World Bulletin of Public Health (WBPH)
Available Online at: https://www.scholarexpress.net
Volume-46 May 2025
ISSN: 2749-3644

THE ROLE OF COMPUTED TOMOGRAPHY IN THE DIAGNOSIS OF PNEUMONIA IN PATIENTS WITH IMMUNODEFICIENCY

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Article history:

Received: April 14th 2025
Accepted: May 10th 2025

Abstract:

Pneumocystis jiroveci pneumonia is a common opportunistic infection affecting immunosuppressed patients. High-resolution CT may be indicated for evaluation of immunosuppressed patients with suspected pneumonia and normal chest radiographic findings. The most common high-resolution CT finding of Pneumocystis jiroveci pneumonia is diffuse ground-glass opacity. Computed tomographic features of pneumonia caused by Pneumocystis jiroveci depend on the stage of the process. High-resolution computed tomography should be used.

Keywords: immunodeficiency, Pneumocystis jiroveci, pneumocysts, pneumocystis pneumonia "ground glass", edematous stage, acute stage (atelectatic), emphysematous stage, reticular changes, "honeycomb lung".

INTRODUCTION.

HIV-related deaths are commonly reported in patients not receiving HAART (highly active antiretroviral therapy) or not adhering to treatment, with progression of tuberculosis being the most common cause (2). The second leading cause of death is the presence of pneumocystis pneumonia (PCP) in more than a quarter of patients (2). The share of PCP among patients with HIV infection accounts for 20% The urgency of the problem is associated with the increasing number of people with acquired immunodeficiency. It is connected with the steady growth of such diseases as AIDS, viral hepatitis C, oncologic diseases and other reasons for the decrease in the patient's immune defense (1,2). This category of patients is increasing and is most susceptible to lower respiratory tract infections, from which patients die more often than from the underlying disease. Modern radial diagnostic methods, namely multispiral computed tomography (MSCT), play an important role in the diagnosis of these diseases (3). It is necessary for a radiologist to know well both clinical and pathomorphologic manifestations of pneumonias against the background of immunodeficiency, which will help a clinician to prescribe an adequate treatment to a patient in a timely and adequate manner. Knowledge of the features of modern radiation semiotics of pneumocystis pneumonia is necessary for the correct interpretation of research data.

OBJECTIVE. Identification of specific computed tomographic (CT) signs of pneumocystis pneumonia at the stages of its development.

MATERIAL AND METHODS. Extended analysis of clinical and computed tomographic data was performed in 20 patients (11 women and 9 men) admitted to the Republican Scientific Center for Emergency Medical Care (RSCEMC) in the therapeutic intensive care unit with symptoms of dyspnea, subfebrile temperature and chest pain. The mean age of the patients was 47.3±18.4 years. All patients were immunodeficient and tested positive for HIV. All patients were hospitalized in the therapeutic intensive care unit. Multispiral computed tomography (MSCT) of the chest organs was performed on the Aquilion Prime 160 MSCT machine (Canon Medica System) using high-resolution computed tomography program. Computed tomographic studies were compared with the clinical picture in different periods of the disease.

RESULTS OF THE STUDY.

All patients were conditionally divided into two groups depending on the duration of the disease: the first group was patients who had been ill for several days (up to 1 week) and patients who had been ill for more than one week (3-4 weeks). According to the data obtained, in the clinical picture of patients on admission to the hospital from all symptoms prevailed signs of respiratory failure, which was manifested by increased heart rate, dyspnea, cyanosis, compensatory increase in blood pressure. In connection with the development of

