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Pattern of Cytology and Lung Biopsy Findings in Patients with Chronic Inflammation, Atypical Lesions and Cancer by Age Group

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Abstract

Lung diseases, both non-neoplastic such as chronic pneumonia and neoplastic such as lung cancer, have similar clinical characteristics so that they are difficult to differentiate. Cytological studies and lung biopsies are important diagnostic methods in determining the pattern of findings between the two conditions, especially when related to the patient's age group. This study used a retrospective descriptive design to analyze patterns of cytology and lung biopsy findings in patients with chronic lung inflammation, inflammation with atypical cells, and lung cancer based on age group. Data was taken from patient medical records at Sidawangi Hospital, West Java, in the period July 2024 – January 2025. Of the 109 patients who met the inclusion criteria, 87 patients were diagnosed with chronic pneumonia and 36 patients with lung cancer. The results showed that the average age of lung cancer patients was 62.78 years, while chronic lung inflammation patients had an average age of 56.12 years. Patients with atypical lesions had a mean age of 47.82 years. These findings indicate differences in cytology and lung biopsy patterns between chronic pneumonia and lung cancer patients, with a higher prevalence of lung cancer in the elderly.

Introduction

Lung disease is a health condition that can have a significant impact on a patient's quality of life (Cho & Stout-Delgado, 2020). Clinical symptoms that are often encountered are coughing, shortness of breath, fever, weight loss, fatigue and others. From the clinical symptoms, non-neoplastic lung diseases such as chronic pneumonia and neoplastic ones such as lung cancer or lung inflammation accompanied by atypical lesions have the same characteristics and are difficult to differentiate, both in terms of clinical manifestations and diagnostic findings (Szalontai et al., 2021). Cytological studies and lung biopsies are important diagnostic modalities in determining the pattern of findings between chronic pneumonia and lung cancer patients, especially when related to the patient's age group (Sung et al., 2020).

Neoplastic and non-neoplastic lung diseases in elderly patients have a fairly high prevalence, so a comprehensive understanding of the pattern of cytology and lung biopsy findings can help improve the accuracy of diagnosis and appropriate management (Zhao et al., 2022). Lung cancer is one of the most common causes of cancer death in the world. Data in GLOBOCAN 2018 recorded that there were 2.1 million new cases of lung cancer with 1.8 million deaths. Both men and women have a high risk of lung cancer, especially those who have a history of smoking (Bray et al., 2018).

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Meanwhile, non-neoplastic lung diseases such as COPD, pneumonia and chronic obstructive pulmonary disease (COPD) are also significant health problems. Various data reports that chronic obstructive pulmonary disease is the fourth leading cause of death in the world (Safiri et al., 2022). Patients with chronic lung inflammation are generally found in older age groups, while lung cancer can occur in various age groups (Atella et al., 2019). Gender can also influence a person's predisposition to suffer from certain lung diseases. Therefore, it is important to examine the pattern of cytology and lung biopsy findings in chronic pneumonia and lung cancer patients based on age and gender characteristics (Liu et al., 2021). A comprehensive understanding of the pattern of cytology and lung biopsy findings in cancer and chronic lung inflammation patients based on age group is expected to improve the accuracy of diagnosis and management (Travis & Rekhtman, 2011).

Methods

This study used a retrospective descriptive design to examine the pattern of cytology and lung biopsy findings in patients with chronic lung inflammation, inflammation with atypical cells and lung cancer based on age group. Data was taken from the medical records of patients at Sidawangi Hospital, West Java Province who met the inclusion criteria, namely patients with a definitive diagnosis of chronic pneumonia or lung cancer who had undergone cytology examination and/or lung biopsy. in the period July 2024 - January 2025. Based on clinical symptoms, histopathological and cytopathological examinations were taken. Sampling is carried out by means of forceps biopsy, cytology which includes; TTNA, pleural effusion, bronchial brushing and bronchial lavage, in 109 patients.

Biopsy samples were taken in 25 patients, TTNA in 7 patients, bronchial brushing in 18 patients, bronchoalveolar lavage in 16 patients, pleural effusion in 43 patients. The forceps biopsy procedure is performed when the patient is lying down. Local anesthesia is administered using nebulized Lidocaine 2% or Lidocaine spray. Midazolam is used for sedation, and the dose depends on the patient's age and response to sedation. Then the forceps are pulled back about 1–2 cm. At this point, the patient is instructed to take a deep breath (if the patient can follow commands) and the forceps are opened. The patient is then instructed to exhale, and at the end of the exhalation, the forceps are closed. If no pain is reported, the forceps are withdrawn quickly. If the patient reports pain, the forceps are opened and withdrawn approximately 1–2 cm and the entire process is repeated (Almadani et al., 2019).

