

# The Comparison of Thyroid Function Tests in Cord Blood Following Cesarean Section or Vaginal Delivery

Ramezani Tehrani F, Aghaei M, Asefzadeh S.

Qazvin University of Medical Sciences, Qazvin, I.R. Iran.

**T**he present study was designed to assess the influence of mode of delivery on fetal pituitary-thyroid axis.

**Materials and Methods:** The endocrine profile (umbilical venous plasma) of three groups of term infants was compared immediately after delivery. Samples were taken after 30 vaginal deliveries, 30 emergency cesarean sections during labor and 30 elective cesarean sections before labor. The study was performed in the Kowsar Hospital in Qazvin. The samples were matched based on maternal age, parity and gestational age and none of them had previous history of medical complications. Measurements of TSH and thyroid hormone levels were performed using immunoenzymometric and radioimmuno assays, respectively.

**Results:** Mean cord plasma TSH level of vaginal and emergency cesarean section was significantly lower than that of the elective cesarean section ( $p < 0.0001$ ;  $3.3 \pm 1.8$ ,  $9.0 \pm 3.2$  and  $12.1 \pm 6.4$   $\mu\text{U/mL}$ , respectively). Mean concentrations of T4 and T3 were significantly higher in the elective cesarean section as compared with the emergency cesarean section and vaginal deliveries ( $p < 0.05$ ;  $8.5 \pm 1.3$ ,  $7.4 \pm 2.4$  and  $7.4 \pm 1.3$   $\mu\text{g/dL}$  for T4 and  $76 \pm 12$ ,  $62 \pm 20$  and  $51 \pm 16$   $\text{ng/dL}$  for T3, respectively).

**Conclusion:** These results suggest that labor may reduce plasma thyrotropin and thyroid hormone concentrations at birth. **Key Words:** Labor, Thyroid hormones, Cesarean section, Hypothyroidism.

## Introduction

Neonatal exposure to cold extrauterine environment at the time of parturition may evoke a marked and transient elevation of TSH peaking at 30 minutes after birth resulting in an augmentation of hepatic T4-to-T3 conversion. The TSH surge stimulates T4 secretion and thyroid conversion of T4 to T3 and there is a further concomitant increase in hepatic T3 production from T4.<sup>1</sup>

Some researchers reported that plasma concentration of thyroid hormones remain lower in cesarean section infants over the first 24 hours of life in comparison to other modes of delivery.<sup>2-6</sup> Other studies indicated that labor pain, duration of labor, and uterotonic agents had no effect on cord serum TSH and thyroid hormone levels and only the mean cord serum TSH in vacuum extractions was significantly higher than that of normal vaginal delivery and cesarean section.<sup>7,8</sup> Fuse et al reported that there was no significant difference among the infants who were delivered vaginally, by vacuum extraction, or by cesarean section.<sup>9</sup> All the studies emphasized that the difference between cord TSH levels in various modes of deliveries were transient and the elevation of cord TSH reflected delivery stress, which would not interfere with the detection of congenital hypothyroidism in the screening programs

---

*Correspondence:* Fahimeh Ramezani Tehrani, Qazvin University of Medical Sciences, Qazvin, I.R. Iran.  
*E-mail:* frtehrani@yahoo.com

using primary TSH test on the fifth day of life.<sup>6</sup> TSH levels of all normal babies correspond after 2-4 days. Neonatal plasma concentrations of thyroid hormones are known to peak within 2 hours of birth,<sup>2</sup> but the influence of labor on both endocrine and metabolic profiles in neonates immediately after birth remains unclear.

Our study was designed to examine the influence of labor on the fetal plasma concentration of TSH and thyroid hormones immediately after birth by comparing umbilical concentrations in groups of babies delivered after labor (vaginal or cesarean section) with a group delivered before labor (elective cesarean section).

### Materials and Methods

The babies from 90 uncomplicated primiparous term pregnancies were studied. None of the mothers had previous history of thyroid disease, diabetes, prolonged rupture of membrane, pre-eclampsia and hypertensive

disorder nor were they taking thyroid affecting medications. 30 labors ended with vaginal delivery and 30 required emergency cesarean section (labor groups). A further 30 had an elective cesarean section before labor (non-labor group). The cases were matched with respect to maternal and gestational age. Umbilical venous blood samples diluted with heparin were obtained immediately after birth from a double clamped segment of the umbilical cord. After centrifugation, the plasma was collected and sent to the referral laboratory.

Umbilical plasma TSH concentration was measured using a two-site immunoenzymometric assay and triiodothyronine (T3) and thyroxine (T4) levels were measured using radioimmuno assay. Limits of detection and intra- and interassay coefficients of variation for all hormone assays are given in Table 1. Mean values were compared using one-way analysis of variance (ANOVA) and p values less than 0.05 were considered to be significant.

