Association between Anemia and Severe Pneumonia among Children 6-59 Months Old in RSUD Wangaya, Denpasar: A Cross Sectional Study

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Abstract

Background: Severe pneumonia dan anemia happened to many children under five years old. Anemia leads to hypercapnia and slowing down red blood cell maturation and facilitate ischaemic syndrome. In the other side, pneumonia may increase hepcidin that suppressed erythropoiesis, hence anemia could worsen pneumonia. The aim of this research is to find association of hemoglobin level and severe pneumonia under five years old.

Methods: Cross sectional study was done in medical record RSUD Wangaya Denpasar starting from May-August 2022. Data was taken from subject with severe and mild and moderate pneumonia age 6-59 months old that admitted to PICU and Kaswari ward from January 2020-June 2022. Variables processed in this study are gender, pneumonia severity, hemoglobin level, and length of stay

Result: This study admits 56 subjects that fulfilled inclusion and exclusion criteria. Boy and girls subjects are found equally (28 subjects equally in both groups). Severe pneumonia found in 18 (32.1%) subjects and 25 subjects (44.6%) has anemia. Length of stay for severe pneumonia is 4.83 ± 1.54 days. Hemoglobin level in severe pneumonia is 10.93±1,96 mg/dL and subjects with mild and moderate pneumonia is 11.69 ±1.41 mg/dL. The result of chi-square test between haemoglobin level and severe pneumonia is p= 0.26

Conclusions: This study shows that there is no correlation between hemoglobin level and severe pneumonia. Further study is needed since the correlation between them is still controversial.

Introduction

Pneumonia is an acute infection of upper respiration tract that involves one or both lungs, according to WHO. Pneumonia is most commonly caused by virus, bacteria, or fungal organisms.[1] Based on epidemiological study, severe pneumonia is one of the leading causes of morbidity and mortality in children under 5 years old, especially in developing countries. Estimated global incidence of pneumonia is 120 million cases in a year, which account for approximately 1.3 million death. Despite the better prognosis in higher income countries, there is still a substantial burden of this disease.[2] Some studies reported that hospitalized child has significant decrease in their quality of life, due to the restricted leisure time, anxiety, and stress. Similarly, the parents also experienced distress.[3,4]

Severe pneumonia presents as general symptoms with abnormality of respiration rates, wheezing, respiratory retractions, oxygen saturation <95%, and difficulty in swallowing food.[5] Risk factors of severe pneumonia in children under 5 years old includes low birth weight, prematurity, breastfeeding exclusivity, nutritional status, and comorbid diseases.[6] It is known that anemia associated as a risk factor of pneumonia. [7,8,9,10]

Anemia is a condition in which the number of red blood cells, serum iron or the hemoglobin concentration is lower than normal. According to WHO, children under 5 years old is diagnosed with anemia if the hemoglobin concentration is lower than 5 g/dL.[11] Iron deficiency anemia is a progressive condition. On young child, anemia is usually worsen by inadequate dietary iron intake by consuming low iron-rich foods after weaning onto solid foods. Beside iron, vitamin B12 and folic acids are also important diet nutrients that relates to anemia. Anemia causes oxygen deprived brain tissue which will disturb cognitive function, psychomotor growth and development.[8,11] Globally, 43% of children under 5 years old suffer from anemia. Children with anemia are significantly prone to stunting, delay in cognitive development, abnormal immunity, disability, and increased morbidity and mortality.[12]

Furthermore, anemia also causes hypercapnia and delay red blood cell maturation in the bone marrow therefore facilitates ischemic syndrome which worsens pneumonia. In turn, pneumonia leads to inflammatory anemia by increasing serum hispinin which suppresses erythropoiesis.[13]

Anemia may associated with pneumonia as it worsen pneumonia through the hypercapnia mechanism and also slow down the redcell maturation in bone marrow, therefore the hypoxic mechanism will eventually worsen pneumonia. In the other hand, pneumonia could cause or worsen anemia through the increased level of hepcidin that supressed erythropoiesis and will cause inflammatory anemia.[10] Some studies show association between anemia and pneumonia or severe pneumonia, but study done by Alsharkawy shows no association between anemia and severe pneumonia.[14] This study is done to find out the association between anemia and severe pneumonia in children age 6-59 months in Wangaya hospital, Denpasar Bali.

Material And Methods

This cross sectional study aimed to find the relationship between anemia and severe pneumonia in children ranged 6-59 months old in Wangaya Regional General Hospital. Patients were hospitalized between January 2020 and June 2022. The inclusion criteria are 6-59 months old children diagnosed with pneumonia who admitted into inpatient ward (Kaswari ward) or Pediatric Intensive Care Unit (PICU) in Wangaya Hospital. Exclusion criteria includes subject with a history of malignancy, underwent anti-neoplastic therapy, a history of thalassemia, severe malnutrition, other systemic conditions, and incomplete medical record data. Samples needed for this study is minimum 52 samples, while this study use 56 samples. Qualified samples are taken from hospital's medical record with consecutive sampling method, analyzed using SPSS version 27 with univariate and bivariate Chi-square test between anemia (hb <11.0) and severe pneumonia. We extracted patients' gender, pneumonia severity, hemoglobin level, and duration of hospital stay.

