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Acute Respiratory Distress Syndrome among Premature Neonates: Prevalence, Mortality rate and Risk Factors of Mortality

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Abstract:-
Introduction: Prematurity is one of the major challenges in neonatology worldwide. Death due to Acute respiratory distress syndrome (ARDS) represents the main cause of death among premature babies.
Aim: To identify the risk factors of death due to ARDS among premature neonates.
Methodology: A retrospective hospital based study was conducted over one year from October 2021 to October 2022 at Al-Sabeen Hospital for Maternity and childhood in Sana'a, Yemen. A pre-designed questionnaire using Google form was used to fill out the data of the patients' retrieved from their hospital's records. Epi-Info program No. 7 was used to analyse the data.
Results: Out of 1086 admitted neonates, 577 premature babies were found eligible to be enrolled in the study. One hundred and nineteen (20.6%) were died. Gestational age < 30 weeks, weight <1.5 kg, Apgar score <7, male sex, being on mechanical ventilator and lack antenatal care were found to be independent significant risk factors on multi-variate logistic regression analysis for death among premature neonates with RDS.
Conclusion: The risk factors associated to deaths among premature neonates with RDS highlight the exceptional characteristics of the health care that should be provided to mothers and infants in areas such as Sana'a, Yemen, where concerns related to quality of care need distinctive attention.

Keywords:- *Neonate, Preterm, Acute Respiratory Distress syndrome, Prevalence, Risk factor, Sana'a.*

I. INTRODUCTION

Prematurity is one of the biggest defies in neonatology. According to the World Health Organization designation, a premature infant is a child born after 22 and before 37 weeks of pregnancy. With latest developments in prenatal care, the incidence of preterm birth in both the developing as well as the developed world has increased in recent years [1]. Worldwide, about 15 million preterm deliveries occur yearly representing 11% of the total annual births with a significant inconsistent burden on the developing countries. Around 1 million deaths per year occur in infants born with gestational age < 37 weeks [2], and acute respiratory distress syndrome (ARDS) is one of the most frequent causes of mortality in this group [3]. Newborns born prematurely are at jeopardy of numerous short- and long-term concerns. Among the short-term consequences, ARDS is regarded as one of the most critical. Neonatal respiratory syndrome (NRDS): was firstly described by Hochheim in 1903 who noticed 2 infants died directly after birth with abnormal membrane in the lung. After 5 to 6 decades, the pathology was firstly described and was called as hyaline membrane disorder (1). Recently the disease is known as surfactant deficiency disorder (SDD)(3) or neonatal respiratory syndrome that defines as a syndrome caused by immaturity of lung due to either insufficiency of surfactant production or genetic disorder leading to non-production of surfactant proteins. There were very scare data globally about RDS in premature babies and no data at all in Yemen that is why this study was conducted.

- *Objective*

To calculate the prevalence and death rate of neonates with premature labour in a tertiary hospital and identify the independent risk factors of mortality due to ARDS among premature neonates.

II. METHODOLOGY

The study is a retrospective hospital based cross-sectional study over one year from October 2021 to October 2022

- *Study site:*

The study was conducted at Al-Sabeen hospital for Maternity and childhood. It is a tertiary hospital in Sana'a – Yemen. It has 80 incubators distributed over 3 nurseries: internal nursery: with a capacity of 30 incubators for those who born inside the hospital, external nursery: with a capacity of 25 incubators for those who born outside the hospital and a neonatal intensive care unit (NICU): with a capacity of 25 incubators for critical cases.

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➢ *Inclusion criteria*

Any preterm newborn admitted to the NICU with the diagnosis of ARDS and his Gestation age < 37 weeks.

➢ *Exclusion criteria:*

1. Know cases with congenital heart diseases
2. Babies with congenital anomalies
3. Neonates with meconium aspiration

A pre-designed questionnaire using Google form were filled with data retrieved from the patients' records.

III. ANALYSIS

Epi-Info program No. 7 was used to analysis the data. Means were used for numerical data , frequencies and tables were used for categoral data. T-student test was used for normally disturbed data with power of 80% and 95% CI, p-value < 0.05 were used as significant. Multiple-logestic regression analysis was used to identify the independent risk factors for mortality among premature neonates with ARDS.

