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SERUM T3 LEVEL AND ITS RELATION TO CHRONIC HAPATITIS C VIRUS IN DIABETIC VERSUS NON DIABITIC PATIENTS

By

Mohammed M Hashim*, Tarek M Emranand Fahmy A Abd El-Aziz****

* Microbiology Department, Faculty of Science, Ain Shams University, Cairo, Egypt.
** Clinical Pathology Department, Faculty of Medicine, Al-Azhar University, Cairo, Egypt.
*** Microbiology Department, Faculty of Science, Ain Shams University, Cairo, Egypt.
**** International Medical Center Hospital, Shubra, Cairo, Egypt.

ABSTRACT

Background: Thyroid gland disorders represent one of the commonest endocrine manifestations of chronic hepatitis C (HCV).

Objective: This study was performed to evaluate thyroid hormones profile in patients with chronic hepatitis C and its relation to severity of liver damage in the presence or absence of diabetes mellitus.

Patients and methods: This study was performed on sixty patients with liver cirrhosis due to hepatitis C virus with or without diabetes mellitus. The patients were divided into three equal groups according to Child-Pough score as following: **Group A**, **group B** and **group C**. All patients were subjected to medical history, clinical examination and laboratory investigations including liver functions tests, renal function tests, complete blood picture (CBC), viral markers for hepatitis, hepatitis C virus antibody (HCV-Ab) and hepatitis B virus antigen (HBs-Ag), polymerase chain reaction (PCR), fasting blood sugar (FBS), postprandial blood sugar(PPBS) hemoglobin A1 C (HbA1c), tetra-iodothyronin (T4), tri-iodothyronin(FT3), thyroid stimulating hormone (TSH) and abdominal ultrasound.

Results: Serum levels of alanine aminotransferase (ALT), aspartate aminotransferase (AST), blood platelet and FT3 were significantly lower in group C than group B and group A, while serum levels of bilirubin andprothrombin time(PT) were significantly higher in group C than B and A. Serum levels of FT3 was positively correlated with serum albumin and negatively correlated with serum bilirubin and PT. There were no significant changes in the serum levels of FT3, FT4 and TSH between diabetic and non-diabetic patients. On the other hand, serum levels of ALT, AST, and albumin significantly elevated in diabetic versus non-diabetic patients.

Conclusions: A highly significant reduction of serum FT3 in liver cirrhosis with normal serum FT4 and TSH levels was attributive to decreased deiodination of T4 to T3. Decreased serum FT3 level correlated with the severity of liver disease, and may be helpful in assessing the course and diagnosis of liver cirrhosis. Also, serum FT3 hormone level could be used as a marker for grading and assessment of the severity of hepatic dysfunctions.

Key words: Thyroid disorders, FT3, Chronic HCV, Diabetes mellitus.

INTRODUCTION

Hepatitis virus infection is an increasing problem and millions of hLiver has an important role in the metabolism of thyroid hormones as it is the most important organ in the peripheral conversion of tetra-iodothyronin (T4) to tri-iodothyronin (T3) by type 1deiodinase resulting to 5'deiodination of T4. Also, it

is involved in conjugation and circulation of thyroid hormones by synthesis of thyroid binding proteins **(Mansour-Ghanaei et al., 2012 and Eshraghian et al., 2013).**

Evidences that HCV may induce metabolic and autoimmune disturbances leading to hypobetalipoproteinemia, steatosis, insulin resistance, impaired glucose tolerance, thyroid disease, and gonadal dysfunction have been found **(Garc?a et al., 2015).**

Kayacetin et al. (2003) and Eshraghian & Taghavi (2014) showed that there are evidences of association between chronic liver diseases and changes in thyroid gland. Furthermore, they demonstrated that levels of thyroid hormones and their binding proteins are altered in patients with hepatic disorders especially cirrhosis. **Merat et al. (2010) and Eshraghian &** ***Hamidian Jahromi (*2014)** evaluated thyroid hormones profile in patients with hepatic cirrhosis due to chronic HCV infections and found that there was a relationship between thyroid hormones and severity of liver damage. On the other hand, thyroxine and tri-iodothyronine modulate hepatic function by regulating hepatocyte basal metabolic rate, besides all other body cells**.** Also, lower total serum T3 dedicates to a lower basal metabolic rate within hepatocyte leading to preservation of liver function and total body protein storage **(Malik and Hodgson, 2002).**

Thyroid hormones play a key role in the regulation and activation of insulin receptor and glucose transporter proteins **(Amati et al., 2009).** Thyroid disorders have also been associated with defective insulin secretion, hyperinsulinemia, altered peripheral glucose disposal, and insulin resistance **(Maratou et al., 2009).** Insulin resistance is the central pathophysio-logical phenomenon of metabolic syndrome, and it has been shown that thyroid hormones and TSH are associated with several components of metabolic syndrome in euthyroid subjects **(Kumar et al., 2009 and Dullaart et al., 2014).**

The present study was performed to evaluate thyroid hormones profile especially serum T3 hormone level in patients with chronic hepatitis C and its relation to severity of liver damage in the presence and absence of diabetes mellitus.

