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# Transient Tachypnea in Neonates Of Mothers Receiving Glucose 5% and Oxytocin During Labour

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## Abstract:

*The aim of this work was to study the frequency of transient tachypnea of the newborn (TTN) and the possible relation to the use of oxytocin and glucose 5% during labour. Subjects investigated were enrolled into two groups: the first (study) group consisted of 100 newborn infants born to mothers who have received IV infusion of aqueous glucose solution 5% and oxytocin. The second (control) group consisted of 30 newborns whose mothers did not receive any IV infusion.*

*In the study group, the amount and rate of infusion of oxytocin and glucose 5% were calculated. The blood samples (maternal and cord) were drawn just after delivery in the study and control groups.*

*Newborns were diagnosed as having TTN if they fulfilled the following criteria: persistent tachypnea with onset within ½ hour after birth, minimal grunting and retractions, with or without cyanosis in room air, necessity for oxygen therapy, spontaneous improvement starting within 24 hours after birth, FiO<sub>2</sub> not more than 0.4 and suggestive radiological findings.*

*Our results showed that maternal and cord serum sodium levels of the study group were significantly lower than those of the control group with a significant negative correlation between the maternal and cord serum sodium and the amount of oxytocin and glucose 5%. No significant difference between maternal and related cord serum sodium in both groups. Hyponatremia developed in 25 out of 100 cases of the study group and in 2 out of 30 cases of the control group with a significant difference.*

*TTN developed in 17% of the study group and in none of the control group. The difference was significant. Serum sodium in the newborns who developed TTN was lower than in those who did not develop TTN. Out of 25 cases with hyponatremia, 8 developed TTN (32%) while out of 75 cases without hyponatremia, only 9 (12%) developed TTN with a significant difference.*

*The amount and rate of infusion of oxytocin were higher in the TTN group than the non-TTN group. TTN was more frequent when the amount of oxytocin exceeded 10 units and the rate of infusion exceeded 25 µ/min. The amount and rate of infusion of glucose 5% did not differ in the TTN group from the non-TTN group.*

*We concluded that the amount of oxytocin and glucose 5% infusion are related to the development of maternal and neonatal hyponatremia and the amount and rate of infusion of oxytocin are related to the occurrence of TTN.*

*To decrease the incidence of TTN, We recommend that the dose of oxytocin should not exceed 10 units at a rate of infusion of less than 25 µ/min.*

## Introduction:

Oxytocin is used in induction of labour, augmentation of spontaneous labour, and induction of abortion. Intravenous oxytocin infusion can be used in the treatment of uterine atony in the immediate postpartum period. Oxytocin is also used to ripen the unfavorable cervix prior to labour<sup>(1)</sup>. Tarnow-Mordi et al<sup>(2)</sup>, have described water intoxication in women receiving infusion of glucose in water with oxytocin during induction or augmentation of labour. It is well established that

oxytocin possesses an antidiuretic activity about 1/200 times that of vasopressin. This antidiuretic effect is exerted through direct action on the kidneys, and is not mediated through stimulation of antidiuretic hormone<sup>(3-9)</sup>. In pregnant women at term or in the immediate post partum period, oxytocin tends to decrease both glomerular filtration rate and renal plasma flow.<sup>(3,6,8,10)</sup>

Battaglia et al<sup>(11)</sup> have shown that the infusion of 5% glucose to the mother will rapidly lower the maternal and newborn infant serum sodium levels as well as the total plasma osmotic pressure. They also showed that sodium level in the mother and

infant are very similar; thus when hyponatremia is induced in the mother there must be a net transfer of water to the fetus and/or sodium to the mother, probably both, and this can occur in a very short time.

Spencer et al <sup>(12)</sup> showed that there is a significant depression of maternal and cord serum sodium levels by glucose infusion. Singhi et al <sup>(13)</sup> have shown that

the infusion of aqueous glucose solution for hydration or as a vehicle for oxytocin treatment may cause transplacental hyponatremia which in turn may be associated with increased risk of transient neonatal tachypnea (wet lung syndrome).

The aim of this work was to study the frequency of transient tachypnea of the newborn (TTN) and the possible relation to the use of oxytocin and glucose 5% during labour.

## Subjects and Methods:

One hundred and thirty parturient mothers and their newborn infants were selected for this study from women admitted to the delivery unit at Alexandria University Maternity Hospital and Damanshour Teaching Hospital.

Subjects enrolled in the study were required to fulfill the following criteria: vaginal delivery, full term pregnancy, single pregnancy and absence of any maternal medical disease or complication of pregnancy. The criteria were pointed by thorough maternal and perinatal history.

The studied subjects were classified into two groups: the first group included 100 neonates born to mothers who have received IV infusion of aqueous glucose solution 5% and oxytocin. The second (control) group consisted of thirty neonates whose mothers did not receive any IV infusions. The indication of oxytocin infusion in our cases was for induction and augmentation of the labour process.

The blood samples (maternal and cord) were drawn just after delivery in the first and second groups.