➢ *Sample size:*

A sample size of 577 eligible neonates were enrolled serially over one year period consequently.

IV. RESULTS

Out of 1086, neonates admitted to the nurseries of Al-Sabeen hospitals over a year. There were 577 premature neonates with a diagnosis of ARDS met the inclusion and exclusion criteria of the study and were enrolled. The prevalence of ARDS among premature neonates was 53.1%. The death rate among them was 20.6 % (119 died neonates). Table 1 showed the demographic features of the study population. Half of the study population were delivered by cesarean section (Fig 1) and also almost half of the study population their body weight were from 1.5-2 kg (Figure 2). Table 2 showed that all the parameters on univriate were statistically significant (p value <0.01) except two parameters, the first is associated maternal disease and the second one is labor problems (p value >0.1). However, table 3 showed that gestational age < 30 weeks, weight <1.5 kg, Apgar score <7, male sex, being on mechanical ventilator and lack antenatal care were independent significant risk factors on multi-variate logistic regression analysis

V. DISCUSSION

The present study showed high prevalence rate of ARDS (53.1%), this is similar to results of a study conducted in KSA (54.7%) (5). The mortality rate from ARDS among premature was 20.6% in this study higher than what was reported in other studies (6). In the current study, lack of antenatal care visits were associated with RDS neonatal mortality significantly and the study showed that less number of the neonates who died had C-section. These findings were similar to other studies (6). Adequate prenatal care may avoid, spot, and treat risk factors for cruel pregnancy consequences; it may permit a pre-assignment hospital for the delivery, and guarantee maternal safe transmission to a reference perinatal center for high-risk pregnancies. Among all these benefits, it includes a higher chance of receiving antenatal corticosteroids for women at risk for preterm delivery (7, 8, 9) and an opportune indication of cesarean section, if needed (10). In a study in São Paulo state (2004– 2013), cesarean section was protective for neonatal deaths by 37% in 22 to 27 weeks of gestation live births, and by 11% for those with 28 to 32 weeks of gestation (11). In an Indian single center study, vaginal delivery increased the risk for RDS associated neonatal deaths in live births with 28 to 34 weeks of gestation by almost 17 times (9). The present study revealed that died neonates had lower Apgar score than the group who survived. Similar to our study, in Fiji, a lower 5-Apgar score augmented the death risk among newborns with RDS (12). The link between lower 5-Apgar score and RDS related neonatal deaths found in this study is probably connected to inequalities in the access of women at risk for preterm delivery and their newborn infants to excellent care, associated with deficiencies in antenatal and delivery care, and in the initial postnatal management.

Lower gestational age, multiple pregnancy, and male sex are considered biological conditions with higher vulnerability for bad consequences (13) and, probably, with the presence of more severe disease in the first hours of life (13, 14, 15). Our results showed that lower gestational age, male sex were significantly higher among died group of newborns and this is similar to other studies (12. 16), male gender is preponderance over female in developing NRDS due to androgen inhibition and delay of fetal surfactant production (16).

However, the present study showed that multiple birth was not a risk factor for mortality among neonates with RDS. Infants with these characteristics may demand the availability of complex resources to ensure the adequate respiratory care and reduce the risk of death (17). Nevertheless, quality of care is much more than the availability of technological resources (18). To achieve the best outcomes, trained human resources, standardized care management based on best available scientific evidence, and continuous surveillance of the quality of care are necessary (19,20)

Our results showed that died neonates had lower birth weight (<1.5kg) than those who lived. This result is similar to other studies (21). In the Brazilian Surfactant Collaborative Group, with 19 centers, almost 40% of deaths of preterm infants with birth weight less than 750 g occurred during the first 72 hours after birth, compared with 5% of deaths within this period in infants with higher birth weight (22). This study is one of the first studies of RDS-associated neonatal deaths in a low-income country and their associated factors. The main causes of death in preterm infants with RDS found in this study and the variables associated to these deaths highlight the unique characteristics of the health care provided to mother–infant in regions such as Sana'a- Yemen, where issues related to quality of care need special attention.

