

Impact of lobar versus multilobar pneumonia in the outcomes of hospitalized patients with community-acquired pneumonia (CAP)

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ABSTRACT

Introduction: The presence of CAP with multilobar involvement has been associated with poor patient outcomes. Multilobar infiltrates may occur in a single lung (unilateral) or in both lungs (bilateral). It is unclear if unilateral multilobar infiltrates cause the same prognosis as bilateral multilobar infiltrates.

Objective: The objective of this study was to define clinical outcomes in hospitalized patients with CAP with 1) single lobe infiltrates (SL), 2) unilateral multilobar (UM) infiltrates, and 3) bilateral multilobar infiltrates (BM).

Methods: This was a secondary data analysis of the Community-Acquired Pneumonia Organization (CAPO) International Cohort Study database. Poisson regression was used to define the adjusted impact of each infiltrate type on mortality.

Results: A total of 3342 with single lobe infiltrates, 208 with UM infiltrates, and 3459 with BM infiltrates were analyzed. Patients with UM infiltrates had a non-significant 10% increased risk of mortality compared to patients with a SL infiltrate. Patients with BM infiltrates had a non-significant 36% increased risk of mortality compared to those with a UM lobe infiltrate. Patients with BM infiltrates had a 50% (P<0.001) increased risk of mortality compared to those with a SL infiltrate.

Conclusions: This study suggests that the outcome of patients with CAP may worsen as an infiltrate moves from a single lobe to multiple lobe in the same lung and worsen further if multi-lung involvement is present. Patients with evidence of multilobar CAP at chest X-ray may need hospitalization and early empiric antibiotic therapy since these patients are at high risk for poor outcomes.

INTRODUCTION

- Pneumonia is the most common cause of death due to infectious diseases in the US with an incidence of 1.1 million hospitalizations annually [1].
- One of the criteria needed to define community-acquired pneumonia (CAP) is the presence of an infiltrate in the lung. This infiltrate can affect one lobe due ad defined as unilobar or single lobe CAP. Multilobar infiltrates may occur in a single lung (unilateral) or in both lungs (bilateral). This is represented in figure 1. Literature reports that 25 % of hospitalized patients with CAP present with multilobar pneumonia [2].