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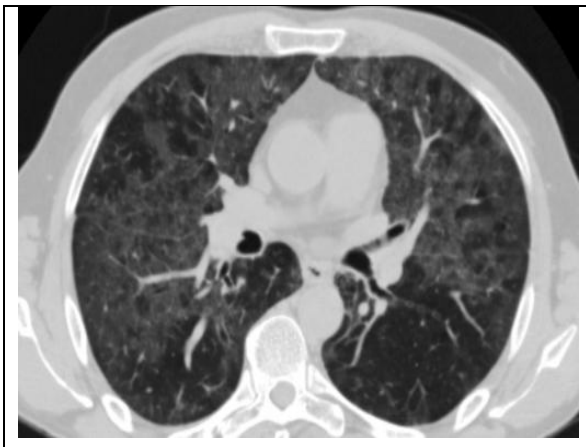
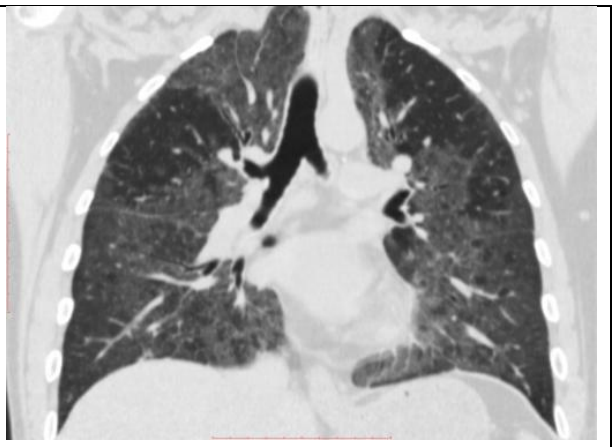
Volume-46 May 2025
ISSN: 2749-3644

clinical picture all patients underwent chest radiography and MSCT. No changes were detected on chest radiographs. Therefore, all patients of the first group underwent computed tomographic study (Table 1). Computed tomography of the chest organs revealed the following signs: in two patients (20%) compaction of lung parenchyma by the type of "ground glass" in the root zone and in the upper parts, resembling "butterfly wings", in four patients (40%) "ground glass" was localized in all fields, but mainly in the upper and anterior parts of the lungs, in four patients (40%) diffusely in all fields, and the peripheral parts were normal pneumatization (Figure 1). The density of pulmonary parenchyma reached -425±35 HU on the right and -325±25 HU on the left. No enlargement of intrathoracic lymph nodes or presence of effusion in the pleural cavity was noted.



a. Diffuse thickening of the lung parenchyma of the " ground glass" type mainly in the anterior segments of the lungs



b) diffuse thickening of parenchyma of " ground glass" type, peripheral parts of normal pneumatization

Fig.1 Patient with pneumocystis pneumonia, HIV positive. HRCT, pulmonary window, a) axial view b) coronal view

MSCT was performed in all patients of the second group. Six (60%) patients showed diffuse consolidation of ground glass type, against which thickened interval septa (paving stone symptom) were detected. Four patients (40%) had consolidation, mainly in the peripheral parts, in addition to fr thickening of parenchyma. The density of pulmonary parenchyma in the areas of "ground glass" type consolidation was -284±35 HU on the right and -384±25 HU on the left, and in the areas of alveolar consolidation type consolidation was +55±15HU on the right and +45±15HU on the left. In two patients (20%) small air cavities - pneumatocele were detected in the lower lobe of the right lung (Fig.2). In six patients (60%) the process was symmetric and in 40% of cases asymmetric. In 60% of cases there was an increase of intrathoracic lymph nodes, mainly of paratracheal group, in four patients (40%) a pericardial effusion layer with density +13 HU was detected (Table 1).

Table 1

CT in the examined patients in a comparative aspect

Indications	First group (n-10)		Second group (n-10)	
	абс	отн (%)		

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ground glass	predominantly in the upper and anterior regions	4	40	0	0
	diffuse	4	40	10	100
	«butterfly wings»	2	20	0	0
The symmetry of "ground glass"	symmetrically	2	20	6	60
	unsymmetrically	8	80	4	40
paving stone symptom		0	0	6	60
Increased intrathoracic lymph nodes		0	0	6	60
Pericardial effusion		0	0	4	40

