

Effects of Restrictive Fluid Management in Transient Tachypnea in Neonates

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ABSTRACT

Background: The transient tachypnea is a common respiratory problem in the neonate. One of the significant issues in pathophysiology of this disorder is the delayed reabsorption of the fluid by the neonate's lungs and the effusion of fluid in the lungs. The purpose of this study is to evaluate the effects of restrictive fluid management in transient tachypnea of the neonate.

Methods: The present study was conducted on the neonates with the gestational age ≥ 34 weeks suffering from transient tachypnea during the first 6 h after birth. The amounts of total fluid in experimental and control groups were 50, 65 mL/kg and 65, 80 mL/kg for term and preterm neonates, respectively. In each group, a daily amount of 20 mL/kg fluid was added until 150 and 170 mL/kg for term and preterm newborns.

Results: This study was carried out on 70 neonates, including 34 cases and 36 controls. The mean of hospitalization period in the experimental group was less than that of the control group. The mean period of respiratory support in the experimental group was less than that in the control group.

Conclusion: The results of the present study revealed that the restrictive fluid management in the neonates with transient tachypnea might decrease the hospitalization period and the respiratory support period. Furthermore, it is a safe and effective method in treating transient tachypnea in neonates.

Keywords: Respiratory support, Restrictive fluid management, Transient tachypnea in neonates

Introduction

Transient tachypnea in the newborn, also known as wet lung or type II respiratory distress syndrome, is one of the common respiratory problems in the neonates (1, 2), which is the cause for a great number of hospitalizations in the Neonatal Intensive Care Unit (NICU) (1). It separates the neonate from the parents and deprives the neonate from breastfeeding. Transient tachypnea in the neonate is usually a benign syndrome, which increases the respiratory rate to 60 breaths per min instantly after birth, and rarely causes problems, such as hypoxemia (i.e., an abnormally low concentration of oxygen in the blood), respiratory failure, and death (1).

Transient tachypnea that is the result of a delay in the absorption of the fluid by a neonate's lungs, is a major cause for the hospitalization of the late-preterm (34 to 36 weeks), term (37 to 42

weeks), and post-term (more than 42 weeks) neonates in the NICU (1). This is especially more common in caesarean deliveries (3).

Moreover, this syndrome is more likely in situations, such as preterm neonates less than 34 weeks, anesthesia during labor, multiple births, delayed cord clamping, perinatal asphyxia, history of maternal asthma, and diabetes. It is also more probable in male neonates (4). The increase of fluid level in the interstitial space can be caused by pulmonary hypertension (in right sided heart failure) or an increase in the pulmonary blood flow (in patent ductus arteriosus) (1).

This syndrome appears precisely after birth and is treated in 2 to 5 days. However, in some of the newborns by C-section that show the symptoms of transient tachypnea, pulmonary hypertension is followed by hypoxia and the

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neonate will even need mechanical ventilation and extracorporeal membrane oxygenation and undergo serious respiratory problem possibly leading to death (1). The term Malignant Transient Tachypnea is used in order to describe this situation (2).

In the fetal period, respiratory epithelium causes fluids to enter the alveoli. This fluid will help the lungs to evolve and will prevent the lungs from collapse. The fluid should be ventilated soon after the birth because the gas exchange shifts from the placenta to the lungs (1). A disturbance in this process will cause problems, such as transient tachypnea, pulmonary hypertension, and respiratory distress (4).

One of the important issues in transient tachypnea in neonates is delayed reabsorption of the fluid by the neonate's pulmonary system leading to effusion of the fluid in the neonate's lungs (5, 6). The objective of this study was to evaluate the effects of the restrictive fluid management in hospitalization period and the respiratory support period, in the neonates diagnosed with transient tachypnea. Up to the present, a variety of treatment methods have been suggested for transient tachypnea in the neonates, such as inhaled epinephrine (7), inhaled salbutamol (8-10), edible furosemide (11, 12), and the prenatal prescription of corticosteroids to mother (13); however, these methods have not yet been approved for the common use.

In pathophysiology of this syndrome, the effusion of the fluid in the lungs is stated; therefore the restrictive fluid management is considered an effective treatment method (1, 2).

Regarding the fact that the treatment of transient tachypnea in the neonate is still a challenging task, this study was investigated to evaluate the effects of restrictive fluid management in transient tachypnea treatment in neonates.

