

SERUM THYROTROPIN, THYROXIN AND TRIIODOTHYRONINE CONCENTRATIONS IN MATERNAL AND CORD BLOOD OF GOITROUS AND NON-GOITROUS PREGNANT WOMEN LIVING IN THE BLACK SEA REGION OF TURKEY*

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Endemic goiter is a well-known problem of the Black Sea Region in Turkey. The importance of this problem in infants and school-age children has been previously reported¹⁻³. We recently conducted a preliminary study with the aim of evaluating the thyroid hormone and thyrotropin values in goitrous pregnant women and in their cord blood and compared them with a non-goitrous group.

Material and Methods

The serum thyrotropin (TSH) thyroxin (T₄) and triiodothyronine (T₃) concentrations were determined in 64 goitrous and 18 non-goitrous gravidas. These values were also determined in the cord blood of 100 goitrous gravidas. The serum T₃ and T₄ concentrations of cord blood from 18 non-goitrous gravidas were also found. The goitrous and non-goitrous subjects were selected at the Trabzon Maternity Hospital. The mothers were either from Trabzon or the surrounding areas. The blood samples obtained during delivery were stored at -10 °C. TSH, T₄ and T₃ determinations were made by the radioimmunoassay method. The samples were assayed in duplicates using coated tubes (Diagnostic Products Corporation) and the values were arrived at by using the mini-gamma counter (LKB).

Infants with a high TSH (>25 micro unit/ml) and a low T₄ (<8 microgram/dl)^{4,5} in their cord blood were asked to come in for an examination, bone age, TSH and T determinations.

Statistical analysis was carried out using the Student's *t* test.

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Results

The serum TSH, T_4 and T_3 concentrations of goitrous and non-goitrous pregnant women and their cord blood are given in Table I. There was a significant difference ($p < 0.01$) between the thyroid hormone values of goitrous and non-goitrous pregnant women. The mean serum T_4 level of goitrous pregnant women was significantly lower than the control group ($p < 0.01$) whereas the mean serum T_3 and TSH levels of goitrous pregnant women were significantly higher than the control group ($p < 0.01$).

The mean cord blood T_4 level of goitrous mothers was significantly lower than the control group ($p < 0.01$) whereas the difference in the T_3 level between the two groups was not significant. Using cord blood TSH and T_4 levels as an index in the diagnosis of hypothyroidism, thirteen of the samples showed high TSH (> 25 micro unit/ml) with a low T_4 (< 8 microgram/dl) (Table II). During the second

TABLE I: Serum TSH, T_4 and T_3 Values of Goitrous and Non-goitrous Gravidas and Their Cord Blood

		TSH microunit/ml	T_4 microgram/dl	T_3 nanogram/ml
Goitrous gravidas	$\bar{X}$	4.30	9.50	1.88
	Sd	3.63	3.25	0.42
	SE	0.45	0.41	0.053
	n	64	64	64
		$p < 0.01$	$p < 0.01$	$p < 0.01$
Non-goitrous gravidas	$\bar{X}$	1.97	11.60	1.08
	Sd	0.50	2.04	0.15
	SE	0.12	0.52	0.037
	n	18	18	18
Cord blood of goitrous gravidas	$\bar{X}$	26.67	8.50	0.58
	Sd	29.69	2.27	0.29
	SE	4.87	0.23	0.029
	n	100	100	37
			$p < 0.01$	$p > 0.5$
Cord blood of non-goitrous gravidas	$\bar{X}$		10.20	0.53
	Sd	ND	1.26	0.27
	SE		0.32	0.064
	n		18	18

ND: not done.

evaluation of the thirteen infants done four weeks later, five still had a low T_4 and a high TSH level (Table II). Two of the five hypothyroid infants displayed a delay in bone age and all of them had minimal goiter.

TABLE II: Thyroid Hormone Status of Some Hypothyroid Infants at Term and Four Weeks Later

No. of cases	Cord blood		Four weeks later	
	T_4 (microgram/dl)	TSH (microunit/ml)	T_4 (microgram/dl)	TSH (microunit/ml)
1	4.0	100	5.0	41
2	3.6	100	4.0	45
3	4.0	100	5.5	30
4	6.4	53	9.0	8
5	5.2	85	6.0	25
6	7.4	29	12.0	5
7	7.8	33	11.0	4
8	7.6	41	14.0	5
9	6.6	31	10.5	6
10	4.6	80	7.0	20
11	7.6	25	9.0	4
12	6.8	55	11.0	3
13	7.2	29	10.5	0.7

Discussion

In this preliminary study the results clearly show the adverse effects of iodine deficiency on maternal and fetal thyroid status. The low T_4 , and high TSH and T_3 levels of goitrous pregnant women compared with the non-goitrous group are in accordance with those of other studies⁶⁻⁸ indicating that although the serum T_4 level may be low in individuals living in endemic regions, their serum TSH and T_3 levels are usually higher than those observed in subjects residing in zones free of endemic goiter.

