

# Analysis of Sputum Culture and Drug Sensitivity Test in Patients with Severe Pneumonia Who Have Abnormal Klebsiella Pneumoniae

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**Abstract:** Objective: To analyze sputum culture and drug sensitivity test in patients with severe pneumonia who have abnormal Klebsiella pneumoniae. Methods: 216 patients who were diagnosed as severe pneumonia were invited to join our study. All participants received the sputum culture test before they receive the treatment, their inspection time was from January 2016 to December 2016. we use different antibiotic discs to test the drug resistance in test medium, it can test the effects of several major antibiotics on Klebsiella pneumoniae. Our research is focus on the information about Drug resistance for Klebsiella pneumoniae. The collection information includes patient characteristics, Klebsiella pneumoniae source medical department and drug resistance of different antibiotics for Klebsiella pneumoniae. Result: Most Klebsiella pneumoniae sample from ICU (29.6%), Respiratory ward (31.0%), Neurological ward (19.0%) and Cardiovascular ward (43.7%). The klebsiella pneumoniae sample of another source are less than 5% in our research result. Some antibiotics have good influence to Klebsiella pneumoniae, that include cefoperazone/sulbactam, Meropenem and Ciprofloxacin (8.9% & 10.9% & 12.9%). However, the result indicate the Aztreonam has strong drug resistance for Klebsiella pneumoniae, it has 66 out of 99 (66.66%) number of resistant. Conclusion: The cefoperazone/sulbactam, Meropenem and Ciprofloxacin have good influence to improve klebsiella pneumoniae situation on patients with severe pneumonia. Additionally, some medical departments have more patients who severe pneumonia caused by klebsiella pneumoniae, such as ICU, Respiratory ward, Neurological ward and Cardiovascular ward.

**Keywords:** Drug Resistance, Sputum Culture, Severe Pneumonia

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## 1. Introduction

In 2011, pneumonia ranked as the third most common cause of death in Japan, it had more than 90% of deaths due to pneumonia occur in patients who aged were higher than 65 years [1]. Base on other report, classification as severe pneumonia was diagnosed as one of the major criteria or at least three minor criteria. Major criteria included (1) invasive mechanical ventilation, (2) septic shock with the need for vasopressors, and minor criteria were (1) respiratory rate  $\geq 30$  breaths per min; (2)  $\text{PaO}_2/\text{FiO}_2 \leq 250$ ; (3) multilobar infiltrates;

(4) confusion or disorientation; (5) blood urea nitrogen  $\geq 20$  mg/dL; (6) leucocyte count  $< 4 \times 10^9$  cells/L; (7) platelet count  $< 100 \times 10^9$  cells/L; (8) core temperature  $< 36^\circ\text{C}$ ; (9) hypotension requiring aggressive fluid resuscitation [2]. Few studies of the treatment of community-acquired pneumonia have examined pneumonia separately, so it is important to study the treatment of pneumonia in an aging society. Moreover, there are still few prospective studies on the effectiveness of antibiotics in pneumonia [3-6].

Drug resistance as an emerging health concern reducing the efficiency and potency of a drug to produce effective

treatment of pathogenic microorganisms or cancer and decrease overall patient survival [7]. Resistance to drugs led to many other problems including toxicity and huge costs for development of new drugs [8]. Drug resistance brings serious clinical obstacles to the prosperous treatment of severe pneumonia patients. To overcome these problems, a well understanding of the drug resistance mechanisms is definitely required [9]. Aim of this study is analysis of sputum culture and drug sensitivity test in patients with severe pneumonia who have abnormal *Klebsiella* pneumoniae.

## 2. Methods

### 2.1. Participants Enrollment and Study Methods

216 patients who were diagnosed as severe pneumonia were invited to join our study. All participants received the sputum culture test before they receive the treatment, their inspection time was from January 2016 to December 2016. In sputum culture test process, our researchers obtain sputum sample from participants, that disposable sputum aspiration tube was connected with low-pressure aspirator. Sputum was absorbed by negative pressure of the trachea through the nose, and the specimen was placed in sterilized test tube. After collection of sputum sample, we use different antibiotic discs to test the drug resistance in test medium, it can test the effects of several major antibiotics on *Klebsiella* pneumoniae. The antibiotics include cefoperazone/sulbactam, meropenem, aztreonam and ciprofloxacin. Our research is focus on the information about Drug resistance for *Klebsiella* pneumoniae. The collection information includes patient characteristics, *Klebsiella* pneumoniae source medical department and drug resistance of different antibiotics for *Klebsiella* pneumoniae.

Their inclusion criteria were: (1) the patients have severe pneumonia; (2) the patients was detected with abnormal *Klebsiella* pneumoniae; (3) The patient agrees to sign the informed consent. Their withdraw criteria were: (1) Too many bacterial species were detected from their sputum culture; (2) the patients who lack basic information recording.

### 2.2. Statistical Analysis

Our data analyzer performed the statistical analysis by SPSS 22.0. The P value, t-test and chi-square test were associated with collection result were analyzed. Besides, the mean standard deviation for statistical description.

