Can we predict the duration of respiratory support in transient tachypnea of the newborn?

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Aim: To assess arterial blood gas values and respiratory rates during transient tachypnea of the newborn detected in the first hour of postnatal life, and to investigate whether any of these parameters can be a good predictor of the duration of respiratory support.

Materials and methods: Data were collected from the charts of newborns with a gestation of ≥37 weeks born in our hospital and admitted to our neonatal intensive care unit with a diagnosis of transient tachypnea of the newborn between January 2007 and December 2009. Patients with respiratory support of ≤5 days were accepted as group A and those with respiratory support of >5 days as group B. The groups were compared with each other on the basis of arterial blood gas values of pH, PaCO₂, PaO₂, oxygen saturation, and respiratory rate detected in the first hour of postnatal life.

Results: Group A consisted of 41 (46%) patients and group B consisted of 48 (54%) patients. The PaO₂ and oxygen saturation levels of group B were significantly lower than those of group A. Time to tolerate full enteral feeding was also significantly longer for group B than for group A. From the total blood gas values, PaO₂ and oxygen saturation were found to be sensitive parameters that can predict the duration of respiratory support. Patients with pH of ≤7.22 (sensitivity, 97.6%; specificity, 8.3%; OR, 3.6), PaO₂ of ≤70 mmHg (sensitivity, 92.7%; specificity, 29.2%; OR, 5.2), and oxygen saturation of ≤80% (sensitivity, 92.7%; specificity, 31.2%; OR, 5.7) were found to be strong candidates for needing respiratory support for more than 5 days.

Conclusion: According to our results, patients with pH of ≤7.22, PaO₂ of ≤70 mmHg, and oxygen saturation of ≤80% seem to be patients that will need respiratory support for more than 5 days.

Key words: Transient tachypnea of newborn, respiratory support, blood gas

Introduction
Transient tachypnea of the newborn (TTN) is a respiratory disorder with onset shortly after delivery that is characterized by tachypnea and has a benign course. TTN often resolves spontaneously within 2–5 days. The disorder currently held responsible for the etiology is maturation deficiency of the epithelial sodium channels (ENaCs) in the alveoli, as a result of which lymphatic absorption of alveolar fluid from the lungs is delayed postnatally and there is poor ventilation of the alveoli. The condition is most common in late preterm infants delivered with elective cesarean section before the 39th week of gestation. In addition, involvement of other factors including mild and transient surfactant deficiency and left ventricular heart failure secondary to asphyxia has been suggested. Although prognosis is typically good, rare cases of TTN with much longer duration of tachypnea where the overall condition severely deteriorates and extensive respiratory aid is required are known to exist (1–3). However, there exists no clear clinical criterion to indicate which patients will require longer respiratory support. Some...
infants who initially require extensive respiratory support may be able to switch to room oxygen, while support for longer periods of time than anticipated may be needed in others.

The objective of the present study is to investigate whether there is a parameter by which patients who will require a longer duration of respiratory support may be predicted based on respiratory rate and arterial blood gas measurements taken during the first hour of hospitalization through retrospective evaluation of patients who had been monitored and treated for TTN.

Materials and methods
Medical files of patients delivered at the Obstetrics Clinic of the Medical Faculty of Akdeniz University between January 2007 and December 2009 and treated for TTN in the neonatal intensive care unit were studied retrospectively. Infants with gestational ages of 37 weeks and above according to the Ballard scoring system and diagnosed with TTN were identified, and the most recent maternal menstruation date and prenatal ultrasonography results were recorded. Neonates with diagnoses of pneumonia, pneumothorax, respiratory distress syndrome, early sepsis, congenital pulmonary/cardiac disorders, left ventricular failure, meconium aspiration syndrome, and perinatal asphyxia as well as infants of diabetic and preeclamptic mothers were excluded from the analyses.