Bronchial brushing is performed by inserting a Teflon catheter with the brush in place into the selected segmental bronchus. The brush is then withdrawn and applied to the glass slide using a circular motion. Bronchoalveolar lavage (BAL) is performed by clamping the tip of the bronchoscope in the subsegmental bronchus, then dripping and sucking 40–60 ml of normal saline into a container. The samples were centrifuged at 1,500 rpm for 15 minutes and 4–5 slides were made from the sediment (Almadani et al., 2019). The TTNA procedure is performed using a single needle or coaxial needle.

The coaxial technique allows placement of the guide needle in a position near the mass or within the mass. A second needle is threaded through the guide needle to obtain tissue. This second device or needle can be an aspiration needle or cutting needle or *core needle* with ultrasound guidance (Rickets et al., 2020). Thoracentesis is performed in the border triangle, where the anterior part is limited by the lateral side of the pectoralis major muscle, the lateral part is limited by the lateral side of the latissimus dorsi muscle, the superior part is limited by the base of the axilla, and the inferior part is limited by the 5th rib space. Thoracentesis needle insertion was performed in the midaxillary line between ribs 6, 7. Aspiration should not exceed 1.5 liters of fluid in one puncture (Greenhill, 2025). Data analysis was carried out descriptively to describe the frequency of cytology and histology findings in each age group, as well as differences in findings between chronic lung inflammation and lung cancer patients.

Results and Discussion

A total of 109 patients who met the inclusion criteria consisted of 87 patients with chronic pneumonia and 36 patients with lung cancer. The patient age group was divided into 3 categories: ≤50 years, 51-70 years, and >70 years. The sample results were divided into 3 groups according to the diagnosis results. Group 1 is neoplastic, group 2 is non-neoplastic (includes non-specific chronic inflammation and granulomatous chronic inflammation) and group 3 is atypical lesions.

Table 1 shows a picture of Group 1 (n=22 patients), biopsy examination was carried out in 8 patients, TTNA in 2 patients, bronchial brushing in 4 patients, bronchial alveolar lavage (BAL) in 2 patients and pleural effusion in 6 patients. Group 2 (n=70 patients), underwent biopsy examination in 7 patients, TTNA in 2 patients, bronchial brushing in 14 patients, BAL in 10 patients and pleural effusion in 37 patients (table 2). Group 3 (n=17 patients), underwent biopsy examination in 10 patients, TTNA in 3 patients, bronchial brushing in 0 patients, BAL in 4 patients and pleural effusion in 0 patients (table 3).

Table 1. Neoplastic Group Biopsy and Cytology Examination

NEOPLASTIC (Group 1)	**Biopsy**	**Cytology**				**Age**			**Sex**		**Total**
		TTNA	Brushing	Bronchial Lavage	Effusion	<50	50-70	>70	M	F	
Adenocarcinoma	7	2	2	2	6	0	17	2	19	5	19
Unspecified Carcinoma	1	0	2	0	0	0	3	0	3	0	3
Total											**22**

This table provides a detailed breakdown of 22 patients diagnosed with neoplastic lung conditions, primarily adenocarcinoma and unspecified carcinoma. The data is organized by diagnostic method, age group, and sex. Biopsy was the most frequently used diagnostic tool, performed on 8 patients, followed by pleural effusion cytology in 6 patients. This reflects the clinical preference for biopsy as the gold standard for definitive diagnosis, while pleural effusion cytology serves as a less invasive alternative for detecting malignant cells. Notably, transthoracic needle aspiration (TTNA) was used in only 2 patients, likely due to its higher risk of complications. The age distribution reveals that all adenocarcinoma cases occurred in patients aged 50–70, with only 2 cases in those over 70, aligning with global trends of lung cancer prevalence in older adults. Additionally, the male predominance (19 males vs. 5 females) underscores the role of smoking and occupational exposures in lung cancer risk. However, the small sample size and lack of data on smoking history or comorbidities limit the generalizability of these findings.