PATIENTS AND METHODS

Sixty patients with liver cirrhosis due to hepatitis C virus, whether diabetic or non diabetic patients, were included in this study. The patients enrolled in this study were taken from inpatient and outpatient clinic of Internal Medicine Department of Al-Azhar university hospital at New Damietta in the period from April 2013 to march 2014. Diagnosis of diabetes mellitus was based on criteria of American Diabetes Association (ADA) standards of medical care in diabetes **(ADA, 2010).**

The patients were divided into three equal groups according to Child-Pough score**(*Child and Turcotte* (1964) and Cholongitas et al. (2005). Group A** with evidence of HCV infection and elevated liver enzymes, their ages ranged between 30 and 52 years, **Group B** with evidence of HCV infection and cirrhosis; their ages ranged between 43 and 66 years**,** and **Group C** with evidence of chronic HCV infection, and advanced cirrhosis their ages ranged between 48 and 66 years.

Exclusion criteria: Patients suffering from previous or present thyroid dysfunctions, patients on medications that affect the study outcome (including carbamazepine, phenytoin, phenobarbitone, salicylates and non-steroidal anti-inflammatory drugs, inderal and steroids), patients under treatment by thyroid stimulating/inhibiting agents, subjects with history of alcohol consumption at last 6 months before the study, patients under treatment by antiviral drugs (ribavirine and interferon), and patients with autoimmune hepatitis and other autoimmune diseases.

All patients were subjected to the following; careful history taking, thorough clinical examination and laboratory investigations including liver functions tests [liver enzymes (AST and ALT), total bilirubin, serum albumin, PT and INR], Renal function tests (blood urea and serum creatinine, serum uric acid), complete blood count, viral markers (HCV-Ab and HBs-Ag), polymerase chain reaction(PCR), fasting and two hours postprandial blood glucose, HbA1c, thyroid hormones estimation(TSH, FT3, FT4), and abdominal ultrasound was done for all groups.

Blood samples were collected by vein-puncture and divided into two parts: The first part was treated immediately with EDTA-K3 for complete blood count and HbA1c, and in the second part sera were separated from the rest of blood samples and were freshly analyzed for other tests required in this study.

Hematological and biochemical tests: Complete blood pictures including platelets counting were determined by Sysmex XS 500 automated hematology analyzer (Sysmex Corporation, Japan). Liver function tests were measured on an automated biochemistry analyzer (Roche/Hitachi 902). Quantitative HCV ribonucleic acid (RNA) by PCR was assayed by applied biosystems(Model 7500 system, Singapore), thyroid hormones (TSH, FT3 and FT4) were measured by chemiluminescence with Immulite(1000)with kit (Diagnostic Products Corporation; Los Angeles, CA, USA).

Informed consent was taken from all subjects.

Statistical analysis: Statistical analysis of the results was performed using ANOVA test for comparison among different items in the same group in quantitative data. Data were expressed as Mean ± SD using student's t-test for unpaired data. A value of $P \leq 0.05$ was considered significant.

RESULTS

Serum levels of ALT, AST, blood platelets and FT3 were significantly lower in group C than group B and group A, while serum levels of serum bilirubin and PT were significantly higher in group C than B and A. On the other hand, no significant changes were found on other parameters among three patient groups (Table 1).

Serum levels of FT3 were positively correlated with serum albumin ($p<0.038$) and negatively correlated with serum levels of bilirubin ($p<0.045$) and PT ($p<0.03$). Accordingly, FT3 was inversely correlated to Chlid-Pough score ($p < 0.0001$), on the other hand, no correlations were found between FT4 and TSH and other laboratory investigations (Table 2).

There were no significant changes in the serum levels of FT3, FT4 and TSH

between diabetic and non-diabetic patients (Table 3). On the other hand, serum levels of ALT, AST, and albumin significantly elevated in diabetic versus non-diabetic patients with chronic liver diseases (Table 4).