The mean T_4 and T_3 concentrations of euthyroid pregnant women living in the USA were compared with our non-goitrous euthyroid control group (Table III). Both T_4 and T_3 levels of the group in the USA were significantly higher than our euthyroid group ($p < 0.01$). The low levels of thyroid hormones, even in the euthyroid control group also show the extent of this problem in the Black Sea Region of Turkey. The magnitude of the problem is even greater in the fetal and neonatal periods. The mean cord blood T_4 level of the goitrous group was

TABLE III: Serum T₄ and T₃ Concentrations of Gravidas and Their Cord Blood in the Black Sea Region of Turkey and the USA

Goitrous gravidas	T ₄ (microgram/dl)	T ₃ (nanogram/ml)
Goitrous gravidas (Black Sea) (n: 64)	9.50 ± 0.45	1.88 ± 0.053
Non-goitrous gravidas (Black Sea) (n: 18)	11.60 ± 0.52	1.08 ± 0.037
Non-goitrous gravidas (USA) (n: 17)	14.30 ± 0.66	1.73 ± 0.084
Cord blood of goitrous gravidas (Black Sea)	8.50 ± 0.23	0.58 ± 0.029
Cord blood of non-goitrous gravidas (Black Sea)	10.20 ± 0.32	0.53 ± 0.064
Cord blood of non-goitrous gravidas (USA)	11.9 ± 0.41	0.51 ± 0.036

Values recorded as mean and SEM.

significantly lower than the euthyroid group ($p < 0.01$). In addition, the mean cord blood T₄ level of the euthyroid group was significantly lower than the USA group⁹ (Table III). The cord blood T₃ level of the goitrous group was higher than the non-goitrous group. However, the difference was not statistically significant. It seems that the T₃ level cannot be used as a sensitive measure in the evaluation of thyroid functions in utero. This can be explained by the immaturity of 5'-iodothyronine monodeiodinase activity and the preferential conversion of T₄ to reverse T₃ instead of T₃¹⁰.

Out of one hundred cord blood samples, thirteen were compatible with hypothyroidism (Table II). After four weeks, five of the infants were still hypothyroid with a low T₄ and a high TSH. Also two of the infants displayed a delayed bone maturation which is a very sensitive index in the assessment of hypothyroidism in the intrauterine period. The thyroid glands of the hypothyroid infants were minimally enlarged. Thyroid hormone (thyroxin 10 microgram/kg/day)

replacement was started as soon as the results confirmed hypothyroidism. This result suggests that while some of the hypothyroid cases are transient, others are permanent. It has not been clearly determined whether transient hypothyroidism poses any serious sequela on the mental development of these children but there is no doubt that permanent hypothyroid patients are in a high risk group.

Despite the recognition of iodine deficiency as a cause of goiter, and even of hypothyroidism, no iodine supplementation program has been started as of yet.

Summary

In this study the serum TSH, T_4 and T_3 concentrations of goitrous and non-goitrous pregnant women and their cord blood were evaluated. A significant difference was found between the thyroid hormone values of goitrous and non-goitrous pregnant women. The mean T_4 level of goitrous pregnant women was significantly lower than the control group whereas the mean T_3 and TSH levels of the goitrous cases were significantly higher than the control group.

The mean cord blood T_4 level of goitrous mothers was significantly lower than the control group whereas the difference in the T_3 level between the two groups was not significant.

Out of 100 cord blood samples from goitrous mothers, 13 were within the hypothyroid range (high TSH and low T_4). During the second evaluation of the hypothyroid infants, five of them still had a low T_4 and a high TSH and two of them displayed a delay in bone age. All of them had goiter.

REFERENCES

1. Teziç T, Gedik Y, Baki A, et al. The incidence of goiter among students living in a group of mountain villages in the Black Sea Region and their thyrotropin and thyroid hormone values. *Turk J Pediatr* 27:193, 1985.
2. Teziç T, Gedik Y, Arslanoğlu M, Demirci Y. A goitrous neonate of a hypothyroidal family living in northern Turkey where this condition is endemic. *Turk J Pediatr* 25:259, 1983.
3. Gedik Y, Teziç T, Kazancıoğlu S, Kaya C. Height and bone age of Turkish children with goiter where this condition is endemic. *Turk J Pediatr* 28:177, 1986.
4. La Franchi SH. Hypothyroidism. *Pediatr Clin North Am* 26:33, 1979.
5. Meijer WJ. Evaluation of screening for congenital hypothyroidism in the Netherlands. In Naruse H, Irie M. *Proceedings of the Second International Conference on Neonatal Thyroid Screening*. Tokyo, August 16-19, 1982. Amsterdam: Excerpta Medica 1983, p 63.
6. Chopra IJ, Hershman JM, Hornabrook RW. Serum thyroid hormone and thyrotropin levels in subjects from endemic goiter regions of New Guinea. *J Clin Endocrinol Metab* 40:326, 1975.
7. Patel YC, Pharoah PO, Hornabrook RW, et al. Serum triiodothyronine, thyroxine and thyroid-stimulating hormone in endemic goiter: a comparison of goitrous and nongoitrous subjects in New Guinea. *J Clin Endocrinol Metab* 37:783, 1973.
8. Koutras DA, Berman M, Sfontouris J, et al. Endemic goiter in Greece: thyroid hormone kinetics. *J Clin Endocrinol Metab* 30:479, 1970.

9. Erenberg A, Phelps DL, Lam R, Fisher D. Total and free thyroid hormone concentrations in the neonatal period. *Pediatrics* 53:211, 1974.
10. Burrow G, Bacrach L, Holland J. Maternal fetal thyroid function. In Naruse H, Irie M. *Proceedings of the Second International Conference on Neonatal Thyroid Screening*. Tokyo, August 16-19, 1982. Amsterdam: Excerpta Medica 1983, p 34.