Table 2. Nonneoplastic Group Biopsy and Cytology Examination

NONNEOPLASTIC (Group 2)	**Biopsy**	**Cytology**				**Age**			**Sex**		**Total**
		TTNA	Brushing	Bronchial Lavage	Effusion	<50	50-70	>70	M	F	
Chronic Nonspecific Inflammation	7	1	14	10	35	17	43	7	30	16	67
Chronic Granulomatous Non Specific	0	1	0	0	2	1	2	0	3	0	3
Total											**70**

This table outlines findings from 70 patients with non-neoplastic lung conditions, such as chronic nonspecific inflammation and granulomatous inflammation. Pleural effusion cytology was the most common diagnostic method, used in 37 patients, suggesting its utility in identifying inflammatory markers in fluid samples. Biopsies were performed on only 7 patients, indicating that cytology alone often suffices for diagnosing non-neoplastic conditions. The age distribution shows that most patients (43 out of 70) were aged 50–70, with a smaller number under 50 (17 patients) or over 70 (7 patients). This suggests that chronic lung

inflammation is more prevalent in middle-aged and older adults, though it can occur across a broader age range than neoplastic diseases. The sex distribution was relatively balanced (30 males vs. 16 females), which contrasts with the male predominance seen in neoplastic cases. The reliance on pleural effusion cytology highlights its diagnostic efficiency, but the lack of granular data on specific inflammatory markers or etiologies (e.g., infections, autoimmune diseases) limits deeper interpretation.

Table 3. Atypical Lesion Group Biopsy and Cytology Examination

ATYPICAL LESION (Group 3)	Biopsy	Cytology				Age			Sex		Total
		TTNA	Brushing	Bronchial Lavage	Effusion	<50	50-70	>70	M	F	
Chronic Nonspecific Inflammation With Atypical Lesion	10	3	0	4	0	5	8	2	14	2	**17**

This table focuses on 17 patients with atypical lesions, a category that bridges benign and malignant conditions. Biopsy was the predominant diagnostic method (10 patients), emphasizing its necessity for evaluating cellular atypia and ruling out malignancy. Interestingly, no bronchial brushing cases were reported, while bronchoalveolar lavage (BAL) was used in 4 patients, likely due to its ability to sample distal airways where atypical cells may reside. The age distribution reveals that most patients (8 out of 17) were aged 50–70, with 5 under 50 and 2 over 70, suggesting atypical lesions can occur across age groups but are most common in middle-aged individuals. The male-to-female ratio (14:2) is striking and warrants further investigation into potential gender-specific risk factors. The absence of pleural effusion cases in this group implies that atypical lesions may not typically present with effusions. These findings highlight the diagnostic challenge posed by atypical lesions, which require careful histopathological evaluation to distinguish between reactive changes and early malignancy.

Of the 109 patients, 23 patients were aged ≤50 years, 73 patients were aged 51-70 years, and 11 patients were aged >70 years. The average lung cancer patient, in this case adenocarcinoma and non-specific carcinoma, tends to be older than non-specific chronic lung inflammation patients. The results of data collection showed that the average age of lung cancer patients was approximately 62.78 years, while in the age group of 56.12 years there were lung patients with nonspecific chronic inflammation and granulomatous chronic inflammation. In patients with atypical lesions, the average patient age was 47.82 years (table 4).

Table 4. Biopsy and Cytology Diagnosis By Age

Cytopathological/Histopathological Diagnoses	Age			Mean Age	Total
	<50	50-70	>70		
Chronic Nonspecific Inflammation	17	43	7	56,12	67
Unspecified Carcinoma	0	3	0	62,66	3
Chronic Non Specific With Atypical Lesion	5	8	2	47,82	15
Chronic Granulomatous Non Specific	1	2	0	46,33	3
Adenocarcinoma	0	17	2	62,78	19

This table synthesizes data from all three groups, comparing mean ages and total cases for each diagnostic category. Lung cancer patients (adenocarcinoma and unspecified carcinoma) had the highest mean age (62.78 years), reinforcing the link between aging and cancer risk. Chronic nonspecific inflammation patients were younger on average (56.12 years), while those with atypical lesions had the lowest mean age (47.82 years), suggesting that atypia may represent an earlier or less age-dependent pathological stage. The table also reveals that chronic granulomatous inflammation was rare (3 cases) and occurred in younger patients (mean age 46.33 years), possibly linked to infections or immune responses. The predominance of the 50–70 age group across all categories underscores the importance of age as a factor in lung disease

patterns. However, the lack of standard deviations or ranges for the mean ages limits the ability to assess variability within groups.

