GSC Advanced Research and Reviews

eISSN: 2582-4597 CODEN (USA): GARRC2

Cross Ref DOI: 10.30574/gscarr

Journal homepage: https://gsconlinepress.com/journals/gscarr/

(RESEARCH ARTICLE)

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Risk Factors of Neonatal Pneumonia in Tertiary Hospital in Bali

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GSC Advanced Research and Reviews, 2022, 10(02), 009–013

Publication history: Received on 01 January 2022; revised on 06 February 2022; accepted on 08 February 2022

Article DOI: https://doi.org/10.30574/gscarr.2022.10.2.0044

Abstract

Neonatal pneumonia is one of the most common infection in neonates which can causes death. Neonatal pneumonia occurs in babies since birth until the age of 28 days. Several risk factors are known to increase the incidence of neonatal pneumonia. However, there still unconclusive results on these factors. The purpose of this study is to determine the risk factors of neonatal pneumonia in tertiary hospital in Bali. This case control study with case group consisted of 70 neonates with neonatal pneumonia while the control group consisted of 70 healthy neonates. Data was collected from level I, II and III neonatal care unit at Sanglah general Hospital in January-June 2021. Descriptive and analytical analysis were performed. Multivariate analyses with logistic regression showed PROM >18 hours (RO 11.2; 95%CI 2.87-44.13), smelly green amniotic fluid (OR 19.9; 95%CI 3.31-120.07), low birth weight (OR 4.4; 95%CI 1.31-14.86) and APGAR score <7 (OR 36.5; 95% CI 11.47-116.37) were statistically significant for the occurrence of neonatal pneumonia. Smelly green amniotic fluid, PROM >18 hours, low birth weight, and APGAR score <7 are risk factors of neonatal pneumonia.

Keywords: Neonatal pneumonia; Risk factors; Amniotic fluid; Birth weight

1. Introduction

Neonatal pneumonia is one of the most common infections in neonates which can causes neonatal death. Neonatal pneumonia occurs since birth until the age of 28 days [1]. Neonatal period is the most susceptible period to infection and contribute to major cause of morbidity and mortality. According to World Health Organization (WHO) report in 2013, the mortality of neonatal pneumonia in Indonesia (22.000) ranked eighth after India (174.000), Nigeria (121.000), Pakistan (71.000), China (48.000), Ethiopia (35.000), China (33.000) and Angola (26.000) [1]. The WHO also estimates that one in three newborn deaths is caused by pneumonia and more than two millions die each year worldwide [2]. Most of neonatal deaths due to pneumonia occur in developing countries [3].

Several risk factors are known to cause pneumonia but are still debated. Some of these risk factors include maternal fever, premature rupture of membranes (PROM) >18 hours, foul-smelling green amniotic fluid, mode of delivery, prematurity and low birth weight (LBW) [4].

Neonatal pneumonia will be diagnosed precisely by knowing and understanding the risk factors, which will directly affect the neonatal mortality rate. Several studies have found the unconclusive results regarding risk factors for neonatal pneumonia. There aren't many researches of neonatal pneumonia in Indonesia and it has never been performed in Sanglah General Hospital. The purpose of this study is to determine the risk factors of neonatal pneumonia in Sanglah General Hospital.

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2. Material and methods

This analytical study with case-control design conducted from January to June 2021. Data were collected restrospectively. Case group consist of neonates who had neonatal pneumonia while the control group consist of healthy neonates. Subjects will be excluded if suffer major congenital abnormalities and had incomplete medical record. Risk factor was assessed through medical record and samples were collected consecutively.

This research had been approved by the Research Ethical Committee of Udayana University/Sanglah Hospital (2362/UN12.2.2.VII.14/LT/2020) and also from Directorate General of Health Services Sanglah Hospital (LB.02.01/XIV.2.2.1/16615/2021).

3. Results

During the study period, 172 infants admitted to neonatal care unit and 32 infants were excluded, leaving 70 infants in each group.

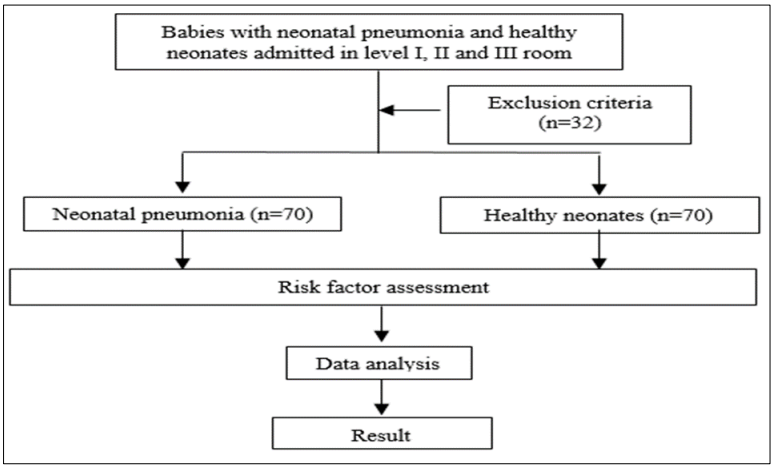

Figure 1 Study flow chart

Both groups were dominated by male infants, 60% for case group and 54.3% for control group. Details on the characteristics of sample are shown in Table 1.

