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Structure Cardiac Lesion in Transient Tachypnea of the Newborn

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ABSTRACT

Background: Transient tachypnea of the newborn (TTN) is one of the commonest causes of respiratory distress in newborns in late preterm and term infants. TTN occurs due to delay in clearance of fetal alveolar fluid after birth.

Objective: The aim of our study was to detect cardiac changes in neonates with TTN and correlating the presence of cardiac changes to the severity of the condition.

Patients and methods: Twenty-five neonates were included in this study (15 males and 10 females) with a mean gestational age of 37.76 ± 0.72 weeks and a mean weight of 3.10 ± 0.33 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 were associated with pulmonary hypertension. 25% showed mild persistent pulmonary hypertension (PPHT), 12.5% showed moderated PPHT and 62.5% showed sever PPHT. The present results showed 13 patients required nasal support, 9 patients required continuous positive airway pressure (CPAP) and 3 patients required advanced respiratory support in the form of mechanical ventilation (SIMV). There was a significant relation between elective cesarean section and occurrence of pulmonary hypertension. 24 neonates included in this study survived and one died. None of our patients developed neonatal sepsis.

Conclusion: Echocardiography represents an important non-invasive tool for assessment of cardiac changes and determination of the severity of the condition in neonates suffering from TTN.

Keywords: Transient tachypnea, Echocardiography, Cardiac changes.

INTRODUCTION

Transient tachypnea of the newborn (TTN) is a benign, self-limited condition that can present in infants of any gestational age shortly after birth. It is caused by a delay in the clearance of fetal lung fluid after birth, which leads to ineffective gas exchange, respiratory distress, and tachypnea [(1)].

The Risk factors for TTN include birth by cesarean section with or without labor, male gender, positive family history of asthma (especially in mother). A significant decrease in respiratory morbidity can be achieved if elective cesarean section is performed after 39 weeks of gestation [(2)].

TTN may be associated with persistent pulmonary hypertension (PPHN). For example, with elective cesarean section newborns with TTN who have low oxygen concentration may be given high concentrations of inspired oxygen (about 100%) by mask or nasal cannula without positive pressure. The formation of reactive oxygen species from the high alveolar oxygen concentration can lead to increased pulmonary vascular reactivity leading to PPHN [(3)]. The degree of PPHN can range from mild hypoxemia with mild respiratory distress to severe hypoxemia and cardiopulmonary dysfunction that needs intensive care support [(4)].

Echo estimates of right ventricular (RV) pressure have limitations when compared directly with cardiac catheterization. A study that compared echocardiographic estimates of RV pressure in comparison to direct measurement with right heart catheterization found that the absolute values by echocardiography varied by at least 10 mmHg when compared to the catheter-measured values more than 50% of the time [(5)].

The aim of our study was to detect cardiac changes in neonates with TTN and correlating the presence of cardiac changes to the severity of the condition.

PATIENTS AND METHODS

This prospective observational study was conducted on 25 neonates suffering from TTN admitted to the NICU of Zagazig University Obstetrics & Gynecology Teaching Hospital. They were studied after an informed consent obtained from the parents.

Inclusion Criteria:

- Neonate ≥ 37 weeks gestational age admitted in the first 3 days 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:

- Clinical or radiological features of congenital heart disease
- Neonates with chromosomal abnormalities.
- Neonates with congenital anomalies.

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- Early-onset neonatal sepsis for example congenital pneumonia, chorioamnionitis in the mother or features of neonatal infection including sepsis screen positivity (two features out of C-reactive protein, total leukocyte count, absolute neutrophil count, and immature to total leukocyte ratio being abnormal).
- Clinical, radiological, or blood gas features of meconium aspiration syndrome.

All cases were subjected to the following: Medical history (prenatal, natal and postnatal) including maternal age, parity, prior abortion, active or passive smoking, diabetes, asthma, obesity, arterial hypertension and mode of delivery. Complete clinical examination including determination of Apgar score at one and five minutes, assessment of gestational age (using Ballard score) & weight and chest and cardiac examination.

