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Serum Electrolyte and Lipid Profile among Patients with Hypothyroidism: A Descriptive Cross-Sectional Study

Bishesh Sah,[1] Madhav Khanal,[2] Asmita Pokharel,[2] Pragya Malla,[3] Subhash Lal Karn,[4] Bishal Sah,[5] Suraksha Sapkota[1]

[1]Department of Biochemistry, Nepalgunj Medical College and Teaching Hospital, Kohalpur, Banke, Nepal, [2]Department of Biochemistry, Nepal Medical College and Teaching Hospital, Kathmandu, Nepal, [3]Department of Biochemistry, Kist Medical College and Teaching Hospital, Lalitpur, Nepal, [4]Department of Microbiology, Nepalgunj Medical College and Teaching Hospital, Kohalpur, Banke, Nepal, [5]Department of Anatomy, National Medical College and Teaching Hospital, Birgunj, Parsa, Nepal.

ABSTRACT

Introduction: Hypothyroidism is a clinical status resulting from a deficiency of thyroid hormones or, more rarely, from their impaired activity at the tissue level. This study aimed to determine the serum sodium, potassium, and lipid profiles among patients with hypothyroidism in a tertiary care centre.

Methods: A descriptive cross-sectional study was conducted in a tertiary care centre from 01 December 2019 to 30 November 2020. The study enrolled patients attending the Medicine Outpatient Department and diagnosed with hypothyroidism. Ethical approval was obtained from the Institutional Review Committee. Convenience sampling method was used.

Results: Among 120 patients in the study group, 89 (74.17%) and 31 (25.83%) were further diagnosed with subclinical hypothyroidism and overt hypothyroidism, respectively. Eighty-two (68.33%) had high TG level and a majority of the participants 56 (46.67%) were in the age group of 51-60 years. Five (4.17%) patients had low sodium and 4 (3.33%) had low potassium levels.

Conclusions: The findings of this study are similar to the findings published in previous articles done in the past.

Keywords: *hypothyroidism, lipid profile, serum electrolytes.*

INTRODUCTION

About 300 million people worldwide are affected by thyroid dysfunction.[1] The prevalence of thyroid dysfunction in Nepal ranges from 17% to 30.87%.[2–4] About 0.2% of deaths in Nepal are caused by endocrine problems, with iodine deficiency being the primary cause.[5]

Hypothyroidism is a clinical status resulting from a deficiency of thyroid hormones or, more rarely, from impaired activity at the tissue level.[6] Subclinical hypothyroidism (SCH), is more common than Overt Hypothyroidism (OHY).[7] SCH may progress into OHY.[8] Thyroid hormones regulate various metabolic functions, viz., regulation of lipids, carbohydrates, proteins, electrolytes and minerals metabolism.[9]

There is a paucity of data on establishing the impact of thyroid hormones on serum electrolytes and lipids in central part of Nepal. So, this study was undertaken to study the serum electrolytes and lipid profile among patients with hypothyroidism in a tertiary care centre.

Correspondence:

Dr Bishesh Sah
Department of Biochemistry, Nepalgunj Medical College, Kohalpur, Banke, Nepal
Email: bisheshsah123@gmail.com
Phone: +977-9849824363.

METHODS

A descriptive cross-sectional study was conducted in the Department of Biochemistry, Nepal Medical College and Teaching Hospital (NMCTH), Jorpati, Kathmandu, Nepal from 01 December 2019 to 30 November 2020. The patients attending the Medicine Outpatient Department of NMCTH and diagnosed with hypothyroidism were enrolled in the study. Ethical approval was obtained from the Institutional Review Committee (IRC) (Reference

number: 34-076/077). Verbal and written consents were taken from all the participants before enrolling for the study. The participants included were from the age group 18 to 60 years and of both sexes. Patients with hepatic disorders, diabetes mellitus, cardiovascular disorders, pregnant women, and lipid-lowering drugs were excluded from the study. Convenience sampling method was used.