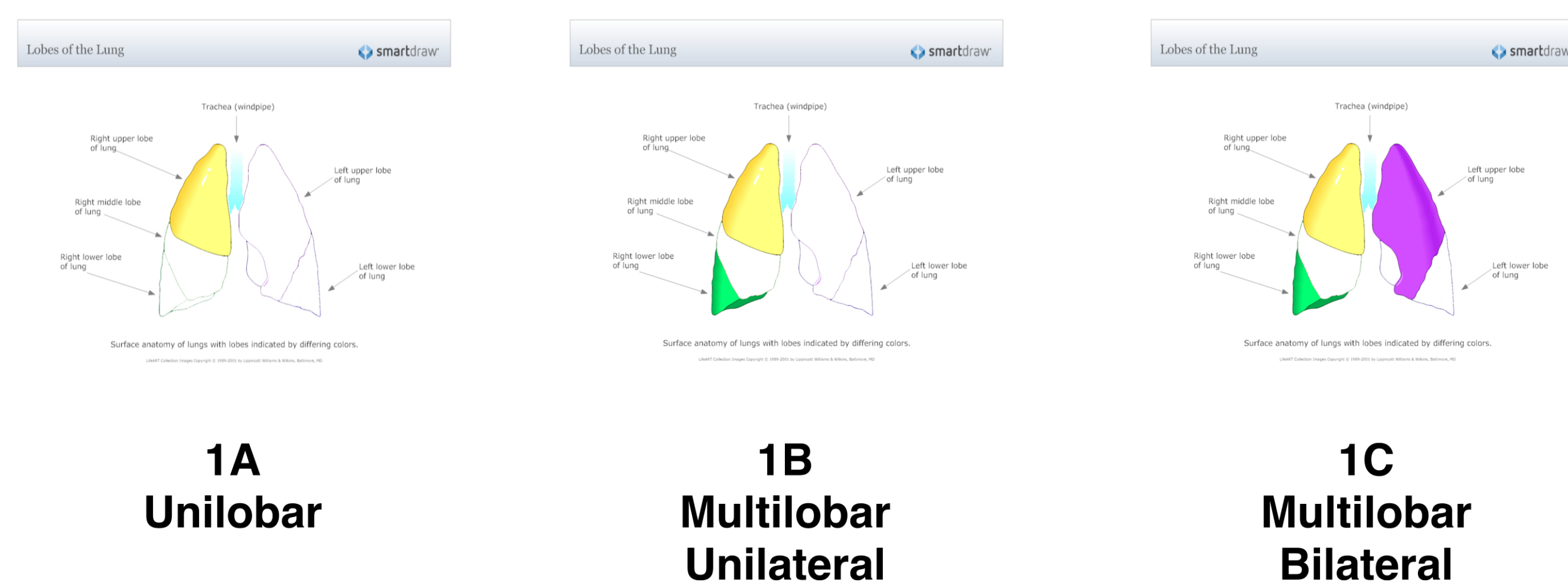


Figure 1: Description of unilobar and multilobar pneumonia

- The presence of CAP with multilobar involvement has been associated with poor patient outcomes. Several severity scores utilized to predict mortality in CAP included multilobar pneumonia as one of the variables associated with increased risk of death [1]. However the two most commonly used scores to assist the definition needed in the admission to the hospital are the PSI and the CURB-65, but those do not include lobar involvement as a variable [3].
- Furthermore it is unclear if unilateral multilobar infiltrates cause the same prognosis as bilateral multilobar infiltrates [3].
- The objective of this study was to define clinical outcomes in hospitalized patients with CAP with 1) single lobe infiltrates (SL), 2) unilateral multilobar (UM) infiltrates, and 3) bilateral multilobar infiltrates (BM).

MATERIALS AND METHODS

Study Design and Study Population

This was a secondary analysis of patients enrolled in the Community-Acquired Pneumonia Organization (CAPO) international cohort study. Data was collected between 2001 and 2015. In each participating center, non-consecutive medical records of hospitalized patients with the diagnosis of CAP were reviewed. A sample of the data collection form is available at the study website (www.caposite.com). Validation of data quality was performed at the study center before the case was entered in to the CAPO database. Institutional Review Board approval was obtained by each participating center.

Study Definitions

CAP: Diagnosis of CAP required the presence of criterion A, B, and C:

- New pulmonary infiltrate on imaging (CT scan or chest x-ray) at the time of admission to the hospital.
- Signs and Symptoms of CAP (at least one of the following)
 - New or increased cough (per the patient)
 - Fever >37.8°C (100.0°F) or hypothermia <35.6°C (96.0°F).
 - Changes in WBC (leukocytosis >11,000 cells/mm³, left shift > 10% band forms/microliter, or leukopenia < 4,000 cells/mm³)
- Working diagnosis of CAP at the time of hospital admission with antimicrobial therapy given within 24 hours of admission.

Patients were assigned to the following study groups:

- Group 1. Unilobar pneumonia: Involvement of only 1 lobe on either the right or the left lung.
- Group 2. Multilobar unilateral pneumonia: Involvement of ≥ 2 lobes on either the right OR left lung.
- Group 3. Multilobar bilateral pneumonia: Involvement of ≥ 2 lobes on both right AND left lung.

Study outcomes

In hospital mortality was defined as all cause mortality during hospitalization.

Statistical Analysis

Baseline categorical explanatory variables were summarized as frequencies and percentages and differences between groups of patients were analyzed using a chi-square test or Fisher's exact test when appropriate and warranted. Continuous variables were summarized as frequencies and interquartile range and differences between groups were analyzed by Wilcoxon-Mann-Whitney test.

Poisson regression was used to define the adjusted impact of each infiltrate type on mortality.

RESULTS

- A total of 3,342 with single lobe infiltrates (group 1), 208 with Multilobar Unilateral infiltrates (group 2), and 3,459 with Multilobar Bilateral infiltrates (group 3) were analyzed.
- Hospital mortality for the three study groups are shown in Figure 2 .
- Patient's characteristics are shown in Table 1.
- Patients with Multilobar Unilateral infiltrates had a non-significant 10% increased risk of mortality compared to patients with a Unilobar infiltrate.
- Patients with Multilobar Bilateral infiltrates had a non-significant 36% increased risk of mortality compared to those with a Multilobar Unilateral lobe infiltrate.
- Patients with Multilobar Bilateral infiltrates had a 50% (P<0.001) increased risk of mortality compared to those with a Unilobar infiltrate.

