The Relationship between the Thickness of Subcutaneous Fat and Abdominal Circumference with Ultrasonographic Grading Scale in a Non-Alcoholic Fatty Liver

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Abstract

Introduction: Nonalcoholic fatty liver disease is one of the most common cause of liver cirrhosis and following that causing mortality that identification of risk factors can reduce the complications. The aim of this study was to investigate the relationship between the thickness of subcutaneous fat and measuring waist with a degree of sonography in nonalcoholic fatty liver.

Methods: The study included 100patients with nonalcoholic fatty liver. The demographic data and consent, thickness of subcutaneous fat and waist circumference and grade fatty liver for all persons were recorded. T, chi-square, ANOVA was used to compare the data.

Results: Our results showed that increasing the degree of NAFLD is directly correlated with the increased waist circumference (P<0.001), hip circumference (P<0.05), and the thickness of subcutaneous fat (P<0.001) as well as the ratio of waist to hip circumference (P<0.05).

Conclusion: Our study showed that the thickness of subcutaneous fat is a predictor factor in determining the degree of NAFLD.

Keywords: Nonalcoholic fatty liver, thickness of subcutaneous fat, waist circumference

INTRODUCTION

Non-alcoholic fatty liver disease or NAFLD is the most common cause of hepatic steatosis [1], which causes liver damage, including simple steatosis, steatohepatitis, progressive fibrosis, cirrhosis, and hepatocellular cancer [2-4]. The prevalence of this disease because of the presence of its risk factors (obesity, diabetes, insulin resistance, dyslipidemia, and systemic hypertension) is rising dramatically in Iran and in the world [5-10], so that liver cirrhosis is the third leading cause of death and the first cause of hospitalization in the Gastroenterology and Hepatology Ward of hospital [8]. Although this disease is rising, its pathogenesis has not been known correctly. However, fat tissue secretes adipokines, which can be an important factor in the increase of liver fat deposite. In addition, metabolism of fatty acids in the liver can be another important factor [11]. These fatty acids can be created by eating or the secretion of free fatty acids from adipose tissue including Subcutaneous fat reserves and intra-abdominal fat reserves that divided into intraperitoneal and retroperitoneal reserves. Venous drain of subcutaneous fat into the blood flow is systemic, but venous drain of visceral fat is to portal vein. Metabolic products reach directly to the liver that affects the hepatic metabolism [13]. However, in people who have a visceral obesity, more than 50-60% transportation of free fatty acids to liver is performed through systematic blood flow. [14,15]. Sonography is accurate method to measure subcutaneous fat and mesenteric fat [16]. Increasing fatty liver disease with its complex and uncontrolled complication have created challenges in understanding and finding the patient, since there is no conclusive evidence on

direct relationship between the subcutaneous fat thickness and the amount and severity fatty liver and previous Studies conducted have not been able to specify this relationship and they are unable in describing the biochemical events arising from fatty liver. In the present study, the severity of the accumulation of fat in the liver (rate of echogenicity) was compared with abdominal circumference, hip circumference and subcutaneous fat thickness.

Methodology

This descriptive-analytical study is a cross-sectional and prospective type of study. Patients of this study included all patients with nonalcoholic fatty liver admitted to Amirolmomenin Hospital. Considering the study performed in 2005 entitled the relationship between body mass index and abdominal circumference and NAFLD grade and considering 95% confidence level, test power of 80%, 100 people were considered for this study (3). Inclusion criteria of study included patients with nonalcoholic fatty liver admitted to Amirolmomenin Hospital that consent to participate in the study. Exclusion criteria included patients who had no obvious cause for fatty liver, including hyperlipidemia, diabetes, systemic hypertension and hypothyroidism, alcohol consumption, and lack of current pregnancy and lack of consent to participate in the study.

In this study, all patients with fatty liver were studied for 12 months and in the case of lack of exclusion criteria (hyperlipidemia, diabetes, systemic hypertension and hypothyroidism, alcohol consumption and current pregnancy), they were introduced for sonography and measurement of subcutaneous fat. Using sonography , the grade of fatty liver was graded based on grade 1 and grade

2 and 3 and the value of subcutaneous fat was measured by sonography device.hip and abdominal circumference were measured,too.

Statistical analysis

All information of patients, including demographic factors and clinical symptoms, was recorded in checklist and it was entered to SPSS 18 software, and statistical analyses were presented in two descriptive and analytical parts. In the descriptive part, the mean and standard deviation of subcutaneous fat was introduced as main variable in the various groups and all demographic and clinical characteristics of patients were reported based on descriptive criteria. In the analytical part, due to holding statistical presumptions, relevant parametric and non-parametric tests were used. For the analysis of qualitative findings, Chi square test was used, and for the analysis of quantitative data, T independent test and ANOVA were used. All tests were examined at the error level of 5%.

