ISSN 2664-8075 (Print) & ISSN 2706-5774 (Online)
South Asian Research Journal of Applied Medical Sciences
Abbreviated Key Title: South Asian Res J App Med Sci

| Volume-4 | Issue-4 | July-Aug 2022 | **DOI: 10.36346/sarjams.2022.v04i04.001**

Original Research Article

The Evaluation of Hematological Parameters in Newborn Diagnosed with Congenital Pneumonia

Munevver Kiyar[1], Burcu Ozkan[1], Kayra Su Arslan[1], Sema Yilmaz[2*]

[1]Usak University Faculty of Medicine, Pediatrics, Usak, Turkey
[2]MD., Professor, Usak University Faculty of Medicine, Pediatric Hematology and Oncology, İzmir Yolu, Atatürk Blv. 8. Km, 64000 Merkez/Usak, Turkey

***Corresponding Author:** Sema Yilmaz
MD., Professor, Usak University Faculty of Medicine, Pediatric Hematology and Oncology, İzmir Yolu, Atatürk Blv. 8. Km, 64000 Merkez/Usak, Turkey

Article History
Received: 26.05.2022
Accepted: 29.06.2022
Published: 02.07.2022

Abstract: The aim of this study is to compare the hematological parameters of transient tachypnea of the newborn (TTN) and congenital pneumonia. The hematological parameters of 84 newborns who had a gestational age over 35 weeks, who were diagnosed with transient tachypnea, and congenital pneumonia, who were hospitalized in the Newborn Unit of the Uşak University, Faculty of Medicine, Training and Research Hospital between 2015 and 2021, were analyzed retrospectively from the electronic records of the patients. The mean gestational age was determined as 38.0±1.4 weeks in patients with TTN and 38.8±1.5 weeks in patients with congenital pneumonia. A statistically significant difference was detected between the patients gestational age (p=0,016), birth weight (p=0,017), lymphocyte (p=0,037), thrombocyte (p=0,001) and delivery types (p=0,027). Statistically cesarean delivery was higher in the TTN group; the patients in the group with congenital pneumonia had a higher gestational age; the median lymphocyte and thrombocyte values were also found to be lower than in the TTN group. No statistically significant differences were detected between the two groups in terms of other hematological parameters. The present study presented that TTN was seen at lower gestational weeks and in newborns with lower birth weights. It was suggested that cesarean delivery can be considered to be a risk factor for TTN. When hematological parameters are examined, it is noted that patients with congenital pneumonia have a predisposition to lymphopenia and thrombocytopenia.

Keywords: Tachypnea, newborn, pneumonia, thrombocyte, lymphocyte, birth weight.

INTRODUCTION

The most common cause of the respiratory distress in newborns is the Transient Tachypnea of the Newborn (TTN), and it constitutes more than 40% of the cases. Its incidence is inversely proportional to the gestational age, and affects approximately 10% of babies born between 33-34 weeks, approximately 5% of babies born between 35-36 weeks, and less than 1% of babies born at term. TTN occurs shortly after birth, and limits itself. The main mechanism is considered to be the delayed resorption of the pulmonary fluid that is secreted during the fetal period. This fluid causes an increase in respiratory workload in the lungs [1]. Tachypnea usually resolves within 72 hours. TTN diagnosis is based on clinical and radiological findings. Chest radiography findings, which show diffuse linear pulmonary interstitial opacities, fluid accumulation in interlobar fissures, and perihilar vascular distension, regress within 48-72 hours [2].

Congenital pneumonia is a serious disease often resulting in stillbirth or postnatal death [3]. The neonatal lung has structural deficiencies in the defense against infections, which is the cause of the susceptibility to infections. Infection in the newborn may result from an ascending infection along the chorioamniotic membranes, or from the hematogenous transplacental route [4]. Pulmonary infection inactivates the available surfactant damaging Type II pneumocytes and preventing regeneration. Group B Streptococcal colonization was detected in surfactant deficiency and clinical

deterioration was seen in E. coli pneumonia. Difficulty in feeding, lethargy, poor reflex, hypothermia or hyperthermia, abdominal distention, cyanosis, and tachycardia are seen in the clinical manifestation of the newborn [5]. The diagnosis is made along with physical examination findings, radiological images, and laboratory findings.

