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Original Research Article

Prospective Observational Evaluation of the Emerging Role of a Newborn Screening Program for Congenital Hypothyroidism

Satish Kumar[1], Mithilesh Kumar[2], Pawan Kumar Yadav[3]

[1]Assistant Professor, Department of Paediatrics, Jawaharlal Nehru Medical College and Hospital, Bhagalpur, Bihar, India

[2]Senior Resident, Department of Paediatrics, Jawaharlal Nehru Medical College and Hospital, Bhagalpur, Bihar, India

[3]Senior Resident, Department of Paediatrics, Jawaharlal Nehru Medical College and Hospital, Bhagalpur, Bihar, India

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Corresponding author: Dr. Mithilesh Kumar
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Abstract

Aim: The emerging role of a newborn screening program for congenital hypothyroidism: a prospective study.

Material and methods: This Prospective observational study was carried out in the Department of Paediatrics, Jawaharlal Nehru Medical College and Hospital, Bhagalpur, Bihar, India for 1 year. A total of 120 babies were enrolled, but 100 were an eligible candidate for the study period. The blood sample was taken in a sterile container under aseptic precautions, between 3-5 days of life to minimize the false positive high TSH values due to the physiological neonatal surge that elevates TSH level and causes T4, T3 changes in 1-2 days. In cases with a healthy newborn baby, sampling was done between 3-5 days.

Results: A total of 120 babies were enrolled, but 100 were an eligible candidate for the study period. Those, not eligible candidates received a blood transfusion, death within 3 days, left against medical advice (LAMA) or shifted to other hospitals and nonconsenting of parents for the study. Out of the delivered babies, 60 were born by lower section caesarian section and 40 were vaginally delivered and there were 36 mothers who were hypothyroid and were on medication. Numbers of term deliveries were 87 and preterm deliveries were 13, with 52 (52%) males and 48(48%) female babies. Of the total eligible neonates, 87 were term babies and 13 were preterm babies with more than 34 weeks (Table 1). Neonatal thyroid-stimulating hormone was estimated in all 90 neonates out of which 1 case were positive for CH, 9 cases had initially high values between 10-19 µIU/L which were later on repeat testing after two weeks were found to be in normal limits and rest all 1258 cases were normal (Table 2). From the 2positive cases of CH, one baby was of Downs's syndrome on 12.5 mcg of Eltroxin and one baby was positive of elderly primi mother on 25 mcg of medication and on regular follow up since last 5 months.

Conclusion: Timely diagnosis and treatment of CH are important in order to prevent psychomotor development disability &improve school progress. NBS is the need of the hour for early diagnosis of CH, which is simple, fast as well as cost-effective.

Keywords: screening, congenital hypothyroidism, newborn

Introduction

Primary congenital hypothyroidism (CH) affects ~1 in 2000 children born in the United Kingdom each year. It is estimated that 8% to 28% of children presenting clinically will develop severe intellectual disability, defined as an IQ <70 [1]. Newborn screening to identify those with CH enables timely T4 replacement therapy and potentially prevents or mitigates this disability [2], Newborn screening was introduced in the United Kingdom in 1981 and is currently based on whole-blood TSH concentrations measured in dried bloodspots collected 5 days postnatally [3]. (Secular increases in the proportion of babies with presumptive positive screening results. may reflect many factors, including increasing ethnic diversity; changes in maternal iodine status; and reduction over time in the lower limit of TSH threshold used to define a presumptive positive result, reflecting technological advances in laboratory measurement. Common symptoms include decreased activity and increased sleep, feeding difficulty, constipation, and prolonged jaundice while myxedematous facies, large fontanels, macroglossia, a distended abdomen with umbilical hernia and hypotonia are common signs. To assess the various causes of congenital hypothyroidism one should ascertain the site of defect, whether it is in the thyroid gland, thyroid regulatory system, due to deficient thyroid hormone receptor activity or due to inborn errors of the thyroid hormone synthesis. Most congenital hypothyroidism is caused by defects in the thyroid gland itself (primary hypothyroidism). Causes of primary congenital hypothyroidism can be broadly classified as the failure of the thyroid gland to develop normally (dysgenesis) or failure of a structurally normal thyroid gland to produce normal quantities of thyroid hormone (dyshormonogenesis). Thyroid dysgenesis which encompasses the spectrum of thyroid agenesis, hypoplasia, and ectopy—is the most common cause of congenital hypothyroidism, and its incidence (about 1:4000 infants) has not changed significantly over the last several decades The thyroid-stimulating hormone receptor (TSHR) and the transcription factors PAX8, NKX2–1, and FOXE1 are all expressed in the developing thyroid, and disruption of any of these genes can lead to failure of normal thyroid gland formation [4].

