



Determining Prognosis in Neonates with Transient Tachypnea by Using Retraction Scores

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Abstract

Aim: The aim of this study is to evaluate the accuracy of physical and laboratory findings to determine the length of hospital stay and oxygen requirement in patients diagnosed with transient tachypnea of the newborn.

Materials and Methods: Patients with respiratory distress symptoms that last more than 24 hours were admitted to the study. Sixty infants were analysed at the fourth hour and then daily in respect to their retraction scores, respiratory rates, urine outputs, blood gas measurements, and length of hospital stay. Infants were grouped into four categories according to their retraction scores and treatment modalities.

Results: In the multiple regression analysis, the retraction scores and base excesses on the first day together with the urine output of the second-day were found to explain the 73% of the variance in the length of hospital stay and 68,7% of the variance in the oxygen requirement. The most important factor was found to be the retraction score of the first day. Boys were found to have five times higher risk than girls for severe transient tachypnea (OR: 5,06 %95 CI: 1,1-23,3, p: 0,037). Cesarean section, prematurity, and birth weight were not found to be risk factors for severe respiratory insufficiency.

Conclusion: The present study proposes that clinicians may use the retraction scores to predict the length of hospital stay and oxygen requirements in neonates with transient tachypnea. The increase in urine output may be a sign of recovery. Male infants have five times higher risk of severe respiratory insufficiency due to transient tachypnea.

Key Words: Blood Gas Analysis; Neonatology; Neonatal Intensive Care; Respiratory Insufficiency; Transient Tachypnea of The Newborn.

Geçici Takipne Tanılı Yenidoğanlarda Retraksiyon Skoru Kullanarak Prognozun Öngörülmesi

Özet

Amaç: Çalışmamızda yenidoğanın geçici takipnesi tanılı hastaların hastanede kalış ve oksijen ihtiyacı sürelerinin fizik muayene ve laboratuvar bulguları ile öngörülmesi amaçlanmıştır.

Gereç ve Yöntemler: Solunum sıkıntısı nedeniyle yenidoğan yoğun bakıma yatırılan ve kliniği 24 saat içerisinde düzelmeyen geçici takipne ön tanılı hastalar çalışmaya alındı. Çıkış tanılarını izole yenidoğanın geçici takipnesi olarak devam eden 60 hastanın doğumdan sonraki 4. saatlerinde ve sonrasında günlük yapılan fizik muayene ve laboratuvar bulguları ile hastanede kalış süreleri karşılaştırıldı. Hastalar yatış retraksiyon skorları ve tedavi yöntemlerine göre 4 gruba ayrıldı.

Bulgular: İlk gün hesaplanan retraksiyon skoru, kan gazındaki baz fazlası değeri ve ikinci gün idrar miktarının hastaların hastanede kalış süresindeki değişiminin %73'ünü; oksijen ihtiyacı süresindeki değişiminin %68,7'sini açıklayabildiği bulundu. Hastanede yatış süresine ve oksijen ihtiyacına etki eden en önemli faktör ilk gün ölçülen retraksiyon skoru olarak saptandı. Ağır solunum yetmezliğinin eşlik ettiği geçici takipne açısından erkek yenidoğanlar kızlara göre 5 kat daha riskli bulundu (OR: 5,06 %95 CI: 1,1-23,3, p: 0,037). Sezaryenle doğum, prematürite ve doğum ağırlığı ağır solunum yetmezliği açısından risk faktörü olarak saptanmadı.

Sonuç: Mevcut çalışma geçici takipne tanılı yenidoğanlarda retraksiyon skoru bakılmasının prognozu öngörmede yardımcı olabileceğini göstermektedir. Hastalarda idrar miktarının artışı iyileşmenin bir bulgusu olarak ele alınabilir. Geçici takipnesi olan yenidoğanlarda ağır solunum yetmezliği riski erkeklerde kızlara göre 5 kat daha fazladır.

Anahtar Kelimeler: Kan Gazı Analizi; Neonatoloji; Solunum Yetmezliği; Retraksiyon Skorlaması; Yenidoğanın Geçici Takipnesi; Yenidoğan Yoğun bakım.

