BENHA MEDICAL JOURNAL bmj

Print ISSN 1110-208X

Online ISSN 2357-0016

Original article

Factors Associated with Neonatal Pneumonia and its Mortality

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Received: 1 September 2024

Accepted:6 December 2024

Abstract

Background: Neonatal pneumonia is a serious infection of neonates, which accounts for nearly six percent of the neonatal deaths globally. Neonatal pneumonia contributes substantially to neonatal illnesses and related mortality. **This study aimed to** identify risk factors and mortality predictors associated with neonatal pneumonia in Benha University hospitals. **Methods:** This prospective observational study was carried on 100 neonates, admitted to neonatal intensive care unit, with clinical and radiological features suggestive of pneumonia. All studied cases underwent complete clinical examination, routine laboratory investigation, blood culture and radiological investigations (chest x ray and CT if needed). **Results**: The length of NICU stay in days ranged from 10 to 35 days with a mean of 23.7 ± 7.35 days. There were 37 (37%) cases required MV and additionally, 13 (13%) cases required re-intubation. The univariate logistic regression revealed that maternal age, GA, parity, mode of delivery, neonatal age, sex, birth weight, preterm birth, respiratory distress, prematurity, pneumonia, sepsis and jaundice were significant predictors for the need of MV. The multivariate logistic regression revealed that mode of delivery, neonatal age, sex, birth weight, preterm birth, respiratory distress, prematurity, pneumonia, sepsis and jaundice were the only significant predictors for the need of MV. **Conclusion:** predictor of increase mortality of neonatal pnumonia were maternal age, GA, parity, mode of delivery, neonatal age, sex, birth weight, preterm birth, respiratory distress, prematurity, pneumonia, sepsis and jaundice. Klebsiella spp. and Acinetobacter were the most detected organisms in the blood culture.

Keywords: Factors, Neonatal, Pneumonia, Mortality.

Introduction

The first month of life, also called the neonatal period, is the most crucial time for the survival of a child. Globally, around 2.5 million neonates died in 2018 (nearly 7000 deaths per day), of which one-third occurred on the first day of life. With a neonatal mortality rate of 22.7 per 1000 live births(1). Neonatal pneumonia is a serious infection of neonates, which accounts for nearly six percent of the neonatal deaths globally(2).

Neonatal pneumonia, which is a major component of neonatal sepsis, contributes significantly to neonatal illnesses and mortality. The high mortality and morbidity can be attributed to the complex and overlapping diagnosis of neonatal pneumonia and neonatal sepsis. The problem is disguised by diseases such as hyaline membrane and compounded by injudicious use of antibiotic therapy leading to resistance or failure and other factors posing challenges in initiating and managing treatment(3).

Pneumonia-specific child mortality and morbidity can be tackled effectively by early detection, effective case management, and timely referral. Although effective case management is important for pneumonia control among children, barriers on the supply side, viz., lack of health system infrastructure and unavailability of healthcare workers, demand side issues such as community-specific socio-cultural barriers, healthcare opinions and experiences, and other barriers such as cost and complexity of treatment negatively affect the potential of the country in reducing the burden of neonatal pneumonia(4).

Some of the major risk factors associated with pneumonia are malnutrition, economic insufficiency, inaccessibility to healthcare services, unsafe child-rearing practices, and household air pollution(5). In neonates, poor prenatal care, home delivery, fever at birth, maternal urinary tract infections, and prolonged rupture of membrane were found as notable risk factors for neonatal pneumonia(6). It is imperative to identify and eliminate risk factors associated with neonatal pneumonia in order to reduce its high prevalence and associated mortality, and to implement appropriate interventions to improve neonatal survival (7).

The purpose of this study was to identify risk factors and mortality predictors associated with neonatal pneumonia in Benha University hospitals.

Patients and methods

This prospective observational study was carried out on 100 neonates, admitted to NICU at Benha University Hospitals with clinical and radiological features suggestive of pneumonia, during the period from March 2023 to September 2023.

