How to Cite:
Sree, Y. S., Joag, G. G., & Kshirsagar, V. Y. (2022). A study of maternal and fetal risk factors associated with persistent pulmonary hypertension of newborn admitted in NICU in a Tertiary Hospital in Maharashtra. *International Journal of Health Sciences*, *6*(S2), 3029–3040. https://doi.org/10.53730/ijhs.v6nS2.5727

A study of maternal and fetal risk factors associated with persistent pulmonary hypertension of newborn admitted in NICU in a Tertiary Hospital in Maharashtra

Yalamanchili Sai Sree
Junior Resident, Department of Paediatrics, Krishna Institute of Medical Sciences Deemed to be University, Karad, Satara, Maharashtra, India

Girish G. Joag
Professor, Department of Paediatrics, Krishna Institute of Medical Sciences Deemed to be University, Karad, Satara, Maharashtra, India

V. Y. Kshirsagar
Professor and HOD Department of Paediatrics, Krishna Institute of Medical Sciences Deemed to be University, Karad, Satara, Maharashtra, India

***Abstract*---**Background: Persistent pulmonary hypertension of the new born (PPHN) associated with neurological injury later in life and this can be prevented by early detection and management. Early detection of PPHN is of utmost importance, especially in our country where the data available is very less and we cannot rely on the studies of developed countries due to the differences in the profiles of these neonates. This early detection requires knowledge of the risk due to associated factors. Aims and Objectives: To study, maternal and fetal risk factors, in neonates diagnosed with PPHN admitted in NICU in Krishna Hospital, Karad. Material and Methods: Study design: This was a single centre, Retrospective observational study based on secondary data done on 60 neonates diagnosed with PPHN in NICU from September 2020 to December 2021 in Krishna Hospital, Karad. Statistical Analysis: The statistical analysis was done with SPSS software version 22. Mean, standard deviation was calculated for continuous variables to know their central tendency. Chi square test was used to test the association between categorical variables and t test for continuous variables. A $p<0.05$ was taken as significant. Results: The male: female ratio was 1:1.30. PPHN was seen more in preterm neonates (60%) than in term neonates (40%).Most of the neonates (81.66%)were born to mothers of age 21-30 yrs.

International Journal of Health Sciences ISSN 2550-6978 E-ISSN 2550-696X © 2022.
***Corresponding author**: Joag, G. G.*
Manuscript submitted: 18 Feb 2022, Manuscript revised: 09 March 2022, Accepted for publication: 01 April 2022

Preeclampsia and gestational diabetes among mothers of neonates were found to be common maternal factors in occurrence. Conclusion: PPHN was seen more in preterm neonates than in term neonates, and the most common aetiology was Meconium Aspiration Syndrome. Pre-eclampsia and diabetes were found to be more common maternal associations in babies with PPHN.

***Keywords*---**persistent pulmonary, hypertension new born, PPHN, retrospective study, MAS.

Introduction

The variation of incidence of Persistent pulmonary hypertension of the new born (PPHN) is estimated from various studies to be from 0.4 to 6.8/1000 live births with 4% to 33% mortality. However, in developing countries, there is a much higher mortality, ranging from 25% to 48%. [1] There is a reported incidence of 0.43 to 6 per 1,000 live births in the United Kingdom and 1.9 (0.4-6.8) per 1,000 live births in the United States. [2-3] and 3.38 per 1000 live births in an Indian study, with the mortality rate in India being 29.06% .[1]

In the developing countries, the data about Persistent pulmonary hypertension of the new born (PPHN) is scarce and these babies with Persistent pulmonary hypertension of the new born (PPHN) have a profile which is reported to be different from those of developed countries. Also, significant neurodevelopmental impairment at the age of 1-2yrs is exhibited by approximately 25% of infants who suffered from severe Persistent pulmonary hypertension of the new born (PPHN) according to some studies in USA. This observation indicates that that the underlying disease is associated with neurological injury and this can be prevented by early detection and management.[4]

In the developing countries like India, the data about Persistent pulmonary hypertension of the new born (PPHN) is scarce even with the increasing number of studies that are being done and the profile of these babies with Persistent pulmonary hypertension of the new born (PPHN) is reported to be different from those of developed countries. Hence, early detection of Persistent pulmonary hypertension of the new born (PPHN) is of utmost importance, especially in our country where the data available is very less and we cannot rely on the studies of developed countries due to the differences in the profiles of these neonates. This early detection requires high index of suspicion clinically. The clinical suspicion of Persistent pulmonary hypertension of the new born (PPHN) should be high when there is association of differential cyanosis with labile hypoxemia.

