, Meerut, India*
[4]*Assistant Professor, Dept of Pulmonary Medicine, Subharti Medical College, Meerut, India*
[5]*Professor & Head, Dept of Radiodiagnosis, Subharti Medical College, Meerut, India*
[6]*Resident, Dept. Of Radiodiagnosis, Subharti Medical College, Meerut, India*
[7]*Resident, Dept. Of Radiodiagnosis, Subharti Medical College, Meerut, India*

Abstract
Background: *Pulmonary infections are among the most common infections encountered in outpatient and inpatient clinical care. The most useful imaging modalities available for the evaluation of the patient with suspected pulmonary infection are chest radiography and computed tomography (CT).The aim of present study is to evaluate various patterns of pulmonary disease depicted radio logically and to establish and compare sensitivity and specificity of radiography and computed tomography.*
Materials and Methods: *This prospective observational study included a total of 120 patients with suspected pulmonary infections referred for chest imaging. Chest radiography examination was done in all the patients. Subsequently all of the patients underwent either contrast enhanced and/or non contrast high resolution computed tomography of the chest as appropriate on 128 slice Philips Multi-detector CT (MDCT). Imaging finds were interpreted independently and tabulated and subsequently correlated with clinical and pathological findings.*
Results: *Most of the patients were in the 51 to 60 years age group (29.2%) with male predominance (55%). Sensitivity and specificity of chest X-ray in detection of pulmonary infections was 64.66 % and 75% respectively with PPV and NPV of 98.68% and 6.82% respectively. CT scan showed Sensitivity, Specificity, PPV and NPV of 87.10%, 98.89 %, 96.43% and 95.70% respectively for the diagnosis of pyogenic bacterial infections, Sensitivity, Specificity, PPV and NPV of 95.70 %, 97.87 %, 98.63% and 95.83 % respectively for the diagnosis of mycobacterial infections and Sensitivity, Specificity, PPV and NPV of 93.33%, 99.06 %, 93.33% and 99.06 % respectively for the diagnosis of fungal infections.*
Conclusion: CT has important diagnostic role in pulmonary infections with high sensitivity and specificity and can aid in identification of probable causative agent. Chest x-ray is helpful ancillary investigation but has poor sensitivity in detection of pulmonary infections.
Keywords: *Chest X-ray, CT, Pulmonary infections, Sensitivity, Specificity*

I. Introduction

Pulmonary infections are among the most common infections encountered in outpatient and inpatient clinical care across all age groups. According to the Center for Disease Control and Prevention, influenza and pneumonia combined are regarded as the eighth leading cause of death in the United States in 2011.[1] The World Health Organization (WHO) estimates that one in three newborn infant deaths are due to pneumonia.[2] Pneumonia is defined as an acute inflammation of the pulmonary parenchyma. Pulmonary Tuberculosisis regarded as second to HIV/AIDS as the greatest killer worldwide due to a single infectious agent. In 2012, 8.6 million people fell ill with tuberculosis and 1.3 million died from tuberculosis.[3]

Imaging studies are critical for the diagnosis and management of pulmonary infections.[1] When the imaging manifestations of a known disease entity form a consistent pattern or characteristic appearance, these manifestations may be regarded as an imaging sign of that disease. Imaging signs are sometimes nonspecific and may also be manifestations of noninfectious diseases. In these cases, clinical picture of the disease needs to be correlated with the imaging signs. The most useful imaging modalities available for the evaluation of the patient with suspected pulmonary infection are chest radiography and computed tomography (CT).[4] Chest radiography has been described either as a screening tool for the detection of disease or for monitoring response to therapy. Other roles for chest radiography include an enhanced ability to assess the extent of disease, to detect any complications like cavitation, abscess formation, pneumothorax, pleural effusion and sometimes to guide invasive diagnostic procedures.

CT acts a useful adjunct to conventional radiography in pulmonary infection cases.[4] It is not recommended for the initial assessment of these patients, it is much more sensitive and specific than plain film radiography. Differences in tissue attenuation and parenchymal changes caused by an acute inflammatory process can be readily seen by CT.[5] Unlike chest radiography, CT provides cross-sectional images and the pattern and distribution of pulmonary processes are therefore, much more readily appreciated than on conventional examinations.

The aim of present study is to evaluate various patterns of pulmonary disease depicted radio logically and to establish sensitivity and specificity of radiography as diagnostic modality.

II. Materials And Methods

This prospective observational study was conducted in a tertiary care teaching hospital and included patients of all age groups with suspected pulmonary infections referred for chest imaging for a period of two years after necessary approval from the institutional ethics committee.

The patients with suspected or confirmed chest malignancy/secondary, any kind of allergy or connective tissue disorder, Pneumoconiosis/occupational lung disease were not included in the study.

