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ORIGINAL ARTICLE

Analysis of Pneumonia Severity Based on CURB-65 Scoring System and its Smplications for Empirical Antibiotics: A Cross Sectional Study at Regional Hospital Denpasar

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ABSTRACT

Background: The largest case of pneumonia found in the community is community-acquired pneumonia, with the main problem of high severity in elderly patients. The severity of pneumonia can be measured, one of which is through the CURB-65 method, which is widely used in various health services to determine the antibiotics used. This study was aimed to see the relationship between the severity of pneumonia and empirical antibiotic therapy at the Denpasar City Hospital.

Methods: The research method used is descriptive analytic with a cross-sectional approach with a study population including all patients diagnosed with community-acquired pneumonia and hospitalized at the Regional Hospital Denpasar in 2022-2023 who meet the inclusion and exclusion criteria. Bivariate analysis was used to see the relationship between the severity of pneumonia and empirical antibiotic therapy.

Results: The number of samples that met the inclusion and exclusion criteria was 152 samples consisting of 64 patients receiving antibiotic monotherapy and 88 patients receiving antibiotic polytherapy. The severity of pneumonia through the CURB-65 score is dominated by mild severity (71.7%). Through the Fisher exact test, a p-value < 0.05 was obtained, which means that there is a relationship between the severity of pneumonia and empirical antibiotic therapy at the Regional Hospital Denpasar.

Conclusion: The results of this study are in line with the guidelines for managing community acquired pneumonia in Indonesia.

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Introduction

Pneumonia is a lower respiratory tract infection that attacks the lung parenchyma with characteristics of difficulty breathing due to excessive fluid or pus in the lungs. Pneumonia is said to be included in the complications of infection that also become problems and contribute to high mortality in the world. Pneumonia has a degree of severity as an indicator of the patient's risk of death. High severity of pneumonia causes an increase in mortality rates in pneumonia patients.[1,2]

In Indonesia, the prevalence of pneumonia has increased from 1.6% in 2013 to 2.0% in 2018. Pneumonia cases in Bali Province ranked third in the top 10 diseases in hospitalized patients at the Bali Provincial Hospital in 2017 with a total of 2,683 cases. In 2018, the number of pneumonia cases in Bali based on diagnostic history was found to be 20,560 cases. Denpasar City has the highest pneumonia cases in Bali Province, reaching 4,450 cases.[3] In the period from 2017 to 2018, Regional Hospital of Denpasar received 349 patients due to pneumonia, thus requiring a comprehensive and efficient review of health services.[4]

The main management of pneumonia is generally bacteriological examination followed by the use of antibiotics. Health services often use antibiotics as drugs to control the severity of pneumonia.[5] Increased use of antibiotics often occurs in developed and developing countries. In developed countries, there is an increase of 13-37% of all sufferers who receive antibiotics, and developing countries have a higher increase of up to 80%.[6] Based on previous studies, the use of antibiotics is done empirically, with a range of 40–62% for diseases that may not actually require antibiotics. A study conducted at Surakarta Hospital, Indonesia stated that the empirical antibiotic ceftriaxone is the empirical antibiotic with the most widely prescribed use in adult and elderly pneumonia patients.[7]

According to the American Thoracic Society (ATS), Infectious Diseases Society of America (IDSA), and British Thoracic Society (BTS), there are several assessment variables that can be used to predict the severity of pneumonia, namely the Pneumonia Severity Index (PSI) and CURB-65. Predicting the severity of pneumonia is fundamental in therapeutic management so that the mortality rate of pneumonia patients can be reduced. Scoring assessment based on CURB-65 can be seen through five main variables, namely confusion (level of consciousness), urea (ureum value divided by 2.14), respiratory rate, blood pressure, and patients over 65 years of age. In assessing the severity of pneumonia, the CURB-65 scoring assessment has several advantages, namely, it is simple to use and can assess the severity of the disease based on the patient's age, so that CURB-65 is said to have better ability in assessing severe pneumonia patients with a high risk of death.[8] In the acute management guidelines for community-acquired pneumonia, it is stated that the CURB-65 score can be an initial assessment in deciding on empirical antibiotics used in pneumonia patients. In patients with a low CURB-65 score, the recommended antibiotic is antibiotic monotherapy, while in patients with a high CURB-65 score, combination antibiotics are more preferred.[9,10]

Based on this background, variations in the determination of empirical antibiotics for pneumonia patients still exist. This study aims to see the pattern of empirical antibiotic use in pneumonia patients and its relationship to the severity of pneumonia as measured by the CURB-65 score.

