Research Article

Relationship Between Serum Pentraxin-3 Level and Non-Alcoholic Fatty Liver Disease in Egyptians

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Abstract
Background: Nonalcoholic-fatty liver disease (NAFLD) is the aggregation of triglyceride inside hepatocytes that initiates cascade of inflammation. NAFLD ranges from simple steatosis to nonalcoholic steatohepatitis (NASH), and advanced fibrosis. **Aim:** To assess serum Pentraxin-3 level (PTX 3) in NAFLD Egyptian populations and search its relation with different grades of NAFLD. **Subjects & Methods:** Our study enrolled 124 Egyptian subjects who attending outpatient clinic of Internal Medicine Department, Zagazig University Hospitals, from June 2017 to April 2018, presented by non-specific symptoms. They were divided according to ultrasound findings into 2 groups: Control group,62 subjects with no evidence of NAFLD, 19 males (30.6%), and 43 females (69.4%), their ages ranged between 26-50 years, and NAFLD Group 62 patients with different grades of NAFLD, 16 males (25.8%) and 46 females (74.2%), their ages ranged between 20-60 years .Serum PTX 3 level and routine laboratory investigations were done for all subjects. **Results**: BMI showed higher significant difference in NAFLD than control group (34.5± 9.8 kg /m2 vs. 26.9 ± 3.9 kg/m2, P<0.001). Also, ALT and AST levels were higher in NAFLD group than control; ALT (37.4±23.9 mg /dl vs. 25 ± 9.6 mg/dl, P=0.001), AST (32.8 ± 18.5 mg/dl vs. 24.3± 11.7 mg/dl,P< 0.001) respectively. Serum pentraxin level was statistically significant higher in NAFLD group (2.9 ± 1.6 ng /ml) vs. control (0.71 ± 0.33 ng/ml), (P< 0.001). US grades of NAFLD group 14 mild (22.6%), 33 moderate (53.2%) and 15 severe (24.2%).PTX-3 level was statistically insignificant regarding grades of severity of NAFLD (P=0.15). **Conclusions**: Serum PTX3 level was higher in NAFLD group than control ,but it had no relation in determining different grades of disease severity. Thus, serum PTX3 level may be used as a useful non-invasive biomarker in detecting NAFLD from non-NAFLD.
Keywords: NAFLD: non-alcoholic fatty liver disease NASH: non-alcoholic steato-hepatitis PTX 3 : Pentraxin-3

Introduction
Nonalcoholic fatty liver disease (NAFLD) is the most famous reasons for abnormal liver function, and intense liver damage that is described by the aggregation of expansive triglyceride beads inside hepatocytes[(1)].This excess storage of fat in the liver sensitizes the organ to inflammation and fibrosis, subsequently prompting macrovesicular hepatic steatosis[(2)]. NAFLD ranges from simple steatosis to nonalcoholic steatohepatitis (NASH), propelled fibrosis, and cirrhosis[(3)].

Simple steatosis without fibrosis or inflammation demonstrates a benign clinical course, While NASH exhibits an increasingly dynamic course that prompts cirrhosis and lower survival rate[(4)] It is therefore important to distinguish simple steatosis from NASH in order to intervene and slow down disease progression in NASH patients[(5)].

Liver biopsy is still considered the gold standard for evaluating both the diagnosis and staging in NASH patients; however, the limitations of liver biopsy include its invasiveness, cost, and potential to cause sampling errors. Subsequently, it isn't appropriate as a screening strategy for a condition involving 30% of the population in the United States, and option noninvasive biomarkers that are less expensive, more reliable, and reproducible are urgently required.[(5)]

In this regard, different noninvasive strategies, for example, imaging studies and blood markers have been connected for clear determination, however these instruments are not standardized for the precise diagnoses of the severity of liver fibrosis[6].

