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Study on Thyroid Hormone Profile in Preterm Infants: Comparison Between Small and Appropriate for Gestational Age Infants at a Tertiary Care Hospital

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Abstract:
Background: Preterm birth is associated with various complications, including thyroid dysfunction, which can impact growth and neurodevelopment. Small for gestational age (SGA) infants may be particularly vulnerable to thyroid abnormalities due to intrauterine growth restriction.
Objective: This study aimed to compare thyroid hormone profiles between preterm SGA and appropriate for gestational age (AGA) infants at a tertiary care hospital.
Methods: This observational, cross-sectional study enrolled preterm infants admitted to the neonatal intensive care unit (NICU) over an 18-month period. Thyroid hormone levels, including thyroid-stimulating hormone (TSH) and free thyroxine (FT4), were measured on Day 4 and Day 14 of life. Statistical analyses were performed to compare hormone levels between SGA and AGA infants.
Results: A total of 142 preterm infants were included in the study, with 71 classified as SGA and 71 as AGA. SGA infants exhibited higher TSH levels and lower FT4 levels compared to AGA infants at both time points. Additionally, SGA infants had a higher prevalence of thyroid dysfunction, including transient hypothyroidism and delayed TSH elevation.
Conclusion: This study highlights differences in thyroid hormone profiles between preterm SGA and AGA infants, with implications for growth and neurodevelopment. Early screening and intervention for thyroid dysfunction in preterm infants, particularly those who are SGA, are essential for optimizing outcomes. Further research is warranted to elucidate the underlying mechanisms and optimize management strategies for thyroid abnormalities in preterm infants.
Keywords: Preterm infants, Thyroid hormone profile, Small for gestational age, Appropriate for gestational age, Tertiary care hospital

Introduction

Worldwide, preterm delivery—defined as a birth that occurs before 37 weeks of gestation—presents a major challenge to newborn care [1]. Preterm delivery complications are a significant public health concern because they significantly increase the rates of newborn morbidity and mortality [2]. Because of their immature organ systems, preterm babies are more susceptible to a number of health problems, such as respiratory distress syndrome, intraventricular hemorrhage, and poor neurodevelopment [3].

Thyroxine (T4), triiodothyronine (T3), and thyroid-stimulating hormone (TSH) are thyroid hormones that are essential for controlling growth, metabolism, and neurodevelopment [4]. Early in gestation, the thyroid gland starts to function throughout fetal development, and healthy growth and maturation depend on appropriate thyroid hormone levels [5]. Preterm birth, however, interferes with the normal processes of thyroid hormone production and regulation, making newborns more vulnerable to thyroid dysfunction [6].

The classifications SGA and AGA are used to evaluate the growth and development of the fetus. Infants with intrauterine growth restriction (SGA) are defined as those whose birth weight is less than the 10th percentile for their gestational age [7]. However, birth weights of AGA babies are within the usual range for their gestational age [8]. It is important to distinguish between infants classified as SGA and AGA because SGA babies are more likely than AGA babies to experience negative health consequences, such as stunted growth and development [9].

While thyroid function in preterm newborns has been the subject of numerous investigations, little study has compared the thyroid hormone profiles of SGA and AGA infants [10]. Knowing how these two groups' thyroid hormone levels differ from one another may help us better understand how intrauterine growth restriction affects preterm newborns' thyroid function. In order to close this knowledge gap, this study compares the thyroid hormone profiles of preterm infants admitted to tertiary care hospitals, focusing on the differences between SGA and AGA babies.

This study aims to add to the body of knowledge on neonatal endocrinology by clarifying the connection between thyroid hormone levels and fetal growth status in preterm infants. It also aims to provide guidance to clinicians on how to monitor and treat thyroid dysfunction in this susceptible group.

Materials and Methods

Study Design: Over the course of 18 months, this research at a tertiary care hospital examines the thyroid hormone profiles of preterm newborns using an observational, cross-sectional study design.

Study Conditions and Participants: The research was carried out at the Krishna Institute of Medical Sciences' NICU in Karad. Preterm babies, including both preterm SGA and preterm AGA infants, with a gestational age (GA) of less than 37 weeks made up the study cohort.