The responsible pathophysiologic mechanisms for Persistent pulmonary hypertension of the new born (PPHN) are classified by Vinay Sharma and Lakshminrusimha into:

Maladaptation
Maldevelopment and

Underdevelopment

Maladaptation is responsible for majority of the cases of PPHN. In this, the pulmonary vasculature are normally developed but excessive secretion and action of vasoactive mediators render them dysfunctional. This is generally seen in conditions like sepsis, Meconium aspiration syndrome (MAS), pneumonia, and asphyxia.

Maldevelopment of pulmonary vasculature occurs due to intrauterine closure of ductus arteriosus. This can occur as a result of use of maternal medications like nonsteroidal anti-inflammatory drugs. Some conditions like chronic foetal hypoxia, foetal anaemia are also associated with intrauterine closure of ductus arteriosus. Maldevelopment also causes Idiopathic Persistent pulmonary hypertension of the new born (PPHN).[4-5]

Underdevelopment of pulmonary vasculature leads to pulmonary hypoplasia. Congenital diaphragmatic hernia or oligohydramnios from any cause are found to cause pulmonary hypoplasia due to underdevelopment. However, overlap between maldevelopment and maladaptation is almost always seen and these can be discriminated only by histological examination.

Traditionally, in our Institute, since facilities for iNO, HFOV & ECMO are unavailable, Persistent pulmonary hypertension of the new-born (PPHN) is managed by other available facilities. We conducted this study to review the factors associated with survival and mortality of neonates with Persistent pulmonary hypertension of the new-born (PPHN) in our NICU of Krishna Hospital.

Materials and Methods

Objectives

The objectives of this study are to describe the association of maternal and fetal risk factors in neonates with PPHN admitted in NICU and to study the infant characteristics (clinical features, presentation) in neonates diagnosed with PPHN.

Inclusion Criteria

60 neonates (both terms and preterm) including inborn and outborns diagnosed with PPHN admitted to NICU in Krishna hospital (retrospective data analysis) were included in the present study.

Exclusion Criteria

Cyanotic babies with congenital cyanotic heart disease other than PPHN on echocardiography were excluded from the present study.

Study Design

The study was a single centre retrospective review of neonates with the diagnosis of PPHN admitted in Neonatal ICU of tertiary care hospital, Karad from September

2020 to December 2021 identified from NICU, KIMSDU database after taking clearance from institutional ethical committee of KRISHNA HOSPITAL, KARAD. Presence of cyanotic congenital heart diseases was excluded and maternal, prenatal, perinatal and post-natal data, treatment details and outcome information were collected from case records. Diagnosis of PPHN was made by a combination of clinical and echocardiographic criteria. Clinical criteria included labile oxygen saturation (SpO2), severe hypoxemia (SpO2 <85%), or differential cyanosis between preductal and postductal sites (more than 5% difference in SpO2). Labile SpO2 refers to fluctuating saturations with handling or agitation.

Diagnosis of PPHN was confirmed by echocardiography (right to left shunt or bidirectional shunt across PDA or PFO, tricuspid regurgitation and increased pulmonary pressures using pulse wave Doppler, flattening of septum or paradoxical septal motion ,etc.). After diagnosis was made, the study was conducted for association of maternal and fetal risk factors with PPHN, prevalence of PPHN, treatment modalities used (mechanical ventilation , milrinone, sildenafil) and outcome (mortality, duration of mechanical ventilation, hospital stay, oxygen supplementation) in NICU in Krishna Hospital.

Statistical Analysis

The data was collected with the help of standard, semi-structured, pre-validated case record proforma.The data was entered with the help of MS excel software and was represented in the form of tables and charts for frequency analysis. The statistical analysis was done with SPSS software version 22. Mean, standard deviation was calculated for continuous variables to know their central tendency. Chi square test was used to test the association between categorical variables and t test for continuous variables. P-value less than 0.05 was considered to be statistically significant.