Table (1): Statistical comparison between the studied groups as regard laboratory investigations

Groups / Parameters	Child (A)	Child (B)	Child (C)	P value
ALT (up to 45 U/L)	59.95±16.19	46.80±10.19	32.65±8.01	0.001*
AST (up to 40 U/L)	60.00±15.32	47.40±10.55	27.25±7.85	0.001*
Albumin (3.5-5.5 g/dL)	4.54±0.40	3.12±0.11	2.15±0.18	0.001*
Bilirubin (up to 1 mg/dL)	0.85±0.11	2.72±0.16*	3.40±0.15	0.001*
PT (13-15 sec)	12.70±0.80	15.05±1.43*	16.85±1.4646.	0.001*
WBCS (4-11X10^3/mL)	5.65±1.11	4.58±0.79	4.81±1.66	0.05 +
Hb (12-16 g/dL)	12.58±0.69	10.94±0.97	10.03±0.86	0.01*
Platelets (150-450X10^3/ml)	151.15±40.31	92.65±6.76**	97.40±24.29	0.01*
Creatinine (0.5-1.5 mg/dl)	0.91±0.27	0.93±0.30	1.19±0.25	0.004*
Urea (15-40 mg/dl)	27.85±6.49	27.85±6.49	29.75±7.95	0.01*
F.B.S (70-110 mg/dl)	127.60±46.07	137.40±62.23	127.60±46.07	0.79+
P.P.B.G (80-140 mg/dl)	178.10±85.88	170.00±89.21	178.10±85.88	0.94+
HbA1c (4-7%)	5.61±1.30	5.33±1.24	5.35±1.09	0.72 +
PCR (x 10^6 IU/ml)	1417±1415	3731±2790	1477±1404	0.001*
FT3 (2.5-4.0 pg/ml)	2.63±0.17	2.11±0.17	1.34±0.13*	0.001*
FT4 (0.8-2.4 ng /dl)	1.40±0.18	1.18±0.07	1.13±0.11	0.001*
TSH (0.4-5.0 mIU/L)	2.47±0.40	2.44±0.18	2.22±0.14	0.01*

P < 0.05 (*=significant), + = insignificant

Table (2): Correlation between TSH, FT3and FT4 versus different variables among all patients

Hormones / Variables	TSH		FT3		FT4	
	r	P	r	P	r	P
ALT (U/L)	0.208	0.379	-0.045	0.849	-0.168	0.478+
AST(U/L)	0.194	0.412	-0.005	0.982	-0.146	0.540+
Albumin (g/dl)	-0.426	0.061	0.540	0.038*	0.122	0.607+
Bilirubin (mg/dl)	-0.155	0.515	-0.470	0.045*	-0.105	0.080+
PT(sec.)	-0.140	0.555	-0.487	0.030*	-0.380	0.099+
WBCs (X10^3/ml)	0.013	0.958	0.058	0.809	-0.361	0.118+
Hb (g/dl)	0.189	0.424	0.085	0.723	-0.042	0.860+
Platelets(X10^3/ml)	0.258	0.272	-0.045	0.852	-0.030	0.902+
Urea(mg/dl)	0.324	0.163	0.156	0.512	0.402	0.079+
Creatinine(mg/dl)	0.214	0.366	0.218	0.355	0.308	0.092+
UA(mg/dl)	0.161	0.498	0.226	0.338	0.373	0.106+
FBS (mg/dl)	0.303	0.194	0.224	0.343	0.098	0.682+
PPBG(mg/dl)	0.386	0.093	0.353	0.127	0.128	0.590+
HbA1c (%)	0.304	0.193	0.349	0.131	0.081	0.733+
PCR(x 10^6 IU/ml)	0.262	0.265	-0.149	0.530	0.297	0.204+

Table (3): Statistical comparison between TSH, FT3, FT4 and diabetic patients in all patients.

Groups / Hormones	Non diabetic (n = 39)	Diabetic (n = 21)	P
FT3(pg/ml)	2.62 ± 0.17	2.63 ± 0.19	**0.850** +
FT4(ng /dl**)**	1.45 ± 0.19	1.32 ± 0.16	**0.113** +
TSH(mIU/L**)**	1.45 ± 0.42	1.49 ± 0.39	**0.815** +

Table (4): Statistical comparison between diabetic patients and liver function in all patients