Result

Secondary data was obtained from patients admitted to Wangaya Regional General Hospital between January 2020 and June 2022, which was recorded in the hospital's medical record. A total of 56 samples are eligible according to the inclusion and exclusion criterias. Characteristics of the subjects included in this study are shown in **table 1.**

Table 1. Demography of the subjects

Characteristic	Frequency
Gender	
Male	28 (50%)
Female	28 (50%)
Age	
6-48 months	53 (94.7%)
49-59 months	3 (5.3%)
Birth Weight	
<2500 gr	4 (7.2%)
≥2500 gr	52 (92.8%)
Exclusive Breastfeeding	
Yes	38 (67.8%)
No	18 (32,2%)
Diagnosis	
Severe pneumonia	18 (32.1%)
Mild to moderate pneumonia	38 (67.9%)
Hemoglobin level	
Hb<11.0 (anemia)	25 (44.6%)
Hb≥11.0 (not anemia)	31 (55.4%)
Hospital stay	
Severe pneumonia	4.83 ± 1.54 days
Mild to moderate pneumonia	4.45 ± 2.20 days

There are same amount of male and female subjects in this study (28 subjects on both genders). Most of the subjects age 6-48 months (94.7%), meanwhile only 5.3% subjects age 49-59 months old. Among all subjects there are 4 subjects(7.2%) was born with birth weight under 2500 gr, while 52 subjects (92.8%) has birthweight ≥2500 gr. Thirty-eight subjects (67.8%) breastfed exclusively while the rest (32.2%) do not get exclusive breastfeeding. Most of the subjects were diagnosed with mild to moderate pneumonia (67.9%) and the rest of them (31.1%) are diagnosed with severe pneumonia. Almost half of the subjects were classified as anemia (44.6%) while the other half are not (55.4%). The length of stay for subjects with severe pneumonia is longer than those who have mild to moderate pneumonia (4.83 ± 1.54 days and 4.45 ± 2.20 days, respectively).

There was no significant correlation found between hemoglobin level and severe pneumonia (p=0.26), as shown **in table 2**. Moreover, it is worth mentioning that the 95% CI have crossed 1 (0.62 – 5.96), which implies that the odd ratio is not precise. Subjects in the mild to moderate pneumonia group has slightly higher hemoglobin level (11.69 ±1.41) compared to the severe group (10.93±1.96).

Table 2. Hemoglobin level and severe pneumonia distribution

Hemoglobin Level	Pneumonia Severity					
	Severe	Mild to Moderate	Total	p	OR	95% CI
Anemia	10 (55.56%	15 (39.47%)	25 (44.64%)	0.26	1.20	0.62 – 5.96
Not Anemia	8 (44.44%	23 (60.53%)	31 (55.36%)			

Discussion

This study shown that there is no significant relation between hemoglobin level and severe pneumonia (p=0.26; OR= 1.20; 95% CI: 0.62-5.96). Concurrent to the previous study by Alshaekawy, et al, who conducted a case control study that compared vitamin D, serum zinc, and serum iron on the severity of community acquired pneumonia, claimed that they found no significant correlation between both arms (p=0.24). Furthermore, Alshaekawy, et al, observed that the serum zinc and vitamin D is significantly correlated to pneumonia severity, and even found that both are protective factors toward pneumonia in children age 2-59 months old.[14] Several lab results that were correlated with severe pneumonia are abnormal neutrophil, lymphocyte, natrium, albumin, proteinuria, and RSV infection.[15] Meanwhile, a systemic review conducted by Preston, et al, found that only abnormal leukocyte level is significantly related to severe pneumonia, in specific, leukopenia as a mortality predictor of pneumonia.[16]

Anemia and pneumonia are two of the most common pathological diseases in younger population, and they both usually coexist. Children under 5 year old and pregnant mothers are very susceptible to anemia, especially in low income countries. There are various conditions that leads to anemia, such as micronutrients deficiency, acute or chronic infections, low socio-economy, demography, genetics, and immunohematology diseases.[17] Low

hemoglobin has been known to cause hypoxemia, therefore the alveolar macrophage has lower capacity to absorb iron from the red blood cells. This disturbance in the balance of immune system leads to worsening of the lung infections and promotes severe pneumonia.[18] Inflammation of the lung triggers the release of IL-6 and Activin B through STAT 3 and SMAD4 pathway. This pathway also increases the production of hepcidin. Hepcidin is a hormone that acts as regulator of serum iron and free iron in the blood through a mechanism that degrade cellular iron exporter. Abnormal increase in hepcidin causes lower amount of iron in the serum. Another hypothesis also suggested that this acts as the defense mechanism of the host, because serum iron could be an essential element required by the pathogens to multiply.[19]

Prevalence of children under 5 year old with anemia in Indonesia, according to UNICEF, is more than 38%. Another epidemiology data in 2014 suggested that the number could be higher than 60% in 6-35 months old population and as high as 80% in the 6-11 months old population.[20] Anemia and pneumonia are both very common in children under five years old, despite the controversy of its relationship to each another as well as the association with the severity of pneumonia.

There are some limitations of this study. First limitation is the small sample size. Presumably, it may be difficult to determine if the outcome is a true finding. We suggest further study with bigger sample size and longer duration to substantiate this study. The second one is that study did not analyze the association of other variable with the severe pneumonia.

Conclusion

There are no significant correlation between hemoglobin level and severe pneumonia in children aged 6-59 months old.

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