Results

In this retrospective study from September 2020 to December 2021, the total no of admissions in NICU during the study period were 976. Out of these total no of neonates diagnosed with PPHN were 60. The prevalence of neonates with PPHN in NICU during this study period was 6.16%. Of the 60 neonates, 34(56.66%) were females, and 26 (43.33%) were males. 40% (24) were term neonates and 60% (36) were preterm neonates. There were no post terms. 48(80%) were born in the institute, while 12 (20%) were transferred from other hospitals. There were no home deliveries or deliveries during transport. Of 12 outborn neonates with PPHN, 75 %(9) were preterm neonates and 25 %(3) were term neonates. 24(40%) were very low birth weight (VLBW), 15(25%) were low birth weight (LBW) and 21(35%) were of normal birth weight. There were no extreme low birth weight (ELBW) or overweight babies. Majority of the neonates were cured and discharged 54 (90%), while 6 (10%) expired.

Demographic characters of neonates with PPHN is in Table 1.

Table 1. : Demographic characters of neonates with Persistent Pulmonary Hypertension of New-born

Demographic Characters		No. of neonates n (%)
Sex	Female	34(56.66%)
	Male	26 (43.33%)
Gestational Age	Term (<37wks)	40% (24)
	Preterm (>37wks)	60% (36)
Place of Birth	Inborn	48(80%)
	Outborn	12 (20%)
Birth Weight	very low birth weight (VLBW	24(40%)
	low birth weight (LBW)	15(25%)
	normal birth weight	21(35%)
Mode of delivery	LSCS (Lower Segment Caesarean Section)	32(53.33%)
	NVD (Normal vaginal delivery)	28(46.66%)
Age of the mother	21-30yrs	49(81.66%) Mean = 24.68 ± 3.19 years.
Outcome	Discharged	54 (90%)
	Expired	6 (10%)

Maternal and infant risk factors were studied. Most of the neonates 49(81.66%) were born to mothers of age 21-30 yrs.The mean age of the mothers was 24.68 ± 3.19 years.PPHN was seen in 32(53.33%) neonates born via LSCS (Lower Segment Caesarean Section) and 28(46.66%) neonates born via Normal vaginal delivery. Some of the mothers were found to have illnesses. We observed that Anemia was found among 2(3.33%) mothers, Gestational Diabetes was found among 6 (10%) mothers, 3(5%) mothers had Fever, Gestational Hypertension was found among 1(1.66%) mothers, Preeclampsia was found among 11(18.33%) mothers, 3(5%) mothers were found to have UTI (Urinary Tract Infection) and 3(5%) were found to have more than one of these illnesses. Among the neonates born to mothers with Pre-eclampsia and gestational diabetes, the neonatal mortality was found in 1(16.66%) of 6 neonates with gestational diabetic mothers. These maternal risk factors are shown in Table 2.

Table 2: Maternal illnesses in inborn and out born neonates with PPHN

Maternal Illnesses	Inborn		Outborn	
	Number of neonates	Percentage	Number of neonates	Percentage
Anaemia	2	4.16	0	0
Gestational Diabetes	5	10.41	1	8.33
Fever	2	04.16	1	8.33
Gestational Hypertension	1	02.08	0	0

Preeclampsia	8	16.66	3	25
Urinary Tract Infection	2	4.16	1	8.33

Of the 60 neonates with PPHN, Capillary Refill Time (CRT) was less than 3 sec among 44(73.33%) and more than 4 sec among 16 (26.66%) neonates. The difference was not found to be statistically significant. Heart murmur was appreciated in 25(48.33%) neonates, hepatomegaly was found in 15 (25%) of neonates.

APGAR scores at 1 and 5 minutes of birth were noted and 6(10%) babies had APGAR score <3 at 1 min and 10% babies had APGAR score <5 at 5 mins. In 12 out born babies, APGAR score records of neonates were not available.In 56 neonates delta SPO2 was <5% and in 4 neonates delta SPO2 was >5% and the difference was not found to be statistically significant. 2D echo was done and the findings were that mean Pulmonary Arterial Pressures of first 2D echo was 67.75 mmHg, while on repeat visit after 5 days was 38.57 mmHg. The reduction was found to be statistically significant. These clinical characteristics are described in Table 3.

