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Relationship between Diabetes Mellitus and Thyroid Dysfunction

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course 5 group BA-512

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- Thyroid dysfunction and diabetes mellitus (DM) are the two most common endocrine disorders. Approximately 4 million people in the United States are hypothyroid and receive thyroxine replacement therapy. By contrast, hyperthyroidism is much less common, with a female-to-male ratio of 9:1

http://journal.diabetes.org/clinicaldiabetes/v18n12000/pg38.htm

- The total prevalence of DM is increasing and is projected to rise to 366 million worldwide in 2030, affecting 4·4% of all age groups. Today, an increase in prevalence is confirmed among individuals >65 years of age .

Leonidas H. Duntas; Jacques Orgiazzi; Georg Brabant Clin Endocrinol. 2011;75(1):1-9.

- The frequency of thyroid dysfunction in diabetic patients is higher than that of the general population: according to the American Diabetes Assocation's 2016 Standards of Medical Care in Diabetes, autoimmune thyroid disease occurs in 17 to 30 percent of people with type 1.
- The pathophysiological basis of this association rests on a complex interaction of common signalling pathways and, in the case of type 1 diabetes and autoimmune thyroid disease, on a linked genetic susceptibility.

http://www.medscape.com/viewarticle/745282_2

Objective of the studies

- Establishment of the relationship between diabetes mellitus and thyroid dysfunction (hypothyroidism and hyperthyroidism)
- Comparison of the blood glucose and HbA1c levels, creatinine and BP levels in diabetics with and diabetics without thyroid problems.
- To evaluate association of complications of diabetes mellitus and thyroid dysfunctions.

Methodology

- Retrospective study included 196 patients diagnosed with diabetes mellitus, treated in 13 Kharkiv city hospital, with or without thyroid disorders (hypothyroidism, hyperthyroidism).
- Diagnoses of Diabetes Mellitus, Hypo-, Hyper- and Euthyroidism were maiden and confirmed by 13 Kharkiv city hospital endocrinologist
- These parameters were analysed: duration of diabetes mellitus, levels of fasting blood sugar, HbA1c, creatinine, blood pressure, incidence of diabetes complications in all groups
- Data was analysed with Microsoft Office Excel and Statistica 7
- Study limitations: small groups of patients with thyroid disorders in combination with DM

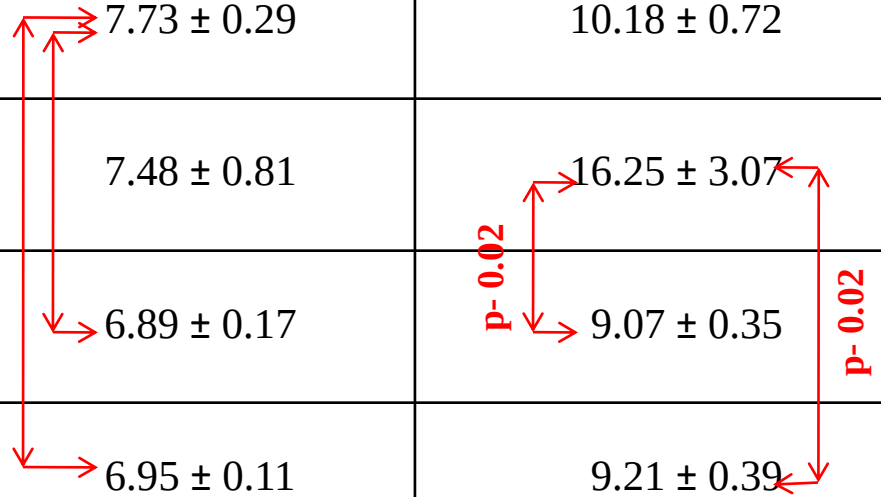
Descriptive characteristics of patients included in study

Demographic Variables		DM + Hypothyroidism (**1**) (36 patients)	DM + Hyperthyroidism (**2**) (6 patients)	DM + Euthyroidism (51 patients) (**3**)	DM (106 patients) (**4**)	P-value
Sex	Male	15 (42%)	1 (17%)	13 (25%)	36 (34%)	0.348
	Female	21 (58%)	5 (83%)	38 (75%)	70 (66%)	
Age		62 ± 2	71 ± 3	62 ± 2	63 ± 1	0.336
DM types	Type 1	2 (6%)	0 (0.0)	3 (6%)	9 (9%)	0.796
	Type 2	34 (94%)	6 (100%)	48 (94%)	97 (91%)	
Systolic pressure		161 ± 6	148 ± 2	142 ± 2	146 ± 2	< 0.05
Diastolic pressure		97 ± 4	83 ± 5	80 ± 1	86 ± 1	<0.0001
Duration of DM (years)		7 ± 1	7 ± 3	8 ± 1	7 ± 1	0.836
Hypertension groups	Normal BP	0 (0.0)	0 (0.0)	1 (2%)	6 (6%)	
	Pre-hypertension	10 (27%)	0 (0.0)	18 (35%)	22 (20%)	
	Stage 1	14 (39%)	1 (17%)	27 (53%)	57 (54%)	
	Stage 2	2 (5%)	0 (0.0)	3 (6%)	6 (6%)	
	Stage 3	10 (29%)	6 (83%)	2 (4%)	15 (14%)	2- 1,3,4 -< 0.05 1-4– 0.02 1-3 – 0.001

Data has been presented as absolute count (percentage); Age, systolic and diastolic pressures and duration of DM are represented as mean ± standard error of mean;
DM – diabetes mellitus, BP – blood preasure

