Olaleye S.B, Ajisafe, B. O, Balogun,E.A. and Soladoye, A.O (1998): Effect of Propranolol on the intestinal transport of glucose in thyroidectomised and thyroxine-treated rats. Bios...

Article · December 1998

CITATIONS
0

READS
18

4 authors, including:

Samuel Olaleye
University of Ibadan
105 PUBLICATIONS **998** CITATIONS
SEE PROFILE

Ayodele Soladoye
Bowen University
81 PUBLICATIONS **483** CITATIONS
SEE PROFILE

Bioscience Research Communications
Vol. 10, No. 4, December 31, 1998
Printed in Nigeria

0795-8072/98 $3.00 + 0.00
Klobex Academic Publishers

BRC 9839/10407

THE EFFECT OF PROPRANOLOL ON THE INTESTINAL TRANSPORT OF GLUCOSE IN THYROIDECTOMISED AND THYROXINE-TREATED RATS.

S. B. Olaleye[1], B. O. Ajisafe[2], E. A. Balogun[2] and A. O. Soladoye[2]

[1]Department of Physiology, University of Ibadan, Ibadan, Nigeria.

[2]Department of Physiology & Biochemistry, University of Ilorin, Ilorin, Nigeria.

(Received May 27, 1998)

ABSTRACT: The effect of propranolol on the transport of glucose in thyroidectomised and thyroxine-treated rats was studied using the everted sac method in the small intestine. Twenty-four male albino rats weighing between 123 - 224g were divided into three groups of eight rats each. Group A served as control (C); Group B thyroidectomised (Tx) and Group C rats were given 6 - 8 µg/100g body weight/day of thyroxine for thirty-five days. Four rats in each of the three groups were treated with normal saline prior to incubation while the remaining four rats were treated with propranolol (0.05%).

Propranolol significantly ($P < 0.05$) increased mucosal glucose trabsfer and gut glucose uptake in the control (56.6% and 22.84% respectively). It also caused a greater transport in thyroid-deficient animals than in hyperthyroid animals. The results suggest that thyroidectomy significantly ($P < 0.05$) increased mucosal glucose transfer and gut glucose uptake (54.72% and 15.3% respectively) while chronic thyroxine treatment had no significant effect ($P < 0.05$). Also, there is a reduced beta-adrenergic response of the intestine to glucose absorption in thyroid deficiency.

Key Words: Glucose transport; Beta-Blockers; Propranolol; Thyroxine; Thyroid gland.

INTRODUCTION

The thyroid hormones have been shown to have significant effects on a number of systems in the body such as cardiovascular (Levin, 1969), haemopoietic (Adeniyi and Olowookorun, 1988), respiratory (Ganon, 1987) among others. Deficiency of thyroid hormones results in cretinism in the young and myxoedema in adults which are characterised by reduced basal metabolic rate, cold intolerance, decreased red cell volume, decreased gastrointestinal motility resulting in constipation, etc.

Thyroid hormones also influence glucose membrane transport and metabolism. This is probably through the effect of the hormones on oxygen consumption and hence basal metabolic rate (Rosenburg and Batomsky, 1965).

However, information from animal studies on the influence of thyroid hormones on the process of sugar (glucose) transport vary with species. Whereas Pfleger *et al.* (1958) reported that guinea pigs given thyroxine treatment had normal glucose transfer, Levin (1969) later showed that rats similarly treated had increased glucose absorption.

Recently, Adeniyi and Olowookorun (1987) observed increased mucosal and serosal transfer of glucose and its metabolism in thyroxine-treated rats while Ajise (1992) also observed a high blood sugar in thyroxine treated rats. There is still a dearth of information on the mechanism of the relationship between the thyroid hormones and intestinal glucose transport. This study was undertaken to further clarify the effect of thyroid hormones on intestinal glucose transport and the mechanism of such effect by studying the role of the β-adrernergic receptors in the transport process.

MATERIALS AND METHODS

Twenty-four male albino rats weighing between 123 - 224g obtained from the Animal House of the Department of Biochemistry, University of Ilorin, were used. They were given water and feed *ad libitum*. The animals were divided into 3 groups of 8 animals each. Each of the groups was further subdivided into 2 groups of 4 animals. One of the subgroups was treated with normal saline while the other subgroup was treated with propranolol.

Thyroxine tablets (A. H. Cox and Co. Ltd., Barnstaple, England), propranolol tablet (Elcee Pharmaceuticals, England) were the main drugs used. All other chemicals used were of high quality analytical grade.

