Original Article

Comprehensive analysis of imaging and pathological features in 20 cases of pulmonary mucosa-associated lymphoid tissue (MALT) lymphoma: a retrospective study

Ruifen Zhao[1], Yan Dong[2], Jiejun Kong[1]

[1]Department of Radiology, Nanjing Chest Hospital, Nanjing, China; [2]Department of Pathology, Nanjing Chest Hospital, Nanjing, China

Contributions: (I) Conception and design: R Zhao, J Kong; (II) Administrative support: J Kong; (III) Provision of study materials or patients: All authors; (IV) Collection and assembly of data: R Zhao, Y Dong; (V) Data analysis and interpretation: R Zhao, Y Dong; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

Correspondence to: Jiejun Kong, BS. Department of Radiology, Nanjing Chest Hospital, 215 Guangzhou Road, Gulou District, Nanjing 210029, China. Email: 13951948306@163.com.

Background: Pulmonary mucosa-associated lymphoid tissue (MALT) lymphoma is a rare, indolent subtype of non-Hodgkin lymphoma with distinct radiological and pathological characteristics. Clinically, patients may present with nonspecific symptoms such as cough or dyspnea, and the disease can mimic other pulmonary conditions. High-resolution computed tomography (HRCT) imaging plays a critical role in identifying characteristic lung patterns, such as nodules, consolidation, or ground-glass opacities, which help in differentiating pulmonary MALT lymphoma from other pulmonary disorders. The study aimed to identify clinical characteristics based on the HRCT imaging features and pathological findings in patients with pulmonary MALT lymphoma.

Methods: The retrospective study involved 20 confirmed cases of pulmonary MALT lymphoma from a thoracic specialty hospital. Comprehensive data analysis included HRCT imaging characteristics such as tumor size, location, bronchial changes and peritumoral pulmonary interstitial infiltration, as well as pathological features, including cell type, morphology, and immunohistochemistry.

Results: HRCT imaging showed a high prevalence of air bronchogram (100%) and bronchiectasis (85%), with tumors predominantly located in the left upper lobe. Pathologically, tumors predominantly exhibited monocytoid and centrocyte-like cells, minimal atypia, and B-cell markers like CD20 and CD3 expression. Surgical resection was the primary treatment modality in 60% of cases, with the rest receiving chemical treatment.

Conclusions: Significant features evident in both HRCT imaging and pathological analysis were identified in pulmonary MALT lymphoma cases. These findings are anticipated to play a crucial role in facilitating early diagnosis and determining optimal treatment strategies.

Keywords: Pulmonary mucosa-associated lymphoid tissue lymphoma (pulmonary MALT lymphoma); high-resolution computed tomography imaging (HRCT imaging); pathology; immunohistochemistry; non-Hodgkin lymphoma

Submitted Jul 04, 2024. Accepted for publication Dec 13, 2024. Published online Feb 21, 2025.
doi: 10.21037/jtd-24-1066
View this article at: https://dx.doi.org/10.21037/jtd-24-1066

Introduction

Pulmonary mucosa-associated lymphoid tissue (MALT) lymphoma, a distinctive subtype of non-Hodgkin's lymphoma (1), exemplifies primary extranodal lymphomas originating in the lung (2). Renowned for its indolent nature and infrequent occurrence, the clinical presentation of pulmonary MALT lymphoma is subtle (3), and its radiological manifestations are diverse, posing considerable diagnostic challenges (4). In contrast to more aggressive lymphomas, MALT lymphoma often lacks the hallmark symptoms of high-grade malignancies (5), making early detection elusive and potentially causing delays in therapeutic intervention.

Clinical manifestations of MALT lymphoma may vary but often include non-specific symptoms such as cough, chest pain, or shortness of breath (6,7). Systemic symptoms, such as fever and weight loss, are less common but can occur (8). The overall incidence of pulmonary MALT lymphoma is relatively low compared to other lymphomas (9,10). Risk factors for developing pulmonary MALT lymphoma may include a history of autoimmune diseases, chronic infections, or exposure to environmental factors that trigger chronic inflammation (11).

The treatment landscape for pulmonary MALT lymphoma primarily revolves around surgical resection, radiotherapy, and chemotherapy, with surgery being the preferred modality for localized disease (12,13). The indolent course of MALT lymphoma, coupled with its relative insensitivity to chemotherapy and radiotherapy, underscores the importance of accurate diagnosis and appropriate selection of treatment modality (14,15). Moreover, the prognosis of MALT lymphoma is generally favorable, with surgical interventions yielding better outcomes compared to cases where complete resection is not feasible (16).

The clinical significance of pulmonary MALT lymphoma transcends its rarity, delving into the domain of differential diagnosis (17). This is particularly critical when distinguishing it from prevalent pulmonary pathologies like adenocarcinomas, focal invasive mucinous adenocarcinoma of the lung, focal organizing pneumonia or infectious granulomas (18,19). The management and prognosis of these conditions vary significantly, underscoring the importance of accurate differentiation. The complexity of pulmonary MALT lymphoma is further complicated by its etiology, commonly associated with chronic inflammatory stimuli (20). This association is notable, especially in patients with autoimmune diseases or a history of chronic infections, adding layers of intricacy to the understanding of the disease (21,22).