Pentraxin 3 (PTX3) is the first identified long pentraxin, a member of the pentraxin super-family, and it is structurally related to, but differs from, CRP (classic short pentraxin) in gene organization, chromosomal localization, and cellular source. PTX3 is multimeric acute phase inflammatory glycoprotein , it can possibly be a reasonable biomarker for many diseases[7]. PTX3 is a basic part of innate immunity that exhibits opsonic activity , thereby facilitating pathogen recognition, and is produced by a variety of tissues and cells in response to pro-inflammatory signals[8].

In normal liver tissue, sinusoidal cells with Kupffer cell morphology strongly express PTX3, and biliary epithelial cells moderately express PTX3. While hepatocytes are negative for PTX3 expression[9]. In contrast to hepatocytes, hepatic progenitor cells that have been segregated from the livers of human patients who have experienced fractional hepatectomy express PTX3 at levels 20-fold higher than essential hepatocytes, suggesting that several cells in the liver tissue at least in part produce PTX3[10].

Hepatic injury in acute liver failure, including hepatocyte necrosis on histo-pathological examination and elevated liver PTX3 levels in comparison with control groups. Thus, raised liver PTX3 is a potential biomarker of the primary local activation of inflammation, and intense histological liver damage[11].

It was proposed that plasma PTX3 levels may separate NASH patients from different subjects, and that higher plasma PTX3 levels are related with extreme phases of hepatic fibrosis[12].Thus, our study expected to assess the clinical utility of serum PTX3 level in Egyptian population with NAFLD in the diagnosis of NASH and to assess the relation of serum PTX3 level and different grades of NAFLD.

Subjects and Methods

A cross-section study included 124 Egyptian subjects who attending outpatient clinic of Internal Medicine Department, Zagazig University Hospitals with their ages between 20-60 years ,from June 2017 to April 2018, presented by non-specific symptoms. They were divided according to ultrasound findings into 2 groups; control Group compressed 62 subjects with no evidence of NAFLD, and NAFLD Group compressed 62 patients, with different ultrasound grades (mild – moderate – severe).

In this study we excluded patients with recent cerebrovascular stroke (last 3 months), patients with recent acute coronary syndrome (last 3 months), other chronic liver disease (viral hepatitis as HCV and HBV, Wilson disease, autoimmune hepatitis, hemochromatosis, hepatic decompansation or hepatocellular carcinoma, diabetes mellitus, renal failure, hypothyroidism, recent history of drugs that affect serum pentraxin 3 level as (amiodarone, diltiazem, tamoxifen, statins and glucocorticoids)

Our included patients were subjected to detailed medical history and full clinical examination, body height, body weight, and body-mass index (BMI), fasting blood sugar, 2 hours post prandial, lipid profile (total cholesterol, triglycerides, HDL, LDL), liver function tests (AST, ALT, GGT, ALP,bilirubin total & direct, serum albumin), blood urea, serum creatinine, thyroid stimulating hormone (TSH) for exclusion of hypothyroidism, HBs Ag , HCV Ab., abdominal ultrasound for grading of liver steatosis (mild– moderate – severe) by single operator, serum pentraxin-3 measured in all subjects of both groups. Ethical approval from the ethical committee for Medical Research in the Faculty of Medicine, Zagazig University was obtained and informed consent taken from all subjects prior to the study.

Measuring of PTX3 procedure by (ELISA), serum samples collected, allowed to clot for two hours at room temperature before centrifugation for 20 minutes at approximately 3000 rpm., then collect the supernatants

carefully, assay immediately or store samples in aliquot at -20C -80C. Avoid repeated freeze/thaw cycles. Reagent preparation and storage thorough wash Solution (1×) (dilute one volume of wash solution (20×) with nineteen volumes of deionized or distilled water). Diluted wash solution is stable for one month at 2-8°C. Undiluted wash solution and other reagents are stable for six months at 2-8°C.

When the kit is opened, all Micro-Elisa strip plate should be used up as soon as possible after removal the plate from the foil pouch, then unused wells return to the foil pouch containing the desiccant pack, and reseal along entire edge of zip-seal for preventing damps. The remaining reagents still need to be stored at 2-8°C. The valid period of this kit is six months at 2-8°C.