A TTN diagnosis was established if the respiratory rate during the first 24 h was over 60 breaths/min, the infant required greater than 21% oxygen, and if characteristic manifestations including hyperventilation, mild cardiomegaly, pronounced hilus, distinction of interlobar fissures, and pleural effusion were present in radiological analyses of the lungs (1).

Data for mode of delivery, birth weight, gestational age, respiratory rate during the first hour following delivery, arterial blood gas, oxygen saturation, and time to switch to full enteral feeding were recovered from patient files.

The infants included in the study were divided into 2 groups: infants who required respiratory support for ≤5 days with mechanical ventilation or free oxygen (group A), and those who required the same interventions for more than 5 days (group B). The 2 groups were compared retrospectively for gestational age, mode of delivery, respiratory rate during the first postnatal hour, arterial blood gas parameters, and time to switch to full enteral feeding.

In addition, the sensitivities of blood gas pH, PaO₂, PaCO₂, respiratory rate measured during the first hour, and oxygen saturation measured at the time of hospitalization were investigated for the purpose of predicting neonates with a risk of longer duration of respiratory support. Parameters selected for analysis were recorded as a whole disregarding the groups, receiving operator characteristic (ROC) curves were drawn for each parameter, and cut-off values were calculated.

SPSS 18 was used for statistical analyses and the results of the predetermined parameters were evaluated using Student’s t-test. Numeric values were expressed as mean ± standard deviation (SD) and the level of significance was set at P < 0.05. ROC curves were used in determining oxygen saturation at presentation, pH, and PaO₂ cut-off points. The odds ratio (OR) and 95% confidence interval (CI) were calculated.

Results
Of the 2470 infants whose files were reviewed, 110 (4.4%) with gestational ages of 37 weeks and above were diagnosed with TTN. A further 21 neonates were excluded for not meeting the inclusion criteria. Consequently, 89 neonates (3.6%) diagnosed with TTN were included in the study.

Of the 89 neonates included in the study, 41 (46%) constituted group A and 48 (54%) were in group B. Group A had 22 male patients (53.6%) and group B had 27 (56.2%). The number of infants delivered via cesarean section was 24 (58.5%) in group A and 30 (62.5%) in group B, while the number of infants delivered via normal spontaneous vaginal delivery were 17 (41.5%) and 18 (37.5%) in groups A and B, respectively (Table 1). Data for birth weight, gestational age, respiratory rate during the first hour of hospitalization, blood gas parameters, and time to full enteral feeding are given in Table 2.
There was no statistically significant difference in sex and type of delivery between groups A and B. Although there were no marked differences between the infants in groups A and B in terms of respiratory rate at time of hospitalization (P = 0.123), the blood pH, oxygen saturation, and PaO₂ values of infants in group B were significantly lower compared to group A (P = 0.006 for pH, P = 0.003 for oxygen saturation, and P = 0.002 for PaO₂). Blood gas carbon dioxide level was not statistically significant in determining patients who required longer respiratory support (P = 0.073). Time to switch to full enteral nutrition in infants of group B was significantly longer in a manner corresponding to prolonged tachypnea compared to group A (P = 0.001).

Cut-off values based on significant results of the infants were pH of ≤7.22 (sensitivity, 97.6%; specificity, 8.3%), PaO₂ of ≤70 mmHg (sensitivity, 92.7%; specificity, 29.2%), and oxygen saturation of ≤80% (sensitivity, 92.7%; specificity, 31.2%). It has been shown that pH values of ≤7.22 increase the likelihood of prolonged respiratory support by 3.6-fold (OR, 3.6; 95% CI, 0.39–33.91), PaO₂ values of ≤70 mmHg increase it by 5.2-fold (OR, 5.2; 95% CI, 1.37–19.72), and oxygen saturation levels of ≤80% increase it by 5.7-fold (OR, 5.7; 95% CI, 1.53–21.64) (Figure).

