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# A study on the impact of Serum Selenium and Glutathione peroxidase in hypothyroidism patients.

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## Abstract

The role of selenium in thyroid metabolism has been confirmed. Se as a selenoprotein participates in antioxidant defense mechanism within cellular system and thus preventing from chronic diseases. Hence this study is intended to evaluate the association of serum selenium with serum lipid concentrations among the hypothyroid patients. Fifty hypothyroid patients aged between 25-65 and 50 healthy age matched controls who attended Sri Jayadeva Cardiology and Diabetology institute were included in this study. Their clinical history was obtained. A fasting blood sample was drawn and the biochemical parameters - blood sugar, lipid profile, thyroid profile, Se and GPX were estimated. Statistical analysis was done by Student's t test and Pearson correlation. A significant increase was observed in TSH and a significant decrease was observed in T3, GPX and HDL in hypothyroid patients when compared to the healthy subjects. Selenium levels were found to be in the lower reference range in the hypothyroid patients as well as healthy individuals. A positive correlation was found between Se and GPX. The significant decrease in the levels of GPX among the hypothyroid patients suggest that Selenium as an important component of antioxidant enzyme. It is also observed that the increase in TSH attempts to stimulate the hormone synthesis in thyroid.

**Keywords** Selenium (Se), Glutathione peroxidase (GPX), hypothyroid, cardiovascular risk.

## INTRODUCTION

The understanding of the essential role of Selenium in thyroid hormone synthesis, metabolism and action as well as for normal cell function increased substantially during the past decades [1, 2, 3]. The thyroid gland is among the human tissues with the highest Se content per mass unit similar to other endocrine organs and the brain. Selenoproteins involved in cellular antioxidant defense systems and redox control such as glutathione peroxidase (GPX) and thioredoxin reductase (TxnRd) family are involved in the protection of thyroid gland from excess hydrogen peroxide and reactive oxygen species, produced by the follicles during biosynthesis of thyroid hormones. In addition 3 enzymes involved in activation and inactivation of thyroid hormones namely deiodinases are also selenoproteins. Se dependent enzymes modulate the immune system not only within the thyroid but also within other tissues [4].

## MATERIALS AND METHODS

The study involved 50 hypothyroid patients aged between 25-65 and 50 healthy age matched controls who attended Sri Jayadeva Cardiology and Diabetology institute, Bangalore. A detailed clinical history was obtained. A fasting blood sample was drawn and the following biochemical parameters were estimated.

Cholesterol – CHOD PAP method; Triglyceride – Glycerol 3 phosphate oxidase method; HDL – sulphated acyclodextrin and a dextran method; LDL – polyvinyl sulphate method

Thyroid status $T_3$, $T_4$ and TSH was quantitated using ELISA technique. The antioxidant enzyme, glutathione peroxidase was measured by enzyme linked immune assay and Selenium was estimated by graphite furnace atomic absorption spectrophotometer.

**Statistical analysis:** Statistical analysis was performed using SPSS version 16. Student's t test was used to compare between groups. Relationship among variables was analyzed using Pearson correlation.

**Inclusion criteria:** subclinical and clinical hypothyroid

**Exclusion criteria:** patients receiving medications such as thyroid hormones, iodine and Se containing agents.

**Ethical clearance:** The study was approved by the institutional ethical committee. The purpose of the study was explained to the participants and an informed consent was obtained.

## RESULT AND DISCUSSION

A significant decrease in $T_3$ and a significant increase in TSH were observed in thyroid disease when compared to the healthy subjects. The increase in TSH is an attempt to stimulate more thyroid hormone production. The $T_4$ level was found to be normal in thyroid group when compared to control. These levels confirm that the study groups have hypothyroidism. The comparison of thyroid profile among the study groups were depicted in Table 1.