INTRODUCTION

Depending on the delay of fetal lung fluid reabsorption due to a variety of reasons after birth, a medical picture

involving moaning, tachypnea, and respiratory distress accompanied by retraction and decrease in oxygen saturation can be seen (1). After eliminating congenital pneumonia, early neonatal sepsis, patent ductus

arteriosus, some congenital heart diseases that cause the same medical picture, and the disappearance of the symptoms causing either of these diseases, patients can be diagnosed with transient tachypnea of the newborn (TTN).

Since it was first described in 1966, TTN continues to be one of the most common conditions in neonatal services (1). Although there is no consensus, it is suggested that patients with respiratory distress within the first two hours ("rule of two hours") should be investigated or, at least, be transferred to a second level intensive care unit (2). Clinical signs usually disappear within 24-48 hours while they can rarely take 72 hours or longer. Treatment is mostly supportive. Doing a retraction scoring using the Silverman-Andersen index is a simple and less time-consuming method (3). In this test, patients are scored between 0 and 2 in each of the 5 categories involving chest movements, nasal flaring, intercostal retractions, subcostal retractions, and moaning; the highest score is 10 and the lowest score is 0.

There are only a few studies in the literature on how to predict which symptoms cause extended clinical course in patients. In these cases, to determine the severity of respiratory distress, practitioners can make use of scorings based on physical examination and laboratory findings (3-5). In our study, we aimed to evaluate the role of measuring retraction score and respiratory rates, blood gas values, and the amount of urine in predicting the length of hospital stay and duration of oxygen demand in infants, as well as to investigate the patient profile having prolonged clinical course.

MATERIALS and METHODS

The study was performed in the neonatal service of our hospital between February 2013 and April 2013. We obtained the approval of the ethics committee and collected the informed consent forms from the families. We prospectively included the infants without any maternal risk factors for infection (premature rupture of membranes, maternal tachycardia or fever, and foul-smelling vaginal discharge) who developed respiratory distress within the first 4 hours after birth that lasted at least for 24 hours. We excluded the following cases from the study: births before 34th week, infants delivered between the 34th-37th weeks and whose hospitalization periods prolonged only because of feeding intolerance, and those who developed pneumonia, sepsis, respiratory distress syndrome requiring surfactant administration, meconium aspiration syndrome, birth dystocia, heart diseases (including patent ductus arteriosus), congenital diseases, central nervous system disorders, muscle diseases, hypocalcemia that may lead to tachypnea, polycythemia, and persistent hypoglycemia throughout hospitalisation. Each patient had chest radiography. The presence of perihilar streaking, prominent fissure lines, increased ventilation, infiltration due to alveoli filled with fluid, atelectasis, or pleural effusion in the chest X-ray was associated with transient tachypnea. Those with signs of

congenital lung malformation in the chest radiography were excluded from the scope of our study.

In order to rule out sepsis, the patients were evaluated in terms of changes in skin colour, peripheral circulatory disorder, hypotension, bradycardia, apnea, respiratory distress, hepatomegaly, gastrointestinal symptoms, leukocyte count, left shift, thrombocytopenia, and metabolic acidosis by Töllner's Sepsis Scoring system (TSS) (6). All patients with a score of ≥ 10 were diagnosed with clinical sepsis and started receiving broad-spectrum antibiotic treatment intravenously on the same day. We did not give antibiotics to patients who did not meet the criteria for clinical sepsis or had maternal risk factors. By taking the duration after birth into account, we gave total parenteral nutrition to patients who had a respiratory rate of over 80/min and to those who could not feed orally or orogastrically.

Oxygen therapy was applied to the patients to stabilize pulse oximetry values between 88-95%. Supplemental oxygen was discontinued in patients with a room air oxygen saturation of 95%. We did not use beta-mimetic agents or diuretics for the treatment of transient tachypnea. We started a total fluid volume of 60 mL/kg for the term newborns and of 80 cc/kg for the late-preterms from the first day onwards. We determined the daily fluid needs of the babies by considering daily weighing conducted twice a day and serum sodium levels.