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VI. LIMITATIONS

The present study has limitations. This is a hospital based study performed using a database built from hospital's records that does not include information such as those related to maternal conditions, such as chorioamnionitis and preeclampsia, which could impact in preterm births and ARDS associated neonatal mortality. In addition, accuracy of critical variables for this study of causes of death cannot be checked.

VII. CONCLUSION

In conclusion, during one-year period in Sana'a, RDS-associated neonatal mortality rate (20.6%) which is a significantly high, compared with rates reported in middle and high-income countries. Male gender, low gestational age, low birth weight , low Apgar score, lack of antenatal care, exposure to mechanical ventilator were found to be independent risk factors for mortality among premature babies with ARDS.

RECOMMENDATIONS

The relationship between RDS-associated neonatal deaths and social, maternal, and neonatal factors suggests the need for perinatal strategies to reduce prematurity and to improve the initial management of preterm infants.

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Table 1. Demographic features of the study population

Criteria	Total No 577
Gestational age (weeks) Means (SD)[range]	32.9 (2.6)[23 – 36]
Apgar Means (SD)[range]	6.8 (1.5)[2-9]
<1.5 kg Body weight	177 (30.6%)
Rural residence	119 (21%)
Male sex	295 (51%)
Antenatal care (ANC) given	111 (48%)
Associated maternal disease	91 (15.7%)
Mode of delivery: C-section	219 (50.4%)
Labor problems	334 (58%)
Multiple birth	134 (23%)
Cortisol therapy	94 (16%)
Mechanical ventilator	94 (16%)
Nothing per Oral (NPO)	518 (89%)
Died	119 (20.6%)

Table 2. Risk factors of mortality (univariate analysis):

	Died 119 (21%)	Alive 458(79%)	OR (CI)	P value
Means of Gestational age (weeks)(SD)	30.8 (3.3)	33.5 (2.1)		<0.001
Gestational age <30 weeks	37[31%]	12[2.6%]	16.6[8.4-34.4]	<0.001
Means of Apgar score at 5 minutes	5.8 (1.7)	7 (1.4)		<0.001
Apgar score <7	59[49.5%)	119[26%]	2.7[1.8-4.2]	<0.001
Body weight < 1.5 kg	102 (57.6%)	75 (42.4%)	5.9 [3.8-9.1]	<0.001
Male sex	69 (58%)	226 (49%)	1.4 [0.9-2.1]	0.04
Rural residence	145(75%)	47 (25%)	1.4[0.9-2.1]	0.05
ANC	16 (32%)	95 (53%)	0.4 [0.2-0.8]	0.006
Associated maternal disease	21 (17.6%)	70 (15%)	1.1 [0.6-2]	0.3
Labor problems	63 (53%)	271 (59%)	0.7 [0.5-1.1]	0.1
Mode of delivery: Caesarian section	46 (38.6%)	245 (53.5)	0.5 (0.3-0.8]	0.002
Multiple birth	20 (17%)	114 (25%)	0.6 [0.3-1]	0.03
Cortisol therapy	30 (25%)	64 (14%)	2 ([1.2-3.3]	0.003
On mechanical ventilator	56 (47%)	36 (7.8%)	11.7 [7-19.7]	<0.0001
Was the patient NPO	113 (97%)	405 (90.6%)	2.4 [1-6.4]	0.01

Table 3. Independent risk factors of mortality (multivariate logistic analysis)

	Died 119 (21%)	Alive 458(79%)	OR[CI]	AOR[CI]	P value
Gestational age <30 weeks	37[31%]	12[2.6%]	16.6[8.4-34.4]	7[3-15.9]	<0.001
Weight <1.5kg	75 [63%]	102[22%]	5.9[3.8-9.1]	3.5[2-6.1]	<0.001
Apgar score <7	59[49.5%]	119[26%]	2.7[1.8-4.2]	1.7[1-2.9]	<0.001
Male sex	69 (58%)	226 (49%)	1.4 [0.9-2.1]	1.7[1-2.9]	0.03
Being on mechanical ventilator	56 (47%)	36 (7.8%)	11.7 [7-19.7]	7.4[4.1-13.2]	<0.001
Had antenatal care	16 (32%)	95 (53%)	0.4 [0.2-0.8]	1.9[1-3.4]	0.02