**Table.1:** Comparison of Thyroid function test among groups

| S.N | Parameters | Healthy (n=50) | Thyroid disease (n=50) | P value |
|---|---|---|---|---|
| 1. | T3 | 2.06±0.45 | 1.44±0.32 | 0.000 |
| 2. | T4 | 115.7±24 | 118.9±47.37 | 0.677 |
| 3. | TSH | 2.48±0.84 | 6.78±3.1 | 0.000 |

Table 2 shows the comparison of selenium levels and GPX activity between the control and thyroid disease. There is a significant decrease in selenium levels among hypothyroid (TD), and healthy patients. A significant decrease

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decrease in GPX activity was observed in thyroid disease patients when compared to normal. It is well known that selenium levels in blood and tissues are very much influenced by dietary intake. The recorded reference level of selenium in blood is 60 -150 ng/ml. A study among the New Zealanders reveals that on Se supplementation not only increase the plasma Se level but also increases GPX activity [5].

**Table.2:** Comparison of selenium and GPX between the groups

| S.N | Parameters | Healthy (n=50) | Thyroid disease (n=50) | P value |
|---|---|---|---|---|
| 1. | Selenium | 67.63±14.6 | 59.8±13.15 | 0.006 |
| 2. | GPX | 271.26±57.04 | 235.08±54.6 | 0.002 |

The prevalence of lower reference value of selenium compared to normal needs further study of it with relation to the other functional selenoproteins, GPX and deiodinase. Selenium is an important component of the antioxidant enzyme GPX which prevents the adverse effects of free radicals. The decrease in GPX activity in part may be ascribed to the fact that it is a selenoenzyme like deiodinase 1 which is involved in transformation of $T_4$ to $T_3$. As body stores of Se are limited, deiodination is given preference over GPX in selenium supply. Other selenoprotein P mediate the transfer of selenium between two enzymes. Thus selenium deficit might be the cause of reduced GPX activity [6].

**Table.3:** Comparison of FBS, Lipid profile among groups

| S.N | Parameters | Healthy (n=50) | Thyroid disease (n=50) | P value |
|---|---|---|---|---|
| 1. | FBS | 98.8 ± 12.6 | 114.7±35.8 | 0.004 |
| 2. | Cholesterol | 169.46±23.9 | 204 ± 52.8 | 0.000 |
| 3. | TGL | 118.0±36.6 | 152.7±55.37 | 0.000 |
| 4. | HDL | 45.0 ± 7.8 | 40.1±1.87 | 0.000 |
| 5. | LDL | 94.4±19.9 | 133.3 ± 49.3 | 0.000 |
| 6. | VLDL | 26.1±13.2 | 29.7 ± 11.39 | 0.154 |

Table 3 showed significant increase in TGL in thyroid patients compared to healthy. This may be due to decreased LPL activity. Significant increase LDL and cholesterol in thyroid patients may due to decrease in LDL receptors. Both LPL and LDL receptor require the active thyroid hormone T3. Decrease T3 seen in thyroid patients in this study is due to decreased Se which results in decrease activity of deiodinase that converts T4 to T3 and low GPX which might increase $H_2o_2$ which is an inhibitor of thyroxin synthesis.

**Table.4:** Comparison of Atherogenic risk parameters among thyroid and healthy pateints

| S.N | Parameters | Healthy (n=50) | Thyroid disease (n=50) | p value | Low risk |
|---|---|---|---|---|---|
| 1 | TGL/HDL | 2.7 ± 0.98 | 4.09 ± 1.87* | 0.000 | 1.57 - 3.5 |
| 2 | LDL/HDL | 2.1 ± 0.60 | 3.59 ± 2.04* | 0.000 | 3.3 - 4.4 |
| 3 | AIP | 0.10±0.1 | 0.22±0.17* | 0.000 | <0.11 |

Table 4: Both TGL/HDL ratio 4 .09 ± 1.87 and LDL/HDL ratio 3.59 ± 2.04 reveals a significant increase in hypothyroid patients compared to healthy control group and suggest that they are under low atherogenic risk level. But AIP which is a better predictor of atherogenic risk clearly reveals that the thyroid patients have high risk for cardiovascular disease.