Methods

The research design that will be used is descriptive analytical with a cross-sectional approach. The sample used in this study is medical record data from patients at Regional Hospital of Denpasar in 2022-2023 with inclusion criteria in the form of patients diagnosed with pneumonia in the hospital's ER and hospitalized with ICD-X diagnosis code J.18, over 18 years old, and receiving empirical antibiotic therapy in the ER. Patients with incomplete medical record data, patients treated in the High Care Unit (HCU), and patients who died during treatment were excluded from this study.

The instrument used was medical record data collected using a data collection sheet consisting of medical record number, age, gender, comorbidities, symptoms, types of antibiotics consumed, and severity of pneumonia using the CURB-65 score. CURB-65 scoring is an assessment carried out to identify risk factors for patient mortality due to community-acquired pneumonia for 30 days. The CURB-65 scoring system has a score ranging from 0 to 5. Each risk factor variable has a score of 1 and can be accumulated to a maximum score depending on the severity of the risk factors experienced by the patient. CURB-65 assessment incorporates five variables: confusion, urea levels, rate of respiration, blood pressure, and age above 65 years old. Confusion means a condition

characterized by disorientation. Additionally, risk factors include urea levels exceeding 7 mmol/L or BUN (blood urea nitrogen) levels above 19 mg/dL, a breathing rate of 30 or more times per minute, systolic blood pressure below 90 mmHg or diastolic blood pressure at or below 60 mmHg, and age of 65 years or older. The CURB-65 data is then classified as mild with a score of 0-1, moderate with a score of 2, and severe with a score of 3.[11]

Data analysis conducted includes univariate and bivariate analysis. Univariate analysis includes demographic characteristics, namely age and gender, as well as clinical characteristics such as comorbidities. We will also use univariate analysis to describe the severity of pneumonia based on the CURB-65 score and the characteristics of empirical antibiotic therapy. Each antibiotic, both monotherapy and polytherapy antibiotics, will be described based on the type of antibiotic. For nominal and ordinal variables, the variables will be described in the form of frequency distribution and percentage, while numeric variables will be described in the form of averages and standard deviations. Bivariate analysis is used to assess the relationship between the severity of pneumonia and empirical antibiotic therapy, with a P value declared significant if more than 0.05.

This research was conducted based on ethical clearance issued by the Health Research Ethics Commission of the Faculty of Medicine and Health Sciences, Warmadewa University, with the number 441/Unwar/FKIK/EC-KEPK/VI/2024.

Results

The number of samples in this study was 152 that obtained through consecutive sampling, with sample characteristics contained in Table 1. According to Table 1, most of the samples were over 65 years old (61.8%), with ages ranging from 41.57 to 83.79, were female (52.6%), had other health issues (80.3%), had mild illness with a CURB score of 0-1 (71.7%), and received multiple antibiotics (57.9%).

Table 1. Sample Characteristic

Characteristic	Frequency (N=84)	Percentage (%)
Age		
> 65 years old	94	61,8
< 65 years old	58	38,2
Gender		
Male	72	47,4
Female	80	52,6
Comorbidities		
Yes	122	80,3
No	30	19,7
Pneumonia Severity		
Mild (CURB Score 0-1)	109	71,7
Moderate (CURB Score 2)	38	28,0
Severe (CURB Score >2)	5	3,3
Antibiotic Type		
Monotherapy	64	42,1
Polytherapy	88	57,9

As shown in table 2, the majority of monotherapy antibiotics used were cefoperazone (31.3%), followed by ceftriaxone (26.5%), levofloxacin (12.5%), cefotaxime (10.9%), ciprofloxacin (7.8%), amoxicillin-clavulanic acid (6.3%), cefixime (3.1%), and moxifloxacin (1.6%). Meanwhile, the most widely used type of polytherapy antibiotic is the combination of cefoperazone and levofloxacin (33.0%).