DM hyperglycemia control among study subjects

Groups	HBA1C (%)	Fasting Glucose (mmol/L)	Creatinine (mg/dL)
DM + Hypothyroidism	7.73 ± 0.29	10.18 ± 0.72	0.19 ± 0.04
DM + Hyperthyroidism	7.48 ± 0.81	16.25 ± 3.07	0.18 ± 0.01
DM + Euthyroidism	6.89 ± 0.17	9.07 ± 0.35	0.17 ± 0.04
DM	6.95 ± 0.11	9.21 ± 0.39	0.15 ± 0.02
P-value	0.01	<0.05	> 0.05



Data has been presented as mean ± standard error of mean

Rate of DM complications among study subjects

Complications	1group DM + Hypothyroidism (patients, %)	2 group DM + Hyperthyroidism (patients, %)	3 group DM + Euthyroidism (patients, %)	4 group DM (patients, %)	p
Stroke	2 (5%)	5 (83%)	1 (2%)	3 (3%)	1-2 groups – 0,0001
MI	2 (5%)	0 (0.0)	2 (4%)	2 (1.8%)	> 0.05
Diabetic nephropathy	21 (58%)	6 (100%)	20 (39%)	60 (57%)	1-2 groups – 0,03 2-4 groups – 0,02
CHF	29 (80%)	6 (100%)	36 (70%)	66 (62%)	1-4 groups – 0,04 1-2 groups – 0,001 2-4 groups – 0,01 2-3 groups – 0,005

Correlations of HbA1c level in study groups, p < 0.05

	creatinine levels	SAP level	DAP level	leucocytes in CBC
DM + Hypothyroidism	0,27	- 0,16	- 0,17	0,12
DM + Hyperthyroidism	0,5	0,30	0,41	- 0,12
DM + Euthyroidism	- 0,19	0,21	0,28	0,09
DM	- 0,10	0,06	- 0,01	- 0,02

DM – diabetes mellitus, MI- myocardial infarction, CHF – chronic heart failure

Discussion

- There was relationship between diabetes mellitus and thyroid dysfunction.
- Both fasting blood glucose and HbA1c level were markedly raised in both thyroid disorders (hypo- and hyper-), but level of HbA1c was higher in DM + Hypothyroidism group. That proves non-optimal hyperglycemia control in this patient's group and could be explained by increased insulin resistance, due to reduced rate of insulin degradation in hypothyroidism which may lower the exogenous insulin requirement. Otherwise, uncontrolled hyperglycemia may lead to an impairment in peripheral conversion of T4 to T3, reducing of T3 levels and worsening of hypothyroidism outcome with enlarged dosages of replacement therapy needed. Studies done in hypothyroid patients showed elevated HbA1c not only in the presence of diabetes but also in non-diabetic subjects *(Diabetes Care. 2010 Dec;33(12):2546-8)*
- Diabetes with hypothyroidism patients had a significantly higher levels of blood pressure as in other groups. This possibly can be explained by association of Hypothyroidism and T3 deficiency with peripheral vasoconstriction and increased arterial stiffness which may occur before or during the early stages of atherosclerosis and appearance of micro and macrovascular DM complications. Early systolic arrival of the reflected waves – from the peripheral arteries to the heart – increases central aortic BP and augments systolic BP. the other hand, the increased systolic and diastolic BP could induce changes in the arterial wall, reducing elasticity and increasing stiffness *(https://www.hindawi.com/journals/jtr/2011/439463/).*

Discussion

➢Diabetics with hyperthyroidism patients had a significantly higher levels of 3 stage arterial hypertension and incidence of chronic heart failure as in other groups despite prescribed antyhypertensive treatment. This possibly can be explained by in thyroid hormones effects as increasing of the heart rate, cardiac contractility, systolic and mean pulmonary artery pressure, cardiac output, diastolic relaxation, atrial arrhythmias and myocardial oxygen consumption, the depression of myocardial contractility, increased β-adrenergic activity, accompanied by increased density of β-adrenergic receptors in the renal cortex, resulting in increased plasma renin, angiotensin II, and serum angiotensin converting enzyme levels especially in elderly patients (*www.eje-online.org/content/167/5/609.full*).

➢Also in DM + hyperthyroidism group level of Diabetic nephropathy incidence was significantly higher than in other groups, exist positive correlation between HbA1c and creatinine levels (higher level of HbA1c is– higher level of creatinine will be). Well known that hyperthyroidism results in intra-glomerular hypertension (increased filtration pressure) and consequent hyperfiltration. Also it predisposes to proteinuria, which is known to cause direct renal injury and hyperthyroidism-induced increased mitochondrial energy metabolism along with down-regulation of superoxide dismutase contributes to the increased free radical generation and consequent renal injury *(Eur J Endocrinol. 2006 Feb; 154(2):197-212).* Because the kidneys play a role in glucose homeostasis, in patients with DM decreased renal gluconeogenesis, microvascular changes, decreased insulin clearance, and inflammation-induce insulin resistance is a base of renal injury in patients with DM *(Diabetology & Metabolic Syndrome, 2016 May, **8**:50).*

Conclusion

- Diabetes and thyroid disorders have been shown to mutually influence each other and associations between both conditions have long been reported. Compensation of thyroid function due to adequate therapy leads to controlled hyperglycemia, less frequency of DM and better DM outcome
- Hyperthyroidism as hypothyroidism impairs glycemic control in diabetic subjects, but hypothyroidism patients alter carbohydrate metabolism with inability to gain stable compensation of DM compering with euthyroidism and DM without thyroid dysfunction

THANK YOU