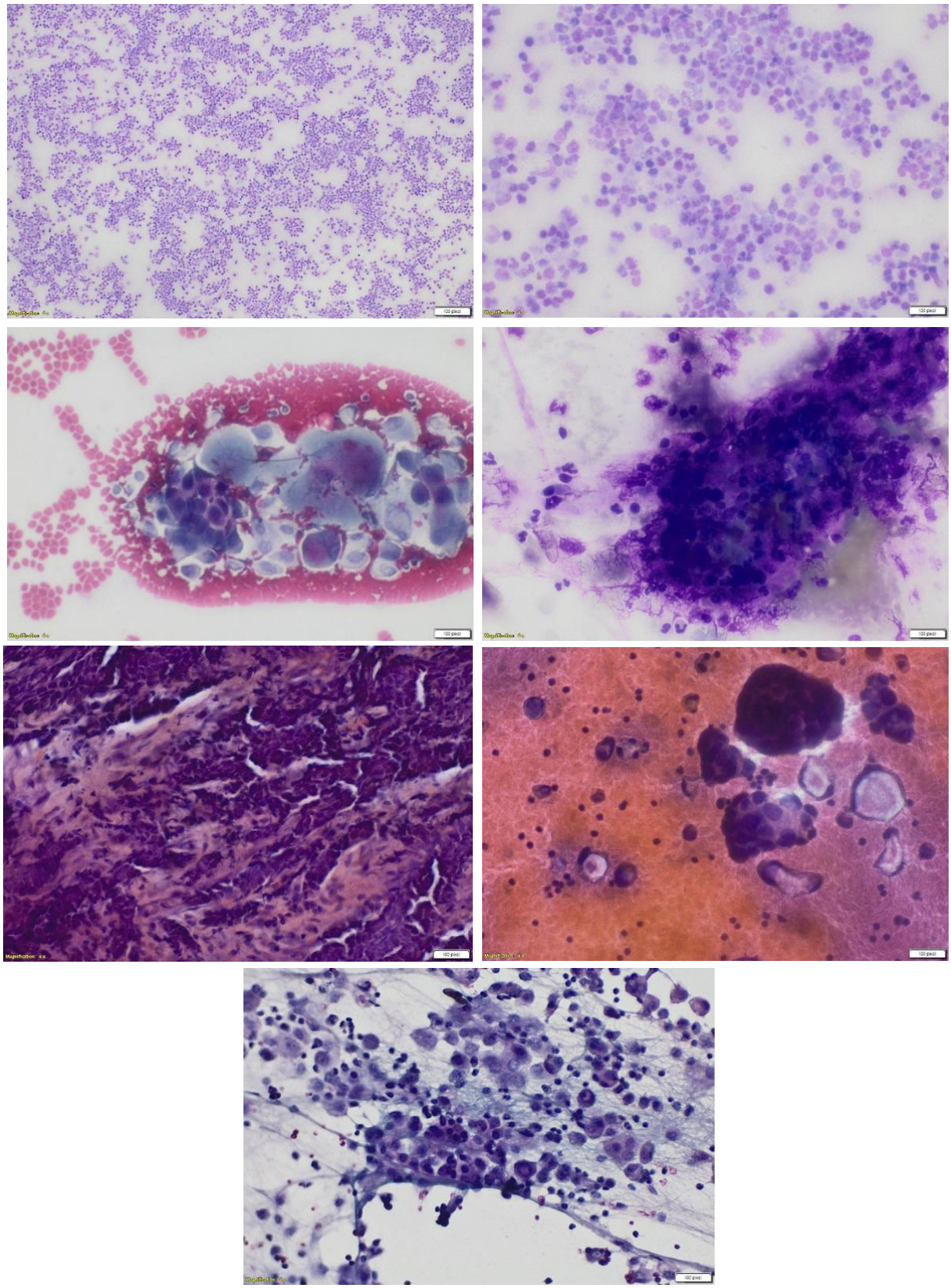

Figure 1. Chronic Inflammatory Cytology (A and B), Inflammatory Cytology Accompanied by Atypical Cells (C And D) and Malignancy On Biopsy and Cytology (E, F and G)

Lung disease today is still a significant health problem. Both neoplastic lung diseases such as lung cancer, and non-neoplastic lung diseases such as chronic pneumonia, have specific

characteristic diagnostic findings (Girard, 2023). This study shows that chronic lung inflammation patients tend to occur at an older age than lung cancer patients (Durham & Adcock, 2015). These findings are in accordance with previous research which stated that the characteristics of lung disease can be influenced by the patient's age. For example, COPD tends to be found in older age groups, while lung cancer can occur in various age groups. Other studies also report that in general, non-neoplastic lung diseases are more common in older age groups, while neoplastic lung diseases, such as lung cancer, can occur in various age groups (Park et al., 2020).