Table 1 Characteristics of the research subjek

Characteristic	Neonatal pneumonia (n = 70)	Healthy neonates (n = 70)
Gender, n (%)		
Male	42 (60)	38 (54.3)
Female	28 (40)	32 (45.7)
Maternal age, n (%)		
<18 and >35 years old	29 (41.4)	24 (34.2)
18-35 years old	41 (58.6)	46 (65.8)
Gravida, n (%)		
Primigravida	46 (65.7)	32 (45.8)
Multigravida	24 (34.3)	38 (54.2)
Maternal education level		
Low	27 (38.5)	20 (28.5)

High	43 (61.5)	50 (71.5)
Status of patients, n (%)		
Referral	43 (61.4)	0 (0)
Non referral	27 (38.6)	70 (100)

Risk factors for maternal fever >38°C, PROM, foul-smelling with green amniotic fluid, spontaneous delivery, prematurity, low birth weight, gender, gravida, maternal age were analyzed using chi-square test and presented in odds ratio (OR) and 95% confidence interval (CI) as shown in Table 2.

Table 2 Bivariate analysis of risk factors for neonatal pneumonia

Variables	Neonatal Pneumonia n = 70	Healthy Neonates n = 70	OR (95% CI)	p-value
Maternal fever, >38°C, n (%)	13 (18.6)	3 (4.3)	5.1 (1.38 -18.76)	0.017
PROM >18 hours, n (%)	18 (25.7)	5 (7.1)	4.5 (1.56-12.93)	0.006
Spontaneous delivery, n (%)	41 (58.6)	28 (40)	2.1 (1.08-4.16)	0.043
Prematurity, n (%)	36 (51.4)	13 (18.6)	4.6 (2.16-9.96)	<0.001
Birth weight, <2500gram, n (%)	30 (42.9)	8 (11.4)	5.8 (2.42-13.94)	<0.001
Foul-smelling green amniotic fluid, n (%)	15 (21.4)	2 (2.9)	9.2 (2.03-42.29)	0.002
APGAR score <7, n (%)	47 (67.1)	6 (8.6)	21.7 (8.23-57.74)	<0.001
Gender, male, n (%)	42 (30)	38 (27.1)	1.2 (0.64-2.47)	0.608
Gravida, primigravida, n (%)	46 (32.9)	42 (30)	0.7 (0.39-1.55)	0.600
Maternal age, <18 dan >35, n (%)	25 (17.9)	28 (20)	0.8 (0.42-1.65)	0.727

Multivariate analysis with logistic regression was performed on variables with p-value <0,25 in bivariate analysis. In this multivariate analysis, the prematurity variable was not included because of inter-collinearity effect with the low birth weight variable. Premature rupture of membrane (PROM) >18 hours, low birth weight, foul-smelling green amniotic fluid, and APGAR score <7 are statistically meaningful for the occurrence of neonatal pneumonia (table 3).

Table 3 Multivariate analysis of risk factors for neonatal pneumonia

Variables	Exp (B)	95% CI	p-value
Maternal fever >38°C	2.1	0.33-12.64	0.443
PROM >18 hours	11.2	2.87-44.13	<0.001
Spontaneous delivery	2.1	0.69-6.21	0.191
Low birth weight	4.4	1.31-14.86	0.009
Foul-smelling green amniotic fluid	19.9	3.31-120.07	0.001
APGAR score <7	36.5	11.47-116.37	<0.001

4. Discussion

This study found the proportion of neonatal pneumonia was higher in males (60%) with male-to-female ratio 1.5:1. Align with previous study that found the incidence of neonatal pneumonia was higher in males with ratio 1.1:1 [6].

Several studies also showed same result this may be due to the factors that regulate the synthesis of globulins located on the X chromosome. Males only have one X chromosome so they are likely to have lower immunological protection than females [5-7].

Asphyxia with APGAR scores <7 was found in the majority of neonatal pneumonia, which was 67.1%, and became significant risk factor of neonatal pneumonia. APGAR score is a valid and rapid index to assess cardiorespiratory adaptation at birth. According to Tochie et al., an APGAR score <7 in the first minute was associated with increased incidence of neonatal pneumonia [8].