**Table.5:** Correlation between Selenium and other Biochemical parameters in thyroid disease (Pearson Correlation)

| PARAMETERS | r- value |
|---|---|
| FBS | 0.140 |
| CHOL | -0.329* |
| HDL | -0.072 |
| LDL | -0.331* |
| TGL | -0.186 |
| TGL/HDL | -0.102 |
| LDL/HDL | -0.151 |
| AIP | -0.133 |
| VLDL | -0.176 |
| T3 | 0.053 |
| T4 | 0.052 |
| TSH | -0.017 |
| GPX | 0.480** |

**denotes significant difference at 0.01 level;
*denotes significant difference at 0.05 level

**Table.6:** Correlation between GPX and other Biochemical parameters in Thyroid Disease (Pearson Correlation)

| PARAMETERS | r-value |
|---|---|
| FBS | -0.084 |
| CHOL | -0.122 |
| HDL | 0.086 |
| LDL | -0.112 |
| TGL | 0.057 |
| TGL/HDL | -0.010 |
| LDL/HDL | -0.176 |
| AIP | -0.004 |
| VLDL | -0.011 |
| T3 | 0.100 |
| T4 | 0.001 |
| TSH | 0.150 |
| Se | 0.480** |

**denotes significant difference at 0.01 level

Table 5 shows the correlation of selenium with thyroid profile, Fasting blood sugar (FBS), GPX and lipid profile. Statistically significant positive correlation was found between selenium and GPX (P<0.001). Cholesterol and LDL revealed a significant negative correlation to Se. However selenium showed a negative correlation with HDL, TGL,

TGL/HDL ratio, LDL/HDL ratio AIP and VLDL, FBS and thyroid parameters T3, T4 showed a positive correlation with Se but TSH showed a negative correlation. The low selenium level in thyroid patients impairs the conversion of T4 to T3 due to decreased activity deiodinase which requires selenium. Hence in thyroid patients T3 is low and TSH is increased compared to healthy group. Increased lipid profile with the decrease in selenium implies that the antioxidant defense mechanism is impaired in thyroid that leads to other defective metabolism. A positive correlation of Se and FBS, cholesterol, TGL, LDL were reported in normal elderly Taiwaneese [7].The change in thyroid status may contribute the reversal of the findings among thyroid patients. The $T_3$ and $T_4$ reveal a positive correlation between selenium while TSH is negatively correlated.

Table 6 presents the correlation between GPX and other biochemical parameters. Statistically significant correlation was found between Selenium and GPX. This can be attributed to the fact that GPX is a selenoprotein hence Se deficit leads to decrease in GPX activity. This raises an intrigury possibility that GPX may provide additional mechanism for controlling thyroid hormone synthesis through regulating the concentration of hydrogen peroxide [8]. The negative correlation between GPX and TGL, LDL and other atherogenic index parameters implies that the antioxidant defense system is impaired. This study is supportive of the previous study that the total cholesterol, LDL and GPX were the positive predictors of oxidative stress while Se is a negative predictor among the health individuals [9].

**Table.7:** Correlation between AIP and other Biochemical parameters in Thyroid Disease (Pearson Correlation)

| PARAMETERS | r- value |
|---|---|
| **FBS** | 0.110 |
| **CHOL** | 0.209 |
| **HDL** | -0.660** |
| **LDL** | 0.172 |
| **TGL** | 0.824** |
| **TGL/HDL** | 0.989** |
| **LDL/HDL** | 0.444** |
| **VLDL** | 0.792** |
| **T3** | -0.092 |
| **T4** | -0.079 |
| **TSH** | -0.135 |
| **Se** | -0.133 |
| **GPX** | -0.004 |

**denotes significant difference at 0.01 level

Table 7 Correlation of AIP with HDL reveals a significant negative correlation while TGL reveals a significant positive correlation. Atherogenic index parameters also show significant positive correlation with AIP. This correlation study emphasized the negative correlation between thyroid status and AIP. The negative correlation of Se and GPX with AIP suggests that oxidative stress also contribute to atherogenicity.

## CONCLUSION

The Significant decreased levels of GPX observed in hypothyroid patients suggest that Se being an important component of antioxidant enzyme. GPX plays an adverse role on free dyslipidemia. Normal T4 levels with decreased T3 may be due to the reduced rate of conversion by deiodinase which is also a selenoprotein. Increase in TSH is attempt to stimulate hormone synthesis in thyroid.

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