FINDINGS

This study was included 100 people, which 55 people (55%) were male, and 45 people (45%) were female. the mean age of patients is 56.29 ± 12.09 years, which the lowest age was 31 years and maximum age was 80 years. The mean BMI was equal to 28.68, and the mean abdominal circumference was 96.74 cm, mean hip circumference was 100.77 cm, and mean subcutaneous fat thickness was 2.85 cm. The results of our study showed a significant relationship between demographic variable (age and gender) and main variable including fatty liver, abdominal circumference, hip circumference, and subcutaneous fat thickness ($P> 0/05$). Mean abdominal circumference has significant relationship with fatty liver grade so that the highest mean abdominal circumference was found in patients with grade 3 fatty liver (105.04 cm) and the lowest mean abdominal circumference was found in patients with grade 1 (91.96 cm) ($P <0/001$). In addition, mean hip circumference has significant relationship with grade of fatty liver so that the highest mean hip circumference was found in patients with grade 3 fatty liver (106.34 cm) and the lowest hip circumference was found in patients with grade 1 (97.02 cm m) ($P = 0/005$). subcutaneous fat thickness has a significant relationship with fatty liver grade so that the highest fat thickness was found in patients with grade 3 fatty liver (3.7) and the lowest amount of it was found in patients with grade 1 (2.29) ($P <0/001$). It was also found that the ratio of abdominal circumference to hip circumference has a significant correlation with the grade of fatty liver so that the highest ratio was found in patients with grade 3 (0.98) and the lowest ratio was found in patients with grade 1 (0.94) ($P = 0.024$).

DISCUSSION

The results of our study showed that the mean abdominal circumference has a significant relationship with the grade of fatty liver so that the highest mean abdominal circumference was seen in patients with grade 3 fatty liver (105.04 cm) and the lowest amount of it was found to patients with grade 1 (91.96 cm). In addition, the mean hip circumference has a significant relationship with the grade of fatty liver so that the highest mean hip circumference was seen in patients with grade 3 fatty liver (106.34 cm) and the lowest amount of it was seen in patients with grade 1 (97.02 cm). It was in line with the results of the study conducted by Shen et al in Japan in 2003 entitled prevalence of non-alcoholic fatty liver.

The results of this study showed that the mean abdominal circumference has a significant relationship with liver fat grade so that the highest mean abdominal circumference was found in patients with grade 3 fatty liver (99.94 cm) and the lowest amount of it was seen in patients with grade 1 (78.60 cm). in addition, the mean hip circumference has a significant relationship with the grade of fatty liver so that the highest mean hip circumference was seen in patients with grade 3 (100.12 cm) and the lowest amount of it was seen in patients with grade 1 (88.74 cm) [17].

Table 1: Mean and standard deviation of the studied variables in terms of fatty liver grading

Variable	Fatty liver grade	N	Mean	SD	P-value
Abdominal circumference cm)(	Grade 1	38	91.96	9.68	<0.001
	Grade 2	39	96.51	11.95	
	Grade 3	23	105.04	9.56	
	Total	100	96.74	11.61	
Hip circumference (cm)	Grade 1	38	97.02	9.25	0.005
	Grade 2	39	101.12	12.77	
	Grade 3	23	106.44	8.5	
	Total	100	100.77	11.1	
Fat thickness (cm)	Grade 1	38	2.29	0.23	<0.001
	Grade 2	39	2.89	0.04	
	Grade 3	23	3.7	0.37	
	Total	100	2.85	630.63	
Abdominal circumference / hip circumference	Grade 1	38	0.94	0.068	0.024
	Grade 2	39	0.95	0.044	
	Grade 3	23	0.98	0.04	

The study conducted by Cortez-Pinto et al in 1999 entitled the relationship between non-alcoholic fatty liver disease and metabolic disease. Results of the study also showed that there is a direct relationship abdominal circumference size and hip circumference size and grade of fatty liver. It was also found that as non-alcoholic fatty liver grade increases, great number of people will be affected by metabolic syndrome criteria so that 95% of people who had grade 3 fatty liver completed metabolic syndrome criteria, while only 20% of people who have grade 1 fatty liver and 45% of people who had grade 2 fatty liver will include metabolic syndrome criteria [18].Enhesari et al performed a study in 2010 to examine the relationship between mesenteric fat thickness and fat accumulation in patients with nonalcoholic fatty liver. The results of this study showed that the echogenicity grade of the liver as an indicator of the severity of fatty liver has significant relationship with abdominal circumference (p = 0.001) [19]. The result of studies were similar to our study.