We recorded daily retraction scores starting from the 4th hour of acceptance to our unit and at the 24th, 48th, 72nd, 96th, and 120th hours of hospitalisation. Retraction scores were calculated by using the Silverman-Andersen index (3). Retraction scores were recorded by three neonatal research assistants who were trained in this area before the start of the study. Patients with a retraction score of 3 or below who at the same time had one of the problems of superficial tachypnea, oxygen desaturation, and feeding failure were considered to have mild respiratory distress and were followed by the hood (Group 1). Patients with a retraction score between 4 and 6 were regarded as having moderate respiratory distress and were randomised according to the admission days. We followed the ones who were admitted on days with odd numbers with the Hood (Group 2) and the ones who were admitted on days with even numbers with the nasal continuous positive airway pressure (nCPAP) (Group 3). Patients with a retraction score 7 or above were evaluated as patients with severe respiratory failure; according to the clinical response, these patients were continuously followed by either nCPAP or mechanical ventilation (Group 4).

Patients who showed deterioration or could not tolerate the first treatment modality were transferred to a higher level of treatment while patients showing clinical improvement were moved to a sub-group of patients according to the retraction scores.

On the first three days of hospitalisation and in cases with clinical needs, we implemented daily blood gas analysis. In addition, throughout hospitalisation period, we recorded average respiration and heart rates as well as daily urine outputs (in cc/kg/h).

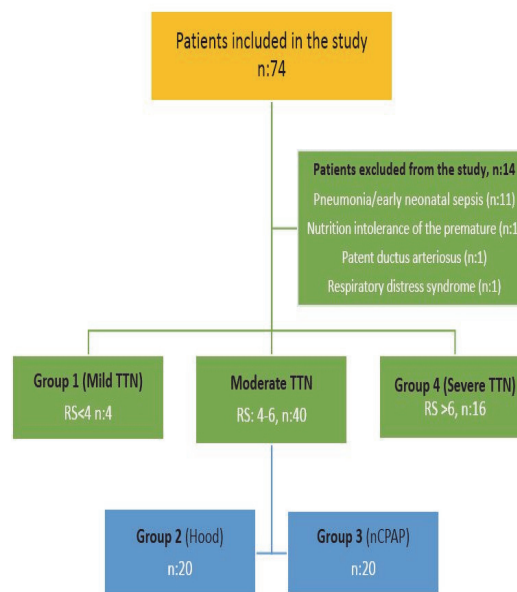
To show the descriptive statistics, we used numbers and percentages as well as the median of the measured values and minimum-maximum values for categorical variables. While comparing the group means and standard deviations in numerical values we made use of the Mann-Whitney Test. We used the Spearman correlation test for the correlation calculation. To compare categorical variables, we made use of the Fisher's exact test and, if needed, the Bonferroni correction. For the prediction of hospitalisation and oxygen support durations, parameters with a correlation coefficient of above 0,3 were included in the equation and all the significant ($p < 0.05$) and almost significant ($p < 0.1$) values in each order were analysed according to the multiple regression method. To calculate the risk factors for severe respiratory failure, patients were compared by logistic regression analysis and their odds ratios (OR) were calculated. All hypotheses were established in two ways. $P < 0.05$ was considered statistically significant. Statistical analyses were performed with SPSS 20.0 software package.

RESULTS

The following cases, who were initially included in the study, were excluded from the study: one of the patients who developed respiratory distress syndrome requiring surfactant application, a patient who required oral ibuprofen application due to patent ductus arteriosus, 11 patients who developed either pneumonia or sepsis, and one 34-week newborn who had a prolonged hospital stay due to nutrition intolerance of the premature after recovering from respiratory distress. A

total of 60 infants were included in the study. The flow chart of the study is shown in Figure 1.

Figure1. Study Flowchart



RS: Retraction score, TTN: Transient tachypnea of the neonate

Figure 1. The flow chart of the study. RS: Retraction score; TTN: Transient tachypnea of the newborn.

The demographic and clinical characteristics of newborns in the study are summarised in Table 1. The 80% of patients were term infants while the remaining 20% were late-preterm infants. The youngest late-preterm infant was 35 weeks and 6 days old.

Table 1. Demographic and clinical characteristics of the patients.