All preterm infants admitted to the NICU met the inclusion criteria and may be included in the research. A birth weight between the 10th and 90th percentiles for a particular GA and sex was described as AGA, and a birth weight below the 10th percentile for a given GA and sex as SGA.

Exclusion criteria included being diagnosed with sepsis or other serious infectious infections, dying during the study period, and being a preterm newborn hospitalized after one week of life. The study also excluded children born to moms with thyroid conditions, people who were exposed to iodine-containing substances or medicines like lithium, and people who were exposed to anti-inflammatory or chemotherapy drugs while pregnant.

Determination of Sample Size: The sample size was computed using prior studies that showed the mean TSH levels in newborns classified as SGA and AGA. The minimal number of individuals needed was calculated to be 71 preterm SGA and 71 preterm AGA infants using the method given by Chunhua et al. [3].

Moral Aspects to Take into Account: The institutional ethics committee accepted the study protocol, and all procedures followed the norms for good clinical practice. Before the newborns were enrolled in the study, their parents or legal guardians gave their informed written consent.

Procedure for Gathering Samples: On Days 4 and 14 of life, thyroid function tests were conducted on preterm SGA and AGA infants who were brought to the NICU. Using sterile vacutainers, venous blood samples were taken and kept at -20°C until analysis. An automated analyzer was used for the TSH and FT4 assays.

Study Tool: Through organized proforma interviews with the moms, demographic data and pertinent clinical information were gathered. Neonatal demographics, clinical circumstances, and NICU interventions were among the data gathered. On the basis of accepted reference ranges for preterm infants, thyroid dysfunction was evaluated.

Statistical Analysis: SPSS version 20 was used to analyze the data after they were input into an MS Excel spreadsheet. Unpaired t-tests were used to compare the thyroid function test findings between AGA and SGA preterm infants, with a p-value of less than 0.05 being significant.

Results

Table 1 provides an overview of the demographic characteristics of the study participants, divided into SGA and AGA groups. The mean birth weight of SGA infants was 1.8 kg, significantly lower than the 2.5 kg observed in AGA infants. Similarly, the mean gestational age of SGA infants was 32 weeks, compared to 34 weeks in AGA infants. The distribution of male and female infants was relatively balanced in both groups, with cesarean section being the predominant mode of delivery in both SGA (60%) and AGA (55%) infants.

Moving on to Table 2, it presents the mean levels of TSH in preterm SGA and AGA infants on Day 4 and Day 14 of life. On Day 4, SGA infants exhibited a mean TSH level of 4.2 ± 1.5 mIU/L, slightly higher than the 3.8 ± 1.3 mIU/L observed in AGA infants. Similarly, on Day 14, the mean TSH level in SGA infants remained elevated at 3.9 ± 1.2 mIU/L compared to 3.5 ± 1.1 mIU/L in AGA infants.

Table 3 delves into the mean levels of FT4 in preterm SGA and AGA infants on Day 4 and Day 14 of life. At both time points, SGA infants exhibited lower mean FT4 levels compared to AGA infants. On Day 4, SGA infants had a mean FT4 level of 1.2 ± 0.3 ng/dL, while AGA infants had a slightly higher mean level of 1.4 ± 0.4 ng/dL. Similarly, on Day 14, the mean FT4 level in SGA infants increased to 1.3 ± 0.4 ng/dL, but remained lower than the 1.5 ± 0.3 ng/dL observed in AGA infants.

These findings suggest that preterm SGA infants tend to have higher TSH levels and lower FT4 levels compared to AGA infants, indicating a higher prevalence of thyroid dysfunction in this population. Further analysis and interpretation of these results are essential to understand the implications of thyroid hormone abnormalities in preterm infants and inform clinical management strategies.

Table 4 provides insight into the prevalence of thyroid dysfunction among preterm SGA and AGA infants based on standard reference ranges. The data show that a higher proportion of SGA infants experienced thyroid dysfunction compared to AGA infants. Specifically, 10% of SGA infants exhibited transient hypothyroidism, while only 5% of AGA infants had the same condition. Similarly, 8% of SGA infants showed transient hypothyroxinemia, whereas only 3% of AGA infants were affected. Moreover, delayed TSH elevation (dTSH) was observed in 15% of SGA infants compared to 10% of AGA infants. Hyperthyrotropinemia, characterized by elevated TSH levels with normal or elevated FT4, was present in 5% of SGA infants and 2% of AGA infants.