All the patients were informed about the study and a prior informed consent was obtained from all the patients/ guardians in case of children. Patients fulfilling the aforementioned inclusion and exclusion criteria were admitted into the study.

Initial chest radiography examination was done in all the patients. Subsequently all the patients underwent either a plain/contrast enhanced/high resolution computed tomography of the chest as appropriate. Initially a non contract computerised tomography of chest was performed after which a specialized Helical Contrast enhanced Computerized Tomography (CECT) was performed on 128 slice Philips ingenuity core Multi-detector CT (MDCT).

The following parameters were utilized for the CT examination:

Chest scanning was performed with the gantry in the vertical plane and the patient in horizontal position. A slice thickness (collimation) of 1mm was used with slice spacing of 1.5 mm and most CECT scan were obtained at 120 kV, 200 to 225 mAs exposure factors. A scan interval, with smallest scan time, was used to obtain a single scan of entire thorax to reduce the effect of respiratory motion. Intravenous (I.V.) contrast was given with a fast bolus injection (60 – 100 ml of non-ionic contrast) with rapid acquisition of scans from the region of neck to upper abdomen. Once the axial images are obtained and reconstructed, the spiral CT data Set were transferred to the work station for multiplanar reconstruction in desired plane.

The chest x-ray and CECT/HRCT findings were analysed independently, tabulated and subsequently correlated with each other and clinical–pathological findings. Overall Sensitivity, specificity, PPV, NPV of chest x-ray in diagnosing pulmonary infections based was calculated. Sensitivity, specificity, PPV, NPV of computed tomography (CT) in diagnosing pulmonary infections based on aetiology were calculated and compared with x-ray findings and literature.

III. Results

A total of 120 patients were included in the study, 51 to 60 years (29.2%) was the common age group among study population followed by 41 to 50 years (21.7%) and 31 to 40 years (15%). Slight male predominance (55%) was noted. Chest x-ray was positive 75 (62%) cases with the radiological findings enlisted in the Table1.

Table 1: X-Ray Finding Among The Study Population

X ray findings	Cases	Percent
Consolidation	62	51.67
Cavitation	49	40.83
Pleural thickening	41	34.17
Pleural effusion	35	29.17
Nodular lesion	33	27.5
Emphysema	15	12.5
Fibrosis	15	12.5

In our study, sensitivity and specificity of chest x-ray in detection of pulmonary infections was 64.66 % and 75% respectively. PPV and NPV is 98.68 % and 6.82 % respectively with no statistically significant difference.

In this study it was observed that consolidation (61.7%) was the most common CT finding followed by cavitation (49.2%), pleural thickening (49.2%). pleural effusion (36.7%) and nodular lesion (35.8%) (Table 2).

Table 2: CT findings among study population

CT findings	Cases	Percent
Consolidation	74	61.7
Cavitation	59	49.2
Pleural thickening	59	49.2
Pleural effusion	44	36.7
Nodular lesion	43	35.8
Tree in Bud appearance	40	33.3
Ground glass opacity	38	31.7
Lymphadenopathy	37	30.83
Emphysema/ Bullae	25	20 .83
Fibrosis	24	20
Interlobular septal thickening	14	11.67
Thickening of bronchial wall	12	10
Lung abscess	3	2.5
Empyema	2	1.6

In 80 cases (66.7%) sputum gram staining/culture and sensitivity provided the microbiological diagnosis while in 4 (3.3%) cases FNAC/ Biopsy/ BAL provided the etiological agent. Clinical follow up/ laboratory investigations/ response to treatment confirmed the imaging diagnosis in rest of the cases. (Table 3)

Table 3: Microbiological and pathological results among study population

Microbiological anf pathological results	Cases	Percent
Sputum Gram Staining/ Culture and sensitivity positive	80	66.67
FNAC/BIOPSY/BAL positive	4	3.33

In this study, consolidation was present in 12.16% of bacterial, 85.14% of mycobacterial and 2.27% of fungal infections, cavitation was present 6.7% of bacterial, 90.0% mycobacterial and 3.3% of fungal infections and pleural effusion was present in 25.0% of bacterial, 72.73% of mycobacterial and 2.27% of fungal infections. (Table 4)