Age has important influence on the health habit of pregnant women, especially pregnant women in third trimester. This is in accordance with Rinata et al, whom stated that pregnancy at too young and too old age are high-risk pregnancy which increased morbidity and mortality in both mother and fetus. Moreover Caroline et al found that mothers aged <18 years and >35 years were risky for delivery babies with respiratory distress. In this study, the incidence of neonatal pneumonia was common in mothers aged 18-35 years. This is in accordance with Condo et al., which found that maternal age did not affect the incidence of respiratory disorders. However, a study in India showed infants with neonatal pneumonia were born by mothers aged > 30 years.

Pregnancy state can affect mother's psychological health, especially in final trimester of pregnant women who will face the birth process [4]. In pregnant women with primipara, the mother is still inexperienced about the process of pregnancy until birth [6]. The risky pregnancy and childbirth are the first and fourth children. In this study, there were more incidences of neonatal pneumonia in primipara, 65.7%. Based on Chandrasekhar et al. 25 out of 40 primipara mothers deliverd babies with respiratory disorders. While research in Italy showed different results, gravida did not affect the incidence of respiratory disorders in newborns [5].

Foul-smelling green amniotic fluid also became the risk factor that influenced the occurrence of neonatal pneumonia in this study. This is in accordance with a study in India that found foul-smelling amniotic fluid could increase the risk of neonatal pneumonia [7]. The smell of green amniotic fluid indicates the state of hypoxia, stress or infection in fetus [8]. Some studies showed that the greener the color, the severe the grade of infection. Meconium in amniotic fluid can cause infections including neonatal pneumonia and increase neonatal morbidity [9].

Premature rupture of membranes increase the contamination of germs in fetus and this increase the occurrence of neonatal pneumonia [10]. The incidence of premature rupture of membranes predics the occurrence of infections in newborns including the occurrence of neonatal pneumonia [11]. In this study, the results showed that premature rupture of membranes was one of the risk factors for neonatal pneumonia (p =<0.001). Premature rupture of membranes was found to be one of the predictors of neonatal pneumonia [11]. The incidence of infection in newborns increases with duration of membranes rupture [10]. This is also in accordance with the study by Malinowski who found PROM as significant factor in the occurrence of neonatal pneumonia [12]. Research Puopolo et al. also found linear relationship between the incidence of infection in neonates and duration of PROM. The highest data on infection in neonates was found in premature rupture of membranes 25 hours before the first uterine contraction [9]. This is different from Meizikri's research, which did not find significant relationship (p =0.616) [13]. This difference is due to the factor of duration in PROM was not assessed in this study.

The risk of developing neonatal pneumonia increases with decrease of gestational age. The immaturity of neonatal immune system, impaired phagocytic ability of neutrophils and monocytes and decreased maternal antibodies contribute to infection in preterm infants and increased risk of neonatal pneumonia. The alternative pathway complement system in preterm infants is also ineffective, causing disruption of body defense against bacteria. Paulopo found that the incidence of neonatal pneumonia in neonates was higher at younger gestational age and decreased with older gestational age [9]. In bivariate analysis, it was found that prematurity was a risk factor for neonatal pneumonia (p=<0.001). This is in accordance with Gessner who found that neonates born at 34 weeks were having 7.6 times greater risk of neonatal pneumonia than neonates born at 38-39 weeks [12].

Another risk factor is birth weight <2500 grams. Low birth weight babies have low immune system function. This low immune system will cause LBW to be at high risk of infection, especially pneumonia. The respiratory control center in LBW is not perfect thus if oxygen is low, anaerobic bacteria can develop easily causing infection and eventually cause neonatal pneumonia [11]. In this study, it was found that LBW was risk factor for neonatal pneumonia (p=0.000). Yang also showed neonatal pneumonia was correlated with birth weight. It was found that the incidence of neonatal pneumonia was higher in infants with low birth weight [10]. Wojkowska also showed that the lower the birth weight, the higher possibility of developing neonatal pneumonia [13]. Herman (2002) also showed that LBW had 1.9 times risk of developing neonatal pneumonia, but this was not statistically significant which the RO value was 1.9 (95%CI 0.7-4.9)

and the p-value=0.175. In the other hand, Walukow et al. found that the highest incidence of neonatal pneumonia was found in birth weight 2500-4000 grams[6]. This was supported by Eviana (2008) who found that the incidence of neonatal pneumonia was higher in infants with birth weight >2500 grams.

5. Conclusion

Foul smelling green amniotic fluid, PROM >18 hours, low birth weight and APGAR score <7 are statistically significant risk factor for the occurrence of neonatal pneumonia in Sanglah General Hospital.

Compliance with ethical standards

Acknowledgments

This research was self-sponsored by authors. Hereby the authors acknowledged Sanglah Central General Hospital for providing access for the collection of information.

Disclosure of conflict of interest

No Conflict of interest to disclose.

Statement of informed consent

Informed consent was obtained from Ethical Committee of Udayana University/Sanglah Hospital and Directorate General of Health Services Sanglah Hospital

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