Table 3: Clinical characteristics of neonates with Persistent Pulmonary Hypertension of New-born

Clinical characteristics		No. of neonates n (%)
CRT	<3sec	44(73.33%)
	>4sec	16 (26.66%)
APGAR scores at 1 min	0-5	6(10%)
	>6	42(70%)
APGAR scores at 5 mins	0-5	6(10%)
	>6	42(70%)
Delta SpO2	<5%	56 (93.3%)
	>5%	4 (6.7%)
Heart murmur		25(48.33%)
Hepatomegaly		15 (25%)

When associated factors were noted among the neonates, BIRTH ASPHYXIA was reported among 7 (11.66%) neonates, Congenital Diaphragmatic Hernia (CDH) was reported among 2(3.33%) neonates, Respiratory Distress (Hyaline Membrane Disease (HMD)) was reported among 1(1.66%) neonates, IUGR WITH RDS (Respiratory Distress Syndrome) was reported among 1(1.66%) neonates, Meconium Aspiration Syndrome (MAS) was reported among 9(15%) neonates, PNEUMONIA was reported among 7(11.66%) neonates, 21(35%) neonates were PRETERMS, PRETERM WITH PULMONARY HEMORRHAGE was reported among 1(1.66%)neonates, PRETERM WITH SEPTIC SHOCK was reported among 2(3.33%) neonates, SEPSIS WITH SHOCK was reported among 3(5%) neonates, Transient Tachypnoea of New Born (TTNB) was the initial diagnosis among 6(10%) neonates with PPHN. Asphyxia associated PPHN babies had mortality of 14.29 %, Congenital Diaphragmatic Hernia associated babies had mortality of 50%, 100% mortality was associated in babies with associated PROM. These are shown in Table 4.

Table 4: Associated factors among neonates with Persistent Pulmonary Hypertension of New-born

Associated factors with Persistent Pulmonary Hypertension of New-born		Total	Discharged		Mortality	
		Number of neonates (n)	Number of neonates	%	Number of neonates	%
Associated Factors	Birth Asphyxia	7	6	85.71	1	14.28
	CDH	2	1	50.00	1	50.00
	HMD	1	1	100.00	0	0.00
	IUGR with RDS	1	1	100.00	0	0.00
	MAS	9	9	100.00	0	0.00
	Pneumonia	7	7	100.00	0	0.00
	Preterm	21	21	100.00	0	0.00
	Preterm with Pulm. Haemorrhage	1	0	0.00	1	100.00
	Preterm with Septic Shock	2	0	0.00	2	100.00
	Sepsis With Shock	3	2	66.67	1	33.33
	TTNB	6	6	100.00	0	0.00

Discussion

Persistent pulmonary hypertension of the newborn is one of the major causes of neonatal deaths. At present, there is no clear understanding of the risk factors for PPHN. This understanding is important for PPHN prevention and for the early diagnosis. We, in KIMS, a tertiary hospital in karad conducted the retrospective study for the association of maternal and fetal risk factors, in neonates diagnosed with PPHN (Persistent Pulmonary Hypertension of Newborn) admitted in our NICU.

In the present study, from September 2020 to December 2021 (study period), the total no of admissions in NICU were 976. Out of these total no of neonates diagnosed with PPHN were 60. The prevalence of neonates with PPHN in our NICU during the study period was found to be 6.16% whereas Syamal Sardar et al[6] in their study observed incidence of neonates with PPHN in their study was 5.49 of babies/1000 NICU admissions.

In the present study of 60 neonates with PPHN, Gender wise distribution among the neonates was 34(56.66%) in females, and 26 (43.33%) in males. The male: female ratio in the current study was 1:1.30. In our study we observed female

preponderance whereas Syamal Sardar et al[7] in their study observed male preponderance (male: female ratio 1.2:1). Small sample size of our study could be the reason for this observation. Similarly, Razzaq A[8]et al., in their work in 2012 noted that PPHN occurred more in males. The reason given by them was that female sex probably had advanced fetal lung maturity which protected them against severe respiratory distress syndrome which might explain the protective effect of female sex on PPHN as studied by Humbert M et al., in 2010 and was backed by studies of Escribano-Subias P et al., in 2012.

