CT findings in multifocal or diffuse non-mucinous bronchioloalveolar carcinoma (BAC)

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Authors: I. Sandu, A. R. Popita, I.-A. Brumboiu; Cluj-Napoca/RO
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Learning objectives

(1) Illustrate the variety of imaging findings of multifocal or diffuse non-mucinous BAC;

(2) Emphasize that non-mucinous BAC can also appear as multifocal or diffuse disease.

Background

BAC is an adenocarcinoma with tumoral cells that grow along the alveolar walls - lepidic growth pattern. By definition, there is no stromal, vascular or pleural invasion. Septa and interstitium may be thickened by fibrosis or chronic inflammatory infiltrate. The tumoral cells may or may not secrete mucous and based on their prevalence, BAC is histologically classified into mucinous, non-mucinous and mixed.

Mucinous BAC represents about 30-40% of the BAC cases. Its CT presentation is more frequently a pneumonic-type infiltrate, but it can also appear like a solitary or multiple nodules. It is more likely multifocal or diffuse, with a bad prognosis.

Non-mucinous BAC represents 50-60% of the BAC cases. Its CT presentation is more frequently a ground-glass attenuation, but it can also appear like consolidation or multiple nodules. It tends to be more localized, which gives him a better prognosis, but it can also have a more diffuse appearance.

Mixed or indeterminate BAC represents a mixture of mucinous and non-mucinous cells that grow along the alveolar walls without invading the stroma.

The 2004 WHO classification of lung cancer defined BAC as a unitary pathology. In the attempt to improve molecular, radiologic, therapeutic and prognostic correlations, the 2011 classification of lung adenocarcinoma replaces the old concept of BAC with: adenocarcinoma in situ, minimally invasive adenocarcinoma, lepidic predominant adenocarcinoma (LPA), other subtypes predominant adenocarcinoma that have lepidic components and invasive mucinous adenocarcinoma (Table 1). The basis of this major change is the association of non-mucinous BAC with the epidermal growth factor receptor mutation and mucinous BAC with the KRAS mutation.

Images for this section:
Table 1

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>1. Adenocarcinoma in situ (AIS)</td>
<td>Which can be non-mucinous and rarely mucinous</td>
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<tr>
<td>2. Minimally invasive adenocarcinoma (MIA)</td>
<td>Which can be non-mucinous and rarely mucinous</td>
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<td>3. Lepidic predominant adenocarcinoma (non-mucinous)</td>
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<td>4. Adenocarcinoma, predominantly invasive with some non-mucinous</td>
<td>Lepidic component (includes some resected tumors, formerly classified as</td>
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<td></td>
<td>mixed subtype, and some clinically advanced adenocarcinomas, formerly</td>
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<td></td>
<td>classified as nonmucinous BAC</td>
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<td>5. Invasive mucinous adenocarcinoma (formerly mucinous BAC)</td>
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Findings and procedure details

In the last 5 years of our practice we found 8 patients with non-mucinous BAC, presented as LPA or lepidic component of other subtypes of adenocarcinoma and a case of mixed BAC. All cases had multifocal or diffuse pattern. The spectrum of the CT findings is broad - a combination of: ground-glass opacities (GGO), crazy-paving, consolidations, nodules, mass. Accessory findings were: air bronchogram sign, angiogram sign, cystic lucencies, bulging fissure, interstitial thickening, fibrosis, pleural tag, spiculated margins, pleural effusion and enlarged lymph nodes.

I. Lepidic predominant adenocarcinoma

LPA appeared under four patterns:

1. **GGO**: multiple ground-glass opacities, disseminated in the entire lungs volume, associated with micronodules and interstitial thickening and sparse areas of consolidation (Fig. 1).

Ground-glass opacity appears when the normal amount of air in the airspaces decreases being replaced with tumoral cells, fluid or other material or when the alveolar walls become thicker. The consolidation areas represent alveoli that are mostly filled with tumoral cells.

BAC tends to have a bronhogenic spread, but lymphatic and hematogenous dissemination may also occur. The reticulo-micronodular pattern may explain the lymphatic extension of the adenocarcinoma or the inflammatory response of the lung that can be observed on the CT like thickened intralobular or interlobular septa.

2. **Crazy-paving**: areas of crazy-paving associated with ground-glass nodules (GGN) (Fig. 2, Fig. 3).