Group	RS < 4		RS 4-6		RS > 6
	Group 1 n:4	Group 2 n:20	Group 3 n:20	Group 4 n:16	
Treatment	Hood	Hood	nCPAP	nCPAP	
RS, median (min-max)	3 (2-3)	5 (4-6)	6 (4-6)	8 (7-10)	
GW, weeks, median (min-max)	38 (35,9-39,1)	38 (36,0-39,4)	37,5 (36-41)	38,2 (36,1-40,4)	
BW, grams, median (min-max)	3135 (2210-4070)	3145 (2600-4130)	3115 (2450-4100)	3605 (2870-4280)	
Males, n (%)	3 (75)	8 (40)	7 (35)	12 (75)	
Cesarian, n (%)	4 (100)	16 (80)	15 (75)	15 (93,8)	
Hospital Stay, days, median (min-max)	2,5 (1-3)	5 (3-8)	5 (3-7)	8 (4-10)	
O ₂ requirements, hours, median (min-max)	6 (5-9)	24 (8-40)	29 (12-51)	78 (21-113)	

RS: Retraction score (first day); GW: Gestational week; BW: birth weight; nCPAP: nasal continuous positive airway pressure.

There was no significant difference between the patients in terms of gestational age, weight (see Table 1; $p: 0.32$, $p: 0.13$, respectively), and mode of delivery ($p > 0.05$),

however, most of the patients with a retraction score of minimum 7 were males (see Figure 2; $p < 0.05$).

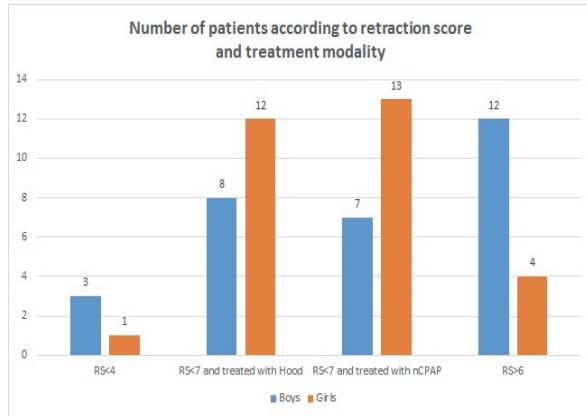


Figure 2. The ratios between genders according to the retraction scores at the 24th hour. RS: Retraction scores.

To investigate the risk factors for severe respiratory failure, we compared Group 4 patients who had severe TTN with the other three groups who had milder clinical picture. We found that the risk for severe TTN was fivefold increased in male patients (OR: 5.06 95% CI: 1.1-23.3; $p=0.037$). The number of male and female patients were equal in the study. We also observed that the risk rate did not change according to gestational age (prematurity) or birth weight (low birth weight).

The rate of cesarean delivery was higher in severe TTN patients compared to patients with mild TTN. However, the difference between the ratios ($p=0.192$) was not statistically significant. Besides, as we observed in the logistic regression results, cesarean delivery did not increase the risk of severe TTN ($p<0.05$, OR: 3.86 CI: 0.45-33.20).

The total duration of oxygen support and hospital stays in the groups according to retraction scores were significantly different from each other (Figure 3 $p<0.001$ and Figure 4 $p<0.001$, respectively). According to the comparison of the groups two and there was no statistically significant difference in terms of hospital stay and time required for oxygen therapy; yet, this difference was significant between other groups ($p<0.001$).

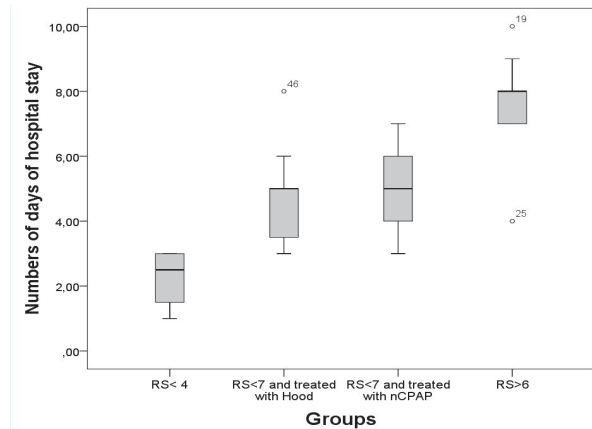


Figure 3. Length of hospital stay according to retraction scores at the 24th hour.