## 3. Result

In Table 1, it shown the patient characteristics in this study. The most participants are male, it accounts for 70.4% of the total participants. In addition, their age was 66.76±21.76 years, their age group has more adult.

*Table 1. Patient Characteristics.*

Projects	statistics	Percent
Male (n)	152	70.4%
Female (n)	64	29.6%

Projects	statistics	Percent
Age (Year)	66.76±21.76	-
Age group (adult)	202	93.5%
Age group (infant)	14	6.5%
Test item (sputum culture)	216	100.0%

The Table 2 indicate the main source of *Klebsiella* pneumoniae cases. Most *Klebsiella* pneumoniae sample from ICU (29.6%), Respiratory ward (31.0%), Neurological ward (19.0%) and Cardiovascular ward (43.7%). The *klebsiella* pneumoniae sample of another source are less than 5% in our research result.

*Table 2. The Klebsiella pneumoniae cases in different medical department.*

Department	<i>Klebsiella pneumoniae</i> cases	Percent
ICU	64	29.6
Pediatric department	7	3.2
Hepatological surgery department	1	0.5
Orthopedic ward	2	1.0
Respiratory ward	67	31.0
Rehabilitation ward	1	0.5
Urological ward	3	1.5
Endocrine and metabolic ward	1	0.5
Medical ward	1	0.5
Neurological ward	41	19.0
Gastroenterology ward	4	1.9
Cardiovascular ward	8	43.7
Hematology ward	10	4.6
Oncology ward	7	3.2

In Table 3, it shown noteworthy antibiotics of drug sensitivity in the table. Some antibiotics have good influence to *Klebsiella* pneumoniae, that include cefoperazone/sulbactam, Meropenem and Ciprofloxacin (8.9% & 10.9% & 12.9%). However, the result indicate the Aztreonam has strong drug resistance for *Klebsiella* pneumoniae, it has 66 out of 99 (66.66%) number of resistant.

*Table 3. Drug sensitivity of klebsiella pneumoniae.*

Antibiotics	Number of resistant	Percent
cefoperazone/sulbactam (n = 123)	11	8.9
Meropenem (n = 64)	7	10.9
Aztreonam (n = 99)	66	66.6
Ciprofloxacin (n = 147)	19	12.9

## 4. Discussion

*Klebsiella pneumoniae* has emerged as an important opportunistic pathogen mostly causing nosocomial infections, due to prevalence of carbapenem-resistant strains as a major source of resistance [10, 11]. Navon-Venezia indicated that *Klebsiella pneumoniae* is a major human pathogen that is increasingly being implicated in both opportunistic nosocomial and community acquired infections accounting for about a third of all Gram-negative infections overall [12]. It is a Gram-negative bacterium belonging to the Enterobacteriaceae family and a natural inhabitant of gastrointestinal tract flora of healthy humans and animals. Infections by this organism are also a common cause of

outbreaks in hospital settings especially in critical care and neonatal units [13]. It also is mainly responsible for urinary-tract infections, meningitis and pneumonia. Since the 1980s various *Klebsiella pneumoniae* strains of hypermucoviscous serotype have emerged in Taiwan and in other countries of the Pacific region [14]. A study performed in New Caledonia at the tertiary medical center between 2008 and 2013 reported a high prevalence of *Klebsiella pneumoniae* strains in community-acquired bacteremia, and highlighted the invasive-ness of these infections [15].

Antimicrobial resistance is a global public-health concern and strategies to mitigate the development of resistance are urgently needed [16]. In addition, broad-spectrum antibiotic use, in particular, poses an increased risk for the development of antimicrobial resistance [17]. Base on USA's estimates of inpatient antibiotic use report, overall antibiotic use has not increased, the use of broad- spectrum antibiotics has increased significantly [18]. Selective lab-oratory antibiotic susceptibility test reporting has been advocated as an antimicrobial stewardship tool to help reduce prescribing of broad-spectrum antibiotic therapy and is recommended by the Infectious Diseases Society of America (IDSA) to promote the use of narrow-spectrum agents when indicated [17, 19].

According to above result, the cefoperazone/sulbactam, Meropenem and Ciprofloxacin have good influence to improve *klebsiella pneumoniae* situation on patients with severe pneumonia. Additionally, some medical departments have more patients who severe pneumonia caused by *klebsiella pneumoniae*, such as ICU, Respiratory ward, Neurological ward and Cardiovascular ward. In drug sensitivity of *klebsiella pneumoniae* assessment, it indicates that Aztreonam has high drug resistance. On the contrary, cefoperazone/sulbactam, Meropenem and Ciprofloxacin have low drug resistance in measure result, they have good performance in severe pneumonia treatment process. In limitation, we were unable to confirm whether these antibiotics performed well against other pneumonia-related bacteria. Severe pneumonia is not usually caused by *Klebsiella pneumoniae* alone, its reason includes other flora. However, we did not collect and analyze other flora factors.

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