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ECHOCARDIOGRAPHIC FINDINGS IN TRANSIENT TACHYPNEA OF THE NEWBORN AND RELATION TO ITS SEVERITY

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Abstract

Background: Transient Tachypnea of the Newborn (TNN) is a common self-limited disorder of the newborn resulting from pulmonary edema due todelayed or inadequate clearance of fetal alveolar fluid. The initial clinical picture is usually completely resolved by 48 to 72 hours. The aim of the present study was to assess the cardiac changes in neonates suffering from TTN by Echocardiography.

Patients and methods: A prospective observational study was conducted on 25 neonates suffering from TTN admitted to the NICU of Zagazig University Obstetrics & Gynecology Teaching Hospital. This study included 15 males (60%) and 10 females (40%) with a gestational age range from 37-40 weeks and a weight range from 2.69- 4 Kg. All cases were subjected to full history and clinical examination and detailed maternal history, laboratory and radiological investigations. Echocardiography was done in all cases as a diagnostic noninvasive tool to assess the cardiac changes in neonates with TTN.

Results: About 32% of TTN cases associated with pulmonary hypertension 25 % with Mild PPHT,12.5 % with Moderated PPHT and 62.5% with Sever PPHT None of the cases had impaired LV functions. Statistically neonates without pulmonary hypertension had higher EF and FS. Among the studied infants who were delivered vaginally one of two required nasal oxygen and the remaining one required CPAP. Twelve of the infants who were delivered by elective cesarean section required nasal oxygen, three required CPAP and two required mechanical ventilation. One infant who were delivered by emergency cesarean section required mechanical ventilation, five required CPAP. And showed that oxygen therapy did not vary significantly in relation to mode of delivery**.** Patients with pulmonary hypertension on their echo were found to have worse Downes score. They were significantly more tachycardiac than neonates without pulmonary hypertension. Patients with pulmonary hypertension on their echo were found to show more acidosis, hypoxia and hypercapnia than those without pulmonary hypertension.

Conclusion: Our study highlights the value of echocardiography as a non invasive tool in assessing cardiac changes in neonates suffering TTN and in correlating the presence of cardiac changes to the severity of the condition.

Keywords: Echocardiography, Transient Tachypnea ; Newborn

INTRODUCTION:

Respiratory Distress (RD) is a common presenting feature requiring admission to Neonatal Intensive Care Unit (NICU) among newborn infants with many of its underlying causes are unique to this age group **(1).**

Transient Tachypnea of the Newborn (TTN) is the commonest cause of RD in full term newborn while surgical conditions such as choanal atresia and congenital Diaphragmatic Hernia (DH) are the lowest. TTN patients had the shortest admission period of admission while patients with congenital pneumonia had the longest period of admission **(2).**

TTN results from delay in clearance of fetal alveolar fluid after birth. The management consists of supportive care, with symptoms generally resolving by 24-72 hours of age. If respiratory distress persists beyond 3-5 days, alternative diagnosis is more likely. Thus, TTN is a retrospective diagnosis. Differential diagnoses of TTN include respiratory distress syndrome, pneumonia, meconium aspiration syndrome, pneumothorax, tachypnoea resulting from central nervous system irritation or metabolic acidosis, and congenital lung and heart malformations **(3).**

TTN occurs in approximately 1 in 100 preterm infants and 3.6 - 5.7 per 1000 term infants. It is most common in infants born by Caesarian section without a trial of labor after 35 weeks' gestation.

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Male infants with an umbilical cord prolapse or perinatal asphyxia are at higher risk. Parental risk factors include use of pain control or anesthesia during labor, asthma, and diabetes **(4).**

Overall prognosis is excellent with most of the symptoms resolving within 48 hours of onset. In some case reports, malignant TTN has been reported in which affected newborns develop persistent pulmonary hypertension due to a possible elevation of pulmonary vascular resistance due to retained lung fluid **(5).**

Echocardiography is an essential tool in the diagnosis and management of a wide range of cardiovascular diseases. As a result, guidelines have developed to ensure accurate quantification and interpretation **(6).**

The incidence of structural cardiac lesions detected by 2Dechocardiography was higher in neonates with TTN **(7).** Overall, malignant TTN and Meconium Aspiration Syndrome (MAS) were the most frequent causes (17.44%) of Persistent Pulmonary Hypertension (PPHN), followed by pneumonia(13.95%) and asphyxia and congenital diaphragmatic hernia (12.79% each**)(8).**

The present work aimed at assessment of cardiac changes in neonates suffering from TTN by Echocardiography and to detect relation between the presence of cardiac changes to the severity of the condition, and to patient outcome.

