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The presentation and outcome of pneumonia in neonates: a case series study

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Abstract

Background and objectives: Pneumonia is defined as inflammation of the lung parenchyma. The aim of this study is to identify types of neonatal pneumonia (congenital or acquired), presentations and outcome. **Methods:** This study is a case series study done in the neonatal care unit of both Rapareen Teaching Hospital and Maternity Teaching Hospital in Erbil City from August 2018 to March 2019. Fifty cases were enrolled, including preterm, term and post-term neonates who were diagnosed as pneumonia. Majority of cases were treated with empirical antibiotics (ampicillin plus cefotaxime or ampicillin plus gentamycine), and we followed them till discharge in order to know the outcome of them (alive or dead). **Results:** Fifty neonates with neonatal pneumonia were included in this study. Their mean age + SD were 13 + 6.76 days, ranging from 2 to 29 days, the majority of neonates (74%) were males and 80% were acquired pneumonia. Among admitted neonates, 70% presented with respiratory distress. Death rate was higher in late-onset pneumonia. **Conclusions:** We confirmed that acquired pneumonia, is more prevalent than congenital pneumonia, most of them presented by respiratory distress. The death rate was more in male neonates, premature, low birth weight neonates and among neonates who presented with apnea.

Key words: Male gender,Neonatal pneumonia, Respiratory distress.

Introduction

Pneumonia is defined by World Health Organization (WHO) as a form of acute respiratory infection. It accounts for 16% of all deaths of children under 5 years old[1]. The greatest risk of death from pneumonia in childhood is in the neonatal period[2].

Neonatal pneumonia categorized as early onset pneumonia which is also called Congenital pneumonia, and late-onset which is also called Acquired pneumonia[2]. There are various definitions of congenital pneumonia, some authors say its pneumonia which occurs in the first 48 hours of life, others have suggested first seven days of life. It's often due to pathogens aspirated by the neonate from the intrauterine environment or from the birth canal during vaginal delivery[3]. Late-onset pneumonia is pneumonia which occurs from 8 to 29 days of life, and is often caused by pathogens encountered in the postnatal environment[4].

Clinical signs of neonatal pneumonia are not specific, may present with respiratory distress of various degree: cough, apnea, temperature instability and poor feeding.

Pneumonia is diagnosed based on a combination of perinatal risk factors, signs of respiratory distress, positive laboratory studies and radiological signs[5].

In the first 7–10 days of life, pneumonia can be treated by using empirical antibiotics (combination of ampicillin plus gentamycin or ampicillin plus cefotaxime)[6]. Pneumonia which is manifested after this time can be treated empirically with ampicillin or vancomycin plus gentamycin or cefotaxime[7,8]. The aim of this study was to determine types of neonatal pneumonia (congenital or acquired), their presentations and outcome (alive or dead).

Patients and Methods

This study is a case series study, done in the neonatal care unit of both Rapareen Teaching Hospital and Maternity Teaching Hospital in Erbil city from August 2018 to March 2019. Fifty cases were collected, including preterm(less than 37 weeks of gestational age), term (37 to 42 weeks) and post-term (more than 42 weeks of gestation).

Patients admitted due to other causes of respiratory distress such as transient tachypnea of the newborn, pneumothorax and congenital anomalies of the chest were excluded from the study.

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Information taken from the mother were age, parity (whether it's primiparous, multiparous [having 2 to 4 babies] or grand multiparous [equal and more than 5 babies]), consanguinity, illness during pregnancy, leaking liquor, duration of rupture of membrane, intrapartum antibiotic use, type of delivery by normal vaginal delivery or cesarean and place of delivery.

Information related to the newborns was postnatal and gestational age, gender, clinical presentation, history of previous admission to the neonatal care unit, current investigations and treatment received.

For each neonate, we did investigations including complete blood count, C-reactive protein (CRP), blood culture, and chest X-ray, and for some of them, specific investigations were done such as Echocardiography. Results of CRP regarded as positive if it was more than 6, and blood culture was taken in the first day of admission.

Normal White Blood Cell (WBC) count in neonates is according to the age: in the first 7 days, the total WBC count ranges from 9-30 $\times 10^3$cell/μL; in 7 to 14 days of age, ranges from 5 -21$\times 10^3$ cell/μL; from 14 to 60 days of age, ranges from 5-20 10^3cell/μL.