Radiologically, pulmonary MALT lymphoma displays a spectrum of patterns on high-resolution computed tomography (HRCT), ranging from solitary or multiple nodules, areas of consolidation, to ground-glass opacities (23,24). These imaging features, although valuable, overlap significantly with those of other pulmonary conditions, thereby necessitating a more nuanced approach to interpretation (25,26). The role of imaging in MALT lymphoma extends to not only diagnosis but also to treatment planning and monitoring response to therapy. Pathologically, MALT lymphoma is characterized by the proliferation of marginal zone B-cells, which may manifest in a variety of cytological appearances (27). Immunohistochemistry plays a pivotal role in diagnosis, with markers such as CD20 and CD79a often showing positivity (28,29). The Ki67 proliferation index is another valuable tool, providing insights into the tumor's

Highlight box

Key findings

- High-resolution computed tomography (HRCT) imaging revealed common features such as air bronchogram (100%) and bronchiectasis (85%), predominantly in the left upper lobe.
- Pathological analysis identified tumors characterized by monocytoid and centrocyte-like cells, minimal atypia, and expression of B-cell markers CD20 and CD3.

What is known and what is new?

- Pulmonary mucosa-associated lymphoid tissue (MALT) lymphoma is recognized as a rare and slow-growing type of non-Hodgkin lymphoma. It exhibits distinctive characteristics in both radiological (HRCT imaging) and pathological assessments.
- This study highlights specific clinical characteristics observed through HRCT imaging, such as a high prevalence of air bronchogram and bronchiectasis, particularly in the left upper lobe. Pathologically, the tumors predominantly feature monocytoid and centrocyte-like cells with minimal atypia and express B-cell markers CD20 and CD3.

What is the implication, and what should change now?

- The high prevalence of characteristic HRCT features such as air bronchogram and bronchiectasis in pulmonary MALT lymphoma suggests these can serve as diagnostic markers, aiding in early identification and differentiation from other pulmonary conditions. Further research is needed to validate these findings across larger patient cohorts and explore additional imaging modalities or biomarkers that could further enhance diagnostic accuracy and prognostic assessment.

growth dynamics (30). Ki67 indicates the level of cellular proliferation activity, representing the proliferation rate of MALT tumor cells. It reflects the degree of malignancy of the cells and is related to the prognosis of the patients. However, the lack of a histological grading system in MALT lymphoma contrasts with other lymphomas, where such grading significantly influences treatment decisions (31).

This study aimed to elucidate the imaging and pathological characteristics of pulmonary MALT lymphoma based on a comprehensive analysis of 20 cases from a thoracic specialty hospital. Our focus is to assist radiologists in understanding the disease's unique imaging features from a pathological perspective, thereby improving differential diagnosis during initial chest imaging assessments. This understanding is critical in guiding further biopsy for definitive diagnosis and timely surgical intervention when feasible, or alternatively, opting for radiotherapy or chemotherapy. We present this article in accordance with the STROBE reporting checklist (available at https://jtd.amegroups.com/article/view/10.21037/jtd-24-1066/rc).

Methods

Study design and participants

The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013) and approved by the Ethics Committee of Nanjing Chest Hospital (No. 2023-KL035-01). Informed consent was waived for this retrospective study due to the exclusive use of de-identified patient data, which posed no potential harm or impact on patient care. All patients diagnosed with pulmonary MALT lymphoma by pathology in Nanjing Chest Hospital were retrospectively included from June 2017 to December 2023. Inclusion criteria were as follows: (I) the patients were diagnosed for pulmonary MALT lymphoma based on diagnostic criteria, including clinical, radiological, and histopathological assessments; (II) involvement of lung or/and bronchus, without hilar or mediastinal adenopathy or mass; (III) no evidence of extrathoracic lymphoma at before and at the time of primary diagnosis; (IV) no evidence of extrathoracic lymphoma within 3 months since onset; (V) no history of other pulmonary diseases before a diagnosis of pulmonary MALT lymphoma; (VI) completed data were available to retrieve from the hospital medical records system. Exclusion criteria were as follows: other causes of similar lung diseases, such as sarcoidosis, infectious processes, and other types of lymphomas. Finally, a total of 20 patients diagnosed with pulmonary MALT lymphoma were included in this study.

HRCT scanning

All patients underwent HRCT scans before histopathologic diagnosis. The technician sets specific parameters suitable for lung scanning, including the slice thickness, voltage, and current. Lung HRCT typically uses thinner slices (e.g., 1–2 mm) to achieve higher resolution images. HRCT imaging parameters were meticulously documented, comprising tumor dimensions, anatomical location, boundary delineation, density variations, and identification of any distinctive morphological features. Experienced radiologists independently reviewed the HRCT images, documenting tumor characteristics. HRCT imaging indicators were analyzed, including the morphology, size, clarity of boundaries, internal structure, and relation to the surrounding tissues of the tumor.

