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Short Communication

Influence of Thyroxine on Blood Parameters and Liver Enzymes in Adult Male and Female Rats

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ABSTRACT

This study investigated and compared the influence of exogenous thyroxine with restricted feeding and sex on the blood parameters and liver enzymes in adult male and female Wistar rats. Twelve adult wistar rats (six males and females) were given thyroxine in drinking water at dosage of 50mg/100ml of water/pair/day with restricted pellet feed of 16gm/pair/day for 28 days. Another set of twelve adult Wistars (six males and six females) received 100ml of water/pair/day for 28 days. The control group of twelve adult rats (six females and six males) received feed and water ad-libitum for the same period of 28days. Thyroxine with restricted feeding significantly increased ($P < 0.05$) haemoglobin level, the alanine aminotransferase values as well as pyruvate aminotransferase values in Wistar rats of both sexes while it significantly reduced the values of white blood cells in both sexes of wistar rats and has no significant effect on values of blood glucose of both sexes. Restricted feeding without thyroxine treatment significantly decreased the values of haemoglobin, white blood cells and red blood cells in wistar rats of both sexes while it significantly increased the levels of alanine aminotransferase and pyruvate aminotransferase ($P < 0.05$). The results suggest that exogenous thyroxine with restricted feed has significant effects ($P < 0.05$) on blood parameters and liver enzymes in wistar rats of both sexes.

Key-words: Exogenous thyroxine, restricted feed, Wistar rat, blood parameters, Liver enzymes.

INTRODUCTION

Thyroid hormones have widespread effects on the body and are involved in daily metabolic functions of

most of the body's tissues and organs (Mountcastle, 1980). It has been reported by Loeb (1991) that hyperthyroidism whether endogenously or exogenously induced, results in negative nitrogen and calcium balance, loss of body protein stores and loss of body fat.

It has also been reported by Iossa et al (1997) that hypothyroid rats developed obesity when fed a high fat diet because of their inability to attain fat balance. Data have shown that euthyroid rats (Mollica et al, 1991) and hyperthyroid rats (Rothwell et al, 1985) avoid excess fat deposition when fed high fat diet. This is because thyroid hormones cause division of fat fuels between oxidation and storage (Iossa et al, 1997) hence play a role in the achievement of fat balance and in body weight maintenance.

Thyroid hormones have been reported to cause a rise in metabolic rate in mammals (Rosenberg and Satomsky, 1965). It has been reported by Hapon et al (2003) that thyroid hormones influence all major metabolic pathways by causing an increase in the basal energy expenditure through actions on protein, carbohydrate and lipid metabolism. With specific regard to liver lipid metabolism, thyroid hormones stimulate fatty acid and cholesterol synthesis (Ness and

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Chambers 2000) ,increase mobilization of plasma cholesterol and triglycerides (Ness et al ,1998) and stimulate fatty acid and cholesterol degradation (Kremser et al, 1991). The role of thyroid hormones in lipid metabolism supported their potential use as agents to promote weight loss (Grasselli et al, 2008).

The above findings differ from the findings of Adeniyi et al (1990) who found that exogenous thyroxine increased the body weight of the treated rats significantly. The results of these earlier studies with different results have not made it possible for one to state clearly the influence that thyroid hormones have on body weights in rats.

Data from animal studies on the influence that thyroid hormones exert on the process of glucose transport are also not consistent. It has been shown by Levin (1969), Adeniyi and Olowookorun (1987) that rats pretreated with thyroxine have increased intestinal absorption of glucose but this finding is not in agreement with the views of other workers who observed a decrease in glucose transfer in the intestine of hyperthyroid mice and rats. (Matty and Seshadri, 1965).

These earlier studies with different results have not made it possible to state clearly the effects of thyroid hormones on glucose absorption in rats. It has been demonstrated by Majewska et al (1983) and Malik and Hodgson (2002) that repeated administration of thyroxine will increase the values of liver enzymes – aspartate aminotransferase and alanine aminotransferase.