**Discussion**

During the intrauterine period, ENaCs in airways function by transport of Na⁺ into alveoli, accompanied by the formation of fetal lung fluid with chloride and water transport. This fluid is necessary for alveoli...
development during the intrauterine period. The mechanism of transport in the ENaC when delivery is nearing changes from influx to efflux from the alveoli, which removes the contents of the alveoli and opens space for air. The key role in this altered fluid transportation belongs to the ENaC, and maturation of the ENaC is necessary for transition to postnatal respiration. A mild or severe course of TTN and a short or long duration of respiratory support are usually associated with ENaC maturation deficiency and a secondary delay in alveolar fluid absorption (4). Maturation is linked with gestational age and deficiencies in ENaC maturation are known to occur more commonly in elective cesarean induced early, whether deliberately or unintentionally. It has been suggested that the earlier the gestational week, the more deficient the ENaC maturation will be, and that this will increase the risk of TTN and therefore prolong the period of respiratory support (5). Deliveries by cesarean section were more common than normal vaginal deliveries for infants in both groups of the present study. Absence of a significant difference between infants in Group B with a longer need for respiratory support and those in Group B who were able to switch to room oxygen sooner in terms of gestational age indicates that factors other than maturation may be involved in the longer need for respiratory support.

Most of the studies on transient tachypnea of the newborn are about the risk factors and duration of tachypnea in patients with TTN. Kasap et al. (6) reported that the duration of tachypnea might be longer if the infant’s respiratory rate is still above 90 breaths/min after 36 min of delivery. In addition, significant decreases in leukocyte and hematocrit levels were also observed in infants with longer durations of tachypnea compared to the control group. Another study reported that presence of antenatal risk factors including multiple pregnancy, preeclampsia, gestational diabetes, placenta previa, and early membrane rupture were associated with prolonged duration of tachypnea (7). In the present study, since the respiratory rate and blood gas values at the time of hospitalization of the studied group of infants were considered, infants with maternal risks with known significant effects on the clinical course and those diagnosed with prenatal asphyxia were excluded from the analyses (8,9). Although the 2 groups did not differ significantly in respiratory rate measured at the time of hospitalization, some of the infants needed markedly longer respiratory support. Based on our findings, estimating whether a particular infant will need longer respiratory support only on the basis of the respiratory rate in the first hour seems to be misleading. Thus, blood gas parameters were studied and pH, PaO₂, and oxygen saturation measurements were found to be significantly reduced in infants with a longer need for respiratory support despite similar respiratory counts at the time of hospitalization.

Although transient tachypnea of the newborn is often a respiratory condition with a good prognosis, tachypnea and respiratory support may last much longer in some patients, which further increases the anxiety of the parents, who are already worried about the infant’s condition. This also puts the physician in a difficult situation to explain, having informed the parents that TTN was a low-risk condition. With this in mind, it should be known that the need for respiratory support may be more than 5 days in infants with blood gas results of pH of ≤7.2, PaO₂ of ≤70 mmHg, and oxygen saturation of ≤80% from the measurements taken during the first hour following delivery. Based on our findings, 2 of these parameters are more sensitive: PaO₂ levels of ≤70 mmHg increase the likelihood that respiratory support will be longer.

Figure. ROC values for oxygen saturation, PaO₂, and pH cut-off points.
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by 5.2-fold (OR, 5.2) and oxygen saturation of ≤80% results in a 5.7-fold increase in the same risk (OR, 5.7).

It could be suggested that oxygen support administered during labor may have altered blood gas values and confounded the results of the study. However, as a standard practice in this unit, all tachypneic patients in the healthcare center are given oxygen support in the form of free oxygen or continuous positive airway pressure in concentrations of 30%–40% if the pulse oximetry reading after stabilization following delivery is below 85%, which is believed to have eliminated this risk. Prospective and well-designed studies are needed to investigate the sensitivity of blood gas measurements in predicting the duration of respiratory support.

In conclusion, a longer duration of respiratory support may be predicted based on pH, PaO$_2$, and pulse oximetry oxygen saturation among the blood gas measurements taken during the first hour after delivery.

References