**Table 1. Limits of detection, inter and intra-assay coefficients of variation (CV) for hormone assays**

Assay	Upper limit	Lower limit	Inter assay CV (%)	Intra assay CV (%)
T <sub>4</sub> (µg/dL)	5	13	2.2	3.2
T <sub>3</sub> (ng/dL)	0.3	4.0	7.1	10.0
TSH (µU/mL)	1.8	20	3.5	2.5

**Table 2. Mean birth weight, gestational age, and duration of labor and neonatal sex**

Mode of delivery	Birth Weight (g)	Gestational age (weeks)	Duration of labor (hours)	Sex	
				Male	Female
Vaginal delivery	3150±205	38.8±0.7	6.8±3.6	14	16
Emergency cesarean section	3230±214	39.1±0.5	6.1±2.0	17	13
Elective cesarean section	3050±188	38.1±0.4	-	14	16

## Results

Mean  $\pm$  SD maternal age was  $23.2 \pm 4.1$  years. Mean gestational age was similar in labor groups, but it was one week shorter in the elective cesarean section group (Table 2).

The duration of labor was similar between vaginal and emergency cesarean section groups. There was no significant difference in birth weight or sex distribution among the groups (Table 2). 85.1% of mothers in the emergency- and 90.4% of mothers in the elective cesarean section groups received halothane general anesthetic and the remainder were administered local spinal blockage. No one in the vaginal group received local or general anesthetic.

All babies started breathing rapidly after birth and had normal Apgar scores of 8-10. Mild respiratory distress (transient tachypnea) was observed in 4 babies of the elective cesarean section group, but no medications were needed.

Table 3 demonstrated the mean umbilical plasma concentrations of T3, T4 and TSH of babies in emergency cesarean section group, according to the reasons for cesarean section.

Table 4 shows umbilical plasma concentrations of TSH and thyroid hormones of the different groups. Mean umbilical plasma concentrations of TSH and thyroid hormones were significantly higher in the elective cesarean than into other two labor groups ( $p < 0.0001$  for TSH and  $P < 0.05$  for T4 and T3).

**Table 3. Mean plasma concentrations of T3, T4, and TSH by various reasons for the emergency cesarean section**

Reason for cesarean section	Number	Percent	TSH ( $\mu\text{U/mL}$ )	T3 (ng/dL)	T4 ( $\mu\text{g/dL}$ )
Failure to progress	11	34.6	$8.9 \pm 3.2$	$63 \pm 30$	$7.4 \pm 2.2$
Malpresentation	7	26.9	$8.7 \pm 3.3$	$60 \pm 20$	$7.0 \pm 2.1$
Failure to descend	4	15.4	$8.8 \pm 3.4$	$62 \pm 20$	$7.5 \pm 2.3$
Fetal distress	6	23.1	$9.8 \pm 3.1$	$64 \pm 20$	$7.8 \pm 2.6$

**Table 4. Mean plasma concentrations of TSH, T3 and T4 by modes of delivery**

Mode of delivery	TSH ( $\mu\text{U/mL}$ )	T3 (ng/dL)	T4 ( $\mu\text{g/dL}$ )
Vaginal delivery	$3.3 \pm 1.8^*$	$51 \pm 16^\dagger$	$7.4 \pm 1.3^\dagger$
Emergency cesarean section	$9.0 \pm 3.2^*$	$62 \pm 20^\dagger$	$7.4 \pm 2.4^\dagger$
Elective cesarean section	$12.1 \pm 6.4^*$	$76 \pm 12^\dagger$	$8.5 \pm 1.3^\dagger$

\*  $p < 0.001$

†  $p < 0.05$

## Discussion

This study indicates the important influence of the labor process on the hypothalamic-pituitary-thyroid axis at birth.

In the current study, like Bird's, the mean umbilical plasma TSH, T3 and T4 concentrations of the elective cesarean section group were higher than the labor groups.<sup>2</sup>

However, some previous studies reported that there was no relation between cord TSH, T3 and T4 values and the delivery route, duration of labor or uterotonic agents.<sup>7-10</sup> Miyamoto demonstrated that the mean plasma venous TSH concentration of the babies following elective cesarean section was lower than that of normal vaginal delivery.<sup>6</sup> Also, the mean serum TSH level in the neonates delivered by vacuum extraction was higher than the others. He mentioned that delivery stress might affect the hypothalamic-pituitary-thyroid axis at the birth.<sup>6</sup> Gemer also observed that fetal distress during labor is associated with higher TSH levels.<sup>11</sup>

Some differences were noted between the results of the present and of previous studies that may be due to different time of specimen collection and also the lack of the studies to stratify the cesarean section into elective or emergency types of deliveries.