Pathologic assessment

Pathological assessments entailed a comprehensive evaluation of tumor histology, encompassing discernment of tumor cell phenotypes, determination of Ki67 proliferation index, and characterization of immunohistochemical profiles. Professional pathologists conducted pathological analysis, covering cytological features and immunohistochemical expression. Specific immunohistochemical markers were used to identify cell types characteristic of MALT lymphoma. Pulmonary MALT lymphoma shows infiltration by small lymphocytes, plasma cells, and marginal zone cells. Immunohistochemistry is essential, typically showing cells positive for CD20 and B-cell markers, and negative for CD5 and CD10, helping to distinguish it from other types of B-cell lymphomas.

Statistical analysis

Descriptive statistics were performed on the collected data. Appropriate statistical methods were used to assess the correlation between imaging and pathological features. All statistical analyses were conducted using SPSS software (version 26.0, IBM Corporation, Armonk, NY, USA). All data were tested for normal distribution by Shapiro-Wilk test. The measurement data that met the normal distribution were expressed as mean ± standard deviation. Categorical variables were presented as n (%).

Table 1 Baseline characteristics (n=20)

Patients	Value
Age (years)	63.19±7.06
Sex	
Male	11 [55]
Female	9 [45]
Disease duration (days)	409.81±635.58
Comorbidity	
None	8 [40]
Hypertension	4 [20]
Drinking alcohol	3 [15]
Smoking	5 [25]
Diabetes	1 [5]
Gastric ulcer	1 [5]
Heart disease	2 [10]
Clinical presentation	
None	6 [30]
Cough	7 [35]
Chest pain	4 [20]
Expectoration	4 [20]
Chest tightness	2 [10]
Fever	2 [10]
Wheezing	1 [5]
Dyspnea	1 [5]

Data are presented as mean ± standard deviation or n [%].

Results

General characteristics

Baseline characteristics are shown in *Table 1*. This study involved 20 patients, with an average age of 63.19±7.06 years, ranging from 54 to 76 years. Regarding gender distribution, there were 11 male patients (55%) and 9 female patients (45%). The average duration of the disease was 409.81±635.58 days, ranging from 1 to more than 1,800 days. In terms of comorbidities, 8 patients (40%) had no additional underlying diseases. There were 4 patients (20%) with hypertension, 3 patients (15%) who consumed alcohol, 5 patients (25%) who smoked, 1 patient (5%) with diabetes, 1 patient (5%) with gastric ulcer, and 2 patient (10%) with heart disease.

Regarding clinical presentation of study disease, 6 patients (30%) were asymptomatic. Cough was observed in 7 patients (35%), chest pain in 4 patients (20 %), expectoration in 4 patients (20%), chest tightness in 2 patients (10%), fever in 2 patients (10%), wheezing in 1 patient (5%), and dyspnea in 1 patient (5%).

Chest CT findings, patterns and features in patient

As shown in *Table 2*, the analysis of main pulmonary imaging changes in patients with MALT lymphoma revealed the following findings. Air bronchogram and bronchial dilation are the most common features. All 20 patients exhibited air bronchogram, with 14 of them showing associated bronchial dilation, accounting for 70% of cases. Among these, 8 cases (40%) displayed a beaded appearance of the dilated bronchial walls, and 6 cases (30%) presented with multiple air-filled cystic lesions, with the majority located around the dilated bronchi. Enhanced CT scans were performed on 10 patients, revealing vascular angiography sign in 7 cases, constituting 35%. Regarding the presence of pleural effusion, 17 cases (85%) showed none, while 3 cases (15%) presented with pleural effusion. All tumors were classified as low-grade. The average number of tumors per patient was 1.69±2.24, with a range from 1 to 10 tumors. The size of the tumors varied, averaging at 30.64±33.97 cm^2, with the smallest being 0.64 cm^2 and the largest 115.20 cm^2. In terms of tumor location, the left upper lobe was the most common site, observed in 13 patients (65%). Tumors in the right lower lobe were found in 7 patients (35%), while those in the left lower lobe and right upper lobe were each present in 3 patients (15%). The right middle lobe and left middle lobe each had tumors in 1 patient (5%). Regarding the border characteristics of these tumors, most (13 patients or 65%) had surrounding lung interstitial infiltration, while clear tumor boundaries were noted in 3 patients (15%).

Regarding calcification and necrosis, 9 cases (45%) showed no signs of either. Enhanced scans revealed non-enhancing circular or ribbon-shaped areas in 5 patients (25%), and calcified plaques were observed in 2 patients (10%). In the study of pulmonary MALT lymphoma, the relationship between the tumor and surrounding lung tissue reveals various radiological features. The round-glass opacity is the most common finding, with 13 out of 20 patients exhibiting more or less ground-glass opacity around the tumor (65%). In 6 patients (30%), there was a spiculated sign around the tumor. In 7 patients (35%), there was thickening of bronchovascular bundles and surrounding

Table 2 HRCT parameters in patients with pulmonary MALT lymphoma (n=20)