Congenital hypothyroidism may be permanent (thyroid aplasia, hypoplasia, ectopia or dyshormonogenesis) or transient (due to maternal blocking antibodies, iodine excess or deficiency, or some types of dyshormonogenesis [5]. Central hypothyroidism is caused by dysfunction of hypothalamic or pituitary control of the thyroid axis that leads to inadequate production and/or bioactivity of TSH. Congenital hypothyroidism of central origin is rare. Permanent CH required lifelong treatment and monitoring whereas, transient CH shows normal thyroid hormone production after the first few months. TSH screening is more sensitive for diagnosis, while T4 is more specific. This study is an attempt to find out the incidence of CH in our hospital, which is a tertiary level medical college in central India, where we are doing regular neonatal screening for CH.

Material and methods

This Prospective observational study was carried out in the Department of Paediatrics, Jawaharlal Nehru Medical College and Hospital, Bhagalpur, Bihar, India for 1 year. A total of 120 babies were enrolled, but 100 were an eligible candidate for the study period.

Inclusion criteria: All newborns with a gestational age of 34 weeks or more delivered in the hospital during the study period were included in the study.

Exclusion criteria: Preterm neonates with gestational age less than 34 weeks, blood transfusion prior to sampling, refusal of informed consent and outborn babies with

age more than 5 days were excluded from the study.

The blood sample was taken in a sterile container under aseptic precautions, between 3-5 days of life to minimize the false positive high TSH values due to the physiological neonatal surge that elevates TSH level and causes T4, T3 changes in 1-2 days. In cases with a healthy newborn baby, sampling was done between 3-5 days.

Detailed antenatal history, parity, medical history, thyroid status, and community were recorded on a predesigned proforma. Details of the baby were recorded on a separate proforma. TSH was estimated within 24 h by chemiluminescence Immunoassay (kit supplied by Roche E411). Newborn with TSH value more than 20µ IU/L were labeled as a case of congenital Hypothyroidism and whose values were between 10-20 µIU/L were followed up with repeat TSH level after weeks.

Interpretation of screening test: Venous TSH >20 mIU/L (serum units) is taken as the cut-off for postnatal screen samples after 48-72 hours of age is to be taken as positive newborn TSH between 10- 20 mIU/L were taken for a second TSH sample at 7 to 10 days of age.

Results

A total of 120 babies were enrolled, but 100 were an eligible candidate for the study period. Those, not eligible candidates received a blood transfusion, death within 3 days, left against medical advice (LAMA) or shifted to other hospitals and nonconsenting of parents for the study. Out of the delivered babies, 60 were born by lower section caesarian section and 40 were vaginally delivered and there were 36 mothers who were hypothyroid and were on medication.

Numbers of term deliveries were 87 and preterm deliveries were 13, with 52 (52%) males and 48(48%) female babies. Of the total eligible neonates, 87 were term babies and 13 were preterm babies with more than 34 weeks (Table 1). Neonatal thyroid-stimulating hormone was estimated in all 90 neonates out of which 1 cases were positive for CH, 9 cases had initially high values between 10-19 µIU/L which were later on repeat testing after two weeks were found to be in normal limits and rest all 1258 cases were normal (Table 2). From the 2 positive cases of CH, one baby was of Downs's syndrome on 12.5 mcg of Eltroxcin and one baby was positive of elderly primi mother on 25 mcg of medication and on regular follow up since last 5 months.

Table 1: Demographic profile from the study.

Variable	Number	Percentage
Mother's age (Years)		
≥18-25	53	53
26-30	36	36
>30	11	11
Sex		
Male	52	52
Female	48	48
Gestational age (Weeks)		
34-<37 weeks (Preterm)	13	13
≥37 weeks (Term)	87	87
Birth weight (Kg)		
<2.5 kg	29	29

≥2.5 kg and above	71	71
Mode of delivery		
LSCS	64	64
Normal	36	36
Maternal history of hypothyroidism	7	7

Table 2: TSH value among Neonates.

Variable	TSH value at 48-72hrs	TSH value after 14days
TSH < 10mIU/L	90	Normal
TSH 10-20mIU/L	9	Normal
TSH >20mIU/L	1	Higher

Discussion

Hypothyroidism results from a deficient production of thyroid hormone from a defect in the gland itself as a result of reduced thyroid-stimulating hormone. The disorder may be congenital or acquired. CH is commonly due to non-genetic cause, deficient thyroid embryogenesis leading to thyroid gland agenesis or dysgenesis while few cases are due to genetic reason or inborn error of metabolism while impaired thyroxin (T4) synthesis. Many mutations are also implicated in CH, namely that if in transcription factor PAX-8 and TTF-2 and in genetic coding for sodium iodide symporter, thyroid peroxidase and thyroglobulin are also responsible

For causing CH [6,7]. Deficiency of maternal iodine is another common contributing factor resulting in CH consequently leading to abnormal fetal depression. Transfer of excess of iodine to the fetus through placenta or secretion of iodine in breast milk may also result in CH among neonates [8,9].

