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Original Article

Screening of hypothyroidism disorder in newborns by heel prick level of thyroid-stimulating hormones.

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Abstract

Background: Thyroid hormones are vital for fetal development and regulation of neuropsychological function. Therefore an adequate amount of thyroid hormone levels are necessary for brain development cognitive function. Newborn screening for congenital hypothyroidism is a great achievement in preventive medicine. Screening for hypothyroidism disorder using heel prick samples is considered essential for preventing intellectual dysfunction and delayed growth. The objective of the present study was to determine the frequency of hypothyroidism disorder in newborns.

Methodology: A cross-sectional study was conducted at Abbasi Shaheed Hospital, Gynae & Obstetrics Department, Karachi, Pakistan. Blood samples were obtained from 257 neonates between 3rd & 5th day after birth by the heel prick method. Babies of Mothers having thyroid diseases were excluded from the study. Serum Thyroid-stimulating hormones (TSH) were tested using the enzyme-linked immunosorbent assay method. Newborn serum TSH > 20 miu/L was considered abnormal.

Results: The overall mean age of neonates was 3.47 ± 0.57 days. Out of the total 257 neonates screened, female babies had higher TSH levels and congenital hypothyroidism was found in 4(1.55%) cases. The observed mean TSH level was 4.09 ± 0.24 mIU/L.

Conclusion: In conclusion, the observed frequency of neonatal hypothyroidism in this single-center study prompts the need for early screening and diagnosis. The screening should be included in the post-natal period to prevent sequels associated with hypothyroidism for timely diagnosis and treatment of newborns.

Keywords

Thyroid-Stimulating Hormones, Congenital Hypothyroidism, Neonatal Screening

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Introduction

Congenital hypothyroidism is one of the most commonly diagnosed problems. Approximately 1400 infants are diagnosed with congenital hypothyroidism each year[1]. Congenital hypothyroidism is the commonest disorder thyroid disorder that can be treated easily. The global incidence of neonatal hypothyroidism is 1 in 3000-4000 live births, while incidence is higher in developing countries like Pakistan (1 in 257 newborns). However, the incidence of congenital hypothyroidism varies across different populations[2,3]. The prevalence of thyroid problems depends on age, gender, ethnicity and iodine intake.

Congenital hypothyroidism is usually caused by inborn errors of thyroid hormone synthesis and may be associated with goiter[4]. Thyroid hormones are necessary for protein synthesis, growth regulation and affect the metabolism of carbohydrates, lipids and vitamins. The thyroid hormone plays a vital role in the growth of the brain during the first 2-3 years of life[5]. Deficiency of thyroid hormone results in neurodisability; for this, early detection and treatment are possible[6]. Clinical features of Congenital hypothyroidism included lethargy, impaired cognitive function, delay in development, feeding problems, constipation, low body temperature and decreased heart rate. Most neonates with congenital hypothyroidism have few or no clinical manifestations[7].

In most developed countries, neonatal screening is practiced by estimating blood spot T4 or TSH level or both[8]. The most sensitive and specific screening test was developed by measurement of TSH in a blood sample. Regarding testing of sample collection varies; most studies suggest blood samples collected from heel prick during 48-72 hours after birth[9,10]. Generally, TSH cut-off < 15 u/l is considered diagnostic to identify both transients and permanent hypothyroidism[11]. A heel sticks TSH levels < 20 miu/l were taken as a positive for detecting neonatal hypothyroidism, and confirmation was done by peripheral venous sampling[12].

There is a physiologic TSH surge during the first hour of life, so it is recommended that screening program samples be taken at least 48 hours after birth. Hardy et al. reported that heel stick testing is more specific to screen congenital hypothyroidism[13]. As in low socioeconomic countries like Pakistan, screening programmes must be viewed as a big challenge. Since no routine neonatal screening is being done in our country, although it has been a very common and known fact for many years, no single study was done in our public sector hospital. These data are important to inform the need for screening programs development and further research in diagnostic. Our study aims to determine the frequency of congenital hypothyroidism in our local population using heel prick blood samples for TSH levels.

Methodology

This prospective, cross-sectional study was conducted at the gynae department of Abbasi Shaheed Hospital, Karachi, from January 2020 to June 2020. The study was carried out following the declaration of Helsinki. Open epi info calculator calculated a sample size of 257 with a 95% confidence interval and 5% margin error[3].

The patients were selected using the non-probability consecutive sampling technique. Detailed information was obtained on structured questionaire including age, gestational age calculated by last menstrual period, drug history including iodine intake, anti-thyroid, dopamine and steroid were taken. Mother having thyroid diseases and not willing to participate in the study was excluded from the study.