Feature	Value
Air bronchogram sign	20 [100]
Bronchiectasis	14 [70]
Vascular angiography sign	7 [35]
Beaded appearance of bronchial walls	8 [40]
Cystic lesion	6 [30]
Presence of pleural effusion	3 [15]
Number and size	
Tumor number	1.69±2.24
Tumor size (cm^2)	30.64±33.97
Tumor location	
Left upper lobe	13 [65]
Right lower lobe	7 [35]
Left lower lobe	3 [15]
Right upper lobe	3 [15]
Right middle lobe	1 [5]
Left middle lobe	1 [5]
Tumor border	
Surrounding lung interstitial infiltration	13 [65]
Clear border	3 [15]
Calcification and necrosis	
None	9 [45]
Round or ribbon-shaped non-enhanced areas after enhancement	5 [25]
Calcification spots	2 [10]
Pattern	
Ground-glass opacity	13 [65]
Fine linear interstitial shadow	6 [30]
Thickening of bronchovascular bundles and surrounding micronodules	7 [35]
Inconspicuous surrounding lung interstitial infiltration	3 [15]
Band-like pleural traction adjacent to the lesion	2 [10]

Data are presented as mean ± standard deviation or n [%]. HRCT, high-resolution computed tomography; MALT, mucosa-associated lymphoid tissue.

Table 3 Immunohistochemical findings in 20 cases of pulmonary MALT lymphoma

Positively expressed	Value
CD20	12 [60]
Ckpan	11 [55]
CD3	11 [55]
Pax-5	6 [30]
CD21	6 [30]
Bcl-2	3 [15]
CD79a	3 [15]
Ki67 positive	
5%	3 [15]
30%	3 [15]
10%	3 [15]
15%	2 [10]
40%	1 [5]
20%	1 [5]

Data are presented as n [%]. MALT, mucosa-associated lymphoid tissue.

micronodules around the tumor, indicating varying degrees of infiltration in the peritumoral interstitium. In 3 cases (15%), infiltration of the surrounding lung interstitium was not apparent. In 2 cases, linear pleural traction was observed around the tumor periphery.

Histopathological classification and immunohistochemical findings

The immunohistochemical analysis of pulmonary MALT lymphoma in this study revealed the expression of various key immunomarkers as shown in *Table 3*. CD20, a B-cell marker, showed the highest positivity, being expressed in 12 patients (60%). Ckpan and CD3, markers associated with epithelial cells and T-cells respectively, were both positive in 11 patients (55%). Other markers such as Pax-5 and CD21, both linked to B-cell lineage, were positive in 6 patients (30%). Bcl-2 and CD79a, related to cell survival and B-cell antigen receptor complex respectively, showed positivity in 3 patients (15%).