Groups / Liver functions	None diabetic (n = 39)	Diabetic (n = 21)	P
ALT (U/L)	28.82 ± 6.84	37.33 ± 7.00	0.013*
AST (U/L)	23.36 ± 5.80	32.00 ± 7.62	0.010 *
Albumin(g/dl)	2.05 ± 0.16	2.96 ± 0.13	0.008 *
Bilirubin(mg/dl)	3.39 ± 0.15	3.40 ± 0.15	0.895 +
PT(sec.)	16.82 ± 1.33	16.89 ± 1.69	0.918 +

DISCUSSION

Liver plays an important role in the metabolism of thyroid hormones, as it is the most important organ in the peripheral conversion of tetraiodothyronin (T4) to triiodothyronin (T3) by type 1deiodinase resulting to 5 deiodination of T4. Moreover, it is involved in conjugation and circulation of thyroid hormones by synthesis of thyroid binding proteins **(Mansour- Ghanaei et al., 2012 and Eshraghian & Taghavi, 2014).**

In the present study, the incidence of fatigability, bleeding tendency, pallor, jaundice, lower limbs edema, ascitis and encephalopathy significantly elevated in patients with group C than group B and in group B than group A. This was in consistent with findings by ***Fabrizi et al. (2003)*** in their study on 59 patients with chronic liver diseases.

In our study, serum levels of ALT, AST, blood platelet and FT3 were significantly lower in group C than group B and group A, while serum levels of serum bilirubin and PT were significantly higher in group C than B and A. ***Htoo et al. (2012)*** reported that alanine amino transferase (ALT) and aspartate amino transferase (AST) indicate the concentration of hepatic intracellular enzymes that have leaked into the circulation which are the markers for hepatocellular injury.

In our study, serum FT3 levels (not FT4 and TSH) were significantly lower among patients of group C in comparison to other groups and correlated with serum albumin, bilirubin and PT in all studied patients. ***Kayacetin et al. (2003) and*** **Eshraghian & Taghavi** ***(2014)*** reported low serum FT3 levels in cirrhotic patients and its association with worsening liver function by Child Pugh classification with absence of correlation between serum FT4 and TSH levels. On the other hand**,** ***Malik and Hodgson (2002) and*** **Eshraghian & Taghavi** ***(2014)*** reported that hypothyroi-

dism occur more in acute and chronic hepatitis and cirrhosis as a complication of chronic of liver diseases. This is in accordance with ***Tran et al. (2009)*** who reported that a significant correlation of low serum FT3 levels in relation to decreased serum albumen, while a negative correlation was found with serum bilirubin levels, and reported that liver and thyroid hormones are intricately correlated. So, thyroid hormone abnormalities are seen in patients of liver diseases, although they are clinically euthyroid.

Green et al. (1997) showed that low serum FT3 levels corresponding to lower serum albumin levels who also documented a significant correlation between the clinical severity and prognosis of the disease and serum thyroid hormone levels, and founded that serum FT3 levels in cirrhotic patients correlated with serum albumin values.

One of side effects of liver dysfunctions on thyroid is the reduced serum T3 concentrations which are due to reduced activity of deiodinase enzyme that catalyzing the convertion of T4 into T3 but the reverse T3 is not reduced because the activity of responsible enzyme is not altered. As whole in liver diseases, T3 is reduced firstly by lower activity of enzyme responsible for conversion of T4 into T3 ***(Mansour-* Ghanaei *et al., 2012).***

As regards HCV-RNA, there was a highly statistically significant difference between studied groups in viral load by PCR. On the other hand, there was no statistically significant correlation between thyroid hormones and viral load. Also, our study reported that there were no significant changes in the serum levels of FT3, FT4 and TSH between diabetic and non-diabetic patients. On the other hand serum levels of ALT, AST, and albumin significantly elevated in diabetic versus non-diabetic patients with chronic liver diseases.

Liu et al, (2012) examined the relationship between HCV infection and severity of liver diseases in relation to diabetes in a large community screening program, He reported that positive anti-HCV antibody and diabetes were found in (10.2%) of studied patients and (9.6%) subjects, respectively. The crude prevalence of diabetes was 10.5% in subjects with positive anti HCV and 9.4% in subjects with negative anti HCV and elevated liver enzymes were associated with diabetes

CONCLUSION

Highly significant reduction of serum FT3 in liver cirrhosis with normal serum FT4 and TSH levels. The finding of decreased FT3 in those patients may be due to decreased deiodination of T4 to T3. Decreased serum FT3 level correlated well with the severity of liver disease and may be helpful in assessing the course and diagnosis of liver cirrhosis. Also serum FT3 hormone level could be used as marker for grading and assessment of the severity of hepatic dysfunctions.