Assay procedure via ,firstly, prepare all reagents and bring all reagents and samples to room temperature (18°-25°C) naturally for 30min before starting assay procedure. It is forbidden to use hot water baths to thaw samples or reagents. It is recommended that all standards and samples be added in duplicate to the plate. Then, set standard wells, sample wells and control wells, add standard 50µl to each standard well, add sample 50µl to each sample well, add sample diluent 50µl to each control well. Add 100µl of horse radish peroxidase enzyme conjugate reagent to each well, cover with an adhesive strip and incubate for 60 minutes at 37°C.Then, wash the micro-titer plate 4 times

Calculation of results through average the duplicate readings for each standard and sample to subtract average optical density of the Control. Using the professional curve fitting software to make a standard curve (usually most of the curves are linear, and a few curves are quadratic or cubic) and calculate the concentration of the samples.

Abdominal ultrasound scans were performed by the same operator using a high-resolution B-mode scanner (SDD-5500; Aloka, Tokyo, Japan) 3.5MHz transducer, we graded the patient to mild, moderate and severe. Mild showed increased hepatic echogenicity with visible peri-portal and diaphragmatic echogenicity, moderate showed increased hepatic echogenicity with imperceptible peri-portal echogenicity without obscuration of diaphragm, severe showed increased hepatic echogenicity with imperceptible peri-portal echogenicity and obscuration of diaphragm[13].

Statistical analysis

Data were coded and entered using the statistical package SPSS (Statistical Package for the Social Sciences) version 24. Quantitative data was summarized by using mean, standard deviation, median, minimum and maximum . Comparisons between groups were done using unpaired t- test in normally distributed quantitative variables while non-parametric Mann-Whitney test was used for non-normally distributed quantitative variables. Quanlitative data was summarized by using frequency (count) and relative frequency (percentage)[14]. For comparing categorical data, Chi square ($\chi 2$) test was performed. Fisher's exact test was used instead when the expected frequency is less than 5[15]. Correlations between quantitative variables were done using Spearman correlation (r) coefficient[16]. P-values less than 0.05 were considered as statistically significant., P value >0.05 insignificant, P<0.05 significant, P<0.001 highly significant.

Results

Our study included 124 Egyptian subjects who attending outpatient clinic of Internal Medicine Department, Zagazig University Hospitals. They were divided according to ultrasound findings into 2 groups: Control group, 62 subjects with no evidence of NAFLD, 19 males (30.6%), and 43 females (69.4%), their ages ranged between 26-50 years with mean (38±5.9), and NAFLD group 62 patients with different ultrasound grades of NAFLD, 16 males (25.8%) and 46 females (74.2%), their ages ranged between 20-60 years with mean (40 ± 9.8).Serum PTX 3 level and routine laboratory investigations were done in all subjects of both groups.

Table (1): Baseline subject characteristics regarding sex and anthropometric measures (n=124)

parameter	NAFLD group (62)	Control group (62)	P value
Male n (%)	16 (25.8%)	19 (30.6%)	0.27 NS
Female n (%)	46 (74.2%)	43 (69.4%)	
Wt (range)	67--149	63--90	
Mean ±SD	93.2 ± 18.3	74.3 ± 7.6	<0.001 HS
Ht (m)	1.54 --1.89	1.58---1.82	
Mean ± SD	1.63 ± 0.11	1.62± 0.09	0.71 NS
BMI (kg/m2)	24.12--49.6	23.14—31.2	
Mean ± SD	34.5 ± 9.8	26.9 ± 3.9	<0.001 HS

NS: non-significant P>0.05 HS: highly significant Wt: weight Ht: height BMI: body mass index SD: standard deviation

Table (2) Laboratory investigations of both studied groups (n=124)