Regarding the Ki67 positivity rate, which is indicative

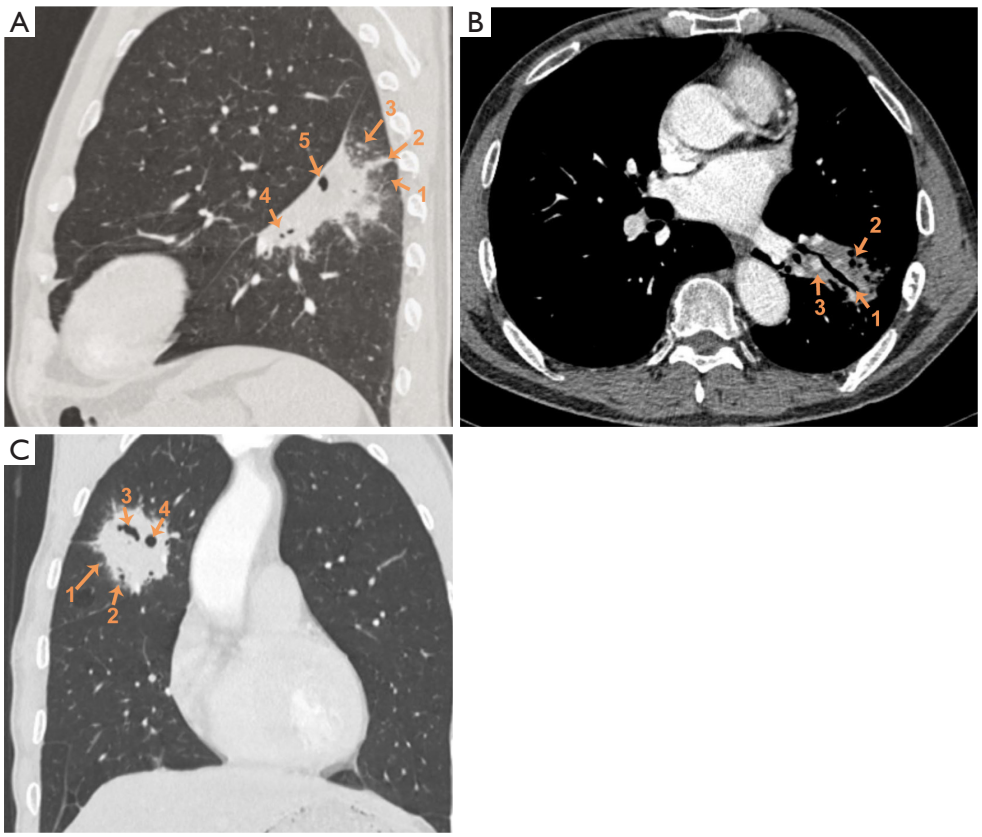

Figure 1 High-resolution computed tomography images of typical cases. (A) consolidation was observed in the lower left lung lobe, accompanied by a ground-glass opacity around the tumor (yellow arrow 1), thickening of bronchovascular bundles (yellow arrow 2), and peripheral micronodules (yellow arrow 3). Within the lesion, signs of air bronchogram (yellow arrow 4) and small air bubbles (yellow arrow 5) were also identified; (B) consolidation was observed in the lower left lung lobe. Within the lesion, there was evidence of bronchial dilation (yellow arrow 1) and signs of air bubbles (yellow arrow 2). After contrast enhancement, vascular imaging signs were visible within the lesion (yellow arrow 3); (C) a mass shadow was present in the upper right lung lobe, with the focal mass with spiculated contours and surrounded by ground glass opacity (yellow arrow 1). Within the lesion, there were signs of air bronchogram (yellow arrow 2), bead-like bronchial dilatation (yellow arrow 3), and small air bubbles (yellow arrow 4).

of cell proliferation, a range of values was observed. In 3 patients (15%), the Ki67 positivity rate was 5%, and another 3 patients (15%) did not undergo immunohistochemical analysis for this marker. Ki67 positivity rates of 30% and 10% were each found in 3 patients, while rates of 15%, 40%, and 20% were observed in 2 patients (10%), 1 patient (5%), and 1 patient (5%) respectively.

HRCT images and H&E-stained histologic findings in pulmonary MALT lymphoma

HRCT images (*Figure 1*) showed stromal infiltration around the tumor, which corresponds to the histological findings in *Figure 2A*, where tumor cells surrounded small blood vessels in a nodular pattern. The histological analysis in *Figure 2B* revealed that the tumor cells of MALT lymphoma grew diffusely as mononuclear lymphocytes. HRCT images (*Figure 1A*,*1C*) also showed bronchial dilatation, and the corresponding histology in *Figure 2C* demonstrated that the bronchial mucosa was largely intact, with tumor cells surrounding it. Additionally, in HRCT image (*Figure 1C*), bronchial dilatation with irregular, bead-like narrowing of the lumen was observed, which correlated with the histological findings in *Figure 2D*, where tumor cells were seen destroying part of the bronchial mucosa, forming lymphoepithelial lesions. The remaining bronchial mucosa was normal, and the lumen is irregularly dilated,