In our study of 60 neonates with PPHN, 48(80%) were born in the institute, while 12 (20%) were out born babies transferred from other hospitals for the need of advanced facilities of a tertiary center as they were preterm babies or babies with birth asphyxia or babies requiring respiratory assistance. There were no home deliveries or deliveries during transport. 40% (24) were term neonates and 60% (36) were preterm neonates. There were no postterms. Of the 48 inborn neonates with PPHN, 56.25 %(27) were preterm neonates and 43.75 %(21) were term neonates and of 12 out born neonates with PPHN, 75 %(9) were preterm neonates and 25 %(3) were term neonates.

We found that, 24(40%) neonates were very low birth weight (VLBW), 15(25%) neonates were low birth weight (LBW) and 21(35%) neonates were of normal birth weight. There were no extreme low birth weight (ELBW) or overweight babies in our study. Syamal Sardar et al[7] in their study observed that Mean birth weight was 2281.77 ± 313.33 g and mean gestational age was 35.74 ± 2.40. Majority of babies in their study were inborn (75.58%), male (54.66%), appropriate for date (AFD) (79.06%) and term (44.18%). Overall mortality rate was 29.06%. In the present study of 60 neonates with PPHN, most of the neonates 49 (81.66%) were born to mothers of age 21-30 yrs. The mean age of the mothers was 24.68 ± 3.19 years.

The type of newborn delivery is also a risk factor for developing PPHN according to increasing evidence day by day. In USA, a case–control based study was done on 9,452 infants by Araujo OR[6] et al., in 2008 which showed that the PPHN risk among infants born via LSCS delivery was five times higher compared to normal delivery with rates of 0.5% and 0.09% respectively. This caesarean section related increased risk of PPHN may be related to prostaglandins as their level is reduced in newborns born via LSCS. In infants prostaglandins acts as the main vasoactive factor to quickly adapt to the extrauterine environment after birth. In addition natural birth canal extrusion is not possible in LSCS resulting in amniotic fluid being residual in the lung interstitium of the neonate which impacts the lung surface-active substances, further affecting the contraction and expansion of the alveoli.

In the present study of 60 neonates with PPHN, we assessed Mode of delivery of the neonates, we observed that PPHN occured in 32 (53.33%) neonates born via LSCS (Lower Segment Caesarean Section) and 28(46.66%) neonates born via Normal vaginal delivery. The diabetic mothers tend to have full-term babies with overweight. Some studies in 2015 by Vinay sharma el al., reported that overweight babies had a higher incidence of PPHN because they require more oxygen, which in turn results in increased incidence of PPHN. Increased

pulmonary artery pressure could be due to acidosis, pulmonary arteriolar endothelial damage or deformation of pulmonary artery. These occur as a result of chronic intrauterine hypoxia and perinatal asphyxia as seen in Preeclampsia which furthermore aggravates the spasm of pulmonary arteriole, leading to PPHN. This agreed with many previous studies that maternal diseases have a key role in occurrence of PPHN.

In the present study of 60 neonates with PPHN, some of the mothers were found to have illnesses. We observed that anemia was found among 2(3.33%) mothers, gestational diabetes was found among 6 (10%) mothers, 3(5%) mothers had fever, gestational hypertension was found among 1(1.66%) mothers, preeclampsia was found among 11(18.33%) mothers, 3(5%) mothers were found to have UTI (Urinary Tract Infection) and 3(5%) were found to have more than one of these illnesses.

Maternal illnesses such as gestational diabetes mellitus and preeclampsia represented maternal risk factors in the neonates of our study. In present study, of the 48 mothers of Inborn babies, 2 mothers were anemic, 5 had gestational diabetes, 2 had fever, 1 had gestational hypertension, 8 had preeclampsia and Urinary tract infection(UTI) was found in 2 mothers. As records of maternal data was available in 6 outborn babies, these mothers were included in the study. There was 1 twin delivery by LSCS. Only one of the twins were admitted, the other one was not admitted, hence not included.