These samples were kept at 4°C until serum was separated by centrifugation within 6 hours. Serum samples were stored at 4°C until analyzed by flame photometry<sup>(12)</sup>

Based on clinical examination and follow up of the newborns of the first and second groups, newborns with the diagnosis of sepsis, neonatal asphyxia, congenital heart disease, pneumonia and/ or meconium aspiration syndrome have been excluded from the study.

Newborns who developed respiratory distress were transferred to the neonatal intensive care unit. They were diagnosed as having transient tachypnea of

the newborn (TTN) if they fulfilled the following criteria: persistent tachypnea (respiratory rate of 60/minute or more for over three hours) with onset within half an hour after birth, minimal grunting and retractions, with or without cyanosis in room air, necessity for oxygen therapy, spontaneous improvement starting within 24 hours after birth; FiO<sub>2</sub> not more than 0.4 and suggestive radiological findings. <sup>(14)</sup>

## Results:

The results of this study revealed that the amount of glucose 5% given to the mothers in group 1 averaged 880 ± 508 ml with a range = 500 – 2000 ml. The rate of infusion of glucose 5% to these mothers was 2.8 ± 0.7 ml/minute with a range = 2.7 – 4 ml/minute.

The amount of oxytocin given to the same mothers averaged 7.6 ± 5 units with a range = 2.5 – 20 units at a rate of infusion = 25 ± 2.3 mu/minute (range = 20.8 – 35 mu/ml).

Table I shows that there was no significant difference between maternal and cord serum sodium levels either in the study or control groups. However, maternal serum sodium and cord serum sodium were significantly lower in the study group than the control group.

Hyponatremia in cord serum (sodium level < 130 mmol/L) and the frequency of transient tachypnea of newborn were more evident in the study group (tables II and III). The cord serum sodium was significantly lower in newborns who developed TTN (range = 109 – 135 mmol/l, mean ±SD = 122 ± 6.5 mmol/l) than in those who did not develop TTN (range = 122 – 138 mmol/l ± 129.5 ± 8.5 mmol/l) (t = 2.517, P < 0.05)

Table IV shows that TTN was more frequent in the hyponatremic neonates than in normonatremic neonates. The amount and rate of infusion of oxytocin was significantly higher in the TTN than non-TTN group (table V).

TTN was more frequent in the group whose mothers received more than 10 units of oxytocin or more than 25 mu/min of oxytocin (table VI). Table VII shows that there was no significant difference between the TTN and non TTN groups as regards the amount or rate of infusion of glucose 5% given to their mothers.

Table VIII shows that there was significant negative correlation between the amount of oxytocin and volume of glucose 5% and the maternal, and cord serum sodium levels.

Table I: Serum sodium levels ( mmol/L ) in mothers and their newly born Infants in study and control

	Maternal serum sodium		Cord serum sodium	
	Group I (n=100)	Group II (n=30)	Group I (n=100)	Group II (n= 30)
Range ( mmol/L)	109 – 137	128 – 142	113 – 135	128- 145
Mean ( mmol/L)	126.5	136.5	125.5	134.2
SD	5.5	4.5	5.7	4.5
t	6.3 *		4.8 *	

p < 0.05, Mothers versus neonates in group I: t = 0.4321( non significant), Mothers versus neonates in group II: t = 0.4491 ( non significant)

Table II: The distribution of the study and control group according to the cord Serum sodium levels ( mmol/L)

Sodium level ( mmol /L)	Study Group (n=100)	Control Group (n= 30)	Total
< 130	25	2	27
> 130	75	28	103
Total	100	30	130

$\chi^2 = 4.315$  , P < 0.05

Table III: Frequency of TTN in cases and control group

Observation	Cases		Control		Total	Z-value
	Nº	%	Nº	%		
No abnormality	83	83	30	100	113	0.8514
TTN	17	17	0	0	17	2.5837*

TTN : transient tachypnea of the newborn, \* P < 0.05

Table IV: TTN and non-TTN observations in hyponatremic and normonatremic classes of the study group

	TTN group		Non TTN group		Total	
	Nº	(%)	Nº	(%)	Nº	(%)
Hyponatremic group	8	( 32 )	17	( 68 )	25	(100)
Normonatremic group	9	( 12 )	66	( 88 )	75	(100)
Total	17		83		100	

$\chi^2 = 5.3145$  , P < 0.05

Table V: Comparison of the amount and rate of infusion of oxytocin given to TTN and non-TTN groups

	Amount of oxytocin ( units)		Rate of infusion of oxytocin (mu/min)	
	TTN group (n=17)	Non TTN group (n= 83)	TTN group (n=17)	Non TTN group (n=83)
Range	10 – 20	2.5 – 20	25 - 35	20 - 25
Mean	15.6	11	30	23
SD	5.4	5.6	5.8	6.7
T	3.1034 *		4.0074 *	

\* P < 0.05

Table VI: Relation between the amount ( U) and rate of infusion (mu/min) of Oxytocin given to mothers and development of TTN in their neonates

Dose of Oxytocin ( U)	TTN	Non TTN	Total	Rate of Infusion (mu /min)	TTN	Non TTN	Total
<10 U	6	71	77	< 25	0	80	80
> 10 U	11	12	23	> 25	17	3	20
Total	17	83	100	Total	17	83	100
$\chi^2$	20.116 *			$\chi^2$	81.929 *		