Laboratory investigations:

- Complete blood count: WBC, RBC, hemoglobin and platelets.
- C-reactive protein.
- Arterial blood gases: PH, $PaCO_2$, PaO_2, HCO_3.

Imaging:

- Chest X-ray
- Echocardiography.

Ethical approval:

The study was approved by the Ethical Committee of Zagazig Faculty of Medicine. A written informed consent was obtained from all patients in this research. Every patient received an explanation for the purpose of the study. All given data were used for the current medical research only. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Statistical Analysis

Data were analyzed as range, mean ± standard deviation, frequencies and percentages when appropriate. Student's t test, Mann Whitney U test and Chi square test were 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) equal or less than 0.05 was considered statistically significant.

RESULTS

The current study was carried out on 25 newborns with transient tachypnea of the newborn. Fulfilled criteria were included in the study. The study was conducted during the period from January 2021 to June 2021. About 60% of the studied newborns (n=15) were males (Table 1). The newborns had a mean gestational age of 37.76 ± 0.72 (37-39) weeks with a mean birth weight of 3.10 ± 0.33 (2.69 – 4) Kg. The majority of the newborns were born by elective cesarean section (72%) (Table 2). Diabetes with pregnancy was the most common maternal illness among the studied cases (Table 3). About 32% of TTN cases were associated with pulmonary hypertension. 25%with mild PPHT, 12.5%with moderated PPHT and 62.5% with sever PPHT (Figure 1). The present results showed that 13 patients required nasal support, 9 patients required CPAP and 3 patients required advanced respiratory support in the form of mechanical ventilation (SIMV) (Table 4). There was a significant relation between elective cesarean section and occurrence of pulmonary hypertension (Table 5).

Table (1): Demographic data of the studied newborns

Demographic Data		Number	Percentage %
Sex	Male	15	60%
	Female	10	40%
Mode of delivery	Vaginal delivery	2	8%
	Elective CS	18	72%
	Emergency CS	5	20%

Table (2): Characteristics of the studied newborns

Parameter	Range	Mean ± SD
Gestational age (weeks)	37- 39	37.76 ± 0.72
Birth weight (Kg)	2.69 – 4	3.10 ± 0.33

Table (3): Percentage of maternal risk factors

Maternal risk factors	Number of Patient	Percentage (%)
Diabetes mellitus	6	24%
Pregnancy induced hypertension	3	12%
Cord prolapses	2	8%

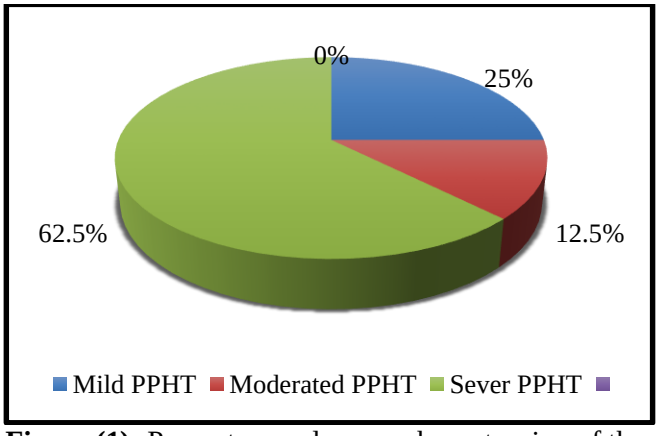

Figure (1): Percentage pulmonary hypertension of the studied newborns

Table (4): Types of respiratory support received during the study

Respiratory support	Number of Patient	Percentage (%)
Nasal	13	52%
CPAP	9	36%
SIMV	3	12%

Table (5): Relation between mode of delivery and pulmonary hypertension

Mode of delivery			Chi-Square test		
	Pulmonary hypertension		Pearson Chi-square	P value	S
Vaginal delivery	N	0	2.28	0.29	NS
	%	0%			
Elective caesarian section	N	6	6.99	0.01	S
	%	24%			
Emergency caesarian section	N	2	2.64	0.16	NS
	%	8%			