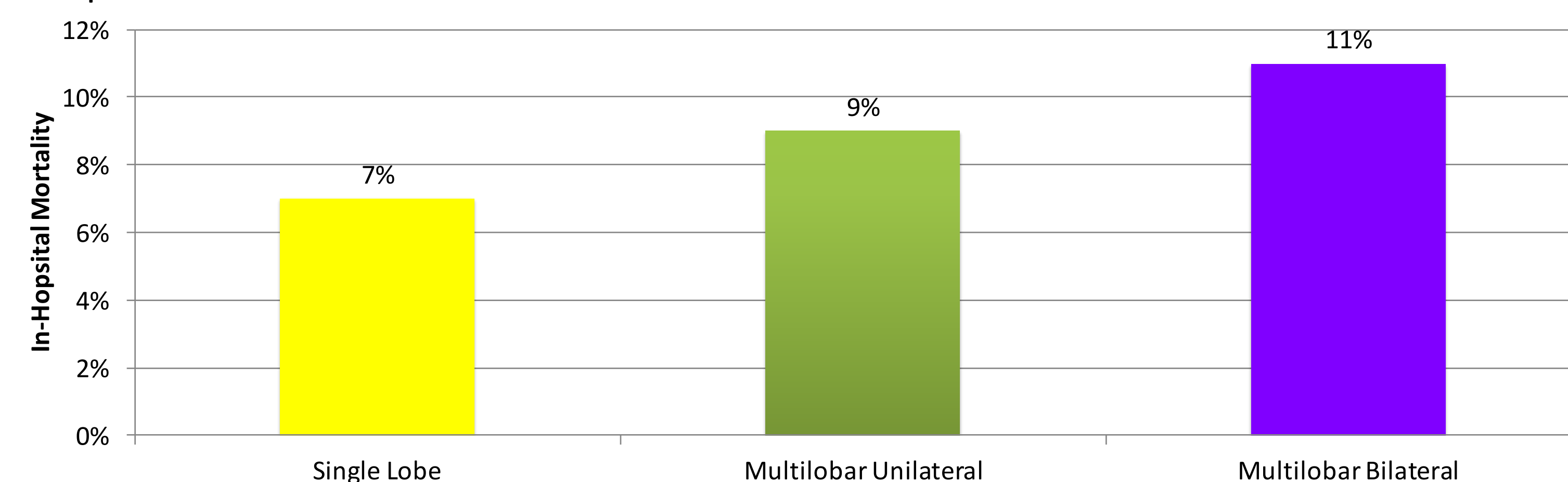


Figure 2: In-hospital mortality rates based on the number of lobes involved

RESULTS

Table 1 Patient's characteristics

| Demographics | Unilobar | Multilobar Unilateral | Multilobar Bilateral | P value |
|---|------------|-----------------------|----------------------|---------|
| Age, Median (IQR) | 66 (29.8) | 70 (23) | 71 (29) | <0.001 |
| Sex, n (%) | 2029 (61) | 128 (62) | 2057 (59) | 0.535 |
| Nursing home resident, n (%) | 160 (5) | 10 (5) | 237 (7) | 0.001 |
| Comorbid Conditions | | | | |
| Congestive Heart Failure, n (%) | 513 (15) | 42 (20) | 704 (20) | <0.001 |
| COPD, n (%) | 806 (24) | 55 (26) | 923 (27) | 0.049 |
| Diabetes, n (%) | 609 (18) | 40 (19) | 642 (19) | 0.889 |
| Renal Disease, n (%) | 324 (10) | 17 (8) | 349 (10) | 0.649 |
| Liver Disease, n (%) | 202 (6) | 16 (8) | 181 (5) | 0.143 |
| Neoplastic Disease, n (%) | 367 (11) | 21 (10) | 369 (11) | 0.891 |
| Physical Exam | | | | |
| Altered mental status on admission, n (%) | 408 (12) | 38 (18) | 548 (16) | <0.001 |
| Respiratory Rate, Median (IQR) | 22 (10) | 24 (10) | 24 (8) | <0.001 |
| Systolic blood pressure, Median (IQR) | 125 (30) | 125 (31) | 125 (32) | 0.96 |
| Temperature, Median (IQR) | 37.8 (1.7) | 37.5 (1.7) | 37.7 (1.6) | 0.01 |
| Heart rate, Median (IQR) | 98 (27) | 100 (29) | 99 (27) | 0.379 |
| Lab/Radiography | | | | |
| Pao2, Median (IQR) | 63 (20) | 57 (19.4) | 61 (21) | 0.014 |
| Blood Urea Nitrogen, Median (IQR) | 30 (31) | 31 (32.8) | 33 (35) | 0.011 |
| Serum sodium, Median (IQR) | 136 (6) | 136 (6.5) | 137 (6) | 0.003 |
| Serum glucose, Median (IQR) | 121 (53) | 123.5 (40.2) | 120 (53) | 0.913 |
| Hematocrit, Median (IQR) | 38.1 (8) | 36 (5.2) | 38 (58) | 0.088 |
| Pleural effusion, n (%) | 666 (20) | 51 (25) | 807 (23) | 0.002 |
| Severity of Disease | | | | |
| ICU admission, n (%) | 291 (9) | 26 (12) | 445 (13) | <0.001 |
| Pneumonia Severity Index, Median (IQR) | 99 (50) | 106 (50.2) | 103 (48) | 0.004 |

CONCLUSIONS

This study suggests that the outcome of patients with CAP may worsen as an infiltrate moves from a single lobe to multiple lobes in the same lung and worsen further if multi-lung involvement is present.

In the pathogenesis of pneumonia, most frequently bacteria from the oropharynx are aspirated into one lobe of the lung. Once bacteria multiply in one lobe, the immune system controls the infection. The most common x-ray finding is pneumonia with involvement of a single lobe. If the bacteria are too virulent or the immune system of the patient is weak the bacteria may move from one lobe to another lobe in the same lung. Farther progression may include lobes in the opposite lung. This pathogenesis may explain why patients do poorly when the lobes move from a single lobe in one lung, multi lobes in a single lung to multiple lobes in both lungs.

Patients with evidence of multilobar CAP at chest X-ray may need hospitalization and early empiric antibiotic therapy since these patients are at high risk for poor outcomes.

If severity scores such as the PSI or CURB-65 are utilized by physicians when considering admission to the hospital, image characteristics may also need to be considered.

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