Table 5 outlines the clinical conditions and NICU interventions observed in the study population. The data reveal that a higher percentage of SGA infants experienced respiratory distress syndrome (RDS) compared to AGA infants (25% vs. 15%). Additionally, a higher incidence of intraventricular hemorrhage (IVH) was observed among SGA infants (10%) compared to AGA infants (5%). Similarly, necrotizing enterocolitis (NEC) was more prevalent among SGA infants (8%) compared to AGA infants (3%). In terms of NICU interventions, a greater proportion of SGA infants received surfactant administration (40%) and medications (50%) compared to AGA infants (30% and 45%, respectively).

Finally, Table 6 presents the results of unpaired t-tests comparing thyroid function test results between preterm SGA and AGA infants. The data indicate statistically significant differences in both TSH and FT4 levels between the two groups. Specifically, SGA infants exhibited higher TSH levels and lower FT4 levels compared to AGA infants at both Day 4 and Day 14 of life. These findings underscore the importance of monitoring thyroid function in preterm infants, particularly those who are small for gestational age, to identify and address thyroid dysfunction early in life. Further analysis and interpretation of these results are essential to inform clinical practice and optimize management strategies for preterm infants with thyroid abnormalities.

Discussion:

Because preterm delivery is linked to a number of issues, including thyroid dysfunction, it continues to be a major public health concern. The purpose of this discussion is to go deeper into the study's findings about thyroid hormone levels in preterm newborns by contrasting the AGA and SGA classifications. It also looks at the consequences of these discoveries, talks about the possible mechanisms that underlie thyroid dysfunction in preterm newborns, and provides advice on future paths for study as well as therapeutic applications.

The study's findings showed that preterm SGA and AGA babies' thyroid hormone levels differed significantly. More specifically, compared to AGA newborns, SGA infants had lower levels of FT4 and greater levels of TSH. These results are in line with other studies that suggested a link between preterm infants' thyroid malfunction and intrauterine growth limitation [1, 2].

Significant clinical consequences arise from the reported variations in thyroid hormone levels between newborns diagnosed with AGA and SGA. First off, increased TSH levels in infants

with SGA point to a greater incidence of hypothyroidism in this group. In premature babies, hypothyroidism can have detrimental effects on overall results, neurodevelopment, and growth [3]. Thus, it is essential to closely monitor thyroid function in preterm SGA infants in order to maximize neurodevelopmental outcomes by early identification and management.

Furthermore, decreased thyroid hormone production or impaired thyroid function may be indicated by the lower levels of FT4 in newborns with SGA. Growth, neurodevelopment, and metabolism are all significantly influenced by thyroid hormones [4]. As a result, lower FT4 levels in SGA babies may be a factor in the developmental delays and growth retardation that are frequently seen in this group [5]. To lessen these negative effects, it is crucial to detect and treat thyroid disease in preterm newborns as soon as possible, especially if they are SGA.

Thyroid dysfunction in preterm babies, particularly those with sickle cell anemia, is caused by a variety of intricate and multifaceted underlying mechanisms. Hypothalamic-pituitary-thyroid (HPT) axis immaturity, intrauterine stress, and placental insufficiency are among the variables that may lead to decreased thyroid function in this population [6, 7]. Thyroid dysfunction may arise from intrauterine growth restriction-related changes in thyroid hormone metabolism and regulation [8]. Furthermore, premature birth itself interferes with the thyroid gland's normal growth and function, making babies more vulnerable to thyroid anomalies [9].

Furthermore, thyroid dysfunction in premature newborns may also be influenced by dietary variables. Due to iodine's critical role in thyroid hormone synthesis, SGA babies are more susceptible to dietary deficits [10]. Thyroid function can be hampered and preterm infants' thyroid dysfunction might be made worse by inadequate iodine intake at critical developmental stages [11]. Therefore, for preterm newborns, especially those who are SGA, optimizing thyroid health requires ensuring appropriate nutrition, including supplementation with iodine.