PATIENTS AND METHODS:

A prospective observational study was conducted on 25 neonates suffering from TTN admitted to the NICU of Zagazig University Obstetrics & Gynecology Teaching Hospital. Informed consent was obtained from the partents of all participants before enrollment in the study in accordance to the Declaration of Helsinki.

Inclusion Criteria:

Neonate ≥ 37 weeks gestational age admitted in the first 3days of life with the suspected diagnosis of TTN. Respiratory rate > 60/min starting within the first 6 h of birth with tachypnea persisting for at least 6 h, with or without other signs like retractions, grunting, nasal flaring, and need for supplemental oxygen. Well-expanded lungs with or without increased fluid in lungs on chest radiograph.

Exclusion criteria:

Neonates with chromosomal abnormalities, clinical or radiological features of congenital heart disease, neonates with congenital anomalies and early-onset neonatal sepsis for example congenital pneumonia, Chorioamnionitis in the mother or features of neonatal infection including sepsis screen positivity

Twenty five neonates were included in this study, 15 males (60%) and 10 females (40%) with a gestational age range from 37-40 weeks and a weight range from 2.69- 4 Kg. All cases were subjected to full history and clinical examination and detailed maternal history, laboratory and radiological investigations.

Echocardiography investigation:

The entire study group was examined by echocardiography during the first three days of life using general electrical vivid 7-dimension echo machine and 10 MHz prop. All routine measurements and norms were taken as recommended by the American Society of Echocardiography **(9).** The echocardiographic windows used: subcostal, apical, left parasternal and suprasternal.

Fractional shortening (FS):

Dynamic function of the left ventricle is most easily assessed using FS, which is the percentage change in LV diameter during systole. FS%= LVEDD - LVESD) LVEDD x 100% Where LVEDD is the left ventricular end-diastolic diameter; and LVESD is the left ventricular end-systolic diameter (or LVIDS) **(10)**.

Statistical Analysis:

Data were described as range, mean +standard deviation, frequencies and percentages when appropriate. Comparison of quantitative values between the study groups was done using Student t test for independent samples in comparing two groups when normally distributed and Mann Whitney U test for independent samples when not normally distributed. For comparing categorical data, Chi square test was used. Pearson moment relation equation for linear relation in normally distributed variables and Spearman rank relation equation for non-normal variables. A probability value (p value) less than 0.05 was considered statistically significant.

RESULTS

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Among the 25 neonates, 8 patients (32%) were diagnosed PPHN estimated from a tricuspid regurge jet to be (50.88 mm Hg) with a range of (45-56), while 17 (68%) had normal pulmonary pressure. All of them showed an associated PDA. four (16%) had an isolated small PDA less than 2 mm with normal pulmonary artery pressure, one (4%) had atrial septal defect (ASD), however not considered an abnormal finding due to the age group **(Table 1)**.

About 32% of TTN cases associated with pulmonary hypertension 25 % with Mild PPHT,12.5 % with Moderated PPHT and 62.5% with Sever PPHT **(Table 2)**.

None of the cases had impaired LV functions. Statistically neonates without pulmonary hypertension had higher EF and FS **(Table 3)**.

Among the studied infants who were delivered vaginally one of two required nasal oxygen and the remaining one required CPAP. Twelve of the infants who were delivered by elective cesarean section required nasal oxygen, three required CPAP and two required mechanical ventilation. One infant who were delivered by emergency cesarean section required mechanical ventilation, five required CPAP. And showed that oxygen therapy did not vary significantly in relation to mode of delivery **(Table 4)**.

There was no significant relation between maternal risk factors and pulmonary hypertension **(Table 5)**.

Patients with pulmonary hypertension on their echo were found to have worse Downes score. They were significantly more tachycardiac than neonates without pulmonary hypertension (**Table 6)**.

Patients with pulmonary hypertension on their echo were found to show more acidosis, hypoxia and hypercapnia than those without pulmonary hypertension (**Table 7)**.

Hospital stays of our patients ranged from 2-8 days with a mean of 4.04 days. Cases with pulmonary hypertension had a prolonged hospital stay than cases without pulmonary hypertension (**Table 8)**.