	NAFLD		Control		P value
	Mean ± SD	Min--max	Mean ± SD	Min--max	
PTX-3 (ng/ml)	2.9 ± 1.6	.49--7.9	.71 ± .33	.21--1.6	< 0.001 HS
LDL	141 ± 37.6	67--212	127.1 ± 29	56--181	0.02
HDL	36.9 ± 9	27--66	43.2 ± 11.3	23--71	0.001 HS
TG	157.9 ± 71.3	49--364	119.3 ± 28	39--189	<0.001HS
ALT	37.4± 23.9	11.0--136	25± 9.6	8.0--57	0.001 HS
AST	32.8 ± 18.5	12--90	24.3 ± 11.7	11.0--76.0	< 0.001 HS
GGT	43.0 ± 26.3	11--183	37.8 ± 12.5	9.0--63.0	0.15
ALP	76.2 ± 30.2	5.9--205	73.7 ± 23.0	38—151	0.59
Albumin	4.2 ± .46	3.5--5.0	4.1 ± .38	3.1--4.7	0.19

PTX-3: Pentraxin-3 LDL: Low density lipoprotein HDL: high density lipoprotein TG: triglyceride ALT: alanine aminotransferase AST: aspartate aminotransferase GGT: gamma glutamine transpeptidase ALP: alkaline phosphatase

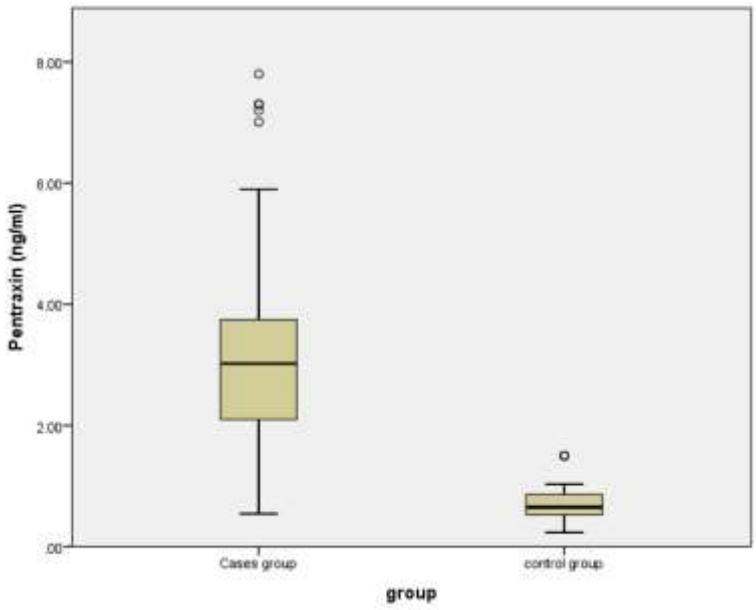

Figure (1): Serum pentraxin 3 level in both studied groups

Table (3): Comparison between males and females in the NAFLD group regarding pentraxin 3 (n=62)

	Male (16)		Female (46)		P value
	Mean ± SD	Min--Max	Mean ± SD	Min--Max	
PTX-3 (ng/ml)	3.1 ± 1.9	1.1--7.5	2.9 ± 1.7	.49--7.9	0.69

PTX-3: Pentraxin-3 SD: Standard deviation Min : minimum Max : maximum

Table (4): Distribution of different US grades in the NAFLD group (n=62)

	grade	Mean ± SD	P
Measurement of Rt Lobe of Liver	**14 Mild (22.6%)**	**16.14 ± 2.1**	**0.01 HS**
	33 moderate (53.2%)	**16.54 ± 1.8**	
	15 Severe (24.2%)	**18.06± 1.7**	

HS: highly significant (P=0.01) . LSD between mild vs moderate insignificant (P=1.00). Mild vs severe significant (P=0.02.) Moderate vs severe significant (P=0.03).

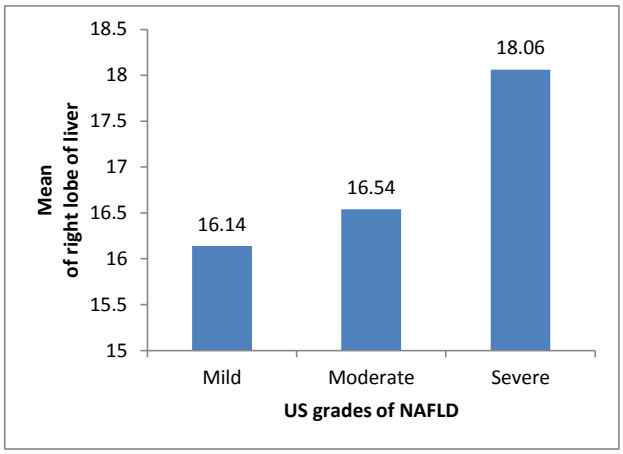

Figure (2) : Different ultrasound grades of NAFLD.