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

DISCUSSION

TTN is a commonly encountered neonatal condition. There are many studies identifying risk factors for TTN and elucidating possible pathophysiological mechanisms that are involved. The detection of structural cardiac lesions in two neonates with prolonged TTN at our center prompted us to review studies on this association. Most studies on TTN have excluded neonates with congenital heart disease. In some studies, 2D echo has been done to detect and exclude neonates with cardiac anomalies [6, 7]. One study used clinical grounds [8], while others mentioned exclusion of neonates with cardiac anomalies but did not give details of how the cardiac anomaly was detected [9, 10]. We did not come across any study specifically addressing the incidence of structural heart lesions in neonates with TTN.

Among the studied neonates, 60% were males and 40% were females. This is in agreement with **AL-Agha *et al.*** [11] where they found that male sex was associated with increased risk for TTN. Previously identified risk factors for TTN included male sex, C/S, macrosomia, maternal asthma, maternal diabetes, preterm birth and perinatal asphyxia [12].

In the current study we found that C/S was the most common factor associated with the development of TTN; 92% of cases in our study were delivered by cesarean section (80% elective &12% emergency section) while 8% were delivered by normal vaginal delivery (NVD). This finding is similar to study done by **Tutdibi *et al.*** [13] who retrospectively studied cases of respiratory distress in the NICU and showed that cesarean section was the most common factor associated with the development of TTN. Also, **Zaazou *et al.*** [14] confirmed this finding stressing that elective cesarean section was the main risk factor.

Tutdibi *et al.* [13] found that both the mode of birth and absence of labor are strongly related to TTN in newborns irrespective of gestational age even at term. This can be explained by the fact that rapid clearance of fetal lung fluid during postnatal lung adaptation, which is largely correlated with the onset of labor before birth. Labor enhances the release of catecholamines in maternal and fetal circulation, resulting in transepithelial sodium ion transport, with subsequent fluid reabsorption, in the neonatal lung. Infants delivered by elective CS often are deprived of this labor-related physiological stress response pattern at birth and consequently experience failure of postnatal respiratory transition. **Signore *et al.*** [15] revealed that fetal thorax compression during labor leads to loss of large volumes (25-35%) of liquid from the lungs. Therefore, an infant born by C/S is at risk of having excessive pulmonary fluids with increased risk of TTN.

Among the studied neonates we observed that 6 (24%) were born to diabetic mothers and 3 (12%) to preeclamptic mothers. Although it has been a common knowledge that diabetes mellitus is a risk factor for TTN, **Zaazou *et al.*** [14] suggested that factors as diabetes mellitus, maternal hypertension, or premature rupture of membrane have minor role in precipitating the occurrence of TTN.

In this study, all newborn with normal cardiac examination, on echocardiography 32% of them were found to have pulmonary hypertension. These findings are in agreement with **Azhar and Habib** [16] who reported that any distressed newborn even without an audible murmur should be considered for immediate echocardiography in order to diagnose the cause of murmur and manage it as soon as possible and stabilize the infant.

Among the studied infants, 8 (32%) with pulmonary hypertension had a prolonged course of the disease, 3 of the 8 babies required mechanical ventilation. Similarly, **Tudehope *et al.*** [17] found in their retrospective study in an intensive care nursery that 26% of their newborns developed pulmonary hypertension and required mechanical ventilation because of hypoxemia and respiratory acidosis. They concluded that babies with the clinical signs and radiographic features consistent with TTN may develop severe ventilatory-perfusion imbalance, fatigue and pulmonary hypertension with right to left shunting of blood across the ductus arteriosus. In addition**, Kasap *et al.*** [18] found that neonates with severe respiratory morbidity required more aggressive respiratory support in the form of CPAP or mechanical ventilation compared to other neonates with TTN who did not have severe respiratory morbidity, as they did not require respiratory support or only need nasal oxygen. **Smith and Alexander** [19]

found that a significant PPHN was associated with TTN in 15.5% of their patients.

CONCLUSION

Echocardiography represents an important non-invasive tool for assessment of cardiac changes and determination of the severity of the condition in neonates suffering from TTN.

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