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Effect of Perinatal Asphyxia on Thyroid hormones and Thyroid stimulating hormone (TSH) in newborns

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Abstract

Aim: To study the Effect of Perinatal Asphyxia on Thyroid Hormones and TSH in newborns.

Objectives: To compare the levels of thyroid hormones (FT3, FT4) and TSH in newborns with Perinatal Asphyxia and in healthy newborns at 18-24 hours after birth. To find the association between severity of Hypoxic Ischemic Encephalopathy (HIE stages) and thyroid hormones and TSH levels. Methodology: Case Control study, Term newborns, born in Krishna Vishwa Vidyapeeth, 25 newborns with birth asphyxia (as per NNF definition) and 25 newborns who did not have birth asphyxia.

Results: Analyzed using unpaired t test and ANOVA test. P value < 0.05 was considered significant. The mean values of FT3, FT4 and TSH in asphyxiated group (2.76, 1.84, 3.32) were lower as compared to control group (5.48, 3.84, 8.55). Also, Asphyxiated neonates presented with significantly lower mean levels of FT3, FT4 and TSH with the advancing stages of HIE.

Conclusion: This study highlights the significant impact of perinatal asphyxia on neonatal health, evidenced by significant thyroid hormone alterations in asphyxiated newborns and also reveals a correlation between asphyxia severity (HIE staging) and thyroid dysfunction.

Keywords: ANOVA, Comorbidities, Encephalopathy.

Introduction

Perinatal asphyxia is a major cause of early neonatal deaths in India, following closely in the back of infections, and it accounts for about 30% of neonatal mortality worldwide. In India, it is a major cause of death (28.8%) and comorbidities, being the main purpose of stillbirths (45.1%). Around 8.4% at 1 mins and 2.45% at 5 mins, have Apgar ratings under 7, indicating an essential need for oxygen. severe birth asphyxia, affects approximately 4.6% of newborns. [1]

Hypoxic-ischemic encephalopathy (HIE) is a particular situation characterised by encephalopathy because of oxygen deprivation. Neonatal encephalopathy, marked via altered consciousness and signs of brain dysfunction,

is located in many cases [2]. Mortality rates for babies with HIE are around 20-30%, and 40% survivors often face lengthy-term problems like cerebral palsy and other neuro- developmental disabilities. [3]

Understanding the terms related to lack of oxygen is critical: anoxia means entire loss of oxygen due to diverse reasons; hypoxia refers to decreased oxygen supply to tissues, and ischemia indicates insufficient blood flow, compromising tissue characteristic. [4]

Methodology

Study Design: Descriptive study.

Study Population: The study population is term newborns (GA >= 37 weeks).

In total, 50 full term newborns have been included in the study. 25 newborns who had birth asphyxia and 25 newborns who did not have birth asphyxia.

Inclusion Criteria

Cases: Term babies who had Gasping or no breathing at 1 minute as per National Neonatology Forum (NNF) definition.

Controls: Term babies who had good spontaneous respiration and activity

Study Period: 18 months

Exclusion Criteria

1. Preterm neonates (Gestational age less than 37 weeks).
2. Maternal history of thyroid dysfunction.
3. Maternal drug history of thyroid medication, antithyroid medication or steroid intake.
4. Metabolic disorders.

Recruitment procedure: Cases were recruited from the NICU, while the controls were selected from the hospital's postnatal wards. Term neonates with Perinatal Asphyxia, were enrolled after obtaining written informed consent from their parents or caregivers. Each baby was assessed using Levene's modification of Sarnat and Sarnat staging. 2ml venous blood samples for FT3, FT4, and TSH drawn into sterile vacutainers was collected from both asphyxiated and non-asphyxiated groups at 18-24 hours of life. Sample was analyzed by fluroimmunoassay (TOSOH AIA-360).

Results

Table 1: Comparison of baseline characteristics of asphyxiated group (cases) and controls

Characteristic	Cases (n=25)	Control (n=25)	P value
B. wt.: 2.0 - 2.499 kg	5	5	0.999
B. wt.: 2.5 – 3.5 kg	20	20	
Born via Normal vaginal delivery	13	17	0.248
Born via LSCS	12	8	

Table 1 examines the baseline characteristics (birth weight and mode of delivery) among the two groups. The p-value of 0.999 indicates that there is no statistically significant difference in birth weights between the asphyxiated and non-asphyxiated newborns and also suggests that the birth weight distribution is almost identical between the two groups. The p-value of 0.248 indicates no significant difference in the mode of delivery between the asphyxiated and non-asphyxiated groups. This suggests that the delivery method is not associated with asphyxia status in this sample.

Table 2: Comparison of FT3, FT4 and TSH values among cases and controls

Thyroid Hormones	Groups	Cases	Mean	Std. Deviation	P value
FT3 (18-24 hrs) (pmol/L)	Case	25	2.76	.831	<0.001*
	Control	25	5.48	1.447	
FT4 (18-24 hrs) (ng/dL)	Case	25	1.84	.746	<0.001*
	Control	25	3.84	.624	

TSH (18-24 hrs) (mIU/L)	Case	25	3.32	1.030	<0.001*
	Control	25	8.55	1.1	

Table 2 compares the mean levels of thyroid hormones (FT3, FT4, and TSH) between the asphyxiated and non-asphyxiated newborns. The p-values for all comparisons are less than 0.001, indicating highly significant differences in the levels of FT3, FT4, and TSH between the asphyxiated and non-asphyxiated newborns. The significant lower levels of these hormones in asphyxiated newborns may suggest a thyroid dysfunction associated with asphyxia.