All neonates were treated by giving intravenous antibiotics, first empiric antibiotics (combination of ampicillin plus gentamycin or ampicillin plus cefotaxime), then according to the result of culture and sensitivity after two days. Follow up was done till the time of discharge to see the duration of stay in the hospital and the outcome (alive or dead).

This study was approved by the research ethics committee of the Kurdistan board of medical specialties. Informed oral consent was obtained from the mother before being enrolled in the study.

Data were analyzed using the Statistical Package for Social Sciences (SPSS, version 22). Chi-square test of association was used to compare proportions. Fisher's exact test was used when the expected count of more than 20% of the cells of the Table was less than 5. A p-value of $\leq$ 0.05 was

considered statistically significant. The relative risk (RR) was calculated to show the strength of association between the outcome and the risk factors.

Results

Fifty neonates with pneumonia were enrolled in the study. Their mean age + SD were 13 + 6.76 days, ranging from 2 to 29 days. The median age was 11.5 days. Table 1 shows that 20% of the neonates were less than 7 days, and 80% aged 8-29 days. The majority (74%) of the patients was male; other variables are shown in Table

1. Regarding the type of pneumonia, it was acquired in the majority (80%) of the patients.

Table (1): Basic characteristics of the neonates with pneumonia.

Variables		No.	(%)
Age (days)	1-7	10	(20.0)
	8-29	40	(80.0)
Gender	Male	37	(74.0)
	Female	13	(26.0)
Gestational age	Term	30	(60.0)
	Preterm	12	(24.0)
	Post-term	8	(16.0)
Weight (Kilograms)	< 2.5	13	(26.0)
	≥ 2.5	37	(74.0)
Type of pneumonia	Congenital 1-7	10	(20.0)
	Acquired 8-30	40	(80.0)
Total		50	(100.0)

Table 2 presents the Mothers characteristics. It shows that 22% of the mothers were primiparous, 56% were multiparous, and 22% were grand-multiparous, and other variables are shown in the Table 2.

Table (2): Basic characteristics of the mothers.

Variables		No.	(%)
Parity	Primiparous	11	(22.0)
	Multiparous	28	(56.0)
	Grand multiparous	11	(22.0)
Illness during pregnancy	None	29	(58.0)
	Pregnancy-induced HTN	9	(18.0)
	Diabetes mellitus	6	(12.0)
	Urinary tract infection	6	(12.0)
Leaking liquor	Yes	14	(28.0)
	No	36	(72.0)
Duration of rupture membrane in hours	< 24	36	(72.0)
	≥ 24	2	(4.0)
Intrapartum fever	Yes	6	(12.0)
	No	44	(88.0)
Mode of delivery	NVD	26	(52.0)
	CS	24	(48.0)
Total		50	(100.0)

Presentation of pneumonia was respiratory distress in majority of cases (70%), reluctance to feeding in 20% of the cases, and 16% of cases had a fever.

Complete blood count was normal in 48% of cases, leukocytosis in 32% of cases (higher than normal according to their age), and 20% with neutropenia for their age. The C-reactive protein was positive (more than 6 regarded as positive) in 74% of the cases, and blood culture was positive in 10% of the cases. Chest X-Ray (CXR) showed that 94% of the patients had opacity.

More than two thirds (68%) of the patients stayed 5-9 days in the hospital, and 28% stayed 10 days or more. Mean period of stay in the hospital was 7.9 days.

All patients received more than one antibiotic: 46% received ampicillin and 3rd generation cephalosporin (cefotaxim or ceftriaxone); 46% received vancomycin and 3rd generation cephalosporin (cefotaxim or ceftriaxone) because of their occurrence after 7 days of life; 6% received ampicillin and gentamycin; 2% received ampicillin and meropenem (according to the result of blood culture).

Table 3 shows that 70% of the patients presented with respiratory distress. The difference between the two types of pneumonia was not significant (p-value > 0.999). The Table shows that 12.5% of patients with acquired pneumonia presented with cyanosis, compared with 0% of patients with congenital pneumonia (p-value = 0.569).

Table (3): Relation between mode of a presentation and type of pneumonia.