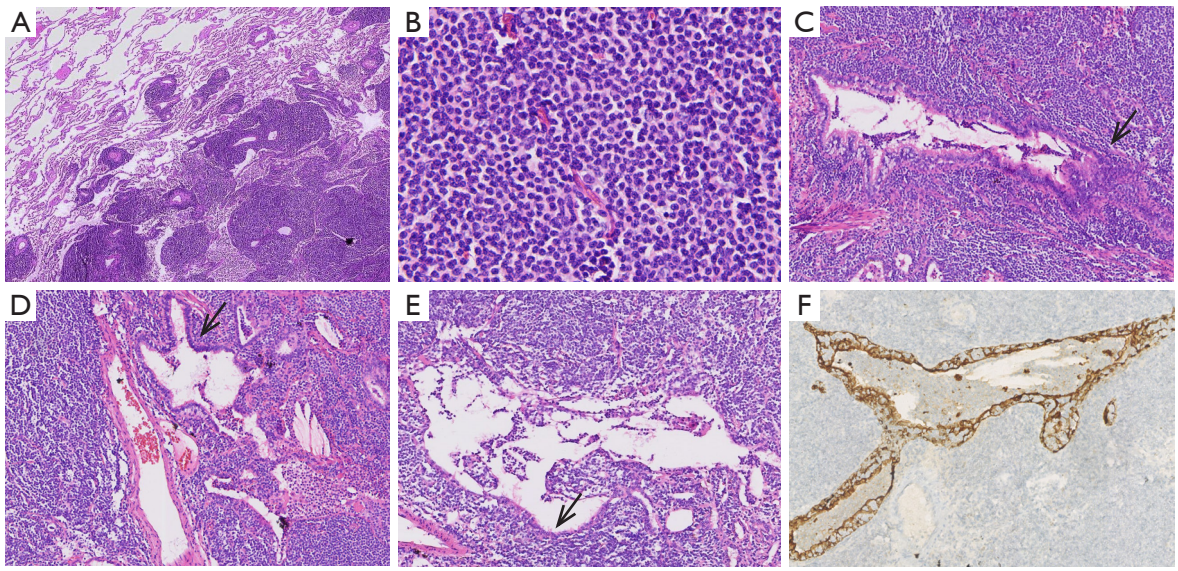

Figure 2 H&E staining of pulmonary mucosa-associated lymphoid tissue lymphoma. (A) Tumor marginal cells surrounding blood vessels grow in a nodular pattern, with focal nodules merging with each other, as seen in low-power magnification with H&E staining (4×); (B) mononuclear lymphocytes in the center of the mass exhibit diffuse growth, with cells of moderate size, disrupting the alveolar structure, as observed in high-power magnification with H&E staining (40×); (C) the bronchial mucosa remains intact, with tumor cells wrapping around the periphery, and localized infiltration of a small number of tumor cells is visible in the mucosa (black arrow) (10×); (D) tumor cells destroy two-thirds of the bronchial mucosa, forming lymphoepithelial lesions, with remnants of mucosal epithelium observed locally (black arrow), accompanied by irregular bronchial dilation, as seen in low-power magnification with H&E staining (10×); (E) tumor cells disrupt the bronchial mucosa, with only a small number of residual epithelial cells visible (black arrow), accompanied by irregular bronchial dilation, as observed in low-power magnification with H&E staining (10×); (F) residual bronchial epithelial cells show positive staining for CKpan, EnVision two-step method, as seen in medium-power magnification with H&E staining (20×).

with nearby blood vessels along the bronchi.

The presence of the "vacuum sign" on HRCT images (*Figure 1A-1C*) was associated with the histological findings in *Figure 2E*, where tumor cells had destroyed the bronchial mucosa, leaving only a small amount of epithelial remnants, while the distal airways showed dilated air spaces. Finally, histology in *Figure 2F* showed that the remaining bronchial mucosal epithelial cells in the tumor tissue express CKpan positively (CKpan stained the bronchial epithelial cells brown; areas of destroyed mucosa remained unstained, indicating the absence of epithelial cells. The brown-stained regions outlined the remaining bronchial lumen).

Discussion

This retrospective study on pulmonary MALT lymphoma provides a nuanced understanding of the disease through the correlation of HRCT imaging and pathological features. Our analysis of 20 cases reveals detailed insights into the characteristic patterns of this lymphoma subtype, emphasizing the importance of an integrated diagnostic approach. In pulmonary MALT lymphoma, changes in the bronchi, such as air bronchogram, bronchial dilation, and cystic lesions, are associated with the pathophysiology of the disease. Unlike bronchial dilation caused by other reasons, the characteristic feature of MALT lymphoma-related bronchial dilation is the beaded appearance of the dilated bronchi. In this group of 20 cases, all exhibited air bronchogram, with 17 cases showing associated bronchial dilation. Among these, 9 cases displayed bronchial dilation with a beaded appearance, and 8 cases had multiple cystic lesions, with most located around the dilated bronchi.

The primary reason for these bronchial changes is the unique growth pattern of tumor cells in MALT lymphoma. Most domestic literature suggests that these tumor cells proliferate along the pulmonary interstitium without disrupting the bronchi and blood vessels, which explains the visibility of air bronchogram. The surrounding

connective tissue proliferation pulls on the bronchi, leading to bronchiectasis. However, the presence of proliferative connective tissue within the lesions and the reason it does not form regular columnar bronchiectasis but rather irregular bead-like patterns raise questions.

Pathologically, tumor cell infiltration into the mucosa of the small bronchi leads to lymphoepithelial lesions. On the same pathological slide, only dilated blood vessels are seen, with no accompanying bronchi. Since bronchi and blood vessels typically run together, it is speculated that the bronchi are invaded by the tumor. Immunohistochemistry reveals CKpan positive expression in the remaining bronchial mucosal epithelial cells within the tumor tissue. Bronchoscopy has revealed uneven mucosal surfaces in the segmental or lobar bronchi, with narrowed or occluded lumens in a few cases. Some believe that bronchiectasis is caused by proximal narrowing and subsequent distal expansion of the bronchi. To explain these bronchial changes (air bronchogram, bronchiectasis, air cysts) in pulmonary MALT lymphoma, one must consider the pathological changes observed where the bronchi are invaded by the tumor. The study's findings, combined with the latest literature, suggest that the irregular bronchial wall expansion and the bead-like appearance could be due to the specific invasion and growth patterns of tumor cells in the bronchial structures, resulting in distortion and deformation of the bronchial architecture (32).

The characteristic of the tumor-lung interface in pulmonary MALT lymphoma is the absence of a capsule around the tumor, with a transition zone from the tumor body to normal lung tissue. Pathologically, tumor cells infiltrate the interstitium around the tumor, leading to a series of imaging changes, such as peritumoral ground-glass opacity, thickening of bronchovascular bundles with surrounding micronodules, and spiculated contours (33). Our pathology data indicate that mononuclear lymphocytes proliferate around bronchovascular walls and septa, forming discrete nodules that merge at the periphery of the tumor. Among the 20 cases, 4 cases (20%) showed no obvious interstitial infiltration, while 16 cases (80%) exhibited peritumoral interstitial infiltration. Among these, 7 cases had extensive infiltration around the tumor, manifested as peritumoral ground-glass opacities, thickening of bronchovascular bundles, and surrounding micronodules, while 6 patients had less peritumoral interstitial infiltration, showing peritumoral ground-glass opacity and spiculated contours. The peritumoral interstitial infiltration is highly characteristic. Lesions with more air bronchogram and bronchial dilation tend to have more surrounding interstitial infiltration, while those with fewer air bronchogram and bronchial dilation have less peritumoral interstitial infiltration (34). Larger lesions exhibit more interstitial infiltration, while smaller lesions have less interstitial infiltration. Tumor cells infiltrate the mucosa of the fine bronchi and the alveolar epithelium, forming lymphoepithelial lesions. Peritumoral mononuclear-like lymphocytes surround the bronchi, blood vessel walls, and interlobular septa, proliferating in a nodular pattern and merging with one another (35).