The aim of the present study is to provide more information on the effects of thyroxine administration on blood glucose, blood parameters as well as on liver enzymes (ALT and AST) values in normal adult Wistar rats of both sexes when compared with rats on restricted feeding with exogenous thyroxine and rats on restricted feeding without thyroxine treatment.

MATERIALS AND METHODS

Thirty six adult Wistar strain rats of both sexes (18 females and 18 males) weighing between 150gm and 200gm were obtained from our departmental animal house. These animals were separated according to sex and were housed in cages in pairs (18 cages in all). All the rats were fed *ad-libitum* and with adequate water for 7 days.

Blood Sampling and Analysis

On the 8th day, the rats were all weighed, blood from the cut-tips of the tails were obtained for glucose values for 6 males and 6 females. The values obtained were recorded as normal or basal blood glucose values. The

rats were then anaesthetized with ether, after which heart blood was collected in EDTA bottles for further haematological and biochemical analysis. The rats were opened up and the stomach, liver, kidneys, spleen, testes and heart were excised from the animals, cleared of adherent tissues and weighed.

Thereafter, the remaining 24 rats were divided into the following two groups:

Test group- 6 males and 6 females (on thyroxine treatment and restricted feed). These rats (6 males and 6 females) were given constant dose of thyroxine (50mg)(Forley Generics Ltd, UK) in 100ml water/pair/day for 28 days. The thyroxine tablets were properly ground and administered through the drinking water. The rats were given 16gms of pellets feed/pair/day for the duration(28 days).

Control group- 6 males and 6 females (on restricted feed but no thyroxine treatment). These rats (6 males and 6 females) were not given thyroxine but were on restricted feed regime of 16gms of rat pellets/pair/day for 28days. They were given water 100ml/pair/day for the duration.

Haematological Analysis: RBC and WBC counts were carried out using the improved Neubauer type haemocytometer. Haematocrit was done using the microhaematocrit centrifuge and reader. Haemoglobin concentration was determined by the cyanmethaemoglobin method using the colorimeter.

Enzyme Analysis: Serum pyruvate aminotransferase and serum alanine aminotransferase values were determined using kits from Randox Laboratories, Ltd, UK.

On the 35th day, the test and control rats were treated as in normal rats on the 8th day. The rats were weighed, blood taken from the cut-tip of the tails for blood glucose determination and the rats were anaesthetized with ether, after which heart blood was collected in EDTA bottles for haematological and biochemical analysis.

The rats were opened up and the stomach, liver, kidneys, spleen, testis and heart were excised from the animals, cleared of adherent tissues and weighed.

Statistical Analysis: Was carried out using the student's t-test. The significance of difference was accepted at (P <0.05.) Data are presented as mean standard deviation of mean (m+S.D)

RESULTS

Effect of thyroxine on blood glucose: There was no significant change in blood glucose level of thyroxine

and non-thyroxine treated rats given restricted feed when compared with the controls as shown in Table 1.

Effects of thyroxine on blood parameters:-

Administration of thyroxine at 50mg/100ml/ pair/day for 28days significantly affected ($p<0.05$) the packed cell volume, haemoglobin contents, red blood cells and white blood cells when compared with the controls (Table 1).

On Haemoglobin: Administration of exogenous thyroxine with restricted feed significantly increased the haemoglobin values in both treated male and female rats ($p<0.05$) while in the non-thyroxine treated but restricted feed male and female rats, there was a significant decrease when compared with the controls ($P<0.05$)

On White blood cells- Administration of exogenous thyroxine at 50mg/100ml of water/ pair/ day for 28 days with restricted feed significantly decreased the white blood cells values in both male and female rats when compared with the controls.

The values in non-thyroxine treated and restricted feed rats reduced significantly ($P<0.05$) when compared with the control.