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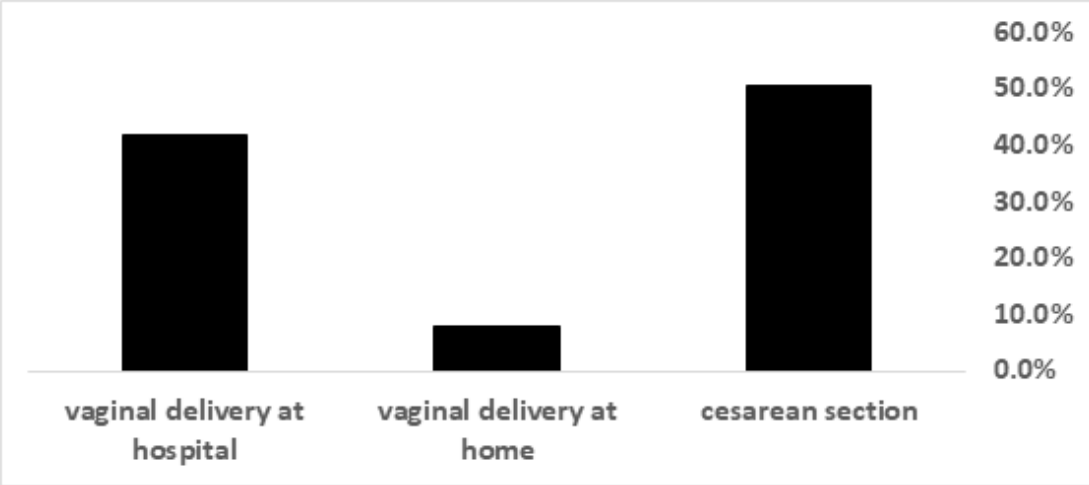

Fig 1. Mode of delivery

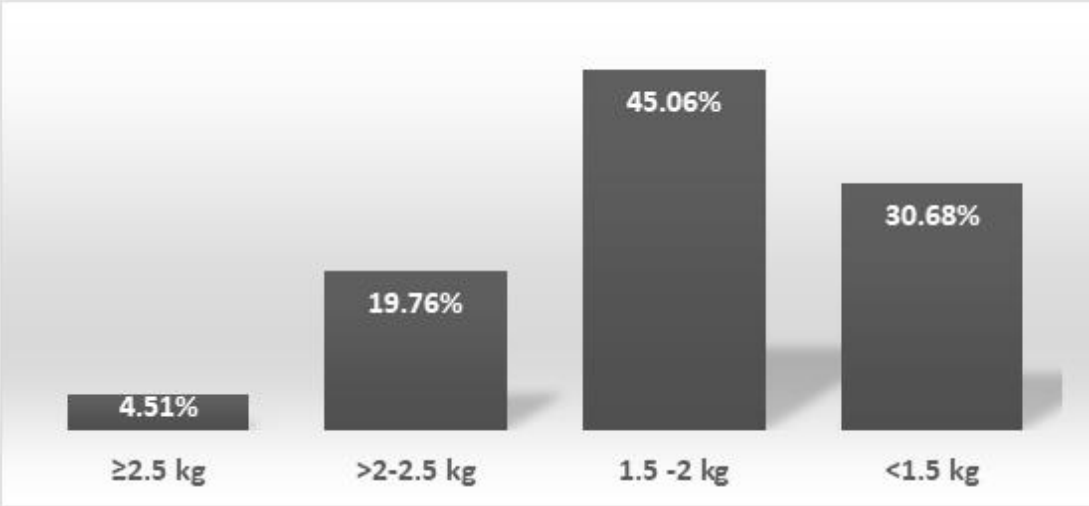

Fig 2: Distribution of body weight of the study population