An informed written consent was obtained from the parents or neonates' guardians, as they received an explanation of the purpose of the study and had a secret code number. The study was done after being approved by the Research Ethics Committee, Faculty of Medicine, Benha University. **(Approval code: MS 5-3-2023)**

Inclusion criteria were both sexes, age <28 days, and neonates with clinical and radiological features suggestive of pneumonia, having tachypnea, respiratory distress (chest retractions/grunting), and evidence of pneumonia on chest X-ray. Nodular or coarse, patchy non-homogenous infiltrates, air bronchogram, lobar, multi-lobar, or segmental consolidation were considered radiological evidence of pneumonia(8).

Exclusion criteria Neonates with meconium aspiration syndrome were excluded, as meconium aspiration causes respiratory distress primarily due to mechanical effects by obstructing small airways and leading to atelectasis. This study focuses mainly on pneumonia as an infection rather than a mechanical issue. Additionally, neonates with respiratory distress developing within the first 2 hours of life and resolving within 12 hours, those with major congenital malformations, or those admitted for >24 hours to another hospital or receiving antibiotics prior to admission were also excluded.

All studied cases were subjected to the following: Detailed history taking: including [Personal history of mother; Age, sex, residence and socio-economic status, history of fever, history of corticosteroids intake, medical history, history of antenatal care routine, arity, health status of the other siblings and family history, **Prenatal history**: Maternal risk factor during pregnancy, fetal risk factor, post-natal including any symptoms which suspect pneumonia and time of appearance, newborn care, neonatal sex, place, mode of delivery and gestational age, neonatal complications: hyperthermia, hypothermia, hypoglycemia, and anemia and their management, presence of congenital anomalies, initial and final diagnosis, any investigation and any operation or procedure done during incubation]. **Clinical presentation of pneumonia** as fever, tachypnea and respiratory distress and auscultation of the chest. **Complete clinical examination included general and local examination:** [General examination included conscious and vital signs as pulse, blood pressure, capillary filling time, respiratory rate and temperature and local systematic examination], **Routine laboratory investigation:** [Complete blood count (CBC), Showing total leukocyte count either >30,000 or <5000 per ml, C-reactive protein (CRP), Alanine aminotransferase (ALT) and Aspartate aminotransferase (AST), Serum urea and creatinine, Arterial blood gases (ABG)

and serum electrolytes (Na, K, Ca), and Blood culture].

Lower respiratory tract sample (Sputum or endotracheal): Sputum samples were taken early in morning: Respiratory specimens were collected either by sputum induction or cough swab technique. Induced sputum samples were taken as previously described by Zar et al. (9). Patients were pretreated with inhaled salbutamol delivered by a nebulizer device, followed by hypertonic saline 5.0% for 10 min. Sputum samples were then obtained by aspirating the nasopharynx through the nostrils with a disposable mucus extractor or by expectoration if the child was old enough to produce an adequate sputum sample. Cough swab was done by nebulization with normal saline first, and then, gag reflex was stimulated by irritation of the uvula to initiate coughing. At the same time, a sterile swab was put in front of the mouth droplets without touching the posterior pharynx(10).

Radiological investigations:

Chest X-ray: The neonates were labeled as RDS if they developed respiratory distress within six hours and chest X-ray showed one or more of the following: Reticulogranular pattern and ground glass opacity. Hyperinflation, prominent perihilar markings and interlobar fissure. Patchy infiltrates with atelectasis).

CT chest if needed: Respiratory distress in the neonates is documented as one or more signs of increased effort of breathing (such as nasal flaring, tachypnea, chest retractions, or grunting), but sometimes the diagnosis of neonatal sepsis was made with the following criteria: Clinical signs of possible serious bacterial infection, according to the Young Infants Clinical Signs Clinical Study criteria of WHO's Integrated Management of Childhood Illness (IMCI) guidelines, are defined as the presence of any one of the following: history of difficulty feeding, history of convulsions, movement only when stimulated, respiratory rate of 60 or more breaths per minute, severe chest retractions, or a temperature of 37.5°C or higher or 35.5°C or lower.

