

Early Respiratory Distress Evaluation in Full Term Newborns

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ABSTRACT

Background: One of the most common reasons for admission of term neonates to a neonatal care unit is respiratory distress, causes could be respiratory and non-respiratory with multiple predisposing factors to it.

Objectives: To study the frequency, causes, possible risk factors and early outcome of respiratory distress in full term newborn.

Methods: A retrospective study was conducted at the neonatal intensive care unit of Al-Yarmook teaching hospital in Baghdad over a period of 6 months from 1st of January 2019 to 30th of June 2019. A questionnaire was designed to gather information from mothers regarding their age, parity, antenatal care, chronic diseases, and mode of delivery. Data also were collected about possible neonatal risk factors, this include sex, birth weight and gestational age for the purpose of including or excluding in this study. Down's score was used to evaluate patients with respiratory distress.

Results: During the 6 months study period, 2173 neonates were delivered at the delivery rooms of Al-Yarmook teaching hospital, out of these sixty full term neonates were admitted to the neonatal intensive care unit with respiratory distress representing 2.76% of the total live births. The majority of them, 42 neonate were diagnosed as transient tachypnea of newborn that represent, 70% of total cases, and 1.9% of the total live births, followed by meconium aspiration syndrome six neonates, respiratory distress syndrome five, congenital pneumonia three, and congenital heart disease two, which represented 10%, 8%, 5% and 3%, respectively. Congenital diaphragmatic hernia and choanal atresia each had been diagnosed in only one neonate 2% from the total cases. Gender distribution showed a statistically significant male predominance with a male: female ratio of 1.8:1. Age of mother, maternal asthma, smoking, mother with absent antenatal care and finally delivery by cesarean section particularly elective one was found to be risk factors. From the total 60 cases with respiratory distress, three cases (5%) had died representing (0.13%) of total live birth.

Conclusions: This study demonstrates that respiratory distress is still an important problem in neonates, with a result that is comparable to other studies.

Keywords: Respiratory distress, Neonatal intensive care unit, Transient tachypnea of newborn.

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Respiratory distress (RD) is a common presenting feature requiring admission to neonatal intensive care unit (NICU) among newborns with many of its underlying causes are unique to this age group⁽¹⁾. Neonatal respiratory conditions can arise for several reason: delayed adaptation or maladaptation to extra-uterine life, existing conditions such as surgical or congenital anomalies or from acquired conditions such as pulmonary infections occurring either pre- or post-delivery⁽¹⁾.

Hence, the cause of RD could be related to the respiratory system or to a cardiac, renal, metabolic, gastrointestinal, or neurologic pathological process⁽²⁾. Respiratory conditions are the most common reason for admission to a neonatal unit in both term and preterm infants, evidence exists of rising rates of neonatal admissions in full term neonates due to respiratory conditions, possibly due to the effect of increased rates of caesarean section delivery⁽³⁾.

Respiratory distress in newborn is recognized as one or more signs of

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increased work of breathing, such as tachypnea, nasal flaring, chest retractions, or grunting^(4,5). Normally, the newborn's respiratory rate is 30 to 60 breaths per minute, tachypnea is defined as a respiratory rate greater than 60 breaths per minute^(4,5). Thus, after initial resuscitation and stabilization, it is important to use a detailed history, physical examination, radiographic and laboratory findings to determine a more specific diagnosis and appropriately tailor management. A thorough history may guide in identifying risk factors associated with RD, a detailed physical examination should focus beyond the lungs to identify non pulmonary causes, such as airway obstruction, abnormalities of the chest wall, cardiovascular disease, neuromuscular or metabolic disease that may initially present as RD in a newborn. Radiographic findings can identify diaphragmatic hernia, congenital pulmonary malformations, and intrathoracic space occupying lesions, such as pneumothorax, mediastinal mass that can compromise lung expansion⁽⁶⁾.

The current study aims to evaluate the frequency, causes and outcome of RD in full term babies who presented with RD and admitted to NICU.

Methods

A retrospective study was conducted at the NICU at Al-Yarmook teaching hospital in Baghdad, Iraq over a period of 6 months that extends from 1st of January 2019 to 30th of June 2019. Eligible cases were 60 full term neonates (gestational ages between 37 weeks to completed 41 week) presented with RD in the first 24 hour of life, whereas the control group consist of a similar number of a full term babies whom had delivered at the same time and the same place with no RD. Gestational age was calculated by fetal sonography and confirmed by the mother's estimated date of her last menstrual period. Physical examination and Ballard scoring system of the neonate had done by pediatrician⁽⁷⁾.