The sample size was calculated using the following formula:

The sample size was calculated using the following formula:

$n = Z^2 \times p \times q / e^2$

$= 1.96^2 \times 0.125 \times 0.875 / (0.06)^2$

$= 117$

Where,

n= minimum required sample size

Z= 1.96 at 95% of Confidence Interval (CI)

p= prevalence of hypothyroidism taken from previous study, 12.5%[4]

q= 1-p

e= margin of error, 6%

After overnight fasting (8-12 hours), 3 ml of venous blood was drawn in a gel tube and subjected to centrifugation at 3500 revolutions per minute (rpm) for 10 minutes to separate the serum. Serum free triiodothyronine (FT3), free thyroxine (FT4) and Thyroid stimulating hormone (TSH) levels were estimated using the chemiluminescence method, using the fully automated Enhanced chemiluminescent immuno analyzer (ECIQ), by Ortho Diagnostics, Johnson and Johnson, USA, The Serum lipid profile was evaluated by the dry chemistry method using the VITROS 250 fully automated analyzer from Johnson and Johnson, USA, whereas, serum sodium and potassium levels were estimated by the ion selective electrode method by using the EX-DS Jokoh electrolyte analyzer, Japan.

The data was entered in MS Excel 2007 and analyzed using the IBM SPSS Statistics, version 16.0. Binary data were expressed as n (%) and continuous data as Mean±SD.

RESULTS

Among 120 patients in the study group, 89 (74.17%) and 31 (25.83%) were further diagnosed with subclinical hypothyroidism (SCH) and overt hypothyroidism (OHY), respectively. The mean age of hypothyroid patients was 46.76±11.54 years (Table 1).

Table 1. Baseline characteristics of the study participants (n= 120).

Variables	Total hypo-thyoid patiens Mean±SD	SCH Mean±SD	OHY Mean±SD
Thyroid stimulating hormone (TSH) (µIU/ml)	13.78±18.65	8.50±5.89	29.49±30.73
Free triiodothyronine (FT4) (ng/dl)	0.96±0.32	1.09±0.24	0.57±0.16
Free triiodothyronine (FT3) (pg/ml)	3.49±0.71	3.69±0.60	2.91±0.73
Sodium (Na+) (mEq/L)	138.21±2.81	138.52±2.92	137.36±2.27
Potassium (K+) (mEq/L)	4.18±0.41	4.19±0.44	4.12±0.32
Total cholesterol (TC) (mg/dl)	190.24±45.92	181.10±42.28	216.94±46.02
Triglycerides (TG) (mg/dl)	203.38±91.23	190.56±94.84	238.35±70.69
Low-density lipoprotein cholesterol (LDL-c) (mg/dl)	106.94±42.57	101.74±39.62	122.59±46.46
High-density lipoprotein cholesterol (HDL-c) (mg/dl)	36.62±10.27	36.79±11.04	36.00±7.83
Very low-density lipoprotein cholesterol (VLDL-c) (mg/dl)	40.76±18.23	38.22±18.96	47.67±14.13

Among 120 patients, a majority of the participants 56 (46.67%) were in the age group of 51-60 years (Table 2).

Table 2. Distribution of study group according to age interval (n= 120)

Age group (years)	n (%)
18-30	13 (10.83)
31-40	21 (17.50)
41-50	30 (25)
51-60	56 (46.67)
Gender	
Male	36 (30%)
Female	84 (70%)

Among 120 patients, 82 (68.33%) had high TG level (Table 3).

Table 3. Serum electrolyte and lipid profile among patients with hypothyroidism (n= 120).

Biochemical parameters		SCH n (%)	OHY n (%)	Total participants n (%)
Na^+ (mEq/l)	<134 (Low)	3 (3.37)	2 (6.45)	5 (4.17)
	134-146 (Normal)	86 (96.63)	29 (93.55)	115 (95.83)
K^+ (mEq/l)	<3.6 (low)	3 (3.37)	1 (3.22)	4 (3.33)
	3.6-5 (Normal)	83 (93.26)	30 (96.77)	113 (94.17)
	>5 (High)	3 (3.37)	0	3 (2.50)
TC (mg/dl)	<200 (Normal)	63 (70.79)	10 (32.25)	73 (60.83)
	≥200 (High)	26 (29.21)	21 (67.74)	47 (39.17)
TG (mg/dl)	<150 (Normal)	33 (37.08)	5 (16.13)	38 (31.67)
	≥150 (High)	56 (62.92)	26 (83.87)	82 (68.33)
LDL-c (mg/dl)	<130 (Normal)	71 (79.77)	21 (67.74)	92 (76.67)
	≥130 (High)	18 (20.22)	10 (32.25)	28 (23.33)
VLDL-c (mg/dl)	<15 (Low)	2 (2.25)	0	2 (1.67)
	15-36 (Normal)	47 (52.81)	6 (19.35)	53 (44.17)
	>36 (High)	40 (44.94)	25 (80.64)	65 (54.17)
HDL-c (mg/dl)	<30 (Low)	32 (35.95)	8 (25.81)	40 (33.33)
	30-70 (Normal)	57 (64.04)	23 (74.19)	80 (66.67)