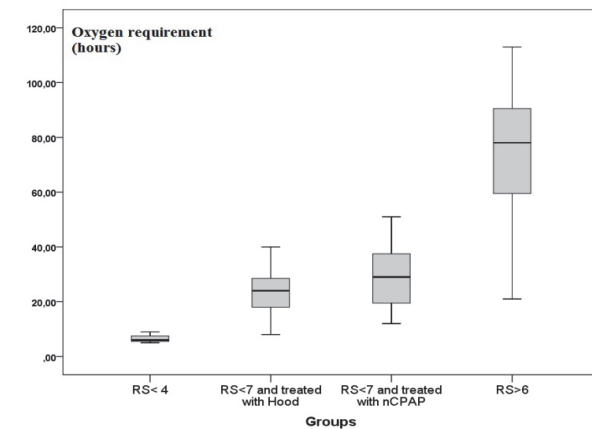


Figure 4. Oxygen support duration according to retraction scores at the 24th hour.

We detected high correlation values between the first-day retraction scores and total hospitalisation and oxygen therapy durations (Table 2). However, there was no correlation between birth weight and gestational age, and length of hospital stay and total oxygen demand times.

Table 2. Correlation between physical examination and laboratory findings and hospitalisation and oxygen therapy durations.

	Length of Hospital Stay		Length of Oxygen Requirement	
	Correlation coefficient (r)	Significance level (p)	Correlation coefficient (r)	Significance level (p)
Day 1 RS	0,74	<0,001	0,74	<0,001
Day 1 RR	0,61	<0,001	0,58	<0,001
Day 1 urine outflow	-0,16	0,27	-0,14	0,33
Day 2 urine outflow	-0,39	0,006	-0,29	0,045
Day 3 urine outflow	-0,43	0,005	-0,37	0,018
Day 1 blood gas pH	-0,33	0,009	-0,47	<0,001
Day 1 blood gas BE	-0,46	<0,001	-0,49	<0,001
Day 1 blood gas HCO ₃	-0,40	0,002	-0,32	0,01

RS: Retraction score; RR: Respiratory rate; BE: base excess; r: correlation coefficient; p: significance level.

There was a good degree of negative correlation between the amount of urine on the second day and patients' retraction scores ($r=-0.642$; $p<0.001$). As the respiratory distress of patients were decreasing, the amount of urine outflow was increasing.

Applying the multiple linear regression using the statistically significant variables in Table 2, we observed that the first day retraction score, the amount of urine outflow on the second day, and base excess level at the first day were correlated significantly with the length of hospital stay ($R^2: 0.731$; $p<0.001$). Using these four factors, we could explain 73% of the variance in the length of hospital stay. We also observed that the most important factor affecting the length of hospital stay was the retraction score measured on the first day.

We evaluated the factors affecting total oxygen requirement by using multiple regression analysis in a similar manner, and a significant relationship between Day 1 retraction score along with Day 1 blood gas base excess values and oxygen demand duration ($R^2: 0.68$; $p<0.001$) were observed. The amount of urine output was not statistically a significant factor. Using these three factors, we were able to explain 68.7% of the variance in the length of oxygen therapy. We concluded that the most important factor affecting the duration of oxygen therapy was the first-day retraction score.

None of our patients required mechanical ventilation; nor did we observe pneumothorax. Although we detected nasal ulceration in one of the nCPAP patients, the patient returned to normal with local care. We did not observe septal necrosis in any of the patients either.

DISCUSSION

The present study presents results that can help practitioners keep track of TTN patients. In patients with a clinical recovery time of more than 24 hours, the duration of prolonged hospital stay and the total amount of oxygen demand can be predicted largely by the retraction score measured on the first day. It has been found out that retraction score is the most valuable indicator in determining the prognosis of TTN patients compared to all other physical signs and blood gas parameters. Kasap et al.'s similar study (7) has also pointed out that maximum respiratory rate within the first 36 hours may also be associated with the duration of hospital stay. In our study, we also found a good correlation between the duration of hospitalisation and respiratory rates. However, this relationship was not found to be statistically significant after the regression analysis.

Although we used the Silverman-Andersen index in our study, there are other scoring methods in the literature that can be used in newborns with respiratory distress (4, 5). However, using these scoring methods in TTN patients may bear some drawbacks. The Downes' scoring may not be suitable for patients with TTN since one of its criteria is the amount of air entry into the lungs, which is more meaningful in respiratory distress

syndrome. It can also lead to extra tests, and radiation exposure prompted at the follow-up (5). The Richardson scoring requires invasive methods such as the arterial blood gas analysis (4).