Table (5): Correlation between pentraxin-3 and other parameters in the NAFLD group

Parameter	Pentraxin 3	
	Correlation Coefficient (r)	P value
Age	0.137	.298
BMI	0.054	.682
LDL	0.163	.213
HDL	-0.066	.616
TG	0.104	.431
ALT	-0.122	.353
AST	-0.061	.642
GGT	-0.270	.037
ALP	-0.242	.063
Albumin	.032	.806
Bil. T	0.098	.454
Bil. D	-0.09	.944
Rt lobe of liver	-0.04	.761

LDL: Low density lipoprotein HDL: high density lipoprotein TG: triglyceride ALT: alanine aminotransferase AST: aspartate aminotransferase GGT: gamma glutamine transpeptidase ALP: alkaline phosphatase Bil T: bilirubin total Bil. D: bilirubin direct

Table (6): Anthropometric measures in different Ultrasound grades in NAFLD group

Parameter	US grades of NAFLD			
	Mild	moderate	severe	P value
	Mean ± SD	Mean ± SD	Mean ± SD	
wt	93 ± 15.6	91.2 ± 10.26	102 ± 23	0.07
Ht	1.63 ± .17	1.65 ± .11	1.61 ± .13	0.61
BMI	32.06 ± 7.84	33.1 ± 6.50	38.6 ± 5.9	0.02*
WC	99.4 ± 10.9	102.6 ± 9.72	113.2 ± 13.8	0.003*
HC	115.3 ± 12.8	117 ± 7.9	122.3 ± 17.6	0.24
W/H ratio	.87 ± .06	.89 ± .08	.92 ± .09	0.23

Wt: weight Ht: height BMI: body mass index WC: waist circumference HC: hip circumference W/H: waist / hip SD: standard deviation . BMI: significant P<0.05 WC: highly significant P<0.01

Table (7):The least significant difference (LSD) of BMI and waist circumference (WC) among sonographic grades of NAFLD.

US grade		Mild	Moderate	Severe
Severe	BMI	p=0.01	p=0.005	
	WC	p=0.006	p=0.003	
Moderate	BMI	p=0.59 NS		
	WC	p=0.35 NS		

Both BMI and WC are non-significant between mild and moderate grades only. However, both mild and moderate are highly significant with severe grade.

Table (8): Comparison between the different NAFLD US grades and Laboratory investigation

parameter	US grades of NAFLD			
	Mild	Moderate	Severe	P value
	Mean ± SD	Mean ± SD	Mean ± SD	
LDL	142.3 ± 27.4	141.4 ± 37.1	156.2 ± 38.6	0.35
HDL	40.8 ± 10.7	37.6 ± 7.9	36.9 ± 12.3	0.5
TG	134.1± 36.5	161 ± 48.9	165 ± 53.2	0.15
ALT	27.79 ± 17.18	40.2 ± 24.84	42.9 ± 12.9	0.11
AST	31.6 ± 16.8	35. ± 17	37.6 ± 12.3	0.67
GGT	35.6 ± 12.9	42.9 ± 36.2	40.3 ± 17.8	0.71
ALP	67.9 ± 23.9	74.3 ± 31.92	78.8 ± 32.1	0.61
BIL T	.41 ± .20	.45 ± .18	.55 ± .16	0.91
BIL D	.13 ± .10	.14 ± .07	.20 ± .13	0.12
ALBUMIN	4.01 ± .36	4.13 ± .43	4.11 ± .35	0.63
PTX-3 (ng/ml)	**2.59 ± 1.59**	**3.61± 1.8**	**3.72 ± 196**	**0.15**