Laboratory findings of the newborns who have respiratory distress may include leukopenia (<4000 WBC/mm^3) or leukocytosis (>15.000 WBC/mm^3), and left shift (>10% band forms) [5]. Thrombocytosis (>450000) or thrombocytopenia (<15000) can also be seen in the course of neonatal infections. As a result, when complete blood count is evaluated along with clinical and imaging findings, it helps in the diagnosis of TTN and congenital pneumonia. In the present study, the purpose was to evaluate the hematological parameters among newborns with congenital pneumonia and transient tachypnea, and also to investigate how possible differences in these parameters can guide the treatment and follow-up in the diagnosis of these two disorders.

MATERIAL AND METHOD

The hematological parameters of 84 newborns who had a gestational age over 35 weeks, who were diagnosed with transient tachypnea, and congenital pneumonia, who were hospitalized in the Newborn Unit of the Uşak University, Faculty of Medicine, Education and Research Hospital between 2015 and 2021, were analyzed retrospectively from the electronic records of the patients. The ethics committee approval was obtained from the Clinical Research Ethics Committee for the study. The study was conducted in line with the Declaration of Helsinki principles.

The diagnosis of TTN was made after at least one of the following was detected in patients presenting with respiratory distress symptoms (moaning, intercostal retraction, nasal wing breathing) in the first 6 hours after birth, respiratory rate above 60 per minute and diffuse linear pulmonary interstitial opacities on chest X-ray, fluid accumulation in interlobar fissures, perihilar vascular engorgement, hyperinflation signs of enlargement of the intercostal spaces, pleural effusion, flattening of the ribs and diaphragm, and exclusion of other diseases that may cause respiratory distress (sepsis, RDS, meconium aspiration, and pneumonia).

The diagnosis of congenital pneumonia was made in the presence of physical examination findings, radiographic evidence and supporting laboratory data evaluated together, radiological findings (consolidation/cavitation/pleural effusion), deterioration gas exchange (O_2 desaturation/increased O_2 requirement/mechanical ventilation requirement), and at least 3 clinical and/or laboratory findings (hypothermia or hyperthermia/leukopenia or leukocytosis and left shift/new onset purulent sputum or changes in the character of sputum or increased respiratory secretions/apnea, tachypnea, nasal wing breathing with intercostal retraction/wheezing, rales or rhonchi/cough/bradycardia or tachycardia.

In the present study, RBC (erythrocyte count), Hgb (hemoglobin), Htc (hematocrit), MCV (mean erythrocyte volume), MCH (mean erythrocyte hemoglobin), MCHC (mean erythrocyte hemoglobin concentration), RDW (erythrocyte distribution width), WBC (white blood cell count), PNL (neutrophil), LYM (lymphocyte), MON (monocyte), EO (eosinophil), BASO (basophil), PLT (platelet), and MPV (mean platelet volume) values were determined. The newborns with underlying diseases and those at a gestational age less than 35 weeks were not included in the study. The birth weights of the patients were classified as 2000-2499 gr, 2500-2999 gr, 3000-3499 gr, 3500-3999 gr, and >4000 gr. Gestational age was classified as preterm (<34 0/7), late preterm (34 0/7-36 6/7), early preterm (37 0/7-38 6/7), early term (39 0/7-40 6). /7), complete term (41 0/7-41 6/7), and late term (≥42 0/7). Also, the gender, number of pregnancies, single/multiple pregnancy information, and mode of delivery of the patients were recorded.

