Journal of Rawalpindi Medical College (JRMC); 2016;20(2):147-149

Original Article

The Effect of Hypothyroidism on the Body Weight of Adult Albino Wistar Rats

Nida Qasim Hayat[1], Shahnila Nadir[2], Mah Jabeen Muneera [3]

1. Department of Anatomy, University of Health Sciences Lahore; 2. Department of Anatomy, Women Medical College, Abbottabad; 3. Department of Anatomy, King Edward Medical University, Lahore.

Abstract

Background: To study the alteration in the body weight of adult albino rats in hypothyroid state.

Methods: In this experimental animal study, change in the body weight of adult albino wistar rats was measured after they were made hypothyroid. Twenty adult albino wistar rats with average weight of 130-150 gms were randomly assigned into two groups. Group A served as control and Group B served as experimental group. The rats in group A were kept as control and given normal food and water ad libitum whereas Group B were administered Methimazole 0.02% for 22 days in drinking water. Body weight was recorded at the beginning and on alternate days.

Results: MMI treatment produced significant influence on the body weight of the animals. Significant difference was observed in the initial and the final body weight of the control and the experimental group of animals, p<0.01.

Conclusion: Hypothyroidism caused increase in the body weight of the experimental albino rats but decreased as compared to previous experimental studies.

Key Words: Hypothyroidism, Body weight, Wistar rats, Methimazole.

Introduction

Thyroid hormones have a strong impact on the metabolism, cardiovascular system, nervous system, lipid profile, expenditure of energy and body weight regulating basal and total energy consumption.[1-4] Thyroid disorders are linked with respiratory distress syndrome, transient tachypnea, sepsis, and apnoea.[2,9] Weight gain and loss had been associated with apparent hypothyroidism and hyperthyroidism respectively.[2,3,19] It incidence is increased in women and elderly.[4] Patients may express dyslipidaemia, mood alteration, cognitive deficit, cardiac dysfunction, osteoporosis, fractures and most importantly weight gain.[4,6] In hypothyroidism unexplained weight gain with decreased intake of food and loss of appetite among men was observed.[7] Other findings included skin changes particularly dermis breakage, functional alterations, dryness and increased exfoliation.[18] It compromised quality of life resulting in stress and depression.[5] However, hypothyroidism did not interfere with the energy intake and absorption of food.[8] Maternal hypothyroidism had been known to cause an increased risk of neonatal intensive care treatment but this relationship needs more study and insight.[9] Thyroidectomy results in significant decrease in the number and weight of the individual fetuses and decreased body weights of fetal organ. There existed an association between maternal hypothyroidism and thyroid hormone deficiency of the conceptus before the fetal thyroid functions.[12]

Brown adipose tissue (BAT) had recently regained attention from researchers in biomedical sciences.[10] It is an important thermogenic tissue that maintains a constant body core temperature. [10, 22] BAT is thought to be absent in humans since many decades but new researches revealed its presence in humans as well.[10] It played an important role in sensitivity of insulin in both rodents and humans.[10] There are two varieties of adipocytes; brown and white. White adipocytes contains a single large lipoid droplet and little mitochondria whereas in brown adipocytes, there are multiple small lipid droplets packed with abundant mitochondria.[10] BAT is abundantly present between the scapulae and more depots are present along the great vessels and in the retroperitoneum.[10] Thyroid hormones are important regulators of development and function of BAT.[11] Hypothyroidism produces several changes in thermogenically active state of BAT.[22] This capability increased the thermogenic capacity in the BAT of hypothyroid albino rats which led to decreased mobilization of tissue lipids. [22] In a previous study hypothyroidism was produced in experimental animals by giving them 0.05% propylthiouracil in drinking water.[13] Weight loss or decreased growth could be attributed to somatomedin activity.[13] Subclinical hypothyroidism at a single time was not associated with weight change as compared with euthyroidism.[14] Overall patients lost weight in hypothyroidism[14]. The data does not support the view that subclinical hypothyroidism caused a significant impact on the weight change in the elderly.[14]

Hypothyroidism had a restraining effect on the hyperglycemic state and the elevated serum T_4 level as well as deteriorated antioxidant defence system present in diabetes mellitus.[15] Body weight was decreased in diabetic and hypothyroid diabetic rats.[15] The identification, prevention and treatment of individuals who are at risk of obesity is an important issue of current times.[16] It can be done by research on the altered thyroid function which could result in weight gain.[16] It is documented that humans gained weight in hypothyroidism but the difference in human and animal studies showed that there is another mechanism for energy dissipation.[8] The presence of BAT in rodents could be correlated to the possible mechanism of decreased weight gained in rats when compared to humans.[8] BAT mechanism is responsible for energy activation which resulted in decreased weight gain in hypothyroid rats.[8]