LDL: Low density lipoprotein HDL: high density lipoprotein TG: triglyceride ALT: alanine aminotransferase AST: aspartate aminotransferase GGT: gamma-glutamyl transferase ALP: alkaline phosphatase Bil T: bilirubin total Bil D: bilirubin direct PTX-3: Pentraxin-3

Discussion

NAFLD is defind as hepatic steatosis without different reasons for hepatic fat aggregation, that joined by different degrees of inflammation and fibrosis, and can progress to liver cirrhosis and hepatocellular carcinoma[17]. NAFLD is the commonest chronic liver disease; the prevalence of simple steatosis and NASH in the general population is approximately 20-30% and 5-12%, respectively. However, in patients with obesity and type 2 diabetes mellitus (T2DM), NAFLD is more common, affecting up to 70% of subjects[18]. The diagnosis of NAFLD requires demonstration of hepatic steatosis by imaging or biopsy, exclusion of significant alcohol consumption and exclusion of diferent reasons of hepatic steatosis[17].

Pentraxin 3 (PTX 3) is a member of the pentraxin superfamily, it is quickly delivered by several cell types, in particular by mono-nuclear phagocytes, dendritic cells, fibroblasts and endothelial cells in response to primary inflammatory signals , it behaves as an acute phase response protein[19]. Predictable and significant rise of plasma PTX3 levels was seen in NASH in correlation with non-NASH. The outcomes recommend that plasma PTX3 levels may not exclusively be research facility marker that separate NASH from non-NASH, yet marker of the severity of hepatic fibrosis in NASH[19].

The aim of the study is to assess serum PTX3 level in Egyptian population with NAFLD, and to search the relation of serum PTX3 level and the ultrasound grades of severity of NAFLD.

The control group included 62 subjects who represented individuals with no evidence of NAFLD, their ages ranged from 26-50 years old with mean (38±5.9), they were 19 males (30.6%), and 43 females (69.4%). On the other hand, NAFLD group included 62 subjects with different sonogrphic grades (mild – moderate – sever), Their ages ranged from 20-66 years old with mean (40±9.8), they were 16 males (25.8%) and 46 females (74.2%). A statistically significant difference detected in body weight between the NAFLD group (93.2±18.3 kg) and the control group (74.3±7.6 kg) with (P value <0.001). Also it was noticed that there is statistically significant difference in BMI which was higher in NAFLD group (34.5±9.8 kg /m2) than in the control group (26.9±3.9 kg /m2) with (P value <0.001) as shown in table (1).

Our results agreed with the consequences of Patell and colleagues (2014) who found significant difference in body weight and BMI between NAFLD and non-NAFLD groups in Indian populatios[20]. Also, Du and colleagues (2016) found that body weight gain was connected with the NAFLD and metabolic syndrome in Chinese at early adolescence[21], additionally Loomis et al., (2016) demonstrated the solid connections among BMI and NAFLD/NASH and accentuate the significance of weight reduction for prevention and management of NAFLD[22]. Additionally , ko and colleagus (2017) found that larger WC, higher BMI, higher levels of body and visceral fat, and metabolic syndrome were significantly correlated with NAFLD[23].

Our results showed significant differences in lipid profile between NAFLD group and the control (non NAFLD) group, LDL was higher in NAFLD group (141±37.4 mg /dl) than in control (127.1±29 mg /dl) with statistically significant difference (P value= 0.02)as shown in table (2), also TG with higher in the NAFLD group (157.9±71.3 mg/dl) than in non-NAFLD (119.3±28 mg /dl) with (p value =0.001), while HDL was significantly lower in NAFLD group (36.9 ± 10 m/dl) than in control (43.2 ± 11.3 mg/dl) with (p value=0.001) that was in concurrence with Peng and colleagues (2017) who found significant positive association between dyslipidemia and NAFLD in adult males[24].