Preeclampsia and gestational diabetes are important associations with PPHN. In the present study, among the neonates born to mothers with Pre-eclampsia and gestational diabetes, the neonatal mortality was found in 1(16.66%) of 6 neonates with gestational diabetic mothers.In studies by Syamal sardar et al., [7] among various maternal risk factors, they found none to be significant, and they mentioned this as under estimation because of the retrospective nature of the study.In the present study of 60 neonates with PPHN, it was found that heart murmur was appreciated in 25(48.33%) neonates. Hepatomegaly i.e., liver was palpable more than 2 cms. below the right costal margin was found in 15 (25%) of neonate as compared to hepatomegaly seen in 37.5% neonates with PPHN in studies by Abdel Mohsen et al.[9] As all the records of neonates did not have the data of liver span mentioned, it was not included in this study.

Capillary Refill Time on admission was less than 3 sec among 44(73.33%) and more than 4 sec among 16 (26.66%) neonates. The difference was not found to be statistically significant. (The chi-square statistic is 0.1094. The p-value is .740875. Not significant at $p < .05$.) In the present study of 60 neonates with PPHN, APGAR scores at 1 and 5 minutes of birth were noted and 6(10%) babies had APGAR score <3 at 1 min and 10% babies had APGAR score <5 at 5 mins. In 12 outborn babies, APGAR score records of neonates were not available. In studies by Syamal Sardar et al., 75-90% of the babies had APGAR score of <7 at 1 min.
In studies by Mohd Nizam Mat Bah et al., [10] APGAR scores < 5 at 1-min were noted in 26.1% and APGAR scores of < 5 at 5-min were noted in 12.8%. This difference could be due to small sample size of our study. In the present study, delta SPO2 (i.e., difference in SPO2 levels of right upper limb and of right lower

limb was calculated) was compared with outcome. Delta SPO2 mentioned is the differential cyanosis which is an important indicator of PPHN. In 56 neonates delta SPO2 was <5% and in 4 neonates delta SPO2 was >5% and the difference was not found to be statistically significant. (The chi-square statistic is 1.0714. The p-value is .300623. Not significant at p < .05.)

In the present study, we observed that BIRTH ASPHYXIA was reported among 7 (11.66%) neonates, Congenital Diaphragmatic Hernia (CDH) was reported among 2(3.33%) neonates, Respiratory Distress (Hyaline Membrane Disease (HMD)) was reported among 1(1.66%) neonates, IUGR WITH RDS (Respiratory Distress Syndrome) was reported among 1(1.66%) neonates, Meconium Aspiration Syndrome (MAS) was reported among 9(15%) neonates, PNEUMONIA was reported among 7(11.66%) neonates, 21(35%) neonates were PRETERMS, PRETERM WITH PULMONARY HEMORRHAGE was reported among 1(1.66%)neonates, PRETERM WITH SEPTIC SHOCK was reported among 2(3.33%) neonates, SEPSIS WITH SHOCK was reported among 3(5%) neonates, Transient Tachypnoea of New Born (TTNB) was the initial diagnosis among 6(10%) neonates with PPHN.

Syamal Sardar et al[7] in their study observed that MAS (Meconium Aspiration Syndrome) and TTNB (Transient Tachypnoea of New Born) (17.44% each) were the most common etiology followed by pneumonia (13.95%) and asphyxia and congenital diaphragmatic hernia (12.79% each). Rest of the cases in their study were due to sepsis with shock (8.14%), pulmonary hypoplasia (10.46%), and idiopathic (6.97%)

In the study by Mohsen AH et al,[9] hyaline membrane disease and transient tachypnea of the newborn resulted in PPHN in 5 cases (16.6%) delivered by LS C-section. The deficiency of surfactant impairs gas exchange in alveoli predisposing the neonates with already increased reactivity of pulmonary arteries (due to hyaline membrane disease) to pulmonary hypertension. In their study, 4 (12.5%) PPHN cases of unknown etiology were mild forms with outcome being good, suggesting extrauterine life transition had a transient maladaptation. 12.5% of cases were later diagnosed to have Down syndrome.

In the present study of 60 neonates with PPHN, 2D echo was done and the findings were that mean Pulmonary Arterial Pressures of first 2D echo was 67.75 mmHg, while on repeat visit after 5 days was 38.57 mmHg. The reduction was found to be statistically significant (p-value < 0.001). 2 out of 60 were excluded as they expired before review echo was done. This outcome in our study was better when compared to the study by Gustavo rocha et al., [11] in which, the duration for normalization of Pulmonary Hypertension varied from 2 days to 25 days. This difference in results could be due to the shorter duration of our study and also less sample size.