Methods

The present study is a clinical trial conducted on 70 neonates diagnosed and hospitalized with transient tachypnea ($RR > 60$) within the first 6 h after birth in the NICUs of Ayatollah Rouhani Hospital, Shafizadeh Children Hospital, and Babol Clinic between October 2015 to March 2016 in Babol, Iran. This study was approved by the ethics committee of Babol University of Medical Sciences and registered in IRCT (IRCT: 201512225650N1) (Ethic code: MUBABOL.REC.1394.8.). The cases in each treatment center were placed by the order of every other case in experimental and control groups.

The inclusion criteria consisted of the late preterm, term, and post-term neonates with tachypnea (respiratory rate > 60) with at least one radiological sign of transient tachypnea (such as lung hyperinflation, peripheral congestion or streaking, fluid filled interlobar fissure, fluffy bilateral infiltration, and pulmonary edema) or symptoms of transient tachypnea with normal chest radiography (respiratory distress score of ≥ 4 based on the Silverman Anderson scoring system [Figure 1]), and hospitalization during the first 6 h after birth.

The term and post-term neonates with tachypnea that had at least one radiological sign of transient tachypnea or symptoms of transient

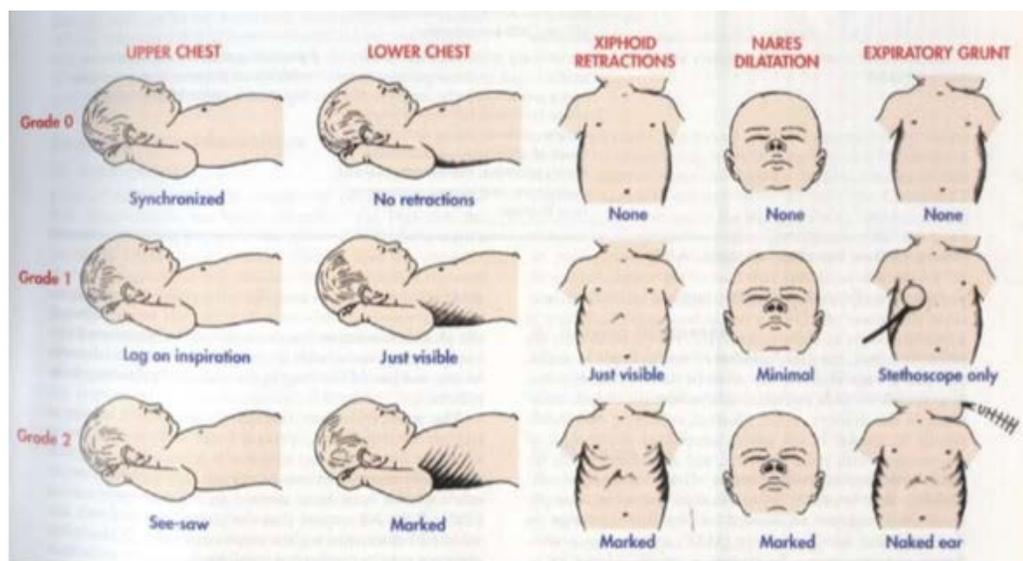


Figure 1. Silverman-Anderson scoring

tachypnea with normal chest radiography diagnosed as transient tachypnea of the neonate decussated in each experimental and control group. In the experimental group, the cases were administered a daily dose of 50 ml fluid from 10% of dextrose solution per kg of body weight; and the late preterm neonates were administered 65 ml fluid from 10% of dextrose solution per kg of body weight. The term and post-term neonates in the control group were administered a daily dose of 65 ml fluid from 10% of dextrose solution per kg; and the late preterm neonates were administered 80 ml fluid from 10% of dextrose solution per kg of body weight.

In the following days, if no contradiction was observed, a daily dose of 20 ml fluids was added to the previous amount; until the overall intake of fluids reached to 150 ml per kg for term and post-term neonates; and 170 ml per kg of body weight for late preterm neonates, or the same amount was taken orally. For the neonates under radiant warmer or phototherapy, 10% of total fluid was added for insensible water loss.