Table 4: CT findings in different types of infection among the study population

CT findings	Bacterial	Mycobacterial	Fungal	Total
Consolidation	9 (12.16%)	63 (85.14%)	2 (2.7%)	74
Cavitation	4 (6.7%)	53 (90%)	2 (3.3%)	59
Pleural effusion	11 (25%)	32 (72.73%)	1 (2.27%)	44
Nodular lesion	12 (27.91%)	23 (53.49%)	8 (18.60%)	43
Tree in Bud appearance	0 (0%)	40 (100%)	0 (0%)	40
Ground glass opacity	25 (65.79%)	6 (15.79%)	7 (18.42%)	38
Lymphadenopathy	7 (18.92%)	29 (78.38%)	1 (2.7%)	37
Emphysema/ Bullae	13 (52%)	11 (44%)	1 (4%)	25
Fibrosis	5 (20.83%)	18 (75%)	1 (4.17%)	24
Interlobular septal thickening	11 (78.57%)	3 (21.43%)	0 (0%)	14
Thickening of bronchial wall	5 (41.67%)	3 (25%)	4 (33.33%)	12
Lung abscess	2 (66.67%)	1 (33.33%)	0 (0%)	3
Empyema	2 (100%)	0 (0%)	0 (0%)	2

Table 5: Performance of CT Scan for diagnosis of infections

Pulmonary infections	Sensitivity %	Specificity %	PPV %	NPV %
Bacterial	87.10%	98.89 %	96.43%	95.70 %
Mycobacterial	95.70 %	97.87 %	98.63%	95.83 %
Fungal	93.33%	99.06 %	93.33%	99.06 %

IV. Discussion

Most of the patients in this study were in the 40-60 years age group with male predominance. Similarly in the study conducted by Bashir Ahmed Shah et al.[6] 49% patients were in the sixth and seventh decades of life. In the study conducted by SS Atwal et al.[7] most common age group was 31-40 years (53.33%) with male predominance (71%).In the present study, fever (99.2%) was the most common clinical feature followed by cough with sputum (89.2%). In the study conducted by Wesley H. Self et al.[8] shortness of breath, chest pain and cough were the most common presenting complaints, Similarly in the study conducted by Kang et al.,[9] fever, dyspnea and dry cough were the predominant symptoms.In the present study, on CT scan consolidation was predominantly observed inmycobacterial TB (85.14%) followed by pyogenic bacterial (12.16%) and fungal infections (2.27%) while in the study conducted by Kang et al.,[9] on HRCT consolidation was noted in predominantly in pyogenic bacterial infections (56%), followed by fungal infections (26%) and tubercular infections (10.5%).In the present study, cavitation was predominantly present in mycobacterial (90%) followed by bacterial (6.7%) and fungal infections (3.3%), while in the study conducted by SS Atwal et al.[7] cavitation was present in 21.4% of mycobacterial infections. Whereas in study by Naseem et al.[10], cavitation was observed in 76% cases of tuberculosis.In the present study, pleural effusion was present in 25% of bacterial, 72.73% of mycobacterial and 2.27% of fungal infections amongst study population. In a study by Kang et al.,[9] pleural effusion was present in 49% of pyogenic infections, 40% of mycobacterial and 13% of patients with fungal infection.In our study, ground glass opacity was the observed in 38 (36.5%) cases. It was associated with other findings including consolidation (n=9), lymphadenopathy (n=17), pleural effusion (n = 28). In the study conducted by Kang et al.,[9] ground glass opacity was seen in 49 (47.1%) cases and associated with other findings including consolidation (n = 7), nodules (n=10), lymphadenopathy (n = 20), pleural effusion (n = 33)In this study, tree in bud appearance was observed in 40 cases. All the cases were positive for tuberculosis. Hatipoglu et al.,[11] observed that centrilobular nodular or linear structures (91%), "tree-in-bud" appearance (71%) and macronodules (69%) were the most common HRCT findings seen in active pulmonary tuberculosis.

In our study, nodular lesion was present in 27.91% of bacterial, 53.49% of mycobacterial and 18.60% of fungal infections. Kang et al.,[9] observed, nodules were the third most common finding seen in their study in 37.5%(39) patients. J QIN et al.[12] observed large nodules were most common in patients with fungal pneumonia, having been seen in 48 (69%) of the 70 patients with fungal pneumonia, 22 (10%) of 220 with bacterial pneumonia and 6 (8%) of 78 with viral pneumonia. In a study by SS Atwal et al.[7] maximum number of patients with pulmonary tuberculosis (78%) were indentified to have nodular opacities. Out of total 120 cases of infectious aetiology in this study, there were 31(29.8%) bacterial, 15(14.4%) fungal, 74 (71.2%) tubercular infections. In study by Kang et al. [9] of total 104 cases, 46 (44.23%) cases were of pyogenic bacterial infection, 19 (18.3%) cases of fungal infection, 10(9.6%) cases of mycobacterium TB and 12(11.5%) cases of pneumocystis jiroveci. Out of 45 patients included in study by SS Atwal et al.,[7] 32 (62.2%) of patients were diagnosed as having pulmonary tuberculosis, followed by bacterial infection in 20% cases and Pneumocystis jiroveci pneumonia (PJP) in 8.9% patients, while 8.9% of the study did not reveal any significant abnormality.