As consanguinity is common in our country, CH although autosomal recessive in inheritance is expressed more commonly than in other developed countries.

Screening for CH by monitoring thyroid level at birth remains one of the most cost-effective tools in preventing mental retardation in these children. This neonatal screening is the norm in developed countries but unfortunately, such a nationwide program is non- existent in our country. There are two main screening ways for CH: primary T4 testing (with backup TSH) or primary thyroid-stimulating hormone (TSH) testing. In some states of USA, T4 estimation is done for screening while some US states screen T4 and TSH simultaneously [10] , which may not be cost-effective for developing countries like India. The primary TSH screen is more sensitive and specific for the diagnosis of primary CH compared to the T4 screen [11].

In India, the first Newborn Screening program for CH was at BJ Wadia Hospital Mumbai in 1982 using cord blood TSH and subsequently in 1984 using postnatal dried blood spot [12,13]. A study conducted in 2001 reported that only 5%-10% of children have been diagnosed with CH under a screening program in India [14]. Therefore, India warrants an effective, robust, and cost-effective screening program. A study conducted by ICMR which screened for inborn metabolic disorders in neonates from the years 2007 to 2012 from Delhi, Mumbai, Chennai, Hyderabad, and Kolkata reported an incidence for CH of 1:1130 newborns [15]. The most influential drawback of the present study is the small sample size. Large population-based studies are required to gauge and calculate the incidence of CH in our country. Therefore, India warrants a simple, effective, fast, and cost-effective screening program with adequate

infrastructure, space, and resources as a part of Newborn screening.

In India, an attempt has been made to screen neonates for thyroid abnormalities at various centers, but a national program does not exist at present. The method of screening is also not uniform. Various cut-offs for TSH levels have been used in different studies [16,18]., but it has been accepted to take cut-off of >20 μIU/mL for recall.

Due to the subtle manifestation of CH in the newborn period, it is often missed which results in delayed diagnosis, mental retardation and growth failure hence it is very important to implement a neonatal screening program.

Whilst taking into consideration the mode/type of deliveries the newborns delivered by elective Caesarean Section had significantly lower mean levels of cord blood TSH as compared to those delivered by vaginal delivery or emergency lower segment cesarean section. This difference can be explained on the basis of a surge in catecholamine secretion during the process of parturition and this can be more in asphyxiated newborns and in vaginally delivered newborns compared to those born by elective cesarean section [19,20]. In contrast, two studies have shown no difference in neonatal TSH levels according to the mode of delivery [21,22]. Babies who received active intervention in the form of resuscitation and LSCS for fetal distress were expected to have raised TSH levels as a response to the stress that they had endured due to the procedures. Thus raised TSH in these neonates has to be interpreted in that context.

The incidence of consanguinity is very common in India and varies from 1 % in the northern region to 30% in Karnataka [23]. Thus, the incidence of expression of autosomal recessive CH is raised in these geographic regions.

In our country implementation of the universal screening program is difficult due to the high number of non-institutional/home deliveries and early discharge of patients. A study conducted among the urban Delhi population in 2014 reported 53% home births [24]. But now the health statistics of our country have improved due to an increased number of institutional deliveries and the mortality rate has declined but now we have to think beyond this implement newborn screening (NBS) to prevent neuro disability.

Being diverse in all aspects, it is very difficult to launch a universal program of NBS. So, the government should prepare such a program that should be effective, rapid, cost-effective and improve coverage from the grass-root level in the present study, the overall incidence is 1:636 while some studies showed 1in 248 and 1 in 1700 [25,26]. This may be due to less sample size and geographic variation. The prevalence of CH was

1.57 per thousand live births. The male to female ratio in the present study was 1:1 while 1.2:1 was in Japan [27] in Bosnia [28] and 1.8:1 in Saudia Arabia [29]. However, some studies did not find any significant differences in mean TSH level according to sex [30,31]. Out of the two babies who were diagnosed CH both were male. The first one had Down's syndrome with cyanotic congenital heart disease (CHD) and second, it was of an elderly primi mother. At present both are under treatment with control.

Studies have reported that TSH levels increase with increasing gestational age however higher TSH levels in preterm than in terms have been reported. There is no statistical significance between low birth weight and normal weight babies with respect to theirs TSH values in the present study, but some studies have reported that low birth weight is related to high TSH [30].

Conclusion

Timely diagnosis and treatment of CH are important in order to prevent psychomotor development disability &improve school progress. NBS is the need of the hour for early diagnosis of CH, which is simple, fast as well as cost-effective.

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