Instantly after hospitalization a complete blood count, C-reactive protein (CRP), blood culture, serum, sodium test, potassium, glucose, arterial blood gas, and a chest X-ray were taken from the neonates. For all cases, oxygen hood (30-40%) was used depending on the respiratory condition and the fraction of oxygen was subtracted with improvement in respiratory conditions, and then stopped. The amount of oxygen provided by the oxygen hood and inhaled by each neonate was considered as the respiratory support for the rest of the neonates in both experimental and control groups that were not afflicted with pneumothorax. Further, they were divided into two groups of mild, including the neonates with 30% or less oxygen, and severe consisted of the neonates received more than 30% of oxygen.

For the evaluation of hydration state, all the neonates were weighed twice a day; moreover, the amount of urination, urine specific gravity, electrolyte levels, and arterial blood gas were checked daily. The blood glucose level of the subjects was checked every 12 h up to complete oral feeding. In the whole treatment period the glucose level and their weight was measured. Enteral feeding started as soon as the neonates were stabilized and gradually resumed as their respiratory rate decreased to 60 per min and was increased daily based on the infant's tolerance. As the oral feeding increased the same amount was subtracted from total daily dose of the fluids.

A checklist for demographic information and study variables included the level of daily respiratory distress score, respiratory rate instantly after hospitalization and 24 hours later, and respiratory support was completed by a trained nurse. During the study, the trained nurse had no information of the control and experimental group. Afterwards, the data were analyzed with SPSS software (version 19). Data distribution was defined by Kolmogorov-Smirnov test and Fisher's exact test was utilized for a comparison between proportions. In addition, paired sample t-test was used for the comparison of mean values.

Results

In the present study, the frequencies of C-section and vaginal delivery were 62.85% (n= 44) and 37.14% (n=26), respectively. Out of all the cases, 44 neonates (62.85%) and 26 neonates (37.14%) were delivered by C-section and vaginally, respectively. Regarding the mode of delivery, transient tachypnea was more likely in the neonates born by C-section. Among 44 neonates born by C-section 29 neonates were delivered by elective C-section (65.90%) and 15 newborns were born by emergency caesarian (34.09%). The neonates that were born by elective C-section were more likely to suffer from transient tachypnea (Table1).

Concerning the gestational age, there were 23 pre-term (32.85%), 47 term and post-term neonates (67.14%). Mechanical ventilation was needed for two patients in each group. The level of respiratory support provided by the oxygen hood at admission did not differ significantly between the two groups (P=0.147) (Table 2). In the present study, positive pressure ventilation was not necessary for none of the neonates and two of the newborns in each group needed mechanical ventilation due to pneumothorax.

The mean scores of respiratory distress at admission for experimental and control group were 3.22 and 3.06, respectively (P=0.484) (Table 2). Furthermore, after 24 h, the mean scores for the experimental and control groups were (1.03) and (1.64), respectively. The mean score of respiratory distress in the experimental group was significantly lower than that in the control group (P=0.039) (Table 2). The mean scores of hospitalization period, for the neonates in the experimental group and the neonates in the control group were 5.65 and 6.78 days, respectively. The cases in the experimental group were released earlier from the hospital than the

Table 1. Demographic information of the experimental and control groups

Variable	Control Group	Experimental Group	P-value
Gender			
Female	16 (44.44%)	16 (47.05%)	0.631
Male	20 (55.55%)	18 (94.52%)	
Delivery mode			
C-section	22 (11.61%)	22 (70.64%)	0.758
Vaginal	14 (88.38%)	12 (29.35%)	
Gestational Age			
Term and Post-term	25 (44.69%)	22 (70.64%)	0.728
Pre-term	11 (55.30%)	12 (29.35%)	

Table 2. The results of variables in the experimental and control groups

Variable	Control Group	Experimental Group	P-value
Respiratory distress score at admission	3.22	3.06	0.484
Respiratory distress score after 24 h	1.64	1.03	0.039
Respiratory rate at admission	74.94	74.65	0.869
Respiratory rate 24 h after admission	59.22	56.56	0.116
Hospitalization period (day)	6.78	5.65	0.020
Respiratory support duration (hour)	31	21.35	0.048
Respiratory support level			
Mild	19	24	0.147
Severe	17	10	

subjects in control group and the difference was statistically significant ($P=0.02$) (Table 2).