The animals were grouped as follows:

A_1 - Control

A_2 - Control rats treated with propranolol (C + Pr).

B_1 - Thyroidectomised rats (Tx).

B_2 - Thyroidectomised, propranolol treated rats (Tx + Pr).

C_1 - Thyroxine treated rats (T_4).

C_2 - Thyroxine and propranolol treated rats (T_4 + Pr).

Group B animals were thyroidectomised while the other groups were sham operated. After the surgical operations, the animals were weighed twice weekly for 5 weeks and thyroxine (6 - 8 µg/100g body wt/day) was administered using a stomach tube (Group C) for thirty-five days. After this, glucose absorption studies were carried out using the everted sac technique of Wilson and Wiseman (1954). For groups A_1, B_1 and C_1, each 10cm long sac was filled with 1 ml Krebs solution, it was then incubated in a Petri dish containing 20 ml of Krebs solution for 30 minutes at 37°C in a shaker bath. For groups A_2, B_2 and C_2, each sac was filled with 1 ml Krebs solution and incubated in a beaker containing 20 ml of 0.05% propranolol in Krebs solution for 30 minutes at 37°C in a shaker bath. The method of Adeniyi and Olowookorun (1987) was used to determine the glucose transport (gut glucose uptake is the difference between the mucosal and the serosal glucose transfer) while the glucose oxidase method (Trinder, 1969) was used for the estimation of glucose.

All data were subjected to Student's 't' test (Steele and Torrie, 1980).

RESULTS

The results of mucosal glucose transfer (MGT), serosal glucose transfer (SGT) and gut glucose uptake (GGU) in normal, thyroidectomised and thyroxine-treated rats are shown in Table 1, while those of propranolol-treated animals are shown in Table 2.

When compared with control, the mucosal glucose transfer in thyroidectomised rats was significantly ($P < 0.05$) higher while that of the thyroxine-treated rats was not significantly different ($P < 0.05$). In Table 2, propranolol significantly increased ($P < 0.05$) the mucosal glucose trabsfer (56.6%), gut glucose uptake (22.84%) and serosal glucose uptake by 0.99% in control animals but in thyroidectomised rats it was 7.32%, 4.68% and 6.08% for MGT, SGT and GGU respectively, while in thyroxine-treated rats it increased the MGT and GGU by 18.43 and 1.08% respectively but decreased the SGT by 13.03%.

DISCUSSION

The results presented here show that thyroidectomy significantly increased the uptake of glucose in the small intestine in rats whereas thyroxine treatment had no significant effect on intestinal glucose uptake. This is in agreement with the report of Gelb and Gerson (1969) who reported increased intestinal transport of glucose in thyroidectomised animals and Pfleger *et al.* (1958) who showed that thyroxine treatment had no significant effect on glucose transport. However, it did not agree with the findings of Adeniyi and Olowookorun (1987) who observed increased glucose transfer in the intestine of rats on thyroxine

Table 1: EFFECT OF THYROIDECTOMY AND THYROXINE ON GLUCOSE TRANFER.

GROUP	Mucosal Glucose Transfer		Serosal Glucose Transfer		Gut Glucose Uptake	
	Concentration	% change	Concentration	% change	Concentration	% change
A (Control)	2.65 ± 0.35		-4.04 ± 0.34		6.7 ± 0.35	
B1 (Tx)	4.10 ± 0.08	54.72*↑	-3.63 ± 0.37	10.15↓	7.73 ± 0.18	15.37*↑
C1 (4)	2.93 ± 0.54	10.57↑	-3.53 ± 0.44	12.62↓	6.46 ± 0.23	3.58↓

Unit = nMol/l/10cm sac/30 min.
Values are means of ≥ 5 determinations ± SEM.
*Significantly different at $P < 0.05$.

Table 2: EFFECT OF PROPRANOLOL ON GLUCOSE TRANSFER AND UPTAKE.