\* P < 0.05

Table VII: Comparison of the amount and rate of infusion of glucose given to the TTN and non-TTN groups

	Amount of glucose		Rate of infusion of glucose	
	TTN	non TTN	TTN	non TTN
Range	1000 –2000	500 – 2000	3 - 5	2 – 3
Mean	1437.5	1333.3	2.9	2.7
SD	363.5	471.4	0.3	0.4
T	0.8592		1.5878	

$P > 0.05$

Table VIII: Correlation between the dose of Oxytocin (U) and volume of glucose infusion (ml) with maternal and cord serum sodium ( mEq/L )

	Maternal serum sodium	Cord serum sodium
Dose of oxytocin	r = - 0.6085 P = 0.0001	r = 0.4202 P = 0.0001
Value of glucose infusion	r = - 0.5134 P = 0.0001	r = - 0.3951 P = 0.0001

## Discussion:

Our results showed a significant decrease in the maternal and cord serum sodium in the group who received IV infusion of oxytocin and glucose 5% than those of the control group. There was no significant difference between serum sodium levels of the mothers and related newborns in both groups.

Neonatal hyponatremia (cord serum level < 130 mmol/L) was found in 25 out of 100 cases of study group, and in 2 out of 30 cases of control group, with a significant difference. Singhi et al<sup>(13)</sup> found that hyponatremia was present in 39% of infants born to mothers who received an IV infusion of aqueous glucose solution during labour for hydration or as a vehicle for oxytocin compared with 6% of infants born to mothers who did not receive any IV fluids.

There was an inverse relation between the amount of oxytocin and the levels of sodium in mothers and their related newborns. Also, there was an inverse relation between the volume of glucose 5% and the level of sodium in the maternal and cord serum. Whether this hyponatremia is caused by infusion of aqueous glucose used as a vehicle for oxytocin or is due to the antidiuretic effect of oxytocin or both is not clear. Neonatal and maternal hyponatremia have been described following oxytocin infusion during labour by many workers<sup>(15,16,17,18,19)</sup> On the contrary, other studies did not prove this effect following oxytocin use<sup>(2,20)</sup>

In our study, we found an increased frequency of TTN in babies born to mothers receiving oxytocin and glucose 5% infusion; we found 17 cases out of 100 newborns of group 1 suffering from TTN while

none of the control group had TTN. The neonates who developed TTN had a significantly lower serum sodium level than that of those who did not develop TTN.

We found that 32% of hyponatremic babies had TTN while 12% of the normonatremic group had TTN ; the difference was significant . This result is in accordance with the results of Singhi et al<sup>(13)</sup> who found that cord serum sodium concentration in two groups of vaginally delivered term infants had a negative correlation with the incidence of TTN.

In our study, we found that mothers of newborns who developed TTN received more oxytocin (amount and rate of infusion) than mothers of newborns who did not develop TTN, the difference was statistically significant.

Studying the relation between the amount and the rate of infusion of oxytocin and the occurrence of TTN revealed that receiving more than 10 units at a rate of 25 mu/ min is associated with greater risk of developing TTN. So, we can conclude that the incidence of TTN is related to dose and rate of infusion of oxytocin.

Abdul Karim and Rizk<sup>(19)</sup> came to the conclusion that in healthy women, oxytocin administered by constant IV infusion produced a definite antidiuresis within 10-15 minutes of the start until 10-15 minutes after it was stopped. This antidiuresis was found to be dose dependent being readily detectable at 15 mu/minute and maximum at 45 mu/minute. They found that 70% of the total antidiuretic effect occurred at the infusion rate of 20 – 30 mu/min.

As regards the amount and rate of infusion of glucose 5%, we found that the mean of the volume and the mean of the rate of infusion of glucose 5%

given to mothers whose newborns developed TTN were not significantly different from those given to mothers whose newborns did not develop TTN. We concluded that the effect is mainly due to oxytocin. Normally, soon after birth, excessive alveolar and interstitial fluid from the neonatal lung is rapidly absorbed and drained by way of the venous circulation and lymphatics. <sup>(21,22)</sup> A delay in this process has been identified as the most probable mechanism causing TTN. <sup>(17,23)</sup> Many factors determine the rate of this pulmonary fluid absorption of which decreased plasma oncotic pressure is most likely to delay the fluid absorption. Kero et al <sup>(17)</sup> suggested that cord plasma oncotic pressure is lower in infants who develop TTN than in healthy infants of the same gestational age.

Shang <sup>(22)</sup> has shown that the sodium pump is important in reabsorption of pulmonary fluid soon after birth. It is possible that the function of this pump is impaired in the presence of hyponatremia, which may further delay the pulmonary fluid absorption.

From this study, it can be concluded that the amount of oxytocin and glucose 5% infusion are significantly related to the development of maternal and neonatal hyponatremia and the amount and rate of infusion of oxytocin are related to the occurrence of TTN.

To decrease the incidence of TTN, We recommend that the dose of oxytocin should not exceed 10 units at a rate of infusion less than 25 mu / minute.

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