Table 2. Antibiotic Type

Antibiotic Type	Frequency	Percentage (%)
Monotherapy (N=64)		
- Ciprofloxacin	5	7,8
- Ceftriaxone	17	26,5
- Levofloxacin	8	12,5
- Cefoperazone	20	31,3
- Cefotaxime	7	10,9
- Amoxicillin-Clavulanic acid	4	6,3
- Moxifloxacin	1	1,6
- Cefixime	2	3,1
Polytherapy(N=88)		
- Ceftriaxone + Levofloxacin	21	23,8
- Cefoperazone + Levofloxacin	29	33,0
- Amoxicillin-Clavulanic acid + Azithromycin	9	10,2
- Moxifloxacin + Azithromycin	3	3,4
- Ceftazidime + Levofloxacin	7	7,9
- Cefoperazone + Azithromycin	6	6,8
- Ceftriaxone + Azithromycin	6	6,8
- Meropenem + Levofloxacin	3	3,4

- Cefotaxime + Azithromycin	1	1,1
- Amoxicillin-Clavulanic acid + Levofloxacin	1	1,1
- Amoxicillin-Clavulanic acid+ Ceftriaxone	2	2,2

Table 3 shows the results of cross-tabulation between the severity of pneumonia and the type of empirical antibiotics. In patients with mild pneumonia severity, most of them received polytherapy antibiotics, namely 56 (51.4%). In patients with moderate pneumonia severity, the antibiotics received were dominated by polytherapy (71.1%). In cases of severe pneumonia, all patients received polytherapy antibiotics (100%). To determine the relationship between the severity of pneumonia and the type of antibiotic therapy, a Fischer exact test was performed, and a p-value of 0.012 ($p < 0.05$) was obtained, which means that there is a relationship between the severity of pneumonia and the type of antibiotic therapy.

Table 3. Cross-tabulation between the severity of pneumonia and empirical antibiotic type

Pneumonia Severity	Monotherapy N=64	Polytherapy N=88	P value
Mild (N= 109)	53 (48,6%)	56 (51,4%)	0.012
Moderate (N=38)	11 (28,9%)	27 (71,1%)	
Severe (N=5)	0 (0,0%)	5 (100%)	

Discussion

Sample Characteristic

In this study, it was found that most of the samples were elderly patients aged ≥ 65 years (61.8%). Research conducted by Farida et al. (2020) showed similar results: the majority of samples obtained were community pneumonia patients aged >65 years (43.6%).[7] The weakening of immune system and respiratory defense system, the occurrence rate of pneumonia especially severe form in elderly is high. The morbidity increases with the aging trend, which is the main cause of death in elderly. Age >65 years is one of the CURB-65 parameters, in order to improve the prognosis of pneumonia in elderly.[12] Based on the data distribution in this study, the majority of samples were female, namely 52.6%. Research conducted by Sari et al. in 2016 found that among 158 community pneumonia patients at RSCM Jakarta, 83 were female.[13] However, research conducted by Malik and Khan (2012) stated that gender does not have a significant relationship to the occurrence of community pneumonia.[14] Previous studies have indicated that males may be at a higher risk of developing pneumonia than females. This sex-related disparity may be partly attributable to the immunomodulatory and immunoprotective effects of estrogen, which may enhance host immune responses in females. Furthermore, differences in lifestyle and behavioral factors, particularly higher rates of smoking and alcohol consumption among men in some populations, may contribute to increased susceptibility to pneumonia. Evidence from previous studies also suggests that men may experience more severe disease manifestations and higher pneumonia-associated mortality rates than women.[15]

In assessing the severity of pneumonia, several methods can be used. One of them is by using the CURB-65 score. The CURB-65 score is seen based on 5 main clinical characteristics, namely confusion (consciousness), urea, respiratory rate (breathing frequency), and age ≥65 years. The CURB-65 score is considered more practical, easier to remember, and simpler to assess compared to the PSI (Pneumonia Severity Index) score, which is specifically designed to evaluate the risk of mortality.[13,16] The sample in this study, most of the pneumonia patients who received empirical antibiotic therapy had a mild pneumonia severity based on the CURB-65 score, namely 109 people, or 71.7%. Different results were obtained in a study conducted by Widasari in 2014 at Kariadi General Hospital Semarang and a study conducted by Sari et al. in 2016 at M Djamil Hospital Padang, namely that most samples had moderate (score 2) to severe (score 3) severity.[13,17] These different results may be caused because in the two studies, all samples taken were from patients over 65 years of age and may also be caused by differences in the initial condition of the patients when they arrived.