On Packed cell volume:- Administration of exogenous thyroxine increases the packed cell volume significantly ($P<0.05$) in treated female rats while it was significantly reduced ($P<0.05$) in treated male rats. The PCV in non-thyroxine treated but restricted feed rats of both sexes reduced significantly on comparing with the controls as observed in table 1 ($p<0.05$)

On Alanine aminotransferase: Administration of thyroxine at 50mg/100ml of water / pair / day for 28days significantly increased ($P< 0.05$) the alanine aminotransferase values in both male and female rats. The values also increased significantly in non-thyroxine treated and restricted feed rats of both sexes as can be observed in table 1 ($P<0.05$)

On Pyruvate aminotransferase: Administration of exogenous thyroxine at 50mg/100ml of water/pair/day significantly increased the values of pyruvate aminotransferase in both male and female rats. Also, the values increased in both sexes of rats in non-thyroxine treated and restricted feed group on comparing with the controls as could be observed in table 1 ($P<0.05$).

DISCUSSION

The present study indicates that thyroxine is able to cause changes in plasma glucose values, haemoglobin content, white blood cells count, alanine and pyruvate aminotransferases values in male and female rats.

Administration of low doses of thyroid hormones have been reported to increase the protein synthesis and induce body growth, Itoh et al (1989) and are also known to regulate insulin-like growth factor- (IGF-1) expression directly as well as by co-operation with endogenous growth hormone. The role of thyroid hormones in mammalian growth is well established (Kohrle et al, 1987).

Table 1:

Glucose, PCV, hemoglobin, red and white cell counts, Alanine aminotransferase and Pyruvate aminotransferase I blood of control and thyroxine treated rats. All values are expressed as mean \pm SEM of six rats in each group

Groups	Blood Glucose (mg/dl)	Packed cell Volume(%)	Haemoglobin (gm/dl)	Red blood cell($10^6/\text{mm}^3$)	WBC ($10^3/\text{mm}^3$)	ALT (U/L)	AST (U/L)
1 Grp AM	3.17 \pm 0.71	47.00 \pm 2.10	14.57 \pm 0.24	5.20 \pm 0.13	5.42 \pm .63	12.12 \pm 2.71	10.23 \pm 1.60
2 Grp AF	3.40 \pm 0.53	43.83 \pm 2.14	14.22 \pm 0.19	4.95 \pm 0.12	4.62 \pm 1.10	10.83 \pm 3.54	10.19 \pm 1.49
3 Grp BM	3.12 \pm 0.49	44.17 \pm 4.30*	14.85 \pm 1.00*	5.18 \pm 0.20*	5.30 \pm 0.88*	25.17 \pm 6.21*	28.33 \pm 2.28*
4 Grp BF	3.73 \pm 0.46	48.00 \pm 7.54*	15.43 \pm 1.38*	5.18 \pm 0.94*	4.48 \pm 0.10*	26.50 \pm 5.50*	28.12 \pm 0.68*
5 Grp CM	3.72 \pm 0.44	37.50 \pm 4.23*	13.65 \pm .43*	4.22 \pm 0.71*	3.82 \pm 0.55*	18.67 \pm 6.38*	15.79 \pm 1.83*
6 Grp CF	3.12 \pm 0.49	31.00 \pm 5.37*	13.02 \pm 0.62*	3.32 \pm 1.01*	4.05 \pm 1.02*	18.50 \pm 4.14*	18.24 \pm 7.73*

Grp AM--- Normal group(male) –Ad libitum water and feed;

Grp BM ---Thyroxine and restricted feed group (male);

Grp CM--- Non-thyroxine and restricted feed group (male);

* ----- ($P< 0.05$)

Grp AF ---Normal group(female)–Ad libitum water and feed

Grp BF ---Thyroxine and restricted feed group (female)

Grp CF ---Non-thyroxine and restricted feed group (female)

The non- significant change in blood glucose levels observed during this study in thyroxine treated rats could have developed either due to an increased insulin level under the influence of hyperglycemia as a result of lipolysis or due to direct stimulation of endocrine pancreas by increased thyroxine levels or both. Previous experiments have reported significant increase in plasma insulin levels in hyperthyroid pigeons and rats. (John and George, 1985; Kohrle et al, 1987).

In this current study, administration of thyroxine caused a significant decrease in packed cell volume values in males while it caused significant increase in females. This may necessitate further investigation.

The current study also revealed that there is increase in the levels of both aspartate aminotransferase and alanine aminotransferase and these values are statistically significant ($P < 0.05$).

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