STATISTICAL ANALYSIS

Statistical analysis was made by using the Statistical Package for Social Sciences for Windows version 23.0 (SPSS, Chicago, IL, USA). If continuous variables were normal, they were defined as mean±standard deviation ((p>0.05) (n<30) in Kolmogorov-Smirnov test or Shapira-Wilk)), and median if continuous variables were not normal. Continuous variables were compared by using the Student's ***t***-test or Mann-Whitney ***U***-test, respectively, depending on the parametric or non-parametric values. Categorical variables were analyzed between groups by using the Chi-Square Test or the Fisher's Exact Test; and p<0.05 level was considered statistically significant in evaluating the statistical differences.

RESULTS

In the present study, 42 (21 girls, 21 boys) TTN and 42 (21 girls, 21 boys) newborns who had congenital pneumonia were examined. The mean gestational age was determined as 38.0±1.4 weeks in patients with TTN and 38.8±1.5 weeks in patients with congenital pneumonia. The difference between the mean gestational ages of the groups was found to be statistically significant (p=0.016). The mean birth weight was found to be 3165.2±409.8 g and

3396.2±456.2 g in the TTN and congenital pneumonia groups, respectively; and a statistically significant difference was detected between them (p=0.017) (Table 1).

Table 1: Demographic Characteristics of the Groups

	TTN (n=42)	**Congenital Pneumonia (n=42)**	***P***
Gestational Age (Week)	38,0±1,4	38,8±1,5	**0,016**
Which pregnancy	2(1-7)	2(1-6)	0,310
Birth Weight (G)	3165,2±409,8	3396,2±456,2	**0,017**

When the gestational ages were separated according to weeks, no significant differences were detected (p=0.103). When the patient groups were classified according to their birth weights, 19 (45.2%) patients who had TTN were found to be 3000-3500 gr, 32 (76.2%) patients with congenital pneumonia were between 2500-3000 gr, and the difference between was significant (p=0.002). Although the patients born with C/S constituted 69% of the TTN group, they constituted 42.9% of the congenital pneumonia group. A statistically significant difference was detected between the delivery types of the two groups (p=0.027) (Table 2).

Table 2: The Comparison of Demographic Characteristics of the Groups

	TTN (n=42)		**Congenital Pneumonia (n=42)**		***P***
	n	%	n	%	
Gestational Age (Week)					
1	1	2,4	1	2,4	0,103
2	6	14,3	4	9,5	
3	22	52,4	13	31,0	
4	12	28,6	24	57,1	
5	1	2,4	0	0,0	
Singular /Plural					
1	40	95,2	41	97,6	1,000
2	2	4,8	1	2,4	
Weight (G)					
1	1	2,4	1	2,4	**0,002**
2	15	35,7	32	76,2	
3	19	45,2	5	11,9	
4	4	9,5	4	9,5	
5	3	7,1	0	0,0	
Sex					
E	21	50,0	21	50,0	1,000
K	21	50,0	21	50,0	
Delivery Method					
C/S	29	69,0	18	42,9	**0,027**
Nsd	13	31,0	24	57,1	

When the hematological parameters were evaluated, the mean WBC value was found to be 16745 and 16470 in the newborns with TTN and congenital pneumonia, respectively. The relation between these was not statistically significant. The mean LYM (lymphocyte) values were 4800 in patients with TTN, and 4095 in patients with congenital pneumonia, and a significant difference was detected between them in this respect (p=0.037). The mean PLT (platelet) values were 290000 in the TTN group and 250500 in the congenital pneumonia group, and the difference was statistically significant (p=0.001). Other hematological parameters were similar between the groups (Table 3). The LYM and PLT values of the patients who had TTN and congenital pneumonia are shown in Figure 1 and Figure 2, respectively.

