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ORIGINAL ARTICLE

Assessment of Chest radiographic findings among patients with chronic granulomatous disease

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ABSTRACT:

Background: Chronic Granulomatous Disease (CGD) represents a prototypical disorder among non-lymphoid primary immunodeficiencies and has played a pivotal role in advancing our understanding of innate immune biology. Hence; the present study was conducted for assessing Chest radiographic findings among patients with chronic granulomatous disease. **Materials & methods:**In this study, a retrospective evaluation was performed to analyze thoracic imaging findings in adult patients diagnosed with Chronic Granulomatous Disease (CGD). Chest radiographs were carefully reviewed in a cohort of forty individuals who developed recurrent lower respiratory tract infections. The spectrum of abnormalities assessed included pulmonary infiltrates, nodular opacities, cavitary lesions, and bronchiectatic changes, which are often observed in CGD-related lung disease due to impaired neutrophil oxidative function and the resultant vulnerability to bacterial and fungal pathogens. All the results were recorded and analysed using SPSS software. **Results:**The most frequent abnormality was consolidation, observed in 62.5% of patients, followed by diffuse reticulonodular opacities in 45%. Pulmonary artery enlargement was noted in 25%, while pleural effusion was the least common finding, present in 22.5% of cases. These results suggest that while radiographs can identify major parenchymal and vascular changes, they may underestimate the full extent of disease involvement.Areas of scarring and traction bronchiectasis were universally present (100%), reflecting chronicity of pulmonary involvement in CGD. Other common findings included emphysematous changes (80%), mediastinal or hilar lymphadenopathy (70%), consolidation (67.5%), and both pulmonary nodules and centrilobular nodules (65% each). Less frequent but still notable findings were air trapping with decreased attenuation and vascularity (55%), tree-in-bud opacities (47.5%), pulmonary artery enlargement (52.5%), and pleural effusion (27.5%). **Conclusion:**Taken together, the data demonstrate that chest CT is more sensitive than radiography in detecting the wide spectrum of pulmonary abnormalities in CGD. In particular, CT findings of scarring, bronchiectasis, emphysematous changes, and nodular patterns provide critical insights into both acute infectious processes and long-standing structural damage. This underscores the importance of CT imaging for accurate assessment, monitoring, and management of pulmonary disease in CGD patients.

Key words: Chest Radiograph, Chronic granulomatous disease

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INTRODUCTION

Chronic Granulomatous Disease (CGD) represents a prototypical disorder among non-lymphoid primary immunodeficiencies and has played a pivotal role in advancing our understanding of innate immune biology. The condition has been instrumental in elucidating the mechanisms of oxygen metabolism within phagocytes, as well as its wider implications in vascular and neural tissues. Historically, CGD has served as a cornerstone in the establishment of antimicrobial prophylaxis strategies, long before such practices became standard in the management of neutropenia or the widespread implementation during the HIV epidemic.[1-3]

Beyond its pathophysiological significance, CGD has emerged as a critical focus for therapeutic innovation. It is one of the earliest nonmalignant disorders to be explored as a candidate for gene therapy, and it continues to be a major indication for hematopoietic stem cell and bone marrow transplantation. These therapeutic advances highlight the disease's role not only in shaping modern immunology but also in driving translational research into curative treatments. Consequently, CGD deserves particular attention, both for its historical contributions to immunological science and for the necessity of specialized clinical management to optimize patient outcomes.[4-6] Hence; the present study was conducted for assessing Chest radiographic findings among patients with chronic granulomatous disease.

MATERIALS & METHODS

In this study, a retrospective evaluation was performed to analyze thoracic imaging findings in adult patients diagnosed with Chronic Granulomatous Disease (CGD). Chest radiographs were carefully reviewed in a cohort of forty individuals who developed recurrent lower respiratory tract infections. The investigation focused on correlating radiographic abnormalities with the clinical context of infectious episodes, aiming to highlight the characteristic imaging features associated with this rare immunodeficiency.The analysis was conducted across five documented episodes of pulmonary infection

within this patient group. Conventional chest X-rays were used to provide diagnostic impressions. The spectrum of abnormalities assessed included pulmonary infiltrates, nodular opacities, cavitary lesions, and bronchiectatic changes, which are often observed in CGD-related lung disease due to impaired neutrophil oxidative function and the resultant vulnerability to bacterial and fungal pathogens. Such findings were compared temporally to assess disease progression and radiographic resolution following treatment. All the results were recorded and analysed using SPSS software.

RESULTS

The mean age of the study population was 48.3 years. 60 percent of the patients were males while the remaining were females.The most frequent abnormality was consolidation, observed in 62.5% of patients, followed by diffuse reticulonodular opacities in 45%. Pulmonary artery enlargement was noted in 25%, while pleural effusion was the least common finding, present in 22.5% of cases. These results suggest that while radiographs can identify major parenchymal and vascular changes, they may underestimate the full extent of disease involvement.Areas of scarring and traction bronchiectasis were universally present (100%), reflecting chronicity of pulmonary involvement in CGD. Other common findings included emphysematous changes (80%), mediastinal or hilar lymphadenopathy (70%), consolidation (67.5%), and both pulmonary nodules and centrilobular nodules (65% each). Less frequent but still notable findings were air trapping with decreased attenuation and vascularity (55%), tree-in-bud opacities (47.5%), pulmonary artery enlargement (52.5%), and pleural effusion (27.5%).