The superimposition of the reticular pattern on the ground-glass opacities on CT produces a new pattern called crazy-paving that can also be found in alveolar proteinosis or hypersensitivity pneumonitis.

3. **Consolidative**: extensive consolidation areas with air bronchogram and bulging fissure associated with GGO (Fig. 4A).
This is the characteristic appearance for the mucinous BAC. The airspaces are taped with tumoral epithelial cells rich in intracytoplasmic mucin. Consolidation can also appear in diffuse non-mucinous BAC, as observed in the present case. The treatment can lead to remission (Fig. 4B).

4. **Multinodular**: diffuse ground-glass micronodules associated with GGO and interstitial thickening; pleural effusion was the accessory finding (Fig. 5A).

After treatment, the micronodules dissapeared and the pleural effusion reduced (Fig. 5B).

The diffuse micronodular form of BAC is reported as a rare pattern. It is often hard to distinguish from miliary tuberculosis or metastatic thyroid carcinoma.

**II. Adenocarcinoma with lepidic component**

Case 1

The first CT showed a solid nodule with spiculated margins and pleural tag, surrounded by an area of ground-glass attenuation associated with other ground-glass nodule (Fig. 6A-B).

Despite the treatment, a two years later CT scan revealed that the nodule and the surrounded ground-glass area became as one, transformed in a mass. The ground-glass nodule became solid nodule and other small GGN appeared at distance from the main lesion (Fig. 6C-D).

This is a case of moderately differentiated adenocarcinoma with lepidic component.

Case 2

The CT revealed an extensive consolidation area with important fibrosis, well demonstrated by the traction bronchiectasis and the right lung volume loss (Fig. 7A). The infiltrative pleural changes contributed to the reduction of the thoracic volume. The lymph nodes and the pleural effusion were accessory findings (Fig. 7B).

Non-mucinous BAC can be associated with central alveolar collapse that leads to fibrosis.
This is a case of well differentiated adenocarcinoma with lepidic component.

Case 3

The CT showed a mass surrounded by many small nodules, that were also disseminated in the other lung, some of them having a tree in bud appearance. The mass determined the bulging fissure sign (Fig. 8). Within the mass the angiogram sign was visible and at its periphery cystic lucencies were noticed (Fig. 9).

This is a case of poorly differentiated adenocarcinoma with lepidic component.

**Mixed BAC**

The first CT revealed a solid nodule with spiculated margins and pleural tag, associated with some GGO and two other nodules: one GGO nodule and one solid nodule in the other lung (Fig. 10A).

After a year of treatment the main lesion has been replaced by a linear opacity of fibrosis, the solid nodule became a GG nodule, but the smallest nodule, hardly noticeable initially, became a bigger solid nodule (Fig. 10B).

Two years later the CT showed multiple areas of GGO, consolidation and many other GGN (Fig. 11).

**Images for this section:**
Fig. 1: Lepidic predominant adenocarcinoma - Diffuse ground-glass opacities
Fig. 2: Lepidic predominant adenocarcinoma - Crazy-paving pattern
Fig. 3: Lepidic predominant adenocarcinoma - Crazy-paving with ground-glass nodules
**Fig. 4:** Lepidic predominant adenocarcinoma - A. Extensive consolidation. B. After the treatment

![Image](image1.png)

**Fig. 5:** Lepidic predominant adenocarcinoma - A. Multinodular pattern B. After the treatment

![Image](image2.png)
Fig. 6: Adenocarcinoma with lepidic component - Before the treatment (A-B). After the treatment (C-D)

Fig. 7: Adenocarcinoma with lepidic component - A. Area of consolidation with bronchiectasis included. B. Pleural effusion and infiltration of the pleura
**Fig. 8:** Adenocarcinoma with lepidic component - Mass with bulging fissure. Tree in bud nodules

**Fig. 9:** Lepidic predominant adenocarcinoma - Angiogram sign and cystic lucencies
Fig. 10: Mixed bronchioloalveolar carcinoma - Before (A) and after (B) the treatment
**Fig. 11:** Mixed bronchioloalveolar carcinoma - GGO, crazy-paving, consolidation
Conclusion

Non-mucinous BAC can be diffuse or multifocal and it can have many CT appearances. Its diagnosis is often challenging due to its variable presentation.

The treatment may act directly on the lesions or on the nearby lung parenchyma leading to collateral changes; these aspects can influence the interpretation of the CT images.

Personal information

References