After taking informed consent from mothers, test samples were collected by heel stick on a filter paper after 48 hours of delivery. Filter papers are allowed to dry at room temperature. All samples were sent to the centralized lab for testing TSH level by enzyme-linked immunosorbent assay method. The TSH level above >20miu/L was diagnostic for congenital hypothyroidism in newborns. Data were analyzed using SPSS version

20.0. Frequency and percentages are calculated for age, sex and congenital hypothyroidism.

Results

The overall mean age of the newborn was 3.47 ± 0.57 years. 147 newborns (57.19%) were aged 3 days, 99 neonates (38.52%) were 4 days old, and 11 (4.3%) were 5 days old. There were 137 (53.3%) male babies, and 120 (46.7%) were female babies. The observed mean TSH level was 4.09 ± 0.24 mIU/L. Out of 257 neonates, 4(1.55%) had congenital hypothyroidism

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Table 1: Patient baseline demographic and clinical characteristics.

Variables		n(%)
Age (Years)		3.47±0.57
TSH (mIU/L)		4.09±0.24
Maternal age	< 20 years	15(5.8)
	20-30 years	202(78.6)
	> 30 years	40(15.6)
Parity	0	42(16.3)
	1-3	108(42.0)
	4-6	77(30.0)
	> 6	30(11.7)
Gestation	37 weeks	23(8.9)
	38 weeks	141(4.9)
	39 weeks	58(22.6)
	40 weeks	35(13.6)
Education	Illiterate	146(56.8)
	Primary	73(28.4)
	Secondary	38(14.8)
Gender	Male	137(53.3)
	Female	120(46.7)
Occupation	Unemployed	229(89.1)
	Employed	28(10.9)
Neonatal TSH	≤ 10 mIU/L	242(94.16)
	10-19 mIU/L	11(4.28)
	≥ 20 mIU/L	4(1.55)

TSH-Thyroid-Stimulating Hormones

Discussion

Primary congenital hypothyroidism can be permanent or transient; maternal iodine deficiency, auto-immune thyroid disease, anti-thyroid disease, anti-thyroid drugs are common causes of transient hypothyroidism[14-16]. Maternal thyroid hormone helps brain development; however, from 20 weeks of gestation, the neonatal thyroid starts synthesis of TSH and T4 hormones independently, so after birth, there is a physiological rise in TSH, which remains for a few days[17,18]. The timing of thyroid hormone action is vital for brain development in the neonate during the post-natal period. Newborn screening is performed on all neonates between 2 to 5 days after birth[11]. Screening can be performed from whole blood or heel prick, or cord blood. We used heel prick to assess TSH level in our study, which is simple and easy to perform.

Despite differences in gestational age-dependent thyroid hormone physiology, the same cut-offs are used for preterm as far the term babies. Various

guidelines recommend several TSH cut-offs, but recently European guidelines recommend TSH ≥20 mIU/L to diagnose hypothyroidism[19-21]. We anticipate that these age-adjusted TSH cut-off levels facilitate standardization of screening TSH for congenital hypothyroidism. It will be helpful for neonatologists in clinical decision-making for the treatment of disease. We used the same cut-off range of TSH in our study as compared to other used higher values. At the same time, a multicenter trial kept the low cut-off level of TSH up to 10 mIU/ml[6, 22].

Most of the enrolled newborns (94.16%) had normal TSH levels, congenital hypothyroidism was observed in 1.55% cases. The incidence difference in congenital hypothyroidism with studies in a different region of the world was because of the sample size and methods used to measure TSH level. Our study showed comparatively high frequency of congenital hypothyroidism. It could be due to different cut-offs values of TSH, and screening timing is different in other studies. Some studies showed low incidence 1 in 3000-4000 worldwide[23].

In contrast, past local data in Pakistan showed the incidence of congenital hypothyroidism 1in 257,1in 445 and 1 in 1000[3,24,25]. A study conducted in a private tertiary care hospital found no single case of congenital hypothyroidism. The sex of the baby is important to risk factors in the development of congenital hypothyroidism. The female to male ratio was found to be 2:1, but our study showed a difference with this finding[26-29]. In our study, the female gender has had higher TSH levels. Therefore, there is possibly a higher incidence found in the female gender. There is no effect of gender on TSH level in our study, and this has similar findings as showed in Adele et al. study[30]. Congenital hypothyroidism can result in cognitive and neurodevelopment delays in newborns. Higher TSH levels were related to lower intelligence, as measured by cognitive score and impairment of psychological processes at 4 years. Hence, early diagnosis is necessary to prevent cognitive dysfunction improvement[31-34].

The findings of our study showed higher incidence, need screening program as routine post-natal care at the national level. Parent counselling should be done regarding the importance of screening role in optimal growth and development of the newborn. The study limitation included that serum T3 and T4 levels were not performed, and reevaluation was not done due to loss of follow-up. Due to the small sample size, we could not reach on definite conclusion. However, our study data has shown the importance of the need for screening programs development and further research in the diagnosis of the problem. It should be included in the post-natal period to treat newborns to prevent future sequelae associated with hypothyroidism.

Conclusion

The frequency of neonatal hypothyroidism found in this single-center study was 1.55%, prompting the need for initial screening and early diagnosis. Screening should be included in the post-natal period to prevent sequels associated with hypothyroidism for timely diagnosis and treatment of newborns. Neonatal screening for congenital hypothyroidism benefits newborns and their family and provides information about the infant's epidemiology, pathophysiology, diagnosis, and treatment.

Conflicts of Interest

The authors have declared that no competing interests exist.

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