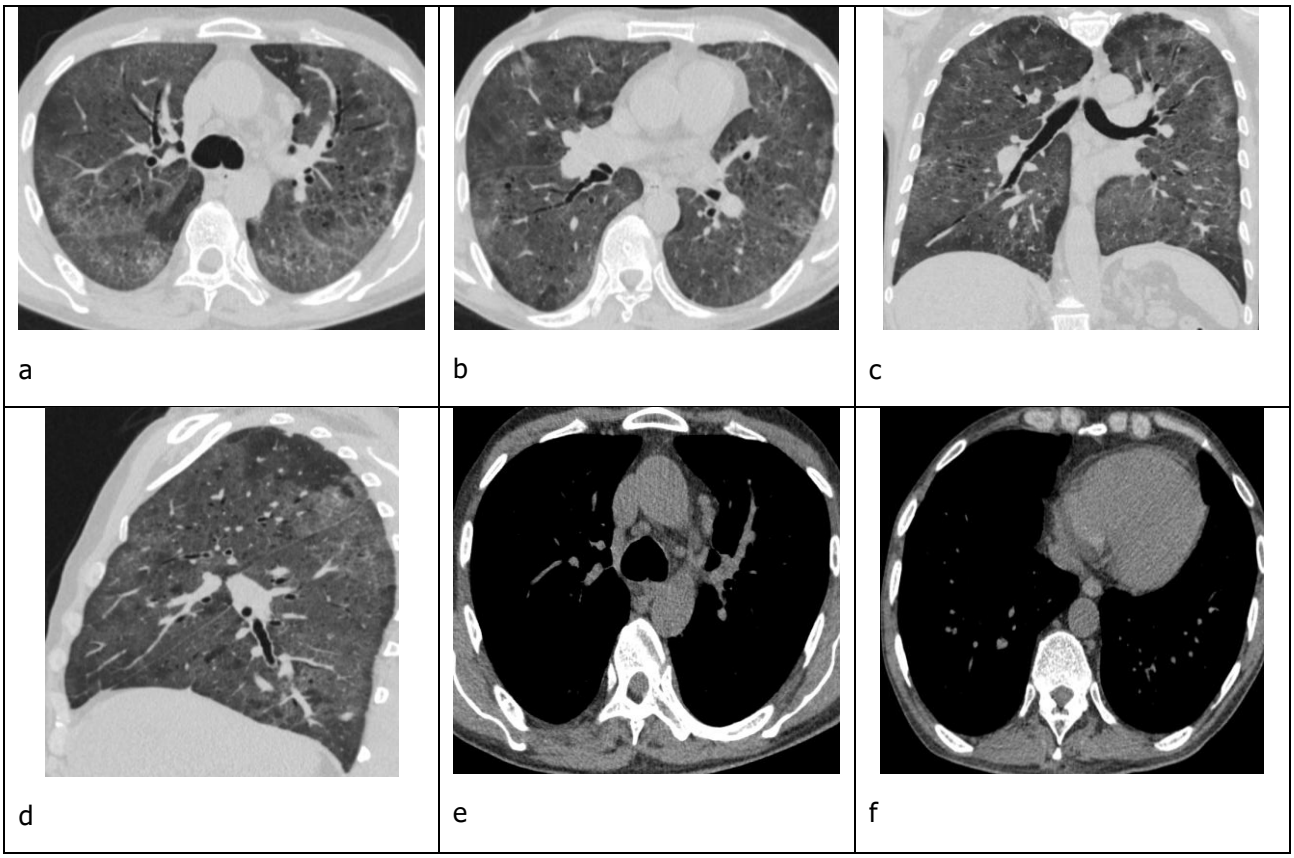

Fig.2 Patient with pneumocystis pneumonia, HIV positive, HRCT a,b,c,d) pulmonary window - diffuse thickening of parenchyma of both lungs like ground glass, thickening of interlobular septa (paving stone symptom), small air cavities in the right lung - pneumatocele e,f) mediastinal window - lymphadenopathy of intrathoracic lymph nodes and pericardial effusion.

One patient's condition at the time of admission was extremely severe and partial pressure of oxygen in arterial blood was 50 mmHg, oxygen saturation SpO2 was 60%. MSCT was performed for timely diagnosis and appropriate therapeutic measures (Fig.5).

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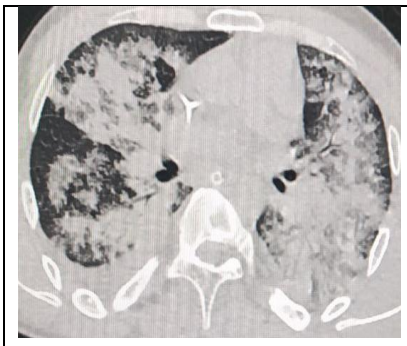	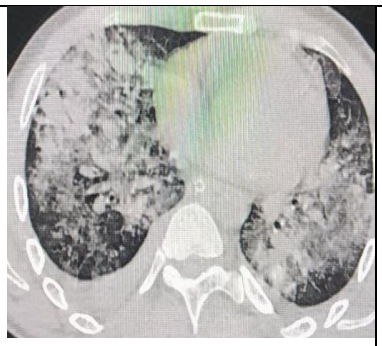	
a. axial view: on both sides symmetrical thickening of pulmonary parenchyma on the type of alveolar consolidation, the density of which was on the right side -173±35 HU, on the left side -291±25 HU	b. axial view: diffuse thickening of lung tissue by the type of alveolar consolidation with "air bronchogram"	c. axial view; right hydrothorax, density +8 HU

Fig.5 . a,b,c - MSCT with subsequent MPR reconstruction. Patient A., 54 years old, HIV positive. ARDS, alveolar stage of pulmonary edema.