GROUP	Mucosal Glucose Transfer		Serosal Glucose Transfer		Gut Glucose Uptake	
	Concentration	% change	Concentration	% change	Concentration	% change
A1	2.65 ± 0.43		-4.04 ± 0.34		6.7 ± 0.35	
A2 (C+Pr)	4.15 ± 0.43	56.6*↑	-4.08 ± 0.17	0.99↑	8.23 ± 0.53	22.84*↑
B1	4.10 ± 0.05		-3.63 ± 0.37		7.73 ± 0.18	
B2 (Tx+Pr)	4.4 ± 0.55	7.32↑	-3.8 ± 0.26	4.68↑	8.2 ± 0.79	6.08↑
C1	2.93 ± 0.54		-3.53 ± 0.44		6.46 ± 0.23	
C2 (T4+Pr)	3.47 ± 0.7	18.43↑	-3.07 ± 0.42	13.03↓	6.54 ± 0.54	1.08↑

Unit = nMol/l/10cm sac/30 min.
Values are means of ≥ 5 determinations ± SEM.
*Significantly different at $P < 0.05$.

treatment and reduced glucose transfer on thyroidectomy, and Smyth (1980) who reported decreased glucose absorption in hyperthyroid rats.

The effect of propranolol on normal untreated animals is consistent with the work of Oyebola and Durosaiye (1988) who reported that propranolol caused an almost three-fold increase in glucose uptake in normal untreated dogs though there was an accompanying relative net rise in glucose transfer in thyroidectomised rats on propranolol administration. Beta-receptor population had been shown to increase in hyperthyroidism (William and Lefkomtz, 1977) and low in hypothyroidism (Malbon *et al.*, 1982) but glucose transfer increases more notably in euthyroid and hypothyroid rats when given propranolol. This suggests, from the results of the present work, that beta-receptors probably have an inhibitory effect on glucose transfer.

This study concludes that thyroid status affects beta-adrenergic response of the intestine to glucose absorption such that the response is more reduced in hypothyroid state than in hyperthyroid state. It also shows that glucose absorption in the small intestine is probably inhibited by beta-adrenergic receptors in altered thyroid status.

ACKNOWLEDGEMENT: The authors wish to thank Messrs A. Akapa, J. Fwangle and Mr. Salisu for their technical assistance.

REFERENCES

Adeniyi, K. O. and Olowookorun, M. O. (1987) Intestinal fluid and glucose transport in rats. Effects of thyroidectomy and thyroxine administration. Nig. J. Physiol. Sci. 3, 61 - 66.

Adeniyi, K. O. and Olowookorun, M. O. (1988) Haematological values in normal, thyroidectomised and thyroxine treated rats. Nig. J. Physiol. Sci. 4, 64 - 66.

Ganon, W. F. (1987) Review of Medical Physiology. 13th Edn. Lange Medical Books.

Gells, A. M. and Gerson, C. D. (1969) Influence of endocrine glands on small intestine absorption. Am. J. Clin. Nutr. 22, 305 - 310.

Levin, R. S. (1969) The effects of hrmones on the absorptive metabolic and digestive function of the small intestine. J. Endocrinol. 45, 315 - 348.

Malbon, C. C. and Greenberg, W. L. (1982) 3,5,5'-triiodothyronine *in vivo* modulates the hormone sensitive adenylate cyclase system of rat hepatocytes. J. Clin. Invest. 69, 414 - 429.

Oyebola, D. D. O. and Durosaiye, G. O. (1988) Effect of adrenaline and propranolol on glucose uptake in canine terminal ileum. Nig. J. Physiol. Sci. 4, 31 - 37.

Pfleger, K.; Rumel, W. and Jacobs, H. (1958) Phosphatdierchtritt am Isolierlen Darm Inter Dinitrophenol und thyroxine. Biochem. 2, 303 - 309.

Rosenberg, N. and Batomsky, C. H. (1965) The thyroid. Ann. Rev. Physiol. 27, 71 - 106.

Smyth, M. W. and Leat, W. M. F. (1980) Mechanism of intestinal absorption in adult animals. In: Scientific Foundations of Veterinary Medicine. Phillipson, A. T.; Hall, L. W. and Pritchard, W. R. (eds.). Heinemann Medical Books, London. pp. 266 - 270.

Steele, R. G. and Torrie, J. H. (1980) Principles and Procedures of Statistics. 2nd Edition. McGraw-Hill Book Co., N.Y.

Trinder, P. (1969) Determination of blood gludose using 4-amino-phenazone as oxygen acceptor. J. Clin. Path. 22, 246 - 248.

Wilham, L. T. and Lefkomtz, R. J. (1977) Thyroid hormone regulation of beta-adrenergic receptor number. J. Biol. Chem. 252, 2787 - 2789.

Wilson, T. H. and Wiseman, G. (1954) The use of sacs of everted small intestine for the study of the transference of substances for the mucosal to the serosal surface. J. Physiol. 123, 116 - 125.