Neonates who presented to the NICU with a diagnosis of sepsis within 72 hours of birth were labeled as EONS, while those who came in after 72 hours of birth are labeled as having late onset of neonatal sepsis (LONS). The diagnosis of respiratory distress syndrome (RDS) was made when a neonate was premature and had clinical criteria of rapid breathing, cyanosis, grunting, and chest indrawing, decreased air entry bilateral on the lung fields, and low saturation of oxygen with pulse oximetry, chest X-ray examination with characteristic findings for RDS, and onset of symptoms shortly after birth. The chest typically appears barrel-shaped, with an increased anterior-posterior diameter because of overinflation. On auscultation, there were rales and rhonchi. These signs usually occur immediately after birth.

Perinatal asphyxia was considered when the 5th APGAR score is <7 or a neonate who did not cry or needed resuscitation. For this study the definition of perinatal asphyxia defined by the national protocol with 5-minute Apgar score less than 7. For those neonates with no documentation on APGAR score, if the neonate did not cry immediately after birth; and if the neonate developed seizure unexplained due to other causes, had respiratory distress, floppiness, decreased level of mentation, presence of seizure, and depressed or absent neonatal reflexes.

Neonatal mortality rate:

Refers to the number of deaths in less than 28 days of age per 1000 live births.

Statistical analysis

Statistical analysis was done by SPSS v28 (IBM Inc., Armonk, NY, USA). Quantitative variables were presented as mean and standard deviation (SD). Qualitative variables were presented as frequency and percentage (%). Logistic regression is also used to estimate the relationship between a dependent variable and one (univariate) or more (multivariate) independent variables. A two tailed P value < 0.05 was considered statistically significant.

Results

Table 1 shows the maternal baseline characteristics, maternal risk factors, and clinical examination of maternal vital signs.

Table 2 shows the neonatal baseline characteristics, risk factors and laboratory investigations.

The Apgar score at 1 minute ranged from 4 to 6, with a mean of 5.2 ± 0.76. The Apgar score at 5 min ranged from 5 to 8, with a mean of 6.5 ± 1.13. Regarding the blood culture findings, Acinetobacter was detected in 27 (27%) cases, coagulase-negative staphylococci was detected in 5 (5%) cases, E. coli was detected in 14 (14%) cases, Enterobacter was detected in 3 (3%) cases, Klebsiella spp. was detected in 29 (29%) cases, Pseudomonas aeruginosa was detected in 17 (17%) cases, and Staphylococcus aureus was detected in 5 (5%) cases. The findings of the chest x-ray were normal in 64 (64%) patients and revealed lung inflammation in 36 (36%) patients. **Table 2**

Regarding the outcome in the current study, the length of NICU stay in days ranged from 10 to 35 days with a mean of 23.7 ± 7.35 days. There were 37 (37%) cases that required MV, where the duration of MV ranged from 4 to 18 h with a mean of 14.7 ± 3.13 h. Additionally, 13 (13%) cases required re-intubation. **Table 3**

The univariate logistic regression revealed that maternal age, GA, parity, mode of delivery, neonatal age, sex, birth weight, preterm birth, respiratory distress, prematurity, pneumonia, sepsis, and jaundice were significant predictors for the need for MV. The multivariate logistic regression revealed that mode of

delivery, neonatal age, sex, birth weight, preterm birth, respiratory distress, prematurity, pneumonia, sepsis, and jaundice were the only significant predictors for the need for MV. **Table 4**

Table 1: Maternal baseline characteristics, maternal risk factors, and clinical examination of maternal vital signs of the studied groups