Our results showed significant elevation in ALT and AST in the NAFLD group, ALT was higher in NAFLD group (37.4±23.9 mg /dl) than in the control group (25±9.6 mg /dl) with (p value 0.001) likewise AST was higher in NAFLD group (32.8±18.5 mg/dl) than in the control group (24.3±11.7mg/dl) with (p value <0.001) and that was in concurrence with Sanyal and colleagues (2015) who found that NAFLD was significantly associated with higher alanine aminotransferase (ALT) and gamma-glutamyl transferase (GGT) but not ALP levels in impaired glucose tolerance and T2DM patients[25].

Also our results showed that pentraxin 3 level is significantly higher in NAFLD group (2.9 ±1.6 ng/ml) than control group (0.7±0.33 ng/ml) with statistically significant difference (P value < 0.001) as shown in table (2) & figure (1), and that was in concurrence with the previous studies that researched serum pentraxin 3 as non-invasive marker of steatosis[12, 19, 26, 27].

Yoneda and colleagues (2008) were the first to exhibit consistent and significant rise of plasma PTX3 levels in NASH in comparison with non-NASH, there was No significant difference of plasma PTX3 levels was observed between the simple steatosis and control groups[12]. A stepwise increment in plasma PTX3 levels was found as the stages of hepatic fibrosis expanded. PTX3, nonetheless, was not related to either hepatic steatosis or necro-inflammation grade. Boga and colleagues (2015) they demonstrated higher PTX3 levels in NAFLD patients compared with controls, and in biopsy proven NASH patients compared with non-NASH ones[19].

In our study, we didn't find difference between males and females in NAFLD group (P=0.69) as shown in table (3). Also, there was no relation between serum PTX-3 level and degree of steatosis as shown in table (8) . Despite that PTX-3 was apparently increased in the values of mean from mild to moderate, and from mild to severe but didn't reach statistical significance (P=0.15) and that was in concurrence with Malwki and colleagues (2014) who investigated pentraxin 3 in 32 NAFLD cases and 34 controls. Liver biopsy was performed for all cases. They concluded that Pentraxin-3 had no efficacy in differentiating different levels of NAFLD and fibrosis[28].

On the other hand, our results disagree Yoneda et al., (2008), and Boga et al., (2015) regarding the relation of serum PTX3 level with the severity of steatosis. Yoneda et al., (2008) reported that PTX3 levels are closely associated with the stages of hepatic fibrosis, and the plasma PTX3 levels in patients with stage3-4 NAFLD are significantly elevated in comparison with patients with stage 0-2 NAFLD (p <0.0001), thereby indicating that PTX3 levels are strongly correlated with disease severity,[13].

The difference between the results might be clarified on the light of ethnic variety, technique for assessment of pentraxin 3, strategy for assessment of liver steatosis (ultrasound in our investigation while liver histopathology in their examinations), also the difference in exclusion criteria and the percentage of mild and moderate stages (75.8% of the NAFLD group in our study in table(4)) which represented as grey zone in Yoneda et al., (2008)[12] .

As regard the relation with the severity , no significant difference between the different grades of NAFLD as detected by ultrasound and the lipid profile as shown in table(5) . Despite that the relation with ALT and AST, they were higher in severe cases than in mild cases of NAFLD but these differences didn't reach statistical significance and that was in concurrence with Oh et al., (2008)[29] and Cuenza et al., (2017) [30].

There was a statistically significant relation detected between the grades of severity of NAFLD as identified by ultrasound and the anthropometric measures (BMI and waist circumference) ,and that was in agreement with Subramanian et al., (2013)[31] and Yanyan et al., (2014)[32]. The Least significant difference (LSD) regarding BMI and WC are non-significant between mild and moderate grades . However, mild versus severe and moderate versus severe were highly significant as shown in table (6),(7).

Conclusion

In light of the findings obtained from our study, the plasma PTX3 level was significantly higher in NAFLD patients than non-NAFLD patients thereby suggesting that plasma PTX3 can be utilized as non- invasive biomarker to recognize NAFLD from non-NAFLD and valuable for focused treatment against fibrosis in NASH patients, however it is constrained in determining disease severity in ultrasound . It might be utilized in the coming days as indicator for the severity of NAFLD, it needs further work up on larger scale of enrolled patients.

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