It is an indolent lymphoma with slow progression and relatively favorable prognosis. For isolated lesions, surgical resection is the preferred treatment; for multiple lesions, when MALT is suspected on imaging, timely lung biopsy is recommended, and after confirmation, hematological oncology-directed chemotherapy is initiated. Among our 14 surgical cases, 12 were completely resected, all being isolated lesions undergoing lobectomy. In our cohort, 5 patients received lung biopsy for pathological confirmation, with 4 having multiple lesions and 1 having a solitary lesion (surgery was recommended, but the patient opted for hematological oncology-directed chemotherapy). Our study, limited by its retrospective design and small sample size, underscores the necessity for future research employing larger patient cohorts and prospective methods. Longitudinal studies are crucial for providing comprehensive treatment outcomes and insights into long-term survival, further enriching our understanding of pulmonary MALT lymphoma.

Conclusions

In conclusion, the findings from our study significantly contribute to the existing knowledge of pulmonary MALT lymphoma, underscoring the crucial role of combining radiological and pathological assessments for accurate diagnosis. This integrated approach not only aids in guiding clinical decisions but also has the potential to improve patient outcomes significantly. Our study emphasizes the need for ongoing research in this area, to refine diagnostic criteria, and to develop more targeted and effective therapeutic strategies for patients with this lymphoma subtype.

Acknowledgments

None.

Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://jtd.amegroups.com/article/view/10.21037/jtd-24-1066/rc

Data Sharing Statement: Available at https://jtd.amegroups.com/article/view/10.21037/jtd-24-1066/dss

Peer Review File: Available at https://jtd.amegroups.com/article/view/10.21037/jtd-24-1066/prf

Funding: None.

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://jtd.amegroups.com/article/view/10.21037/jtd-24-1066/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013) and approved by the Ethics Committee of Nanjing Chest Hospital (No. 2023-KL035-01). Informed consent was waived for this retrospective study due to the exclusive use of de-identified patient data, which posed no potential harm or impact on patient care.

References

1. Thandra KC, Barsouk A, Saginala K, et al. Epidemiology of Non-Hodgkin's Lymphoma. Med Sci (Basel) 2021;9:5.
2. Borie R, Wislez M, Antoine M, et al. Pulmonary mucosa-associated lymphoid tissue lymphoma revisited. Eur Respir J 2016;47:1244-60.
3. Bacon CM, Du MQ, Dogan A. Mucosa-associated lymphoid tissue (MALT) lymphoma: a practical guide for pathologists. J Clin Pathol 2007;60:361-72.
4. Du C, Zhang J, Wei Y, et al. Retrospective Analysis of 9 Cases of Primary Pulmonary Mucosa-Associated Lymphoid Tissue Lymphoma and Literature Review. Med Sci Monit Basic Res 2018;24:233-40.
5. Ahlawat S, Kanber Y, Charabaty-Pishvaian A, et al. Primary mucosa-associated lymphoid tissue (MALT) lymphoma occurring in the rectum: a case report and review of the literature. South Med J 2006;99:1378-84.
6. Isaacson PG. Mucosa-associated lymphoid tissue lymphoma. Semin Hematol 1999;36:139-47.
7. Moriyama E, Yokose T, Kodama T, et al. Low-grade B-cell lymphoma of mucosa-associated lymphoid tissue in the thymus of a patient with pulmonary amyloid nodules. Jpn J Clin Oncol 2000;30:349-53.
8. Pang Y, Li D, Chen Y, et al. Thymus and lung mucosa-associated lymphoid tissue lymphoma with adenocarcinoma of the lung: a case report and literature review. World J Surg Oncol 2023;21:20.
9. Singh R, Shaik S, Negi BS, et al. Non-Hodgkin's lymphoma: A review. J Family Med Prim Care 2020;9:1834-40.
10. Sawalha Y, Maddocks K. Novel treatments in B cell non-Hodgkin's lymphomas. BMJ 2022;377:e063439.
11. Kiesewetter B, Raderer M. How can we assess and measure prognosis for MALT lymphoma? A review of current findings and strategies. Expert Rev Hematol 2021;14:391-9.
12. Cheah CY, Seymour JF. Marginal zone lymphoma: 2023 update on diagnosis and management. Am J Hematol 2023;98:1645-57.
13. Alderuccio JP, Kahl BS. Current Treatments in Marginal Zone Lymphoma. Oncology (Williston Park) 2022;36:206-15.
14. Kiesewetter B, Raderer M. Immunomodulatory treatment for mucosa-associated lymphoid tissue lymphoma (MALT lymphoma). Hematol Oncol 2020;38:417-24.
15. Ying L, Liu P, Ding Z, et al. Anti-CD40L therapy prevents the formation of precursor lesions to gastric B-cell MALT lymphoma in a mouse model. J Pathol 2023;259:402-14.
16. Sapkota S, Shaikh H. Non-Hodgkin Lymphoma. In: StatPearls. Treasure Island (FL): StatPearls Publishing; February 24, 2023.
17. Violeta Filip P, Cuciureanu D, Sorina Diaconu L, et al. MALT lymphoma: epidemiology, clinical diagnosis and treatment. J Med Life 2018;11:187-93.
18. Li AW, Xu JF, Zhou CC, et al. Clinical characteristics