Material and Methods

This experimental study was carried out in the research laboratory of University of Health Sciences, Lahore. Twenty male Albino rats, 6-8 weeks old, weighing between 130-150 grams were procured from the National Institute of Health, Islamabad. All the animals were examined thoroughly for general health status and weighed before the commencement of the experiment. The rats were housed under controlled conditions of temperature 22 ± 0.5°C, humidity 50 ± 10%, 12 hours light/dark cycle. Animals were fed on rat chow, tap water ad libitum and were acclimatized for a period of one week. Body weight was recorded at the beginning and on alternate days. Health condition of all animals was noted during the investigation.Twenty male Albino rats were divided into two groups of 10 each; Group A served as control whereas Group B was used as an experimental group. Animals were made hypothyroid by giving them 0.02% w/v Methimazole (MMI) for three weeks; one full feeding bottle was consumed daily.[7] Fresh solution of MMI was prepared daily.[23] Control group received distilled water as placebo. On day 22nd; the experimental animals were weighed and euthanized in CO_2 and chloroform chamber. Each animal was taken out of cage by holding its tail and placed in a plastic container containing cotton ball soaked in chloroform. Blood samples for determination of thyroid hormone concentrations in the serum were collected. 6 ml of blood was taken in 10 ml disposable syringe by cardiac puncture. Total serum T_3, T_4 and TSH concentrations were quantitatively determined by enzyme immunoassay.p-value < 0.01 was considered as statistically significant.

Results

MMI treatment strongly affected body weight of the animals. Significant difference was observed in the initial and the final body weight of the control and the experimental group of animals, p<0.01. The mean body weight of animals from group A was 140.90±1.66g at the beginning of the experiment and 274.30±4.71g at the end of the experiment; the mean gain of weight was, therefore, 133.40±3.169g (Table 1). Whereas, the mean body weight of group B at the start was 140.80±1.75g and it was 199.70±4.57g toward the end of the experiment, thereby mean weight gain in the group was 58.90±3.10g (Table 1-3).

Table1: Comparison of the initial and final mean body weight (g) in group A

Parameter	Initial Mean ± S.D (n=10)	Final Mean ± S.D (n=10)	p-value
Body weight(g)	140.90±1.66	274.30±4.71	<0.01*

*p value < 0.05 is statistically significant

Table2: Comparison of the initial and final mean body weight (g) in group B.

Parameter	Initial Mean ± S.D (n=10)	Final Mean ± S.D (n=10)	p-value
Body weight(g)	140.80±1.75	199.70±4.57	<0.01*

*p value < 0.05 is statistically significant

Table3: Comparison of the mean body weight gain (g) in groups A & B at the end of the experiment

Parameter	Group A Mean ± S.D (n=10)	Group B Mean ± S.D (n=10)	p-value
Body weight gain(g)	133.40±3.169	58.90±3.10	<0.01*

*p value < 0.05 is statistically significant

Discussion

Present study indicates that MMI treated rats gained less body weight than animals from the control group, which are in accord with those previously reported.[20-22] Burstein et al (2013) proved that the weight was markedly decreased from the normal rats in infant and immature hypothyroid rats.[13] There was hardly any difference in quantity of ingested food and water consumed between the control and the experimental groups. We can accordingly rule out the possibility of MMI producing its effect on the body weight gain in experimental animals through the elements of food or water. Thyroid hormones are known to play an important role in homeothermy; hypothyroid state, presumably induces several alternate mechanisms in

BAT metabolism, characteristic of an active thermogenic state in response to deficiency of thermogenesis induced by hypothyroidism like the study of Mory et al., 1981.[22] The same mechanism presumably explains reduced weight gain of the experimental animals in our investigations. Fox et al (2008), conducted a study on humans and documented that moderate increase in concentrations of TSH was associated with weight gain unlike the current study.[3]
It was assumed by Mory *et al.*, 1981 that BAT metabolism was the mechanism for energy dissipation responsible for the reduction of body weight gain in hypothyroid rats. Therefore, the difference in weight gain in hypothyroidism that exists between rodents and humans is due to the fact that functionally active BAT is present only in rodents but not in adult humans and is the only organ in mammals whose function is to produce heat.[22]

Conclusion

Clinical and histopathological researchers explore the anatomy and physiology of human tissues. The researchers are intrigued in normal structure and functioning of animals used for experimental purposes and procedures. The assumption that humans are the same as rodents is not true and there may be changes in responses and anatomical variations between different organs and functions. In the previous studies, it was evidenced that there was weight gain in patients with hypothyroidism which is not the case with the present experiment with adult albino rats which showed that there was moderate increase in the weight of rats after being made hypothyroid.