Table 3: The Comparison of Hematological Parameters in TTN and Congenital Pneumonia Group

	TTN (n=42)	**Congenital Pneumonia (n=42)**	***P***
RBC	4915714,0±620712,2	4846905,0±648869,5	0,621
Hgb(g/dL)	17,1±2,1	16,6±2,3	0,292
Htc%	50,7±5,9	49,5±7,6	0,430
MCV (fL)	103,5±6,3	101,4±14,7	0,408
MCH(pg)	34,9±2,2	34,4±3,3	0,443

	TTN (n=42)	Congenital Pneumonia (n=42)	*P*
MCHC(g/dL)	33,8±1,2	33,1±2,3	0,123
RDW (%)	15,8±3,4	16,2±2,5	0,534
WBC	16745(8740-33200)	16470(10040-99500)	0,163
NEU	9935(3570-25900)	10090(1900-70300)	0,164
LYM	4800(2520-12460)	4095(1670-10010)	**0,037**
MON	1295(580-8970)	1105(280-4800)	0,069
EOS	300(90-1020)	355(10-1160)	0,140
BAS	60(0-760)	40(0-320)	0,397
PLT	290000(139000-454000)	250500(30000-423000)	**0,001**
MPV (fL)	8,9±0,7	9,2±0,8	0,144