Variables		Congenital No.(%)	Acquired No. (%)	Total No. (%)	p-value
Respiratory distress	Yes	7 (70.0)	28 (70.0)	35 (70.0)	
	No	3 (30.0)	12(30.0)	15 (30.0)	>0.999*
Cyanosis	Yes	0 (0.0)	5 (12.5)	5 (10.0)	
	No	10 (100.0)	35 (87.5)	45 (90.0)	0.569*
Apnea	Yes	0 (0.0)	3 (7.7)	3 (6.1)	
	No	10 (10.0)	36 (92.3)	46 (93.9)	>0.999*
Fever	Yes	0 (0.0)	8(20.5)	8 (16.3)	
	No	10 (100.0)	31 (79.5)	41 (83.7)	0.180*
Reluctance to feed	Yes	1 (10.0)	9 (22.5)	10 (20.0)	
	No	9(90.0)	31 (77.5)	40 (80.0)	0.663*
Total		10 (100.0)	40 (100.0)	50 (100.0)	

*By Fisher's exact test.

The proportion of death among our patients was 8%. No significant association was detected between the outcome with the presence of respiratory distress (p-value > 0.999), cyanosis (p-value > 0.999), grunting (p-value = 0.571), and reluctance to feed (p-value > 0.999) as presented in Table 4, which also shows that the death rate (66.7%) was significantly high among those with apnea (p-value = 0.008).

Table (4): The outcome depending on the severity of pneumonia and presence of associated sepsis.

Variables	``	Outcome			
		Alive	Dead	Total	
		No. (%)	No. (%)	No.	P-value
Respiratory	Yes	32 (91.4)	3 (8.6)	35	
distress	No	14 (93.3)	1 (6.7)	15	>0.999*
Cyanosis	Yes	5 (100.0)	0 (0.0)	5	
	No	41 (91.1)	4 (8.9)	45	>0.999*
Apnea	Yes	1 (33.3)	2 (66.7)	3	
	No	45 (97.8)	1 (2.2)	46	0.008*
Fever	Yes	9 (100.0)	0 (0.0)	8	
	No	37 (90.2)	4 (9.8)	41	>0.999*
Grunting	Yes	10 (100.0)	0 (0.0)	10	
	No	36 (90.0)	4 (10.0)	40	0.571*
Reluctance to	Yes	9 (90.0)	1 (10.0)	10	
feed	No	37 (92.5)	3 (7.5)	40	>0.999*
Total		46 (92.0)	4 (8.0)	50	

*By Fisher's exact test.

Table 5 shows that the proportion of death was significantly high (23.1%) among neonates with LBW, compared with 2.7% among those with normal weight, and proportion of death was also high among male neonates (10.8%) compared with female neonates (0%). No significant association was detected between the outcome with gestational age, and type of pneumonia.

Table (5): Relation between Relative risk of the outcome and variables.

Variables	Outcome					
	Alive	Dead	Total	RR**	95% CI of RR	p-value.
	No. (%)	No. (%)	No.			
Age of child (days)						
1-7	10 (100.0)	0 (0.0)	10	1.105	0.962-1.270	
8-14	17 (89.5)	2 (10.5)	19	0.989	0.804-1.217	0.827*
15-29†	19 (90.5)	2 (9.5)	21			
Gender						
Male	33 (89.2)	4 (10.8)	37	0.892	0.797-0.998	0.561*
Female†	13 (100.0)	0 (0.0)	13			
Gestational age (weeks)						
Term	29 (96.7)	1 (3.3)	30	0.967	0.905-1.033	
Preterm	9 (75.0)	3 (25.0)	12	0.750	0.541-1.040	0.057*
Post-term†	8 (100.0)	0 (0.0)	8			
Weight (Kg)						
< 2.5	10 (76.9)	3 (23.1)	13	0.791	0.584-1.070	0.049*
≥ 2.5†	36 (97.3)	1 (2.7)	37			
Type of pneumonia						
Congenital	10 (100.0)	0 (0.0)	10	1.111	1.002-1.232	0.571*
Acquired†	36 (90.0)	4 (10.0)	40			
Parity						
Primipara	9 (81.8)	2 (18.2)	11	0.900	0.644-1.259	
Multipara	27 (96.4)	1 (3.6)	28	1.061	0.868-1.296	0.219*
Grand multipara†	10 (90.9)	1 (9.1)	11			
Leaking liquor						
Yes	13 (92.9)	1 (7.1)	14	1.013	0.850-1.207	>0.999*
No†	33 (91.7)	3 (8.3)	36			
Duration of rupture membrane (hours)						
< 24	32 (88.9)	4 (11.1)	36	0.889	0.792-0.998	> 0.999*
≥ 24	2 (100)	0 (0.0)	2			
Intra-partum fever						
Yes	6 (100.0)	0 (0.0)	6	1.108	1.002-1.225	>0.999*
No†	40 (90.9)	4 (9.1)	44			
Mode of delivery						
NVD	22 (84.6)	4 (15.4)	26	0.846	0.718-0.997	0.111*
C/S†	24 (100.0)	0 (0.0)	24			
Total	46 (92.0)	4 (8.0)	50			