References

1. Trexler ET, Smith-Ryan AE, Norton LE. Metabolic adaptation to weight loss: implications for the athlete. JISSN. 2014; 11(7): 1-7.
2. Roef G, Lapauw B, Goemaere S. Body composition and metabolic parameters are associated with variation in thyroid hormone levels among euthyroid men. European Journal of Endocrinology 2013; 1169:835-41
3. Fox CS, Pencina MJ, D' Agostino RB. Relations of thyroid function to body weight. Cross sectional and longitudinal observations. Arch Intern Med. 2008; 168(6): 587-92.
4. Biondi B and Leonard W. Combination treatment with T_4 and T_3:Personalized replacement therapy in hypothyroidism?J Clin Endocrinol Metab 2012;97:2256- 71.
5. Kelderman-Bolk N, Visser TJ, Tijssen JP, Berghout A. Quality of life with primary hypothyroidism related to BMI. Eur J Endocrinol. 2015; 173: 507-15.
6. Warner A, Rahman A, Solsjo P, Gottschling K. Inappropriate heat dissipation ignites brown fat thermogenesis in mice with a mutant thyroid hormone receptor α 1. PNAS. 2013; 110(40): 16241- 46.
7. Milosevic M, Korac A, Davidovic V. Methimazole-induced hypothyroidism in rats: Effects on body weight and histological characteristics of thyroid gland. Jugoslov Med Biochem 2004; 23(2):143-47.
8. Curico S,Lopes AM, Ribeiro MO, Francoso A Jr. Development of compensatory thermogenesis in response to overfeeding in hypothyroid rats. Endocrinology 1999;3438-43.
9. Mannisto T, Mendola P, Reddy U, Laughon SK. Neonatal outcomes and birth weight in pregnancies complicated by maternal thyroid disease. AJE 2013;178 (5):731-40.
10. Betz MJ, Enerback S. Human brown adipose tissue: what we have learned so far. Diabetes. 2015; 64: 2352-60.
11. Laahesmaa M, Orava J, Schalin-Jantti C. Hyperthyroidism increases brown fat metabolism in humans. J Clin Endo Metab 2013; 99(1):1-7.
12. Escobar GM, Pastor R, Obregon MJ. Effects of maternal hypothyroidism on the weight and thyroid hormone content of rat embryonic tissues before and after onset of fetal thyroid function. Endocrinol 1985;117(5):1890-1900.
13. Burstein PJ, Draznin B, Johnson CJ.Effect of hypothyroidism on growth, serum growth hormone, the growth hormone-dependent somatomedin, insulin –like growth factor, and its carrier protein in rats. Endocrinol 1979;104(4):1107-11.
14. Garin MC, Arnold AM, Lee JS, Tracy RP. Subclinical hypothyroidism, weight change and body composition in the elderly: the cardiovascular health study. J Clin Endocrinol Metab. 2014; 99(4): 1220-26.
15. Ahmed OM, Gabar MA, Ali TM. Impacts of the coexistence of diabetes and hypothyroidism on body weight gain, leptin and various metabolic aspects in albino rats. J Diabetes Complications. 2012; 26(6): 491-500.
16. Krotkiewski M. Thyroid hormones in the pathogenesis and treatment of obesity. Eur J Pharmacol. 2002; 440(2-3): 85-98.
17. Le Grow AB, Fielding DC, Pressley TA. Stimulation of Na, K-ATPase by hypothyroidism in the thyroid gland. JEndocrinol 1999; 222: 59-64.
18. Strus K, Yashchenko A, Smolkova O. Influence of maternal experimental hypothyroidism on quantitative-qualitative indicator of rat progeny skin mast cells. Adv Biosci Biotechnol 2013;4:840-45.
19. Milionis A, Milionis C. Correlation between body mass index and thyroid function in euthyroid individuals in Greece. ISRN biomarkers. 2013; 1-7.
20. Bhargava HN, Ramarao P, Gulati A. Effect of methimazole-induced hypothyroidism on multiple opioid receptors in rat brain regions. Pharmacology 1988;37(6):356-64.
21. Kimura T and Furudate S. Pituitary GH and prolactin deficiency and testis enlargement in hypothyroid rats caused by goitrogen methimazole. Exp Anim 1996;45(4):369-75.
22. Mory G, Ricquier D, Pesquies P. Effects of hypothyroidism on the brown adipose tissue of rats : Comparison with the effects of adaptation to cold. J Endocr 1981; 91: 515-24.
23. Hayat NQ, Tahir M, Munir B. Effect of methimazole- induced hypothyroidism on histological characteristics of parotid gland of albino rat. JAMC. 2010; 22(3): 22-27.