Regarding the period of respiratory support, the neonates in the experimental group needed a shorter period of respiratory support than the subjects in the control group (i.e., 21.35 h versus 31 h) ($P=0.048$) (Table 2). None of the newborns needed nasal continuous positive airway pressure (NCPAP) treatment. There was not a significant difference between the two groups in the means of respiratory rates at admission ($P=0.869$). Respiratory rates after 24 h in the experimental and control groups were 56.56 and 59.22 per min, respectively ($P=0.116$) (Table 2).

In this study the desired objects were between the male and female neonates. The average hospitalization period for female neonates in the experimental and control groups were 5.28 and 7.29 days, respectively ($P=0.007$). The mean of hospitalization period for male neonates in the experimental and control groups were 5.89 and 6.65 days, respectively ($P=0.243$). There was not statistically significant difference between female and male neonates of both groups in respiratory support period, respiratory distress score before hospitalization, respiratory distress score after 24 h, respiratory rate instantly after hospitalization and respiratory rate instantly after 24 h.

Four the Neonates in the experimental group and two neonates in the control group antibiotics were prescribed due to a history of premature

rupture of membranes. Overall 12 cases in the experimental group and 9 neonates in the control group received antibiotics due to increased CRP ($CRP>10$ mg/dL). None of these newborns showed positive blood culture.

Discussion

The results of this study revealed that there was statistically significant difference between the experimental and control groups in the means of the hospitalization period and duration of respiratory support. Based on the results of a study performed by Annemarie et al. in New York on the effects of restrictive fluid management in late preterm, term, and post-term neonates, it was shown that there was no significant difference in the hospitalization period (5). However, in the comparison between the two groups, the respiratory support period was significantly shorter in the neonates with malignant transient tachypnea administered limited fluids.

In a study carried out by Annemarie, none of the neonates' urine volume decreased to less than 1 ml/ kg/h. However, in the present study three subjects from the experimental group and two cases from the control group suffered from this condition and were excluded from the investigation. Regarding the necessity for NCPAP in this study similar to the mentioned study, no neonate needed a NCPAP.

Dehdashtian et al. investigated the effects of

restrictive fluid management on late pre-term, term and post-term neonates in Ahvaz Imam Khomeini hospital (6).

In the abovementioned study, the main goal was to examine the restriction effect of fluid intake on the neonates with transient tachypnea (6). Regarding the hospitalization period, there was not a significant difference. However, as indicated in the present study there was a meaningful difference between both groups concerning the oxygen therapy period; it was less used for the experimental group compared to the control group. In addition, the duration for NCPAP need was shorter in the experimental group than that in the control group.

The challenge for the treatment of transient tachypnea in neonates encouraged the authors of the present study to search a harmless and effective method for the treatment of this problem. Regarding the results of this study, the findings of the some other studies, and the fact that in the pathophysiology of transient tachypnea in neonates, the accumulation of fluids in the neonate's lungs and its delayed reabsorption of lungs are involved, restrictive management of the fluids can be performed as an effective and harmless therapy. Considering the possible side effects, similar to a decrease in urine volume or blood glucose, no significant difference was observed in the present study and other studies and this can be considered as a proof for the harmlessness of this treatment technique.

With regard to the fact that in most clinics and treatment centers the neonates with transient tachypnea are admitted in the NICU, a shorter period of hospitalization can bring back the neonate to the mother earlier. Moreover, it reduces treatment costs, consequently, which can decrease the mental and financial strain on both parents and neonate. In this study, the newborns that received restrictive fluids needed a shorter respiratory support period, which helped the neonate to be breastfed sooner.

Transient tachypnea in neonates is less common in the neonates born vaginally and it was confirmed by the results of this study. According to the literature, transient tachypnea has been more likely in male neonates; however, in the present study there was not a significant difference between the two genders. The reason for that might be the limited statistical number of study population. Transient tachypnea is more probable in term neonates than in pre-term newborns as revealed by the findings of this

study.

Conclusion

The present study demonstrated that the restrictive fluid management can decrease the hospitalization period, respiratory support period, and the respiratory distress score after 24 h in the neonates with transient tachypnea. Furthermore, this method can function as a harmless and effective technique for the treatment of transient tachypnea in neonates.

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Conflicts of interests

None declared.

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