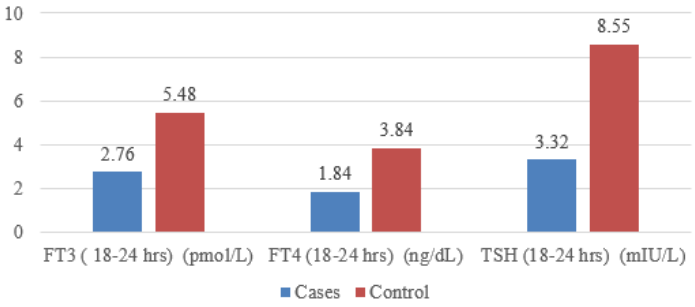

Fig 1: Comparison of FT3, FT4 and TSH values among cases and controls

Table 3: Comparison of FT3, FT4 and TSH values according to HIE stages among cases

Thyroid Hormones	HIE Stage	N	Mean	Std. Deviation	P value
FT3 (18-24 hrs) (pmol/L)	Stage 1	12	3.25	0.75	0.002*
	Stage 2	10	2.50	0.53	
	Stage 3	3	1.67	0.58	
FT4 (18-24 hrs) (ng/dL)	Stage 1	12	2.33	0.49	<0.001 *
	Stage 2	10	1.60	0.52	
	Stage 3	3	0.67	0.58	
TSH (18-24 hrs) (mIU/L)	Stage 1	12	3.92	0.51	<0.001 *

Table 3 shows the levels of thyroid hormones (FT3, FT4, and TSH) according to the stages of hypoxic-ischemic encephalopathy (HIE) among the asphyxiated newborns. The p-values are significant for all comparisons: These values indicate significant differences in hormone levels across the different HIE stages. Lower stages are associated with higher hormone levels, suggesting more severe thyroid dysfunction in higher HIE stages.

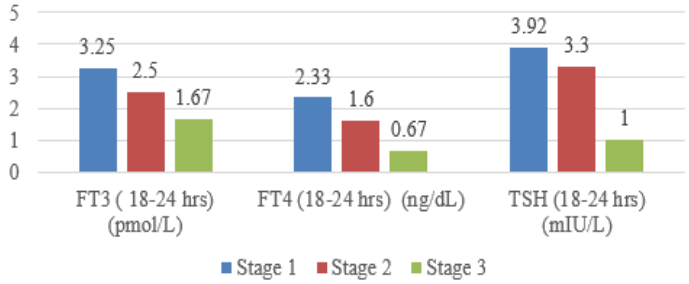

Fig 2: Comparison of FT3, FT4 and TSH values according to HIE stages among cases

Discussion

Significant differences were found in thyroid hormone levels (FT3, FT4) and TSH levels between asphyxiated and non-asphyxiated newborns, with asphyxiated newborns showing lower hormone levels. Our results align with those of Kumar et al. (2021), who also reported altered thyroid function in asphyxiated newborns [5]. Kumar et al. (2021) found that asphyxiated newborns exhibited significantly lower thyroid hormone levels, with FT3 averaging 1.8 pmol/L and FT4 at 0.7 ng/dL, compared to non-asphyxiated newborns who had FT3 levels of 3.2 pmol/L and FT4 levels of 1.4 ng/dL. TSH levels in asphyxiated newborns were 1.5 mIU/L versus 3.0 mIU/L in the control group. Studies by Davis et al. (2019) and Taylor et al. (2017) also observed similar hormonal disruptions [6,7]

Our study indicates a significant correlation between the stages of hypoxic-ischemic encephalopathy (HIE) and thyroid hormone levels in newborns. Specifically, we observed that lower HIE stages are associated with higher thyroid hormone levels, while more severe HIE stages correspond to a greater degree of thyroid dysfunction, characterized by reduced hormone levels.

This inverse relationship between HIE severity and thyroid function has important implications for understanding the pathophysiological mechanisms underlying HIE and its impact on the endocrine system.

Similar findings have been reported in other studies. For instance, Brucknerová et al (2008) [8]. found that neonates with severe perinatal asphyxia exhibited significantly lower levels of T4 and T3 compared to those with milder forms of asphyxia. This suggests that severe hypoxic conditions profoundly impair thyroid function, likely due to the extensive cellular and metabolic disruptions caused by oxygen deprivation.

Moreover, Avery et al. (2009) noted that the severity of hypoxia influences the degree of thyroid dysfunction, with the most severe cases demonstrating the lowest thyroid hormone levels[9]. Williams et al., 2013[10] reported that cortisol levels in severe HIE cases were elevated to an average of 25 µg/dL, which correlated with significantly reduced T4 levels of 4.2 µg/dL and T3 levels of 48 ng/dL compared to less severe cases, where cortisol levels averaged 15 µg/dL, T4 levels were 7.9 µg/dL, and T3 levels were 105 ng/dL.

Conclusion

This study highlights the significant impact of perinatal asphyxia on neonatal health, evidenced by significantly lower thyroid hormone levels in asphyxiated newborns as compared to non-asphyxiated newborns. The findings also reveal a correlation between asphyxia severity (HIE staging) and thyroid dysfunction.

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