However, in this study it was found that lung cancer patients tended to be older than those with chronic lung disease with a mean age of 62.78 years, while in the 56.12 year age group there were lung patients with non-specific chronic inflammation and granulomatous chronic inflammation. This result is more in line with epidemiological data which shows that the incidence of lung cancer increases with age, especially over the age of 50 years, while chronic lung diseases such as chronic obstructive pulmonary disease generally have an onset at a younger age. It is possible that this is caused by genetic mutations in older patients (Gupta et al., 2022). Cytological findings in the chronic lung inflammation group generally showed increased inflammatory cells, macrophages, and cell debris, without the presence of malignant cells. Meanwhile, in the lung cancer group, cytology findings mostly showed the presence of malignant cells with various subtypes (Figure 1) (Karpathiou et al., 2022).

In the lung biopsy examination, the chronic lung inflammation group generally showed edema, congestion, and inflammatory cell infiltration, whereas in the lung cancer group, proliferation and invasion of malignant cells with various subtypes were found (Molfino & Jeffery, 2007). Among these are atypical lesions found in elderly patients, which require further attention because they can be premalignant (Figure 1) (Albano et al., 2021) Atypical lesions are non-specific findings and can be associated with various lung pathological conditions, so a comprehensive understanding is needed to differentiate them from lung cancer, especially in the elderly group. Understanding the patterns of cytology and lung biopsy findings based on age groups can help improve the accuracy of diagnosis and management of patients with chronic lung inflammation and lung cancer (Layfield et al., 2021).

Terms including “atypia”, “atypical” and “suspected of malignancy” have been used to convey cytopathologists' concern for malignancy when a definitive distinction between “benign” and “malignant” cannot be achieved. Historically, the term “atypical” has been used to imply that the changes present precluded a definitive “benign” diagnosis but were associated with a low level of concern on the part of the cytopathologist that malignancy was present. The term “suspected for malignancy”. Diagnostic criteria include nucleus size, nucleus/cytoplasm (N/C) ratio, anisonucleosis and nuclear hyperchromasia all varying in the degree of analysis performed for the nucleus/cytoplasm ratio (N/C ratio) and nuclear area.

Based on histopathological findings, chronic lung inflammation patients tend to show acute and chronic inflammatory patterns, with features of inflammatory cell proliferation, fibrotic and squamous metaplasia. In contrast, lung cancer shows a proliferation of malignant cells with various histological types, such as adenocarcinoma, squamous and small cell (Korsunsky et al., 2022). Knowledge of patterns of cytology and lung biopsy findings based on age groups in chronic pneumonia and lung cancer patients can help improve the accuracy of diagnosis and appropriate management. In elderly patients with suspicious lung radiological features, cytology examination and lung biopsy need to be carried out comprehensively to differentiate chronic lung inflammation from malignancy (Kim et al., 2017).

On the other hand, in young patients with radiological images of the lungs that are suspicious for malignancy, cytological examination and lung biopsy also need to be performed to confirm the diagnosis of lung cancer and determine the histological subtype (Poon et al., 2023). Thus,

an integrated approach between clinical findings, radiological examination, and lung cytology/biopsy can increase the accuracy of lung disease diagnosis, thereby having a positive impact on patient management. This study has several limitations, including the limited sample size, especially for the lung cancer patient group. Apart from that, other factors that could influence the pattern of cytology and lung biopsy findings have not been studied, such as smoking history, comorbidity status, and the results of other supporting examinations (Sekhon et al., 2013).

Conclusion

The results of this study show that there are differences in the pattern of cytology and lung biopsy findings between chronic pneumonia and lung cancer patients which are related to age group, with the most common average age being 50-70 years. In lung cancer patients, a higher prevalence was found in the 62.78 year age group, with a dominant histological picture of malignant cells with various subtypes accompanied by a distribution of inflammatory cells. In contrast, chronic lung disease occurs at a younger age 56.12 with a variable pattern of findings of inflammatory cells.

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