The increase in serum thyrotropin level during the early minutes after birth is due to exposure of neonates to the cold extrauterine environment.<sup>1,3</sup> Infants delivered by cesarean section have lower axillary, and skin temperature than those delivered per vaginum.<sup>3</sup> Therefore, lower body temperature of the neonate in cesarean section maybe a stimulus for the higher TSH levels, which evokes increased secretion of T4 and T3 by the thyroid.

These adaptations may be the stimulus for the subsequent surge of TSH, which increases the thyroid hormone levels over the first few hours after birth. Further studies for explaining the exact mechanism of thyroid hormone changes after labor pain are recommended.

However, mean TSH levels of neonates on days 3-5 in heel blood spotted filter paper were not significantly different among the three groups.<sup>12,13</sup> It is therefore preferable to obtain blood samples on the fifth day of life for the congenital hypothyroidism screening TSH test.<sup>14</sup>

The mothers' plasma concentrations of thyroid hormones and antithyroid antibodies were not checked in the present study and undiagnosed hypothyroidism of pregnant women may adversely affect the results. Data from normal pregnant female population demonstrated that more than 10% have positive levels of thyroid antibodies,<sup>14</sup> so it is recommended to assess the levels of maternal thyroid hormones and antithyroid antibodies in future studies. Also, it is better to re-check the plasma concentration of thyroid hormones 2 hours after birth for evaluation of transient changes of these hormones by different routes of delivery.

We could not study the effect of fetal distress because of the limitation of sample size, therefore, further investigation on larger number of cases is recommended.

## Acknowledgement

We thank Dr. Naji for his kind assistance with the measurement of thyrotropin and thyroid hormone levels in our plasma samples.

## References

1. Fisher DA, Polk DH. Thyroid disease in the fetus, neonate, and child. In: DeGroot LJ ed. *Endocrinology* 3rd ed. Philadelphia; W.B. Saunders Company, 1995, p 783-98.
2. Bird JA, Spencer JA, Mould T, Symonds ME. Endocrine and metabolic adaptation following cesarean section or vaginal delivery. *Arch Dis Child Fetal Neonatal Ed.* 1996; 74: F132-4.
3. Christensson K, Siles C, Cabrera T, Belaustequi A, de la fuente P, Lagercrantz H, et al. Lower body temperatures in infants delivered by cesarean section than in vaginally delivered infants. *Acta Paediatr* 1993; 82: 128-31.
4. Ericsson UB, Ivarsson SA, Persson PH. Thyroglobulin in cord blood, the influence of the mode of delivery and the smoking habits of the mother. *Eur J Pediatr* 1987; 146: 44-7.
5. Lao TT, Panesar NS. Neonatal thyrotrophin and mode of delivery. *Br J Obstet Gynaecol* 1989; 96: 1224-7.
6. Miyamoto N, Tsuji M, Imataki T, Nagamachi N, Hirose S, Hamada Y. Influence of mode of delivery on fetal pituitary-thyroid axis. *Acta Paediatr Jpn* 1991; 33: 363-8.
7. Shi LX, Ma QL, Zhang JX. Influence of perinatal factors and sampling methods on thyroid stimulating hormone and thyroid hormone levels in cord blood. *Zhonghua Fu Chan Ke Za Zhi.* 1994; 29: 714-6.
8. Bielawski J, Dzieciuchowicz L, Nowak S, Bielecka W, Jarzab B, Ulfik A. Effect of physiologic and instrumental labor on the hormonal activity of the hypothalamo-hypophyseo-thyroid system. I. Physiologic labor. *Ginekol Pol (obs)* 1988; 59: 470-5.
9. Fuse Y, Wakae E, Nemoto Y, Uga N, Tanaka M, Maeda M, et al. Influence of perinatal factors and sampling methods on TSH and thyroid hormone levels in cord blood. *Endocrinol Jpn* 1991; 38: 297-302.
10. Eltom A, Eltom M, Idris M, Gebre-Medhin M. Thyroid function in the newborn in relation to maternal thyroid status during labour in a mild iodine deficiency endemic area in Sudan. *Clin Endocrinol (Oxf)* 2001; 55: 485-90.
11. Gemer O, Shenhav S, Segal S, Tur-kaspa I. Thyroid hormone level in cord blood of infants with acidemia at birth. *Eur J Obstet Gynecol Reprod Biol* 2000; 93: 53-5.
12. Roti E, Fang SL, Green K, Emerson CH, Braverman LE. Human placenta is an active site of thyroxine and 3, 3'-triiodothyronine tyrosyl ring deiodination. *J Clin Endocrinol Metab* 1981; 53: 498-501.
13. Symonds ME, Clarke L, Lomax. The regulation of neonatal metabolism and growth. In: Ward RH, Smith SK, Donnai D, eds. *Early fetal growth and development.* London: Royal College of Obstetricians and Gynaecologists, 1994; 407-19.
14. Dussault, JH. The anecdotal history of screening for congenital hypothyroidism. *J Clin Endocrinol Metab* 1999; 84: 4332-4.