Table (1): Echo findings detected in the studied newborns:

Echo Findings	Number of Patient	Percentage (%)
Normal echo findings	12	48%
ASD	1	4%
PDA +Pulmonary hypertension	8	32%
PDA alone	4	16%

Table (2): pulmonary hypertension of the studied newborns:

pulmonary hypertension	N	Percentage (%)	rang
Mild PPHT	2	25%	35 – 45 mmhg
Moderated PPHT	1	12.5%	45 – 50 mmhg
Sever PPHT	5	62.5%	50 - 55 mmhg

Table (3): Comparison of echo cardiac function between TTN cases with pulmonary hypertension and those without pulmonary hypertension:

Cardiac function	Cases with pulmonary hypertension	Cases without pulmonary hypertension	t-value	P-value	S
	Mean± SD	Mean± SD			
EF	72.86±2.47	81.39±4.81	4.47	0.002	S
FS	42.0±1.63	48.74±4.57	3.78	0.001	S

*SD: standard deviation, P: probability, S: significance.

Table (4): Relation between different types of O_2 therapy and mode of delivery:

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Mode of delivery	O_2 treatment						Chi-Square test		
	CPAP N	%	Nasal N	%	SIMV N	%	Pearson Chi-square	P value	S
Vaginal delivery	1	4	1	4	0	0	1.8	0.47	NS
Elective caesarian section	3	12	12	48	2	8	5.99	0.05	NS
Emergency caesarian section	5	20	0	0	1	4	2.33	0.35	NS

*NS: no significant, S: significant, P: probability.

Table (5): Relation between maternal risk factors and pulmonary hypertension:

Maternal Risk factors		Pulmonary hypertension	Chi-Square test: Pearson Chi-square	P value	S
Diabetes mellitus	N	5	7.2	0.16	NS
	%	20%			
other	N	1	1.44	0.68	NS
	%	4%			
Pregnancy induced hypertension	N	2	0.64	0.59	NS
	%	8%			
Premature rupture of membrane	N	0	0.58	1.0	NS
	%	0%			

*NS: no significant,S: significant,P: probability.

Table (6): Comparison of some clinical findings between TTN cases with PHN and those without PHN:

Clinical finding	Cases with pulmonary hypertension	Cases without pulmonary hypertension	t-value	P-value	S
	Mean± SD	Mean± SD			
Apgar score-1	7.5±0.53	8.26±0.3	12.87	0.24	NS
Apgar score-5	8.125±0.74	8.96±0.2	12.69	0.27	NS
Downes' Score	7. 5±0.76	5.78±0.57	6.88	0.0001	S
HR	160.13±8.82	124.12±13.96	13.15	0.0001	S

*SD: standard deviation, P: probability, S: significance.

Table (7): Comparison of blood gas analysis & O_2 saturation between TTN cases with pulmonary hypertension and those without pulmonary hypertension:

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Blood gas analysis & O_2 saturation	Cases with pulmonary hypertension	Cases without pulmonary hypertension	t-value	P-value	S
	Mean± SD	Mean± SD			
pH	7.2±0.01	7.25±0.03	3.84	0.001	S
PaCO2	56.57±8.73	40.0±3.77	7.31	0.001	S
SaO2	70.29±6.57	88.26±4.29	8.53	0.002	S

*SD: standard deviation, P: probability, S: significance.

Table (8): Comparison of the hospital stay period between TTN cases with pulmonary hypertension and those without pulmonary hypertension:

	Cases with pulmonary hypertension	Cases without pulmonary hypertension	t value	P-value	S
Hospital stay period (day)	Mean± SD	Mean± SD			
	6.87±1.25	2.7±0.92	9.43	0.0001	S

DISCUSSION

Transient tachypnea of the newborn (TTN) is usually a benign self-limiting disease, but associated hypoxemia and respiratory failure can increase the risk of morbidity and mortality. It is thought to be caused by delayed resorption of fetal lung fluid from the pulmonary lymphatic system **(11).**

Twenty-five neonates diagnosed with TTN were included in this study. Following confirmation of diagnosis by clinical examination, chest x-ray and exclusion, echocardiography was performed to all cases as a diagnostic noninvasive tool to assess the cardiac changes in neonates with TTN. The aim of our study was to detect cardiac lesion assess the cardiac changes in neonates suffering from TTN and to detect relation between the presence of cardiac changes to the severity of the condition, and to patient outcome.