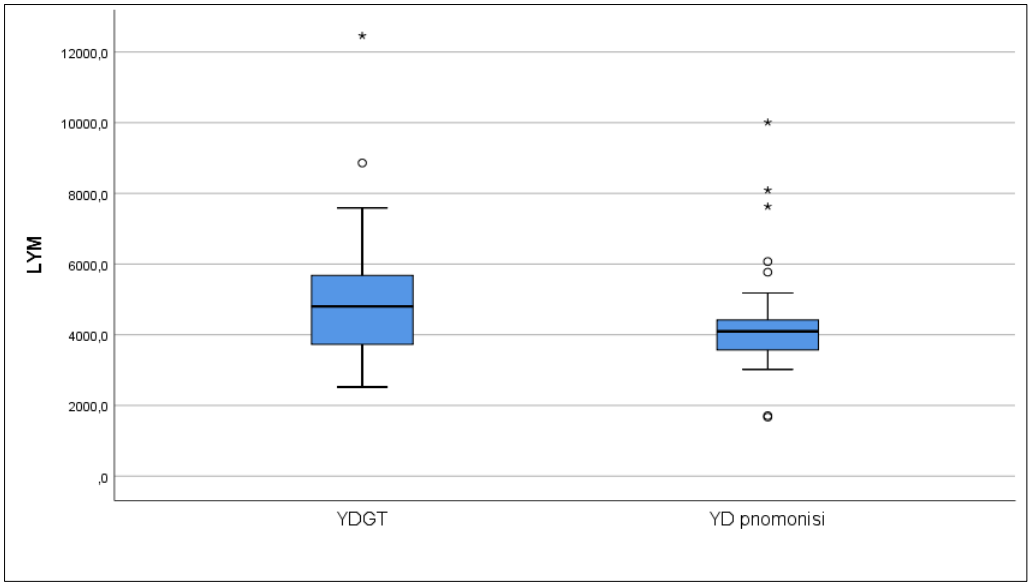

Figure 1: LYM Values in Newborns Diagnosed with TTN and Congenital Pneumonia

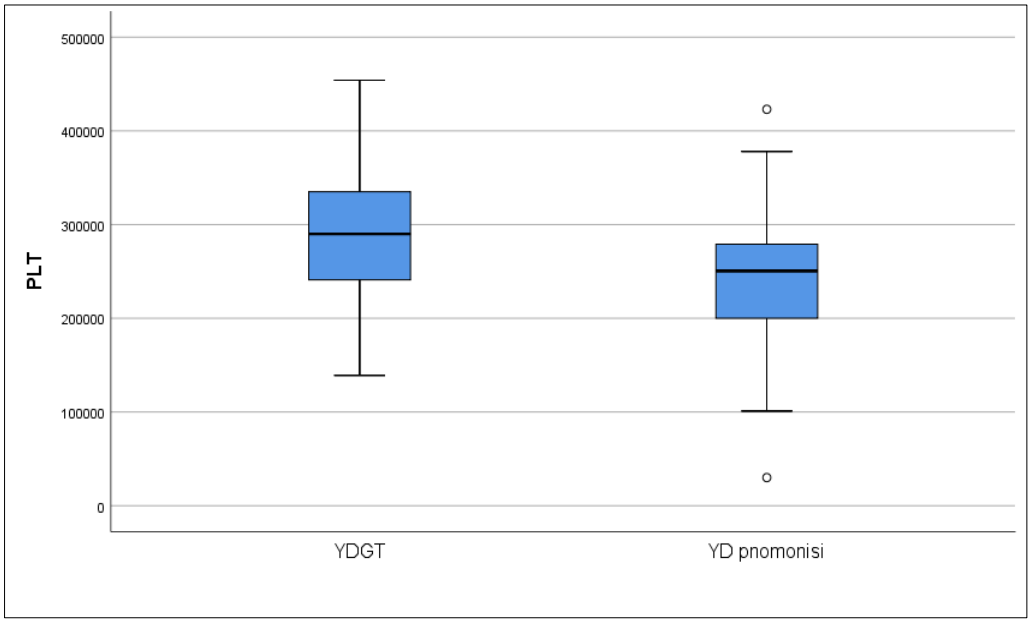

Figure 2 PLT Values in Newborns Diagnosed with TTN and Congenital Pneumonia

DISCUSSION

It was reported previously that transient tachypnea of the newborn is seen more frequently in term (37-41) and late preterm (34-36) newborns [3, 6]. In the present study, 52.4% of the TTN patients were early term (37-38), 28.6%

were full-term (38-39), and 14.3% were late preterm (34-36) newborns. According to the results of the study, it was found that TTN is more common in term newborns. Also, the fact that an important proportion of late preterm infant is born by cesarean section, these babies does not have adequate hormone response and their chest cages lack compliance needed to ensure the effect of thoracoabdominal compression may impair lung clearance. When all these factors are considered, the risk of TTN increases in late preterm infants [7]. When the patients with congenital pneumonia in the present study were examined, it was found that it was seen in term (39-40) newborns with a rate of 57.1%, and in premature term (37-38) newborns with a rate of 31%. When the mean gestational ages of the disease groups were compared, there was a statistically significant difference, and it was found that TTN was seen at lower gestational weeks compared to congenital pneumonia. In the study of Costa *et al.,* when newborns with congenital pneumonia and transient tachypnea were compared, the mean gestational age of the groups was found to be 38 weeks, and unlike our study, no statistically significant differences were detected between them [8]. For this reason, we believe that the risk of developing TTN is increased in lower gestational weeks.

It was reported that low birth weight is a risk factor for congenital pneumonia and TTN [4, 9, 10]. In the present study, 76% of the congenital pneumonia group was found to be between 2500-3000 grams, and 2.4% had low birth weight (<2500 g). Among the newborns who had transient tachypnea, 7.1% had high birth weight (>4000 g), 2.4% had low birth weight, and 90.5% had normal birth weight. In previous studies in the literature, mean birth weights of newborns were found to be similar in both disease groups [8, 11, 12]. Unlike these studies, in the present study, when the mean birth weights of TTN and congenital pneumonia patients were examined, statistically significant differences were detected between them, and it was found that the average birth weight of newborns who had the diagnosis of transient tachypnea was lower. The present data were found to be consistent with previous studies indicating that lower birth weight is associated with TTN [10].