In the present study of 60 neonates with PPHN, we found that majority of the neonates were cured and discharged 54 (90%), while 6 (10%) expired. Syamal Sardar et al[7] in their study observed 18.18% neonates had mortality. Mortalities reported in babies with PPHN varies across different countries, and across

different institutions in a country such as 20.6% in Asian countries, 4%–33% in the USA, 32% in Portugal, 25% in Egypt, and 26.6% in Pakistan.

Limitations

Our study is a retrospective study due to which there could be interpersonal variation in reports to explain clinical characteristics of babies with PPHN.Neonates with PPHN require follow-up to assess for the neurological status up to 2 yrs. of life. This follow-up was not included in our study.The sample size of this study was small. So some of the results could not be explained.The detailed records of out born babies were not available which made it difficult for comparison with inborn babies in many parameters. We could not include modalities of treatments like HFOV, iNO, ECMO due to non-availability.

Conclusion

The prevalence of neonates with PPHN in our NICU was 6.16% of the total of 976 NICU admissions during the study period from September 2020 to December 2021. The male: female ratio in the current study of 60 neonates with PPHN was 1:1.30. Pre-eclampsia and diabetes were found to be more common maternal associations in babies with PPHN. PPHN was seen more in preterm neonates than in term neonates, and the most common aetiology was Meconium Aspiration Syndrome. Neonates with PPHN who were operated for Congenital Diaphragmatic Hernia were associated with poor prognosis.

References

1. Razzaq A, Iqbal Quddusi A, Nizami N. Risk factors and mortality among newborns with persistent pulmonary hypertension. Pak J Med Sci 2013;29:1099-104. Back to cited text no. 1
2. Abdel Mohsen AH, Amin AS. Risk factors and outcomes of persistent pulmonary hypertension of the newborn in neonatal intensive care unit of Al-Minya university hospital in Egypt. J Clin Neonatol 2013;2:78-82. Back to cited text no. 2
3. Roofthooft MT, Elema A, Bergman KA, Berger RM. Patient characteristics in persistent pulmonary hypertension of the newborn. Pulm Med 2011;2011:858154. doi:10.1155/2011/858154. Back to cited text no. 3
4. Nakwan N. The Practical challenges of diagnosis and treatment options in persistent pulmonary hypertension of the Newborn: A developing country's perspective. Am J Perinatol 2018; 35:1366-75. Back to cited text no. 4
5. Dakshinamurti S. Pathophysiologic mechanisms of persistent pulmonary hypertension of the newborn. Pediatr Pulmonol 2005; 39:492-503. Back to cited text no. 5
6. de Araujo OR, Andrea de Cdssia Stefano, Vanessa Aparecida. Cesarean deliveries and other risks for persistent pulmonary hypertension of the newborn. *Bras Ter lntensiva.* 2008; 20:394–7. [PubMed] [Google Scholar]
7. Sardar S, Pal S, Mishra R. A retrospective study on the profile of persistent pulmonary hypertension of newborn in a tertiary care unit of Eastern India. J Clin Neonatol 2020; 9:18-26.

8. Razzaq A, Iqbal Quddusi A, Nizami N. Risk factors and mortality among newborns with persistent pulmonary hypertension. Pak J Med Sci 2013; 29:1099-104
9. Abdel Mohsen AH, Amin AS. Risk factors and outcomes of persistent pulmonary hypertension of the newborn in neonatal intensive care unit of Al-Minya university hospital in Egypt. J Clin Neonatol 2013; 2:78-82
10. Mat Bah MN, Tan RYH, Razak H, Sapian MH, Abdullah N, Alias EY. Survival and associated risk factors for mortality among infants with persistent pulmonary hypertension of the newborn in Malaysia. J Perinatol. 2021 Apr; 41(4):786-793. doi: 10.1038/s41372-021-00962-6. Epub 2021 Feb 15. PMID: 33589728; PMCID: PMC7883964.
11. Rocha, Gustavo et al. "Persistent pulmonary hypertension of non-cardiac cause in a neonatal intensive care unit." *Pulmonary medicine* vol. 2012 (2012): 818971. doi:10.1155/2012/818971