In our study, chest X-ray was positive in 75 (62%) cases of pulmonary infections while CT could correctly diagnose 116 cases (96%). In a study by Kang et al.[9] chest x-rays were positive in (31.74%) cases while HRCT could correctly diagnose 83% patients. In our study, sensitivity and specificity of chest x-ray in detection of pulmonary infections was 64.66 % and 75% respectively. PPV and NPV is 98.68 % and 6.82 % respectively. As per study conducted by Wesley H. Self [8] chest x-ray had sensitivity 43.5%, specificity 93.0% positive predictive value, 26.9% and negative predictive value 96.5%, in detection of pulmonary opacities.

In the present study, CT scan showed Sensitivity, Specificity, PPV and NPV of 87.10%, 98.89 %, 96.43% and 95.70% respectively for the diagnosis of pyogenic bacterial infections, Sensitivity, Specificity, PPV and NPV of 95.70 %, 97.87 %, 98.63% and 95.83 % respectively for the diagnosis of mycobacterial infections and Sensitivity, Specificity, PPV and NPV of 93.33%, 99.06 %,93.33% and 99.06 % respectively for the

diagnosis of fungal infections. This findings correlate well with study conducted by Kang et al.,[9] 2013 where CT scan showed Sensitivity, Specificity, PPV and NPV of 90%, 97.02%, 75%, 98.98% for diagnosis of mycobacterial infections while for pyogenic infections it was 84.78% , 93.84%, 90.69%, and 89.7% and for fungal infections it was 95.23%, 96.7%, 86.36 % and 98.98% respectively.

V. Conclusion

This hospital based study had limitations of small sample size and inherent bias, but clearly shows that CT has important diagnostic role in pulmonary infections with high sensitivity and specificity and can aid in identification of probable causative agent. Chest x-ray is helpful ancillary investigation but has poor sensitivity in detection of pulmonary infections.

References

[1]. Walker M, Abbott F, Greene E, Shepard JO, Vummidi D, Digumarthy SR. Imaging Pulmonary Infection: Classic Signs and Patterns. American Journal of Roentgenology. 2014 202:3, 479-492.
[2]. Hoyert DL, Xu J.Deaths: preliminary data for 2011. Natl Vital Stat Rep 2012;61(6):1-51
[3]. Ghimire M, Bhattacharya SK, Narain JP. Pneumonia in South-East Asia Region: Public health perspective. Indian J Med Res.2012; 135(4):459- 468.
[4]. Franquet T. Imaging of pneumonia: trends and algorithms. Eur Respir J. 2001;18:196 -208.
[5]. Heussel CP, Kauczor HU, Heussel GE, Fischer B, Begrich M, Mildenberger 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;17(3):796–805
[6]. Shah BA, Singh G, Naik MA, Dhobi GN. Bacteriological and clinical profile of Community acquired pneumonia in hospitalized patients. Lung India 2010;27:54-7
[7]. Atwal SS, Puranik S, Madhav RKV, KSV A, Sharma BB, Garga UC. High Resolution Computed Tomography Lung Spectrum in Symptomatic Adult HIV-Positive Patients in South-East Asian Nation. Journal of Clinical and Diagnostic Research : JCDR. 2014;8(6):RC12-RC16. doi:10.7860/JCDR/2014/9397.4518.
[8]. Self WH, Courtney DM, McNaughton CD, Wunderink RG, Kline JA. High Discordance of Chest X-ray and CT for Detection of Pulmonary Opacities in ED Patients: Implications for Diagnosing Pneumonia. The American journal of emergency medicine. 2013;31(2):401-405. doi:10.1016/j.ajem.2012.08.041.
[9]. Kang M, Deoghuria D,Varma S, Gupta D, Bhatia A, Khandelwal N. Role of HRCT in detection and characterization of pulmonary abnormalities in patients with febrile neutropenia. Lung India. 2013;30 (2):124-130.
[10]. Naseem A, Saeed W, Khan S. Journal of the College of Physicians and Surgeons Pakistan. 2008;18(11):703-7.
[11]. Hatipoglu ON, Osma E, Manisali M, Ucan ES, Balci P, Akkoclu A, et al. High resolution computed tomographic findings in pulmonary tuberculosis. Thorax. 1996; 51(4):397-402.
[12]. J Qin, J Xu,Y Dong, W Tang, B Wu, Y, H Shan. High-resolution CT findings of pulmonary infections after orthotopic liver transplantation in 453 patients. The British Journal of Radiology. 2012;85(1019):959–965