		Total (n=100)
Age (years)	**Mean± SD**	28.3 ± 4.37
	Range	21 - 35
GA (weeks)	**Mean± SD**	36.8 ± 3.09
	Range	32 - 42
Weight (Kg)	**Mean± SD**	77.8 ± 10.45
	Range	60 - 95
Residence	**Urban**	52 (52%)
	Rural	48 (48%)
Family history of consanguinity		34 (34%)
Parity	**1**	30 (30%)
	> 1	70 (70%)
Gravidity	**1**	26 (26%)
	2	37 (37%)
	3	22 (22%)
	4	15 (15%)
Type of birth	**Single**	89 (89%)
	Twins	11 (11%)
Mode of delivery	**Vaginal delivery**	31 (31%)
	Caesarean section	69 (69%)
Risk factors	**Hypertension**	43 (43%)
	Diabetes mellitus	34 (34%)
	IHD	15 (15%)
	Hypertension	43 (43%)
	History of corticosteroids intake	7 (7%)
Vital signs		
HR (beats/min)	**Mean± SD**	84.8 ± 8.62
	Range	71 - 100
SBP (mmHg)	**Mean± SD**	130.5 ± 12.26
	Range	110 - 150
DBP (mmHg)	**Mean± SD**	75.8 ± 9.97
	Range	60 - 90

GA: gestational age. IHD: ischemic heart disease. HR: heart rate, SBP: systolic blood pressure, DBP: diastolic blood pressure.

Table 2: Baseline characteristics, Apgar score, neonatal risk factors, laboratory investigations, blood culture, and chest x-ray of the studied groups

		Total (n=100)
Neonatal age (days)	**Mean± SD**	14.6 ± 8.01
	Range	2 - 27
Sex	**Male**	47 (47%)
	Female	53 (53%)
Birth weight (g)	**Mean± SD**	2017.9 ± 819.69
	Range	1000 - 3483
Preterm birth		45 (45%)
Apgar score at 1 min	**Mean± SD**	5.2 ± 0.76
	Range	4 - 6
Apgar score at 5 min	**Male**	6.5 ± 1.13
	Female	5 - 8
Fever		5 (5%)
New-onset apnea		9 (9%)
Antibiotic		53 (53%)
Lethargy		24 (24%)
Respiratory distress		40 (40%)
Prematurity		31 (31%)
PROM		28 (28%)
Pneumonia		36 (36%)
Poor feeding		33 (33%)
Sepsis		38 (38%)
Jaundice		35 (35%)
Hb (g/dL)	**Mean± SD**	14.7 ± 1.02
	Range	13 - 16.4
PLT (*10^9/L)	**Mean± SD**	273.7 ± 48.17
	Range	190 - 349
WBCs (*10^9/L)	**Mean± SD**	12.01 ± 3.83
	Range	5.9 - 17.8
Na^+ (mEq/L)	**Mean± SD**	138.9 ± 1.94
	Range	136 - 142
K^+ (mEq/L)	**Mean± SD**	4.5 ± 0.59
	Range	3.5 - 5.5
Ca (mg/dl)	**Mean± SD**	10.6 ± 1.19
	Range	8.5 - 12.5
ALT (U/L)	**Mean± SD**	41.5 ± 11.78
	Range	19 - 64
AST (U/L)	**Mean± SD**	35.6 ± 8.62
	Range	20 - 50
CRP	**Positive**	58 (58%)
	Negative	42 (42%)
pH	**Mean± SD**	7.4 ± 0.05
	Range	7.32 - 7.47
Acinetobacter		27 (27%)
Coagulase-negative staphylococci		5 (5%)
E. coli		14 (14%)
Enterobacter		3 (3%)
Klebsiella spp.		29 (29%)
Pseudomonas aeruginosa		17 (17%)
Staphylococcus aureus		5 (5%)
Chest x-ray	**Normal**	64 (64%)
	Lung inflammation	36 (36%)

Apgar: appearance, pulse, grimace, activity and respiration. PROM: premature rupture of membranes. Hb: hemoglobin, PLT: platelets, WBCs: white blood cells, ALT: alanine aminotransferase, AST: aspartate aminotransferase, CRP: c-reactive protein.

Table 3: Outcome of the studied patients

		Total (n=100)
Length of NICU stay (days)	**Mean ± SD**	23.7 ± 7.35
	Range	10 - 35
MV requirement		37 (37%)
Duration of MV (h)	**Mean ± SD**	14.7 ± 3.13
	Range	4 - 18
Number of re-intubations		13 (13%)

NICU: neonatal intensive care unit, MV: mechanical ventilation.