However, it was inconsistent with a study conducted in 2011 by Flegal et al entitled prevention and the prevalence of obesity in America in 2009 and 2010, their results showed that the highest mean of the hip and abdominal circumference was seen in grade 2 fatty liver,however the current study did not find relationship between abdominal circumference and hip circumference with grade of fatty liver. This inconsistency can be due to larger size of population of the study compared to our study and lack of considering the exclusion criteria (systemic hypertension, hyperlipidemia, hypothyroidism, and current pregnancy, etc) in their study. [20].

The results of our study showed that the mean thickness of the subcutaneous fat has a significant relationship with fatty liver grade so that the highest thickness of subcutaneous fat was seen in patients with grade 3 fatty liver (3.7cm) and the lowest amount of it was seen in patients to grade 1 (2.29cm), which it was in line with the results of the study conducted by Enhesari et al to examine the relationship between the thickness of mesenteric fat and fat accumulation in the non-alcoholic liver fatty disease in 2010. The results of this study showed that among the people studied, 13.3 % are lack of non-alcoholic fatty liver, 55.2% have mild fatty liver 2, 23.8% had moderate, and 7.6% have severe fatty liver. The echogenicity grade of liver as an indicator of the severity of fatty liver has a significant correlation with subcutaneous fat thickness (p <0.001) and mesenteric fat thickness (p <0.001) [19].

In addition, it is similar to results of the study performed by Roberto Velloso Eifler in 2013, which this study showed a significant relationship between the thickness of the skin fat and liver steatosis followed by non-alcoholic fatty liver [21].

Our result is similsr to result of Andrade LJ et al who examined the relationship between skin fat thickness and visceral fat with nonalcoholic fatty liver grade. This study showed that the mean age of the 225 women (63.9%) and 127 men (36.1%) was 47.5 (18-77) years, and 255 patients had normal tests, and among 97 patients with NAFLD, 37 patients had grade 1, 32 patients had grade 2, and 28 people had grade 3. Subcutaneous fat thickness was in the range of

3.5 to 0.26 cm with mean of 1.3 ± 0.6 cm and a thickness of visceral fat was in the range of 0.83 to 8.86 cm with mean of 3.6 ± 1.7 cm. Linear regression showed with 1 cm increase in subcutaneous fat thickness, visceral fat thickness increases by 0.9 cm, and both have significant correlation with fatty liver grade [22]. It was similar to the results of the study performed by Fukuda K et al who examined the relationship between NAFLD and skin fat thickness. The results of this study showed that among 340 people, 209 people (61%) were diagnosed with NAFLD. Abdominal skin fat thickness in patients with NAFLD was significantly higher than that in people without NAFLD. Among 209 patients with NAFLD, 31 (15%) were diagnosed with advanced NASH. The multivariate analysis showed that the abdominal skin fat thickness is recognized as a factor in predicting advanced fibrosis and it has a direct relationship with non-alcoholic fatty liver grade [23]. However, the results of this study was different to results of Ruhl et al entitled the relationship between trunk fat and fatty liver in the United State of America. The results of this study showed, subcutaneous fat thickness range was 4.30 to 0.69 cm and mean of it was 2.1 ± 1 cm and visceral fat thickness range was 7.67-0.95 cm with mean of 4.1 ± 1.2 cm, which these results showed a significant relationship between increased thickness of subcutaneous fat and visceral fat. However, this research could not find direct relationship between increased subcutaneous fat thickness and visceral fat thickness and sonographic grade of fatty liver, which the maximum thickness of subcutaneous fat was almost equal in all three grades of fatty liver with relative superiority of grade 2 fatty liver [24]. This inconsistency could be due to one of the following reasons:The difference in sonographic criteria and operator and Non-considering of exclusion criteria (systemic hypertension, hyperlipidemia, hypothyroidism, current pregnancy, alcohol consumption) in this study

CONCLUSION

Based on these findings, it could be said that obesity and high abdominal circumference, hip circumference, and thickness of subcutaneous fat as well as the ratio of abdominal to hip circumference are correlated with disease severity in patients with nonalcoholic fatty liver, so these factors can be used to predict the severity of nonalcoholic fatty liver disease to start the treatment and prevention earlier to prevent disease progression.

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