DISCUSSION

In the present study, about 70% of the patients who had hypothyroidism were female, with a 2.33:1 female: male ratio, indicating that hypothyroidism was more common in females compared to males, which is in concordance with the study by Regmi et al. (2010).[10] The increased prevalence of hypothyroidism in females might be due to estrogen, which is considered an antagonist of the hormones FT3 and FT4 as it competes with FT3 and FT4 for binding sites on receptor proteins.[11]

Among the study participants (SCH and OHY), the majority of participants belongs to the age group 51-60 years (46.7%), while the minority was noted in the age group 18-32 (10.8%) which was in accordance with the study done by Mahanta et al (2017)[12] but is discordant with the study by Mahato et al (2015)[4] wherein they reported that SCH (23.1%) and OHY (14.7%) were the maximum in the age group of less than 15 years. In our study, the majority of cases were of SCH (89) and a smaller number of OHY (31) cases, which is contradicted

by the study done by Khatri P et al (2021)[13] where they reported a higher number of OHY cases.

In the present study, five and three hypothyroid participants have decreased serum Na+ and K+ levels respectively. Our study was in accordance with the study by Murgod et al. (2012).[9] where they reported decreased serum Na+ and K+. However, in contrast to the present study, Bharti et al. (2015)[14] reported a significant increase in serum K+ in both SCH and OHY. The possible mechanism of hyponatremia in hypothyroidism could be due to enhanced renal water retention mediated by vasopressin[15] as well as suppressed plasma renin and plasma aldosterone activity, which leads to Na+ excretion, causing hyponatremia.[16]

In the present study, 47 and 28 hypothyroid participants have increased serum TC and LDL-c, Our results were similar to that of Khatri P et al (2021)[13] Murgod et al. (2012)[9] and Regmi et al. (2010).[10] Hypercholesterolemia and increased LDL-c in hypothyroidism could be due to decreased fractional clearance of LDL-c by a reduced number of LDL receptors in the liver.[17]

In the present study 82 hypothyroid participants have increased TG. These results were similar to the study done by Khatri P et al (2021)[13], Regmi et al. (2010)[10] and Murgod et al. (2012)[9] where they also reported increased serum TG in hypothyroidism. Hypertriglyceridemia in these hypothyroid cases could be due to delayed clearance of chylomicron remnant and intermediate-density lipoprotein from circulation due to reduced activity of lipoprotein lipase. These lipoprotein remnants are taken up by macrophages in the arterial walls to produce foam cells, which may lead to the development of atherosclerotic coronary artery disease in hypothyroidism.[18–20]

In the present study 40 hypothyroid participants have decreased HDL-c. Our results are similar to the studies done by Khatri P et al. (2021).[13] In contrast, Murgod et al. (2012)[9] reported significantly increased HDL-c in OHY and a positive correlation with TSH. The reduction in HDL levels in hypothyroid individuals is caused by increased activity of hepatic lipase and Cholesteryl ester transport protein.[13] In our study, we measured LDL-C using Friedwald's formula, but it would have been better if direct estimation had been done. The sample size was small. A study on the general population and involving a larger sample size will help elucidate the problem more clearly.

CONCLUSIONS

The findings of this study are similar to the findings published in previous articles done in the past. Regular evaluation of serum electrolytes and lipid profiles among hypothyroid patients which would be beneficial in managing and treating the disorder and prevent further complications related to lipid and electrolyte disorders.

Conflict of Interest: None.

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