and diagnosis of pulmonary mucosa-associated lymphoid tissue-derived (MALT) lymphoma: a retrospective analysis of 29 cases. Zhonghua Zhong Liu Za Zhi 2012;34:390-3.
19. Wu T, Huang Y, Wang Z, et al. Pulmonary MALT lymphoma: Imaging findings in 18 cases and the associated pathological correlations. Am J Med Sci 2022;364:192-7.
20. Wang L, Ye G, Liu Z, et al. Clinical characteristics, diagnosis, treatment, and prognostic factors of pulmonary mucosa-associated lymphoid tissue-derived lymphoma. Cancer Med 2019;8:7660-8.
21. Deng W, Wan Y, Yu JQ. Pulmonary MALT Lymphoma has variable features on CT. Sci Rep 2019;9:8657.
22. Xu HY, Jin T, Li RY, et al. Diagnosis and treatment of pulmonary mucosa-associated lymphoid tissue lymphoma. Chin Med J (Engl) 2007;120:648-51.
23. Chen Y, Chen A, Jiang H, et al. HRCT in primary pulmonary lymphoma: can CT imaging phenotypes differentiate histological subtypes between mucosa-associated lymphoid tissue (MALT) lymphoma and non-MALT lymphoma? J Thorac Dis 2018;10:6040-9.
24. Qiu W, Chen H, Zhang J, et al. Evaluation of HRCT for the Differential Diagnosis of Pneumonia-Like Consolidation Pattern of Pulmonary MALT Lymphoma from Lobar Pneumonia. Cancer Manag Res 2021;13:7813-21.
25. Gozzi L, Cozzi D, Cavigli E, et al. Primary Lymphoproliferative Lung Diseases: Imaging and Multidisciplinary Approach. Diagnostics (Basel) 2023;13:1360.
26. Qiang J, Qi PF, Gao WQ, Chen DS, Yü W. Imaging findings of non-contrast CT scan, enhancement and HRCT of pulmonary mucosa-associated lymphoid tissue lymphoma. Zhonghua Yi Xue Za Zhi 2013;93:1634-6.
27. Goyal A, LeBlanc RE, Carter JB. Cutaneous B-Cell Lymphoma. Hematol Oncol Clin North Am 2019;33:149-61.
28. Sheikhpour R, Pourhosseini F, Neamatzadeh H, et al. Immunophenotype evaluation of Non-Hodgkin's lymphomas. Med J Islam Repub Iran 2017;31:121.
29. Felisberto R, Matos J, Alves M, et al. Evaluation of Pax5 expression and comparison with BLA.36 and CD79αcy in feline non-Hodgkin lymphoma. Vet Comp Oncol 2017;15:1257-68.
30. Lu J, Wu Y, Li B, et al. Predictive value of serological factors, maximal standardized uptake value and ratio of Ki67 in patients diagnosed with non-Hodgkin's lymphoma. Oncol Lett 2020;20:47.
31. Zafar S, Sharma RK, Cunningham J, et al. Current and future best practice in imaging, staging, and response assessment for Non-Hodgkin's lymphomas: the Specialist Integrated Haematological Malignancy Imaging Reporting (SIHMIR) paradigm shift. Clin Radiol 2021;76:391.e1-391.e18.
32. García Pulido B, Fernández Fernández A. Pulmonary Malt Lymphoma With Amyloidosis: An Uncommon Pulmonary Entity. Arch Bronconeumol 2024;60:107-8.
33. Moriyama S, Kido T, Sakamoto N, et al. Pulmonary Nodular Lymphoid Hyperplasia Evaluated with Bronchoalveolar Lavage Fluid Findings: A Case Report and Review of the Literature on Japanese Patients. Intern Med 2023;62:95-102.
34. Piña-Oviedo S, Moran CA. Primary Mediastinal Nodal and Extranodal Non-Hodgkin Lymphomas: Current Concepts, Historical Evolution, and Useful Diagnostic Approach: Part 2. Adv Anat Pathol 2019;26:371-89.
35. Zhang CS, Yang XR, Ding W, et al. Pulmonary mucosa-associated lymphoid tissue lymphoma concurrent with lung squamous cell carcinoma: a case report and literature review. Zhonghua Jie He He Hu Xi Za Zhi 2020;43:1071-6.

Cite this article as: Zhao R, Dong Y, Kong J. Comprehensive analysis of imaging and pathological features in 20 cases of pulmonary mucosa-associated lymphoid tissue (MALT) lymphoma: a retrospective study. J Thorac Dis 2025;17(2):969-978. doi: 10.21037/jtd-24-1066