Table 4: Logistic regression for predictor of increase mortality of neonatal pneumonia

	Univariate regression			**Multivariate regression**		
	OR	**95% CI**	**P value**	**OR**	**95% CI**	**P value**
Maternal age (years)	0.9021	0.8184 to 0.9944	**0.038***	0.9014	0.7950 to 1.0220	0.105
GA (weeks)	1.8510	1.4603 to 2.3462	**<0.001***	0.6699	0.1882 to 2.3847	0.536
Parity	0.0538	0.0187 to 0.1548	**<0.001***	1.872	0.6587 to 5.3199	0.239
Gravidity	0.9910	0.9418 to 1.0429	0.729	0.7536	0.3165 to 1.7942	0.523
Mode of delivery	0.9020	0.8182 to 0.9943	**0.037***	1.8812	1.4600 to 2.4239	**<0.001***
Neonatal age (days)	0.0026	0.0003 to 0.0229	**0.003***	0.0482	0.0154 to 0.1509	**<0.001***
Sex	0.9006	0.8168 to 0.9930	**0.026***	0.0020	0.0002 to 0.0217	**<0.001***
Birth weight (g)	0.9974	0.9962 to 0.9985	**<0.001***	0.9983	0.9971 to 0.9996	**0.011***
Preterm birth	0.0095	0.0012 to 0.0747	**<0.001***	0.0273	0.0031 to 0.2432	**0.001***
Apgar score at 1 min	1.0346	0.6033 to 1.7744	0.901	0.7688	0.3804 to 1.5536	0.464
Apgar score at 5 min	1.2761	0.8844 to 1.8413	0.192	1.3992	0.8630 to 2.2688	0.173
Fever	2.4828	0.2668 to 23.0999	0.424	0.8522	0.0799 to 9.0893	0.895
New-onset apnea	2.2273	0.4374 to 11.3409	0.334	1.9417	0.2768 to 13.6221	0.504
Antibiotic	0.7865	0.3475 to 1.7798	0.564	0.8419	0.2940 to 2.4112	0.749
Lethargy	1.0268	0.6240 to 1.6896	0.917	0.9992	0.9207 to 1.0844	0.985
Respiratory distress	0.0095	0.0022 to 0.0403	**<0.001***	0.0061	0.0005 to 0.0701	**<0.001***
Prematurity	0.0371	0.0117 to 0.1177	**<0.001***	0.0333	0.0098 to 0.1130	**0.002***
PROM	1.0573	0.3955 to 2.8267	0.911	0.1251	0.0124 to 1.2575	0.0775
Pneumonia	0.0005	0.0000 to 0.0075	**<0.001***	0.0009	0.0000 to 0.0623	**0.001***
Poor feeding	0.8563	0.5690 to 1.2888	0.457	0.0574	0.0012 to 2.8266	0.151
Sepsis	0.0014	0.0001 to 0.0141	**0.001***	0.0066	0.0005 to 0.0836	**<0.001***
Jaundice	0.0026	0.0003 to 0.0229	**<0.001***	0.0180	0.0009 to 0.3491	**0.008***

GA: gestational age, IHD: ischemic heart disease, OR: odds ratio, CI: confidence interval, *: statistically significant as p value <0.05.

Discussion

Our study showed that the maternal age ranged from 21 to 35 years with a mean of 28.3 ± 4.37 years. The GA ranged from 32 to 42 weeks with a mean of 36.8 ± 3.09 weeks. The maternal weight ranged from 60 to 95 kg with a mean of 77.8 ± 10.45 kg. There were 52 (52%) subjects from urban areas and 48 (48%) subjects from rural areas.

Similarly, Kumar et al., (8) evaluated the clinical and microbiological characteristics and other risk factors that predict mortality in neonates admitted with pneumonia. The mean (SD) gestational age was 37.29 (1.9) weeks.

Thirty (30%) mothers were unipara while 70 (70%) mothers were multipara. Regarding the gravidity, 26 (26%) mothers had one previous pregnancy, 37 (37%) mothers had two previous pregnancies, 22 (22%) mothers had three previous pregnancies, and 15 (15%) mothers had 4 previous pregnancies. 89 (89%) mothers gave birth for a single fetus and 11 (11%) gave birth for twins. There were 31 (31%) neonates delivered through vaginal delivery, while 69 (69%) neonates delivered by CS.