*By Fisher's exact test.

**RR: Relative risk of the outcome 'alive' for a category compared with the reference category.

†Reference category.

The probable maternal risk factors were not associated significantly with the outcome, for example, parity (p-value = 0.219), leaking liquor (p-value > 0.999), intrapartum fever (p-value > 0.999), intra partum antibiotics (p-value > 0.999), and mode of delivery.

Discussion

In the current study, majority of neonates were male (74%), and the proportion of death was high among male neonates (4 deaths). This is similar to another study that showed the male gender is a significant risk factor for neonatal infections[8].

The study showed that the proportion of death was higher in preterm and Low Birth Weight (LBW) babies. This is consistent with other studies that shows mortality rate for the LBW and preterm babies were higher than full term and normal birth weight babies[9]. Prematurity is associated with an incomplete maturation and/or function of the innate immune system resulting in an increased likelihood of infections[10, 11].

In our study, parity was not significantly associated with an increased incidence of neonatal pneumonia, which is

not consistent to that found in other studies, such as case study done by Siakwa who showed that maternal parity was strongly related to the risk of neonatal infections including pneumonia[12]. It is expected that multiparity of mother would enhance mothers' knowledge on how to care for the newborn and enhance hygienic practices to prevent being diseased compared to primi mothers[13].

Mode of delivery didn't show a significant difference in relation to neonatal pneumonia in our study, this is the same as another study done by Siakwa where they found that mode of delivery did not relate to neonatal pneumonia[12]. This disagrees with a study done in Indonesian by Utomo which found cesarean section to be associated with increasing risk of developing neonatal pneumonia[8].

In the study, we found that some maternal risk factors like maternal hypertension, gestational diabetes, and consanguinity between parents were not significant in the outcome of neonatal pneumonia, and that's proved in other research's[14,15]. In current study, acquired pneumonia was more common (80%) than congenital pneumonia, as with improved obstetrical management and use of intrapartum antimicrobial therapy, early-onset neonatal infections are becoming less frequent[16]. The study showed that respiratory distress was the most common cause of admission (70%). Respiratory distress was also a risk factor for death, same like another study done by Mathur which shows that 83.4% of neonates were admitted because of pneumonia and presented with respiratory distress, and they were 2-4 times more likely to die than those without respiratory distress[17].

The death rate was high among neonates that presented with apnea (2 deaths among total 4 deaths), which is similar to another study done by Nissen MD who revealed that 35% of preterm and 22% of term infants who died after apneic episodes had pneumonia[2].

In regard to the proportion of death in our study, it was exclusively higher in acquired pneumonia, which is similar to a study done by Ballot who reported higher case fatality rate in late-onset infections (19.6%) as compared to early-onset infections (6.3%)[18]. In contrast to another review done by T Duke, he shows that mortality in congenital pneumonia is much higher (74%) than that of acquired pneumonia[3].

There is a good response to empirical antibiotics in our neonatal care units as nearly half of our cases (51%) received empirical with good outcome. If compared to another study which revealed that a significant concern with nosocomial infection is that the organisms are increasingly resistant to common antibiotics such as ampicillin and gentamycin[19].

Conclusions

In the current study, we confirmed that acquired pneumonia is more common than congenital pneumonia, and most of them were presented by respiratory distress. Death rates were more common among male, premature, low birth weight neonates and among neonates who presented with apnea. We confirmed that there is a good response to empirical antibiotics among our neonatal intensive care units.

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