Empirical Antibiotic Characteristic

Based on the research that has been conducted, most patients use cefoperazone (31.3%) as a type of monotherapy antibiotic, while in patients with polytherapy, most use a combination of cefoperazone and levofloxacin (33.0%). These results are in line with the types of antibiotics shown by samples from the research by Permatananda and Widhidewi (2021), namely

cefoperazone (12.5%) as monotherapy and a combination of cefoperazone and levofloxacin (24.2%) as polytherapy. The administration of a combination of cefoperazone and levofloxacin antibiotics is good for use as polytherapy because this combination of drugs does not have the risk of drug interactions or side effects that have the potential to cause comorbidities, so the administration of polytherapy is safe to use as a management of community-acquired pneumonia.[4]

According to research conducted by Pradipta et al. (2012), the cephalosporin group, such as ceftazidime, ceftriaxone, and cefoperazone, has broad-spectrum properties against gram-positive and gram-negative bacteria, so the cephalosporin group is a good monotherapy or empirical polytherapy antibiotic therapy[18]. Levofloxacin (fluoroquinolone group) has a large distribution volume and can penetrate well into tissues and body fluids, so levofloxacin is safe to use in adult patients with special attention to kidney function related to its limited metabolism, and levofloxacin is also excreted intact through urine.[19]

Relationship Between Pneumonia Severity Based on CURB-65 Scoring System and Empirical Antibiotic Therapy

Based on the results of the Fisher exact test analysis, it was found that there was a relationship between the severity of pneumonia and empirical antibiotic therapy. In this study, mild, moderate, and severe cases of pneumonia were all dominated by the use of polytherapy empirical antibiotics compared to monotherapy. Even in patients with severe pneumonia, all patients received polytherapy empirical antibiotics.

The Guidelines for the Management of Community-Acquired Acute Pneumonia indicate that patients with mild pneumonia, who have a CURB score of 0-1, should be treated with one type of antibiotic, while those with moderate to severe pneumonia should be treated with more than one type of antibiotic[10]. In line with this research, healthcare providers often administer antibiotic polytherapy (combination therapy with more than one type of antibiotic) instead of monotherapy (therapy with one type of antibiotic), especially in cases of serious infections like pneumonia. Polytherapy is known to allow wider coverage of various pathogenic bacteria that may cause infection, especially when the exact cause of the infection is unknown. The use of more than one type of antibiotic can reduce the risk of antibiotic resistance. The combination of antibiotics can inhibit the growth of bacteria that are resistant to one antibiotic, thereby improving the effectiveness of treatment. Different combinations of antibiotics, like beta-lactams with macrolides or fluoroquinolones, can work better together, making them more effective than if they were used alone.[20] Other guideline issued by ATS/IDSA also approved the use of combination therapy for patients with severe community-acquired Pneumonia or when the risk of infection by resistant pathogens or atypical bacteria is high. In addition, contributing factors, such as older age, comorbidities (diabetes mellitus, chronic heart or lung disease), and immunocompromised situations also promotes the use of massive initial antibiotic therapy.[2]

The evidence in choosing empirical antibiotic for pneumonia is still limited. But some studies suggest monotherapy and combination antibiotic could be used for mild to moderate cases of pneumonia, meanwhile for severe case, combination antibiotic are mostly advised.[21] Studies conducted by Metersky et al. in 2007 and Rahmel et al. in 2017 showed that combination antibiotic therapy can improve the survival of patients with pneumococcal infection and reduce the risk of in-hospital mortality, as well as reduce the incidence of readmission within 30 days.[22,23] Previous study also revealed that patient with combination therapy had shorter length hospitalization than patient with monotherapy.[24] While polytherapy antibiotic may reduce the likelihood of treatment failure due to resistant organisms, the excessive use, paradoxically, can also contribute negative outcome. The aggressive use of broad-spectrum antibiotics can lead to adverse drug events, gut microbiota disruption, and furthermore, this approach can promote antimicrobial resistance, that still be a major global health concern. Therefore, the use of definitive antibiotic with specific action once the pathogen identified are strongly recommended.

Conclusion

This study successfully found a significant relationship between the severity of pneumonia and the type of empirical antibiotics given to pneumonia patients at Regional Hospital Denpasar. This finding emphasizes the importance of choosing the right antibiotic based on the severity of the disease to improve patient clinical outcomes. We expect the results of this study to serve as a reference for developing

clinical practice guidelines for pneumonia patients and health care providers are always encouraged to implement antibiotic stewardship programs to promote rational antibiotic use.

Conflict of Interest

The authors declare no conflict of interest.

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