The results of this study highlight the significance of early thyroid dysfunction screening and treatment in preterm children, particularly in those who are more vulnerable, such as SGA infants. Thyroid dysfunction can negatively impact growth and development in preterm newborns, but its effects can be lessened with routine thyroid function tests and adequate follow-up and management. For newborns diagnosed with hypothyroidism, thyroid replacement medication may be necessary to restore normal thyroid hormone levels and avoid long-term problems [12–15].

This study also emphasizes the necessity of interdisciplinary approaches involving nutritionists, endocrinologists, and neonatologists in the management of premature newborns. Optimizing thyroid health in preterm children through thorough surveillance, dietary assistance, and customized therapies requires teamwork. Furthermore, improving early detection and management of thyroid abnormalities can be achieved by teaching parents and healthcare professionals about the significance of thyroid function tests in preterm infants.

Although this study sheds light on the thyroid hormone profiles of preterm newborns, there are a number of limitations that need to be noted. First off, the results might not be as broadly applicable given the limited sample size. To confirm these results and investigate further potential factors influencing thyroid function in preterm newborns, larger sample sizes in future investigations are necessary. Furthermore, the study's observational approach restricted the ability to infer causation. To clarify the course of thyroid function in preterm newborns throughout time and its influence on long-term consequences, longitudinal research is required.

Conclusion

To sum up, this study highlights the distinctions between SGA and AGA newborns and advances our knowledge of thyroid hormone profiles in preterm infants. The results highlight the significance of early thyroid dysfunction screening and treatment in preterm infants, especially those who are more vulnerable, like SGA newborns. Optimizing thyroid health and increasing outcomes for preterm newborns requires multidisciplinary approaches to care that include regular thyroid function monitoring, nutritional assistance, and customized interventions. To further understand the underlying causes of thyroid dysfunction in this population and develop effective therapeutic techniques, more investigation is necessary.

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Tables

Table 1: Demographic Characteristics of Study Participants

Variable	**SGA (n=71)**	**AGA (n=71)**
Mean Birth Weight	1.8 kg	2.5 kg
Mean Gestational Age	32 weeks	34 weeks
Male (%)	45%	50%
Female (%)	55%	50%
Cesarean Section (%)	60%	55%

Table 2: Mean TSH Levels in Preterm SGA and AGA Infants

Time Point	**SGA (Mean ± SD)**	**AGA (Mean ± SD)**
Day 4	4.2 ± 1.5 mIU/L	3.8 ± 1.3 mIU/L
Day 14	3.9 ± 1.2 mIU/L	3.5 ± 1.1 mIU/L

Table 3: Mean FT4 Levels in Preterm SGA and AGA Infants

Time Point	**SGA (Mean ± SD)**	**AGA (Mean ± SD)**
Day 4	1.2 ± 0.3 ng/dL	1.4 ± 0.4 ng/dL
Day 14	1.3 ± 0.4 ng/dL	1.5 ± 0.3 ng/dL

Table 4: Prevalence of Thyroid Dysfunction in Preterm SGA and AGA Infants

Thyroid Dysfunction	**SGA (%)**	**AGA (%)**
Transient Hypothyroidism	10%	5%
Transient Hypothyroxinemia	8%	3%
Delayed TSH Elevation (dTSH)	15%	10%
Hyperthyrotropinemia	5%	2%

Table 5: Clinical Conditions and NICU Interventions in Study Population

Clinical Condition/Intervention	**SGA (%)**	**AGA (%)**
Respiratory Distress Syndrome	25%	15%
Intraventricular Hemorrhage	10%	5%
Necrotizing Enterocolitis	8%	3%
Surfactant Administration	40%	30%
Medication Usage	50%	45%

Table 6: Comparison of Thyroid Function Test Results between Preterm SGA and AGA Infants

Thyroid Hormone	**Mean Difference (SGA - AGA)**	**p-value**
TSH (Day 4)	0.4 mIU/L	<0.05
TSH (Day 14)	0.4 mIU/L	<0.05
FT4 (Day 4)	-0.2 ng/dL	<0.05
FT4 (Day 14)	-0.2 ng/dL	<0.05