Demisse et al., (11) conducted a retrospective cross-sectional study was conducted among all admitted neonates in the NICU and found that majority (670, 87.1%) of the study neonates were singleton and 94 (12.2%) were twins. There were 430 (55.9%) primipara mothers and 339 (44.1%) multiparous women. Mode of delivery was spontaneous vaginal delivery in 463 (60.2%) and cesarean section in 259 (33.7%) study participants.

In disagreement with us, John et al. (12) study reported that CS was lower than normal vaginal delivery as it represented only (35.3%) and NVD (64.7%). And Ayaz and Saleem (13) performed a cross-sectional study on 565 neonates and found that the majority of them were born by vaginal delivery (94.9%).

The Apgar score at 1 min ranged from 4 to 6 with a mean of 5.2 ± 0.76. The Apgar score at 5 min ranged from 5 to 8 with a mean of 6.5 ± 1.13.

Similarly, Workineh and Workie et al., (14) found an Apgar score of less than 7 at 1 min and 5 min was recorded on 28 neonates (53.9%).

Forty-three (43%) mothers were hypertensive, 34 (34%) mothers were diabetics, 15 (15%) mothers had IHD, and 7 (7%) mothers had a history of corticosteroids intake. The maternal HR ranged from 71 to 100 beats/min with a mean of 84.8 ± 8.62 beats/min. SBP ranged from 110 to 150 mmHg with a mean of 130.5 ± 12.26 mmHg. DBP ranged from 60 to 90 mmHg with a mean of 75.8 ± 9.97 mmHg. The neonatal age ranged from 2 to 27 days with a mean of 14.6 ± 8.01 days. Among the neonates, there was 47 (47%) males and 53 (53%) females. The birth weight ranged from 1000 to 3483 g with a mean of 2017.9 ± 819.69 g. There were 45 (45%) preterm neonates.

In agreement, Workineh and Workie et al., (14) case-control study regarding the sex of neonates, female was higher in cases (31 [59.6%]). About 21 (40.4%) cases had a birth weight of 2.5 to 4.0 kg with mean birth weight (±SD) of 2.5 ± 0.63 to 3.14 ± 0.38 kg, respectively.

However, a previous study by Hady et al., (15) aimed at determining the incidence of neonatal mortality among cases admitted to Benha University Hospital NICU and to determine its underlying factors. They found that 52.4% of the studied neonates were males while 47.6% were females, but their mean age was 5 days ranging from 1-30 days, which was similar to our range.

We investigated the neonatal risk factors and found that, 5 (5%) neonates had fever, 9 (9%) neonates had new-onset

apnea, 53 (53%) neonates had received antibiotics, 24 (24%) neonates had lethargy, 40 (40%) neonates had respiratory distress, 31 (31%) neonates were premature, 36 (36%) neonates had pneumonia, 33 (33%) neonates had received poor feeding, 38 (38%) neonates had sepsis, and 35 (35%) neonates had jaundice. In the current study, premature rupture of membranes (PROM) was a risk factor in 28 (28%) neonates.

However, another study Tripathi et al., (16) found PROM in 42% of neonates with VAP.

In current study, Hb concentration ranged from 13 to 16.4 g/dL with a mean of 14.7 ± 1.02 g/dL. PLT count ranged from 190 to 349 $*10^9$/L with a mean of 273.7 ± 48.17 $*10^9$/L. WBCs count ranged from 5.9 to 17.8 $*10^9$/L with a mean of 12.01 ± 3.83$*10^9$/L. ALT ranged from 19 to 64 U/L with a mean of 41.5 ± 11.78 U/L. AST ranged from 20 to 50 U/L with a mean of 35.6 ± 8.62 U/L. pH from 7.32 to 7.47 with a mean of 7.4 ± 0.05. CRP was positive in 58 (58%) of the studied neonates.