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محمد محمد هاشم* ، طارق مصطفى عمران، فهمى السيد عبد العزيز***

قسمى الباطنة العامة *والباثولوجيا الإكلينيكية– كلية الطب بنين - جامعة الأزهر**

خلفية البحث: خلل هرمون الغدة الدرقية شائع فى أمراض الكبد الفيروسية.

الهدف من البحث: دراسة مستوي هرمون الغدة الدرقية الثلاثى بمصل الدم وعلاقته بالإلتهاب الكبدي الفيروسى المزمن (سي) فى المرضى المصابين والغير مصابين بالبوال السكرى.

المرضى وطريقة إجراء البحث: تم إختيار المرضى الذين إشتملت عليهم هذه الدراسة من بين المرضى المترددين على قسم الأمراض الباطنة العامة بمستشفى جامعة الأزهر بدمياط الجديدة وعددهم ستون مريضا مصابون بالتهاب كبدى فيروسى (س) وقد تم تقسيمهم إلى ثلاثة مجموعات متساوية على النحو التالى:-

المجموعة الأولى : يعانون من إلتهاب كبدى فيروسى مزمن من الدرجة الأولى
المجموعة الثانية: يعانون من إلتهاب كبدى فيروسى مزمن من الدرجة الثانية
المجموعة الثالثة : يعانون من إلتهاب كبدى فيروسى مزمن من الدرجة الثالثة

وجميع المرضى بالمجموعات تم أخذ التاريخ المرضي لهم وعمل فحص إكلينيكي شامل مع عمل الفحوصات المعملية التالية: وظائف كبد(إنزيمات الكبد –والألبيومين- والبليروبين- وزمن البروثرومبين)، وظائف كلى(الكرياتينين – اليوريا – حمض اليوريك) صورة دم كاملة، وسرعه الترسيب , دلائل الفيروسات الكبدية (الفيروس الكبدي "بى" والفيروس الكبدي "سى") وهرمونات الغدة الدرقية الثلاثى الحر والرباعى الحر و(تى إس إتش) وقد تم عمل موجات فوق صوتية على البطن لكل المرضى ، كما تم أخذ موافقة مكتوبة من المرضى على المشاركة فى هذا البحث.

النتائج:

1- فيما يتعلق بالمقارنة بين المجموعات التي درس بها معدل هرمون الغدة الدرقية الثلاثى الحر بمصل الدم، كان هناك فارقا إحصائيا كبيرا بين المجموعات،حيث تنخفض نسبته بالدم فى المجموعة الثالثة مقارنة بالمجموعات الأخرى.

2- كما تبين وجود علاقة طردية بين نقص نسبة الألبومين ونقص هرمون الغدة الدرقية الثلاثى الحر بمصل الدم.

3- كما تبين أيضا وجود علاقة عكسية بين كل من نسبة البليروبين وزمن وتركيز البروثرومبين وهرمون الغدة الدرقية الثلاثى الحر بمصل الدم.

4- لم يتبين وجود إرتباط كبير بين هرمون الغدة الدرقية الثلاثى الحر وإنزيمات الكبد فى جميع المجموعات.

5- هرمون الغدة الدرقية الثلاثى الحر يمكن أن يستخدم كمؤشر موثوق بـه للاستدلال على الخلل في الغدة الدرقية نتيجة تليف الكبد ، كما يمكن أن يستخدم كعلامة لدرجات شدة ضعف الكبد.

6- ليس هناك فرق فى وظائف الغدة الدرقية بين المرضى المصابين بالسكر وغيرهم.

الإستنتاج:

1- الخلل في الغدة الدرقية يظهر إتجاها تصاعديا بين مرضى أمراض الكبد المزمنة وخاصة بسبب الإصابة بفيروسات إلتهاب الكبد (سى).

2- نقص هرمون الغدة الدرقية الثلاثى الحر بمصل الدم يظهر إرتباطا إيجابيا مع نقص نسبة الألبومين بالمصل، كما يظهر إرتباطا سلبيا مع كل من نسبة البيليروبين بالمصل وزمن البروثرومبين.

3- هرمون الغدة الدرقية الثلاثى بمصل الدم يمكن أن يستخدم كمؤشر على الخلل في الغدة الدرقية نتيجة تليف الكبد في المرضى المصابين بفيروس الكبد(سي).

كشفت الدراسة أن هرمون الغدة الدرقية الثلاثى الحر ظهر كمؤشر موثوق بـه للإستدلال على الخلل في الغدة الدرقية نتيجة تليف الكبد.