It was found that the mean value of (EF) % in cases with normal pulmonary artery pressure was 81.4% and (FS) was 49.17%. A mild decrease in both values was present among cases with increased pulmonary artery pressure (EF) 72.86 % and (FS) 42.1 % than those with normal pulmonary artery pressure. These findings correlate with **Fraise et al., (12)** found that left ventricular ejection fraction and fractional shortening were normal or mildly decreased in 87% of their patients with PPHN.

All the studied cases required oxygen support; 13 cases (52%) received nasal oxygen, 9 cases (36%) received nasal CPAP, and 3 cases (12 %) received SIMV. We found that currently, at least in our practice, there is a trend toward early introduction of other supportive respiratory intervention namely nasal CPAP. Similarly **Riskin et al., (13)** reported 89% of their cases required oxygen support, 63% received nasal oxygen, 13.4% nasal CPAP, and 11.9% received mechanical ventilation.

In this study it was clear that cases who were delivered by elective cesarean section required more aggressive oxygen support than those delivered vaginally or by emergency cesarean section, yet the difference did not reach statistical significance (p value=0.01). These findings correlate with **Tutdibi et al., (14) and Bak et al., (15)** who found that the absence of exposure to labor contractions is associated with more aggressive oxygen support and longer duration of oxygen supplementation.

It is also in agreement with **Tutdibi et al., (14)** who retrospectively studied impact of labor on outcome in TTN and showed that absence of labor before birth was significantly associated with higher rate of CPAP and mechanical ventilation.

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Among the studied neonates, PPHN occurred in (32%) of cases. The neonates who developed PPHN were more frequently female, 5 out of 8 (62.5%) and all of them were delivered by CS. Opposite to observations were noted by **Winovitch et al., (16) and Wilson et al., (17).** They reported a higher rate of PPHN following elective cesarean section than vaginal delivery.

Also, **Hernández et al., (18)** found that the risk for PPHN was 7 times higher after cesarean section deliveries than after vaginal deliveries.

Based on these findings and those of others, it is important that physicians include the neonatal risks, such as respiratory morbidity including transient tachypnea of the newborn (TTN), respiratory distress syndrome (RDS), and respiratory failure, associated with elective cesarean delivery, when obtaining informed consent. Although TTN is usually benign, it can result in delays in normal newborn transition, a considerable oxygen requirement, and ultimately, PPHN necessitating mechanical ventilation. It is difficult to evaluate properly the causality of lack of labor on neonatal respiratory compromise and magnitude of benefit of labor on the neonatal lung function. Together, the physician and patient should weigh the maternal risks, neonatal risks, and the need for cesarean delivery whether medically indicated or not.

In our study we found no significant relationship between maternal risk factors and increased risk for PPHN. Similarly**, Hernandez et al., (18)** mentioned that factors such as maternal diabetes, asthma, or pre-eclampsia did not account for increased risk for PPHN among cesarean delivery.

Blood gas analysis of cases with (PPHN) showed that the mean value of pH was 7.25, PCo2 was 44,3, and SO2 was 97% i.e more acidosis, hypercapnia, than cases without (PPHN) .These findings are similar to those of **Hernandez et al., (18)** concluded that the pulmonary arterioles remain very active in the neonates and can undergo profound vasoconstriction in response to a variety of stimuli such as hypoxia, acidosis, hypercapnia. The vasoconstriction may be sufficiently severe to result in a large rise in pulmonary vascular resistance which leads to right to left shunting through the ductus arteriosus and foramen oval. The reduced pulmonary flow worsens the hypoxia and leads to perpetuating the cycle of increasing pulmonary venous resistance and worsening hypoxia and acidosis if no intervention takes place.

Transient tachypnea of the newborn is known to be a benign and self-limiting disorder, but in this study, we found that it could cause severe morbidity such as respiratory distress, and persistent pulmonary hypertension requiring respiratory support and prolonged hospital stay as for cases associated with (PPHN). The mean value of hospital stay was 6.78 days in comparison to cases that were not associated with (PPHN) the hospital stay was 2.7 days. Similarly, **Kasap et al., (19)** found in their retrospective study of 95 newborns with TTN, that 33 newborns (34.74%) developed severe respiratory morbidity and their hospital stay was 7.3 days in comparison to the other group, 62 newborns (65.26%) who did not develop severe respiratory morbidity and their hospital stay was 4.6 days.

CONCLUSION

Our study highlights the value of echocardiography as a non invasive tool in assessing cardiac changes in neonates suffering TTN and in correlating the presence of cardiac changes to the severity of the condition.

No conflict of interest.

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