"Similarly, regarding Hb, Platelet, and CRP in El-Ganainy et al. (17) study and in relation to the neonatal outcome of cases, it was proved to be statistically between dead and survived neonates. In survived group, the mean Hb value among survived neonates was 10.51 g/dL. The mean CRP value among survived neonates was 18.74 mg/L. Platelets among survived neonates was 122755.81 cells/µL."

The blood culture findings showed that Klebsiella spp., followed by Acinetobacter, Pseudomonas aeruginosa, and E. coli which were detected in 29%, 27%, 17% and, 14% of the cases. While coagulase-negative staphylococci and Staphylococcus aureus, each was detected in 5% of the cases and Enterobacter was detected in 3% of the cases.

In addition, another study by Tripathi et al., (16) studied VAP in NICU and found that the most common bacterial isolated from endotracheal aspirate of VAP patients was Klebsiella spp (32.8%), E.coli (23.2%) and Acinetobacter (17.8%) being the other two common organisms.

In accordance with us, Mir et al., (18) prospective observational study aimed to investigate the risk factors, pathological profile and outcome of ventilator associated pneumonia in NICU. The authors stated that the most common bacteria isolated was Klebsiella spp. (37.5%). This was followed by E. coli (21.8%), Acinetobacter (15.6%) and staphylococcus aureus (9.3%). Polymicrobial infection was seen in 6.25%. Citrobacter was also grown in 6.25%.

In our study, chest X-ray findings were normal in 64 (64%) patients and revealed lung inflammation in 36 (36%) patients. The length of NICU stay in days ranged from 10 to 35 days with a mean of 23.7 ± 7.35 days. There were 37 (37%) cases required MV, where the duration of MV ranged from 4 to 18 h with a mean of 14.7 ± 3.13 h. additionally, 13 (13%) cases required re-intubation.

The univariate logistic regression revealed that maternal age, GA, parity, mode of delivery, neonatal age, sex, birth weight, preterm birth, respiratory distress, prematurity, pneumonia, sepsis

and jaundice were significant predictors for the need of MV.

In a partial similar manner, John et al., (12) performed a prospective study was carried out in NICU and concluded that, readily available parameters like birth weight, gestational age, APGAR score, oxygen saturation and Downe's score could together be used to predict mortality and requirement of respiratory support in the resource limited setting.

In line with our study, NAIR et al., (19) conducted a systematic review and meta-analysis including 3 studies to identify risk factors associated with neonatal pneumonia and its mortality in India. They stated that 11 risk factors were identified from two studies: duration of mechanical ventilation, postnatal age, birth weight, prematurity, sex of the neonate, and length of stay in NICU, primary diagnosis, gestational age, and number of re-intubations.

A meta-analysis of observational studies conducted by Tan et al., (20) investigated the risk factors for VAP although it has been a serious complication of MV with a high morbidity and mortality in the newborn. The risk factors were found to be related to neonatal VAP, length of stay in NICU, reintubation, enteral feeding, mechanical ventilation, transfusion, low birth weight, premature infants, parenteral nutrition, bronchopulmonary dysplasia, and tracheal intubation. Which support our factors but the difference between our study and this study is that we assessed the risk factors for the need of MV, while they assessed the risk factors for VAP.

While, Pantoja-Gómez et al., (21) describe the clinical course and outcomes during the first 7 days after diagnosis in newborns, they found that most common clinical conditions and comorbidities in the newborns were sepsis, then respiratory distress syndrome, followed by patent ductus arteriosus, Pneumonia, Perinatal asphyxia, Shock, Electrolyte imbalance, and Neonatal respiratory distress syndrome.

Conclusion

Predictor of increase mortality of neonatal pnumonia were maternal age, GA, parity, mode of delivery, neonatal age, sex, birth weight, preterm birth, respiratory distress, prematurity, pneumonia, sepsis and jaundice. Klebsiella spp. and Acinetobacter were the most detected organisms in the blood culture.

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To cite this article: Mohamed M. Rashad, Osama O. Allam, Ashraf M. Shahin. Factors Associated with Neonatal Pneumonia and its Mortality. BMFJ 2025;42(4):468-480.