However, it is not usually necessary to take blood gas every day from TTN patients, who do not always suffer from respiratory distress. On the other hand, retraction score assessment is simple and less time consuming as it does not require technological equipment. It can be useful to spare a space for retraction score assessment in the routine follow-up procedures for a more objective evaluation of clinical follow-up of TTN patients. Using a scoring system is helpful to predict prognosis and also a potential way to set standardisation of the patients and studies.

The length of stay in hospital of our patients (2,5-8 days) is over the average stated in the literature (8). This is due to the fact that we excluded the patients who had respiratory distress for less than 24 hours and that we continued to hospitalisation for a one-day mother-infant nutrition and caretaking training after the patients recovered from respiratory distress. The duration of oxygen demand recorded in our study is consistent with the values reported in the literature (8).

Examining the factors affecting the severity of TTN and length of hospital stay, Aydemir et al. (9) have found plasma NT-pro-BNP levels to be higher in patients requiring mechanical ventilation with prolonged hospitalisation. It is known that there are receptors for atrial natriuretic peptides in type 2 alveolar cells and amiloride-sensitive epithelial sodium channels (ENaC) (10).

Besides, atrial natriuretics increase endothelial permeability in the lungs (11). In order to facilitate the removal of excess fluid in the lungs, atrial natriuretic peptides increase in number, which results in an increased amount of urine production. This is, in turn, may be taken as a sign of improvement in respiratory distress. The negative correlation between the urine output and retraction score may have been caused by these atrial natriuretic peptides.

TTN patients lose weight later than healthy infants born at the same gestational weeks (9). It has been shown that applying IV fluid restrictions (a total fluid of 40 ml/kg in term infants and of 60 mL/kg in preterm infants) decrease the amount of time spent in the service as well as oxygen demands without any side effects (12). It can be helpful to provide limited volume until the amount of urine outflow increases or patients start to lose weight. However, the use of diuretics does not shorten the duration of respiratory distress (13).

In terms of the risk factors for TTN, the majority of the cases in our study (83%) were infants born by cesarean section; this was higher than the average cesarean rate of our hospital (60%) (14).

Macrosomic babies are known to encounter TTN more often. In our study, 10 infants (20%) had a birth weight of above the 95th percentile when their birth weeks are taken into consideration (15). Although maternal asthma and diabetes are among the risk factors for TTN, none of the mothers in our study had these diseases (15, 16).

Although TTN is more common in boys, the number of boys and girls with TTN in our study was equal (15). In contrast, the patients with higher retraction scores consisted mostly of male newborns. In newborns with transient tachypnea of the newborn according to the results of the logistic regression, the risk of severe respiratory failure was increased 5-fold in boys than in girls. There is a need for more studies to understand why boys with TTN are more prone to severe respiratory failure.

The increase in the incidence of TTN as the gestational age decreases is well established in the literature (15, 17-19). However, to the best of our knowledge, a relationship between the clinical severity of TTN and gestational age has not been documented in the literature. The most important reason may be the fact that conditions causing respiratory problems like respiratory distress syndrome and congenital pneumonia occur very often in premature infants, and we can not observe TTN separately. In our study, we did not detect any correlation between the gestational age, birth weight, the length of stay in the hospital and the length of total oxygen demand. Kasap et al. (7) did not detect any relationship between gestational age, birth weight and the length of TTN symptoms, similarly.

The practitioners who measured the retraction score were also among the team giving the treatment, which was a limitation that could not be avoided due to the operating conditions of the service. Giving no antibiotics to any of the patients was one of the strong sides of our study. Although administering antibiotics to every infant with respiratory distress until excluding early neonatal sepsis is standard practice in most of the neonatal intensive care units, this practice has been proven to be unnecessary. A recently published retrospective study on 745 neonates with TTN has shown that there was no difference between patients who received antibiotics treatment and those who were not given any antibiotics in terms of infection-related complications (20).

CONCLUSION

As a result, measuring retraction scores while evaluating the patients can help practitioners foresee the durations of hospital stay and total oxygen demand with high reliability. The risk for severe respiratory failure is 5 times higher in boys with transient tachypnea of the newborn.

The increase in the amount of the urine outflow could be considered as a sign of clinical improvement. Further studies supporting presented findings of our study is needed.

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