A questionnaire was designed to gather information from mothers of participants in

both groups (eligible and control cases), after obtaining their written agreement to participate in the study. These informations include their age, parity, antenatal care (ANC), smoking, chronic diseases including diabetes and/or asthma, mode of delivery whether by normal vaginal delivery or by cesarean section (C/S), whether emergency or elective. Data were collected about possible neonatal risk factors, this include sex, birth weight and gestational age for the purpose of including or excluding from the study. Exclusion criteria were the babies who were delivered at preterm (that means before 37 weeks of gestation), and post term (that means pregnancy extend beyond 42 weeks of gestation), neonates. Newborns with RD were investigated by random blood sugar, complete blood count, C-reactive protein, blood culture, and chest x-ray. Echocardiography was done just to two cases suspected to have cardiac problems.

Case diagnosis:

- Respiratory distress syndrome is suspected clinically and supported by chest roentgenogram showing a reticular granularity appearance and air bronchograms, which is characteristic but not pathognomonic appearance, and a negative blood culture⁽⁸⁾.
- Transient tachypnea of newborn (TTN): is characterized by the early onset of tachypnea, sometimes with retractions, or expiratory grunting and, occasionally, cyanosis that is relieved by minimal oxygen supplementation (<40%). Most infants recover rapidly, usually within 3 days the chest radiograph shows prominent pulmonary vascular markings, fluid in the intralobar fissures, over aeration, flat diaphragms⁽⁸⁾.
- Meconium aspiration syndrome (MAS): is defined as meconium stained amniotic fluid with the presence of meconium in the trachea supported by chest roentgenogram appearance of over inflation, coarse opacities and flattening of the diaphragm⁽⁹⁾.
- Congenital pneumonia (CP): in which the infant typically suffers progressive RD

and has signs of systemic sepsis, which develop within a few hours of birth. The appearance is varied; there can be lobar or segmental consolidation, atelectasis, diffuse haziness or opacification. This is accompanied by positive blood culture and/or elevated inflammatory indices⁽¹⁰⁾.

- Congenital heart disease (CHDs): were supported by clinical features, CXR and echo study of the heart⁽¹¹⁾.
- Choanal atresia (CA): Diagnosis is established by the inability to pass a firm catheter through each nostril 3-4 cm into the nasopharynx⁽¹¹⁾.
- Tracheo-oesophageal fistula (TOF): is usually diagnosed with a CXR which show either a coiled nasogastric tube in the upper pouch of the esophagus, proximal

esophageal stump may be distended with air, the presence of air in the stomach and bowel in the setting of oesophageal atresia implies that there is a distal fistula, also the lung demonstrate areas of consolidation / atelectasis due to recurrent aspiration.

- Congenital diaphragmatic hernia (CDH): is usually diagnosed by CXR which reveals herniation of abdominal organs (such as intestine, stomach and liver), up through the hole in the diaphragm into the chest of neonate after their birth.

Down's score was used to diagnose and differentiate those who had RD and to categorize them according to severity (Table 1). The Down's score is more comprehensive and can be applied to any gestational age and condition⁽¹²⁾.

Table 1: Down's score for respiratory distress evaluation.

Test	Score		
	0	1	2
Respiratory rate	< 60/min	60-80/min	> 80/min
Retraction	No retraction	Mild retraction	Severe retraction
Cyanosis	No cyanosis	Cyanosis relieved by O ₂	Cyanosis with O ₂
Air entry	Good bilateral air entry	Mild decrease in air entry	No air entry
Grunt	No grunt	Audible by stethoscope	Audible with air
Evaluation			
Total	Diagnosis		
< 4	No respiratory distress		
4 – 7	Respiratory distress		
> 7	Impending respiratory failure, blood gas are required		

Statistical package for social science (SPSS) program version 23 was used for analysis of data. Parametric data was expressed as mean ±SD and non-parametric data was expressed as number and percentage of the total.

Fischer's exact test of significance and chi test was used when indicated in order to compare proportion between non parametric categorical variables. P value <0.05 is considered significant.

Results

During the 6 months study period, 2173 neonates were delivered at the delivery rooms of Al-Yarmook teaching hospital, out of these sixty full term neonates were admitted to the NICU with RD representing 2.76% of the total live births.

The majority of full term neonates who had presented with RD were diagnosed as TTN that accounted for 70% of total cases with RD and 1.9% of the total neonates delivered during the study period, MAS was the cause of RD in 6 neonates representing 10% of the RD cases and 0.27% of the total;

whereas RDS was diagnosed in 5 cases representing 8.3% of RD cases and 0.23% of the total. The incidence of other less frequent causes of RD are shown in table 2.