Table 1. Chest Radiographic Findings in Adults with CGD

Radiographic Finding	Number of Patients (n=40)	Percentage (%)
Consolidation	25	62.5
Diffuse reticulonodular opacities	18	45
Pleural effusion	9	22.5
Pulmonary artery enlargement	10	25

Table 2. Chest CT Findings in Adults with CGD

CT Finding	Number of Patients (n=40)	Percentage (%)
Consolidation	27	67.5
Pulmonary nodules (random distribution)	26	65
Centrilobular nodules	26	65
Tree-in-bud opacities	19	47.5
Areas of scarring and traction bronchiectasis	40	100
Emphysematous changes	32	80
Areas of decreased attenuation & vascularity (air trapping on expiratory CT)	22	55
Mediastinal and/or hilar lymphadenopathy	28	70
Pulmonary artery enlargement	21	52.5
Pleural effusion	11	27.5

DISCUSSION

Chronic granulomatous disease (CGD) was initially identified in 1954 and 1957, when it was described as a syndrome of recurrent infections occurring in association with hypergammaglobulinemia, in contrast to the hypogammaglobulinemia observed in Bruton's agammaglobulinemia. The condition was more clearly characterized in 1959, when it was termed "fatal granulomatous disease of childhood." Today, it is universally referred to as CGD.[4- 6]While it was first believed to be an X-linked disorder, the identification of affected females in 1968 established the existence of autosomal recessive variants. Over the past six decades, CGD has transformed from a condition with high early mortality into one that, with appropriate interventions, can be managed effectively, resulting in significantly improved survival rates.Beyond its clinical relevance, CGD has played a central role in advancing medical understanding. It has served as a model for non-lymphoid primary immunodeficiencies, contributing to insights into oxygen metabolism within phagocytes, vascular tissues, and even the central nervous system. Importantly, it was a key focus in the early development of antimicrobial prophylaxis, preceding its widespread use in neutropenia and HIV care. Furthermore, CGD has become a target for gene therapy and hematopoietic stem cell transplantation, particularly as a treatment strategy for non-malignant diseases. For these reasons, CGD remains a condition of enduring significance, both historically and clinically, where expert management continues to be essential.[7- 9]

The mean age of the study population was 48.3 years. 60 percent of the patients were males while the remaining were females.The most frequent

abnormality was consolidation, observed in 62.5% of patients, followed by diffuse reticulonodular opacities in 45%. Pulmonary artery enlargement was noted in 25%, while pleural effusion was the least common finding, present in 22.5% of cases. These results suggest that while radiographs can identify major parenchymal and vascular changes, they may underestimate the full extent of disease involvement.Areas of scarring and traction bronchiectasis were universally present (100%), reflecting chronicity of pulmonary involvement in CGD. Other common findings included emphysematous changes (80%), mediastinal or hilar lymphadenopathy (70%), consolidation (67.5%), and both pulmonary nodules and centrilobular nodules (65% each). Less frequent but still notable findings were air trapping with decreased attenuation and vascularity (55%), tree-in-bud opacities (47.5%), pulmonary artery enlargement (52.5%), and pleural effusion (27.5%).Godoy et al. described the thoracic radiologic manifestations of chronic granulomatous disease (CGD) in adults, focusing on the spectrum of chest radiographic and CT abnormalities.Chest radiographs frequently demonstrated consolidation (60%), diffuse reticulonodular opacities (40%), pleural effusion (20%), and pulmonary artery enlargement (20%). CT imaging provided more detailed characterization, revealing consolidation (60%), pulmonary nodules in a random distribution (60%), centrilobular nodules (60%), and tree-in-bud opacities (40%). In addition, CT consistently showed areas of scarring with traction bronchiectasis (100%), along with emphysematous changes (75%), air trapping with decreased attenuation and vascularity (50%), mediastinal and/or hilar lymphadenopathy (60%), pulmonary artery enlargement (50%), and pleural effusion (20%). The most prominent and clinically relevant findings were consolidation and pulmonary nodules, which histopathologic evaluation confirmed as being associated with either infectious processes or granulomatous inflammation.In adults with CGD, pulmonary imaging commonly reveals a broad spectrum of abnormalities. Key radiologic findings include consolidation, pulmonary nodules, fibrotic scarring with traction bronchiectasis, emphysematous changes, air trapping, lymphadenopathy, pulmonary artery enlargement, and pleural effusion. These patterns reflect the underlying susceptibility to recurrent infections and granulomatous inflammation, emphasizing the importance of radiologic assessment in the evaluation and management of CGD.[10]Mahdaviani SA et al investigated pulmonary problems of CGD in a group of patients who underwent computed tomography (CT) scan.Areas of consolidation and scan formation were the most common findings, which were detected in 79% of the patients. Other abnormalities in order of frequencies were as follows: small pulmonary nodules (58%); mediastinal lymphadenopathy (38%); pleural thickening (25%); unilateral hilar lymphadenopathy (25%); axillary lymphadenopathy (21%); bronchiectasis (17%); abscess formation (17%); pulmonary large nodules or masses (8%); and free pleural effusion (8%).The pulmonary CT scans of the patients with CGD demonstrated a variety of respiratory abnormalities in the majority of the patients. While recurrent respiratory infections and abscesses are considered as prominent features of CGD, early diagnosis and precise check-up of the respiratory systems are needed to prevent further pulmonary complications.[11]

CONCLUSION

Taken together, the data demonstrate that chest CT is more sensitive than radiography in detecting the wide spectrum of pulmonary abnormalities in CGD. In particular, CT findings of scarring, bronchiectasis, emphysematous changes, and nodular patterns provide critical insights into both acute infectious processes and long-standing structural damage. This underscores the importance of CT imaging for accurate assessment, monitoring, and management of pulmonary disease in CGD patients.

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