One week after resuscitation measures, dynamic MSCT was performed. Improvement of lung tissue pneumatization was noted in dynamics. On both sides, mainly in the basal segments, diffuse compaction of pulmonary parenchyma of "ground glass" type was noted, density on the right up to -514±35 HU, on the left up to -520±25 HU thickening and edema of interlobular septa, zones of alveolar consolidation along the periphery, decrease of fluid in the left pleural cavity - which indicated the resolution of the alveolar stage of pulmonary edema.

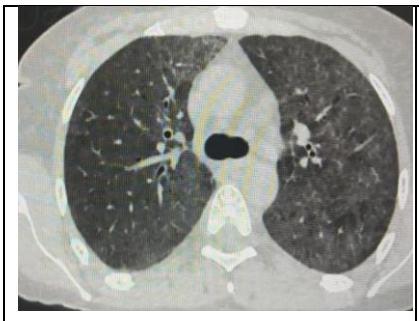		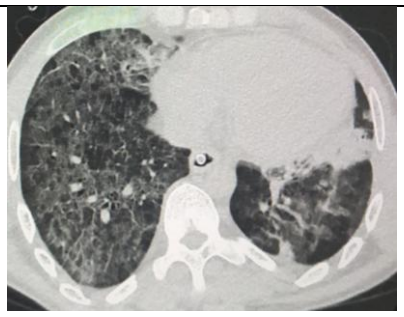
a. axial view: on both sides symmetrical thickening of pulmonary parenchyma on the type of ground glass on the right up to -514±35 HU, on the left up to -520±25HU	b. axial view: compaction of lung tissue like a ground glass on the background of which thickened interlobular septa are determined	c. axial view: in the lower lobe of both lungs there are zones of alveolar consolidation on the background of matt consolidation of pulmonary parenchyma, thickening of interlobular septa

Fig.6 . a,b,c - MSCT with subsequent MPR reconstruction of patient A., 54 years old, HIV positive. ARDS, resolution of alveolar stage.

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CONCLUSIONS.

1. Pneumocystis pneumonia is most often detected in persons with congenital or acquired immunodeficiency, and especially in HIV infection.
2 Clinically and radiologically three stages of the disease are distinguished: edematous, atelectatic and emphysematous stages.
3. In the first edematous stage (7-10 days) X-ray picture is often without any changes. And on computed tomography in the given period of time the following signs were determined: compaction of lung parenchyma by the type of "ground glass" in the root zone and in the upper parts, reminding "«butterfly wings»", in 40% of cases the process can be localized in all fields, but mainly in the upper and anterior parts of lungs, in 40% of cases diffusely in all fields, and peripheral parts of usual pneumatization.
4. In the second stage (atelectatic), more than 10 days from the moment of the disease), computed tomography revealed diffuse thickening of the lung parenchyma on the type of "ground glass" (60%), on the background of which thickened interlobular septa ("paving stone" symptom) are determined. There may be zones of alveolar consolidation (40%) in subpleural zones, small air cavities (20%) - pneumatocele. The pathologic process in the lungs is more often symmetric. Often (60%) there is an increase in intrathoracic lymph nodes, there may be effusion in the pericardium.
5. Pneumocystis pneumonia may be complicated by pulmonary edema (PPE) - which radiologically proceeds in three stages: interstitial, alveolar and fibrosis stages. The computed tomographic picture of the interstitial stage of ARDS is characterized by a symmetrical diffuse enhanced interstitial pattern. In the second stage (alveolar) - symmetric compaction of pulmonary parenchyma by the type of alveolar consolidation mainly in the peripheral zones.
6. Computed tomography with high resolution program (HRCT) is a sensitive technique and allows to assess the stage of the disease, activity of the process, detect timely complications and shows high correlation between radiological and clinical manifestations.

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