Gender distribution of RD cases shows a significant male predominance that 39 (65%) of cases were males and 21 (35%) were females in a ratio of 1.8:1, beside that male gender predominate in all case groups of RD, (Table 3).

When comparing the birth weight of patients with RD with that of the control group, there was no significant difference in their birth weight regarding the incidence of low birth weight (infant born weighing 2500 gram or less), as shown in table 4.

A statically significant difference is noted when comparing the gender between the cases and control group that males constitute 61.9% versus 38.1% in cases and control group, respectively, (Table 5).

Age of the mothers of RD cases show a significant risk factor as compared to the control group that 90% of cases had a mothers with their ages below 20 years as opposed to only 10% in the control group, beside 77.7% of RD cases had a mother age above 40 years compared to only 22.3% in the control group, (Table 5).

Despite that 52.5% of RD cases were delivered to multiparous mothers, this result was not shown to be statically different as opposed to the control group (p. value 0.353), (Table 5).

Maternal asthma was not shown to be a risk factor for RD (p value 1.00); on the other hand, maternal diabetes and smoking was found to be a statically significant risk factor for RD that maternal diabetes was

found in 88.8% of RD cases versus only 11.3% in the control group (p value of 0.032) and maternal smoking was found in 100% of cases; whereas, none of the control group had a smoking mother, (Table 5).

Mother with absence of ANC was found to be a strong risk factor for RD (p value of 0.009), (Table 5).

Nearly 2/3 of RD cases were delivered by cesarean section opposed to 1/3 in the control group, thus delivery by cesarean section was found to be a strong risk factor for RD, (Table 5).

Of the 39 RD cases who had delivered by cesarean section, the majority 33 cases (82.5%) were delivered electively versus only 7 cases (17.5%) were delivered by elective cesarean section in the control group. Hence elective cesarean section was found to be a risk factor for RD, (Table 6).

Down's score for RD was highest in congenital pneumonia with a mean of 8.3 (± 0.5) then 7.0 (± 1.4) in CHD, followed by MAS 6.8 (±1.3); whereas RDS had a mean score of 6.0 (± 1.0). The lowest recorded score were in TTN cases group in which the mean was 5.5 (± 0.7), (Table 7).

Of the 60 RD cases, three cases (5%) died representing (0.13%) of total live birth, one with complex CHD, the other one with MAS, the third one was a patient with CP. The cases of CA and CDH were referred to specialized surgical wards. TTN patients had the shortest hospital stay period with a mean of 5 hours; on the other hand patients with congenital pneumonia had the longest.

Table 2: Distribution of respiratory distress cases according to the cause.

Cause of RD	TTN	MAS	RDS	CP	CHD	CDH	CA
Number of cases	42	6	5	3	2	1	1
Percent of RD cases	70%	10%	8%	5%	3%	2%	2%
Percent of total delivered	1.933%	0.276%	0.230%	0.138%	0.092%	0.0465	0.0465%

Table 3: Gender distribution of respiratory distress cases.

Condition	Male No. (%)	Female No. (%)	Total no.
TTN	27(64.3)	15(35.7)	42
MAS	4(66.7)	2(33.3)	6
RDS	3(60)	2(40)	5
Congenital pneumonia	2(66.7)	1(33.3)	3
CHD	1(50)	1(50)	2
CDH	1(100)	0(0)	1
CA	1(100)	0(0)	1
Total	39(65)	21(35)	60

P value 0.02

Table 4: Mean birth weight in respiratory distress and control groups.

Total no.(120)	RD group (No. = 60)	Control group (No. = 60)	P value
Mean birth weight (Kg)	3.32	3.44	0.141
Standard deviation (Kg)	±0.32	±0.54	

Table 5: Possible risk factors for respiratory distress.

Possible risk factor		No.	RD group No. (%)	Control group No. (%)	P value
Gender	Male	63	39(61.9)	24(38.1)	0.010
	Female	57	21(36.8)	36(63.2)	
Maternal age	Less than 20 y	10	9(90)	1(10)	0.012
	20-30 y	64	28(43.7)	36(56.3)	
	31-40 y	37	16(43.2)	21(56.8)	
	More than 40 y	9	7(77.7)	2(22.3)	
Parity	Primiparous	23	9(39.1)	14(60.9)	0.353
	Multiparous	97	51(52.5)	46(47.5)	
Maternal asthma	Asthmatic	5	3(60)	2(40)	1.000
	Not	115	57(49.5)	58(50.5)	
Maternal diabetes	Diabetic	9	8(88.8)	1(11.2)	0.032
	Not	111	52(46.8)	59(53.2)	
Maternal smoker	Smoker	7	7(122)	0(0)	0.013
	Not	113	53(46.9)	60(53.1)	
Antenatal care	With ANC	49	17(34.6)	32(65.4)	0.009
	Without ANC	62	34(54.8)	28(45.2)	
Mode of delivery	NVD	64	21(32.8)	43(67.2)	0.0001
	C/S	56	39(69.6)	17(30.4)	

Table 6: Elective Caesarean section and respiratory distress relationship.