In the present study, when the birth patterns of the newborns were examined in the two disease groups, statistically significant differences were detected, and cesarean delivery was more common in patients with a diagnosis of TTN. Unlike the present study, when the literature was reviewed, Er *et al.,* compared these two disease groups, and found no significant differences in terms of delivery types [11]. The rate of cesarean delivery was found to be 42.9% in the congenital pneumonia group in our study, and babies born by normal spontaneous vaginal delivery constituted the majority. The rate of delivery by cesarean section was 69% in newborns with transient tachypnea. Tutdibi *et al.,* showed that TTN was strongly associated with elective cesarean section [12]. Similarly, other studies show that elective cesarean section plays roles in the development of TTN [13, 14]. According to current studies, cesarean delivery is a risk factor for TTN development [1, 3]. Since there is no high transpulmonary pressure caused by uterine contractions in deliveries with elective cesarean section and there will be no stress-induced catecholamine release during labor, reabsorption of alveolar fluid in the fetal lung will be delayed. For this reason, the risk of TTN is higher in babies born with elective cesarean section [1]. This supports the result of our study. In a previous study conducted by Tefera *et al.,* sixteen previous studies were examined, and a total of 327.272 newborns that were born vaginally and 55.246 newborns that were born by elective cesarean section were included. Compared with newborns that were born by spontaneous vaginal delivery, the risk of neonatal respiratory morbidity was found to be increased by 95% in newborns that were born by elective cesarean section [15]. According to the results of the present study, it was found that cesarean delivery is a risk factor especially for TTN. For this reason, we recommend restricting and avoiding cesarean deliveries without medical indications before the 39th gestational week.

When the hematological parameters of the two groups were compared in the present study, statistically significant differences were detected between the mean platelet and lymphocyte values. It was found that patients with congenital pneumonia had lower platelet and lymphocyte values. Because of the endothelial damage in the course of neonatal infections, platelets are activated, and the reticuloendothelial removal of platelets increases and thrombopoiesis is activated as a response. However, since the amount of platelet produced cannot meet the amount of platelet consumed, it predisposes to thrombocytopenia, which explains the predisposition to thrombocytopenia in the newborns who have congenital pneumonia [16]. When the literature was reviewed, no statistically significant differences were detected in a previous study between the mean platelet values of patients who had TTN and congenital pneumonia [11]. When the lymphocyte parameter is considered, it was suggested that low lymphocyte values are associated with early-onset sepsis [16]. Although no study was detected in the literature examining the lymphocyte values in newborns with congenital pneumonia, according to the results of the present study, it is noteworthy that these patients are predisposed to lymphopenia. For this reason, the present study is the most comprehensive study in terms of hematological parameters compared with other studies conducted in patients diagnosed with congenital pneumonia and TTN.

The Mean Platelet Volume (MPV) was used as a marker of many inflammatory diseases. Chorioamnionitis, which is the indicator of intrauterine infection, is known to be a risk factor for congenital pneumonia [5]. Go *et al.,* speculated that chorioamnionitis is associated with MPV in term newborns [17]. No significant differences were detected between MPV values in the two disease groups in the current study, and when the mean MPV values were examined, it

was found that they were in the normal reference range. For this reason, it is considered that other risk factors aside from chorioamnionitis were present in newborns with congenital pneumonia in the study.

The present study had some limitations. It was primarily a single-center and retrospective study, and was conducted in a limited group of cases.

In conclusion, the present study presented that TTN was seen at lower gestational weeks and in babies with lower birth weights. It was suggested that cesarean delivery can be considered to be a risk factor for TTN. When hematological parameters are examined, it is noted that patients with congenital pneumonia have a predisposition to lymphopenia and thrombocytopenia. However, we believe that this predisposition requires confirmation with larger case series.

ACKNOWLEDGEMENTS

Conflict of Interest Statement

No financial or non-financial benefits have been received or will be received from any party related directly or indirectly to the subject of this article. All authors declared no conflict of interest.

AUTHOR CONTRIBUTIONS

Munevver Kiyar organized and designed the study. Burcu Ozkan and Karya Su Arslan contributed to the collection of patient cases. Sema Yilmaz prepared and reviewed the manuscript. All authors have read and approved the content of the manuscript.