Variable	No.	RD No. (%)	Control No. (%)	P value
Elective C/S	40	33(82.5)	7(17.5)	0.002
Non elective C/S	16	6(37.5)	10(62.5)	

Table 7: Mean Down's score in different respiratory distress causes.

Causes	Down' s score
	Mean \pm SD
TTN	5.5 \pm 0.7
MAS	6.8 \pm 1.3
RDS	6.0 \pm 1.0
CHD	7.0 \pm 1.4
CP	8.3 \pm 0.5
CDH	7.0 \pm 0.0
CA	6.0 \pm 0.0

Discussion

One of the most common reasons for admission of term neonates to a NICU is RD. The cause may be of pulmonary or non-pulmonary origin. This study focuses on the major causes and predisposing factors for RD in term infants.

In this study, sixty full term neonates were admitted to the NICU with RD representing 2.76% of the total live births, this is close to the result of the incidence of RD in a similar study conducted in Al Fallujah teaching hospital by Al Ajeli et al in which 147 neonates had developed RD from 5828 total birth, constituting 2.5% of the total live births⁽¹³⁾. A nearly similar result was obtained in Baghdad by Numan Nafie et al in which 50 full term neonates had developed RD from 2312 total birth, constituting 2.1% the total live births⁽¹⁴⁾. However, this is lower than that of another study conducted by Fadhil Musa Aljawadi H et al⁽¹⁵⁾, and Abdurrahman SM et al⁽¹⁶⁾, in which the incidence of RD in full term neonates was found to be 4.8% which is higher than that obtained in this study. This could be attributed to the different study design and different incidence of RD risk factors.

In this study, TTN accounted for the majority (70%) of full term RD, this is in accordance with Numan Nafie et al study that showed that 79% of full term RD cases had TTN⁽¹⁴⁾. Similarly, Keerti Swarnkar et al study showed that TTN ranked first as a cause of RD in both full term and preterm newborns⁽¹⁷⁾. On the other hand, Al Ajeli et al⁽¹³⁾, study showed that TTN was the most

common cause of full term RD but with a percentage lower than that obtained in the present study (40%).

MAS and RDS ranked second and third as the cause of full term RD in this study with a nearly similar percentage of 10% and 8.3%, respectively. Similarly, Al Ajeli et al⁽¹³⁾ found that the RDS and MAS occur with nearly a proximal percentage of 34.7% and 14.35% respectively, however, in Numan Nafie et al study, RDS and MAS accounted for 12% and 4% of full term RD, respectively⁽¹⁴⁾.

Regarding pulmonary infection was diagnosed in three neonates (5%) out of the 60 full term neonates in this study, which is higher than that of Al Ajeli et al⁽¹³⁾, and Fadhil Musa Aljawadi H et al⁽¹⁵⁾ which are 2% and 1.6%, respectively.

The percentage of CHD presented with RD in this study and in Keerti Swarnkar et al was close (3% and 3.5% of all RD cases, respectively⁽¹⁷⁾. Only one case was diagnosed for both congenital DH and choanal atresia accounted for only 2% of cases for each. Available data for comparison of these frequencies is scarce, this could be related to the rare occurrence of these surgical conditions. Although the commonest causes of RD in the different studies are similar, yet their arrangement in frequency is different. These differences between this study and other studies could be attributed to the differences in the sample size and the frequency of RD risk factors.

Gender distribution of RD cases shows a statically significant male predominance; a

similar result was obtained by Al Ajeli et al⁽¹³⁾, Numan Nafie et al⁽¹⁴⁾ and Aynalem YA et al⁽¹⁸⁾, this could be related to the fact that male gender is a risk factor for RDS, TTN and sepsis⁽¹⁹⁾, who are the major risk factors for RD in this study, but opposite to this study Fadhil Musa Aljawadi H et al⁽¹⁵⁾ found there is no significant relation to male gender.

There was no significant difference in the birth weight of newborn with RD and the control group, beside low birth weight was not considered to be a risk factor for RD, this is in accordance with a Turkish study conducted by Mervan Bekdas et al⁽²⁰⁾; however, in another study conducted by Numan Nafie et al whom had studied 100 TTN cases in children welfare hospital in Baghdad had found that there was a highly significant correlation between the neonates' weight and the incidence of TTN, that the incidence much decrease with the larger weight⁽²¹⁾. This could be related to the small number of cases with LBW (only 3 cases) in the RD group.