REFERENCES

1. Jha, K., Nassar, G. N., & Makker, K. (2019). Transient tachypnea of the newborn. In: StatPearls. Treasure Island (FL): StatPearls
2. Alhassen, Z., Vali, P., Guglani, L., Lakshminrusimha, S., & Ryan, R. M. (2021). Recent advances in pathophysiology and management of transient tachypnea of newborn. *Journal of Perinatology*, *41*(1), 6-16.
3. Pramanik, A. K., Rangaswamy, N., & Gates, T. (2015). Neonatal respiratory distress: a practical approach to its diagnosis and management. *Pediatric Clinics*, *62*(2), 453-469.
4. Hooven, T.A., & Polin, R.A. (2017). Pneumonia. Semin Fetal Neonatal Med, 22(4), 206-213.
5. Nissen, M. D. (2007). Congenital and neonatal pneumonia. *Paediatric respiratory reviews*, *8*(3), 195-203.
6. Zaman, S., Goheer, L., & Riaz, H. (2013). Prevalence and etıology of respıratory dıstress in newborns. Pak Armed Forces Med J. 63(1), 22-25.
7. Uslu, S., Zubarioglu, U., & Bulbul, A. (2017). Early respiratory outcomes of late preterm infants. *The Medical Bulletin of Sisli Etfal Hospital*, *51*(3), 184-190.
8. Costa, S., Rocha, G., Leitão, A., & Guimarães, H. (2012). Transient tachypnea of the newborn and congenital pneumonia: a comparative study. *The Journal of Maternal-Fetal & Neonatal Medicine*, *25*(7), 992-994.
9. Duke, T. (2005). Neonatal pneumonia in developing countries. *Archives of Disease in Childhood-Fetal and Neonatal Edition*, *90*(3), F211-FF219.
10. Tutdibi, E., Gries, K., Bücheler, M., Misselwitz, B., Schlosser, R. L., & Gortner, L. (2010). Impact of labor on outcomes in transient tachypnea of the newborn: population-based study. *Pediatrics*, *125*(3), e577-e583.
11. Er, İ., Cetin, C., Baydemir, C., & Günlemez, A. (2020). Can immature platelet fraction be an early predictor for congenital pneumonia?. *Turkish Archives of Pediatrics/Türk Pediatri Arşivi*, *55*(4), 409-417.
12. Bozkaya, D., Yigit, S., & Yurdakok, M. (2019). Is serum procalcitonin level a reliable indicator in early diagnosis of congenital pneumonia?. Turk J Pediatr, 61(1), 34-39.
13. Liem, J. J., Huq, S. I., Ekuma, O., Becker, A. B., & Kozyrskyj, A. L. (2007). Transient tachypnea of the newborn may be an early clinical manifestation of wheezing symptoms. *The Journal of pediatrics*, *151*(1), 29-33.
14. Kasap, B., Duman, N., Özer, E., Tatli, M., Kumral, A., & Özkan, H. (2008). Transient tachypnea of the newborn: predictive factor for prolonged tachypnea. *Pediatrics International*, *50*(1), 81-84.
15. Tefera, M., Assefa, N., Mengistie, B., Abrham, A., Teji, K., & Worku, T. (2020). Elective cesarean section on term pregnancies has a high risk for neonatal respiratory morbidity in developed countries: a systematic review and meta-analysis. *Frontiers in pediatrics*, *8*, 286.
16. Manzoni, P. (2015). Hematologic aspects of early and late-onset sepsis in preterm infants. *Clinics in perinatology*, *42*(3), 587-595.
17. Go, H., Ohto, H., Nollet, K. E., Kashiwabara, N., Chishiki, M., Hoshino, M., ... & Hosoya, M. (2020). Perinatal factors affecting platelet parameters in late preterm and term neonates. *PloS one*, *15*(11), e0242539.