In this study, maternal age was found to be a significant risk factor for RD, that women with their ages below 20 years and more than 40 years were considered as a risk factor for RD. Maternal age older than 29 years was found to had an impact on the incidence of TTN in a study conducted by Esengül Keleş et al in Turkey⁽²²⁾; on the other hand, Masahiro Fukushima et al⁽²³⁾ and Mervan Bekdas et al⁽²⁰⁾ shows no significant role of maternal age in the incidence of RD. However; the role of maternal age as a risk factor for RD seems to be unclear.

Maternal parity was not considered as a risk factors for RD in the present study, this agrees with Numan Nafie et al⁽¹⁴⁾, Mervan Bekdas et al⁽²⁰⁾ and Shamel mostafa et al⁽²⁴⁾ studies who had found that parity was not considered as a risk factor for RD.

In the current study and in Numan Nafie et al study⁽¹⁴⁾ maternal asthma was not shown to be a risk factor for RD, this could be related to the small number of asthmatic mothers in both studies, while infants of

diabetic mother in this study were more prone to develop RD as opposed to the control group. This could be attributed to the fact that infants of diabetic mothers had increased rates of premature birth, CHD, TTN and diaphragmatic paralysis from a brachial plexus injury beside RDS requiring admission to a NICU occurs almost 6 times as frequently in infants of diabetic mothers as in infants of non-diabetic one^(25,18).

History of smoking was found in 7 (11.7%) mothers in RD group while none of the mothers in the control group were smokers; thus maternal smoking was considered as a risk factor for RD in agreement with Numan Nafie et al⁽¹⁴⁾ and Stylianou-Riga et al⁽²⁶⁾. Smoking affects the intrauterine lung development in the way that fetal breathing movements are essential for normal growth and structural maturation of the fetal lungs. It had been found that lung function tests in infants born to smoking mothers confirm reduced airway patency and the effect of prenatal smoke exposure most likely plays a greater role on lung function in childhood than postnatal and childhood exposure.

Mother with no ANC was found to be a strong risk factor for development of RD in their full term babies this is in accordance with a study conducted by Joel Noutakdie Tochie1 et al⁽²⁷⁾. The association of absent ANC and RD could be related to the absence of anticipatory guidance, diagnosis and treatment of the mothers' comorbid conditions during the pregnancy.

Delivery by C/S was found to be a strong risk factor for RD development (p value of 0.0001) and in particular in those delivered by elective C/S (p value of 0.002), this is in agreement with many other studies such as Fadhil Musa Aljawadi H et al⁽¹⁵⁾, Numan Nafie et al^(14,21) and Noutakdie Tochie et al⁽²⁷⁾. The effect of labor in those delivered by NVD and emergency C/S enhances the release of catecholamines in maternal and fetal circulation, resulting in β -adrenergic receptor mediated upregulation of surfactant synthesis and transepithelial sodium ion transport, with subsequent fluid reabsorption, in the neonatal lung. Infants

delivered through elective C/S often are deprived of this labor-related physiological stress response pattern at birth and consequently experience failure of postnatal respiratory transition^(15,14,21).

TTN is characterized by relatively mild symptoms that resolve naturally over time with most infants recover rapidly, usually within 3 days⁽⁸⁾; that is why patients with TTN had the lowest Down's score as well as the shortest admission period in our study, Numan Nafie et al study⁽¹⁴⁾, and Fadhil Musa Aljawadi H et al⁽¹⁵⁾.

Death occurs in three patients with RD which accounted for 5% of total neonates presented with RD and 0.13% of total live birth representing the case fatality rate of this study. This is close to case fatality rate of 0.17% and 0.2% of total live birth in Numan Nafie et al⁽¹⁴⁾ and Eman F Badran et al⁽²⁸⁾ studies, respectively, but lower than the fatal rate of Fadhil Musa Aljawadi H et al⁽¹⁵⁾ which is 21% of total neonate.

In conclusions; Respiratory distress is still an important cause for full term newborn admission to NICU. Transient tachypnea of newborn is the commonest cause of RD in full term newborn with the shortest admission period while patients with congenital pneumonia had the longest period of admission, while surgical conditions such as choanal atresia and congenital DH are the lowest causes of RD. Male gender, maternal diabetes and mothers with absent ANC was considered to be risk factors for RD development. Delivery by C/S particularly elective C/S was found to be a strong risk factor for RD development.

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