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Original Research Article

Evaluation of Fatty liver Infiltration Using Ultrasound among Sudanese Population

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Abstract: The main objective of this study is to evaluate fatty liver infiltration in Sudanese population using ultrasonography. This was a descriptive cross section study deals with assessment of patient affected with fatty liver infiltration using ultrasonography. The study conducted on141 patients confirmed fatty liver by routine transabdominal ultrasound carried out during the period from January to August 2016. Study was conducted in Khartoum state, Sudan, in different ultrasound departments of Khartoum hospitals and medical diagnostic centers. The analysis showed that 86 cases (61%) were female and 55 cases (39%) were male. The Prevalence was high among the age group (31-60) which represented 49 cases by (34, 8%). Most patients were overweight 124 cases (87.9%). Regarding patients' habit (alcoholic consumptions) and history of chronic disease (diabetic and hypertensive), most common affected disease was diabetic 47 patients (33.3%). Most patients were a symptomatic 76 cases (53.9%). Most patients affected by diffuse fatty infiltration and the most prominent. Liver size in most patients (75) by (53%) was normal, and (63) by (44.5%) had hepatomegaly. Most patients (66) by (46.8%) had a moderate degree of fatty infiltration. Also found there was strong positive relation between patient habit and history of disease and degree of fatty infiltration and liver size. No correlation found between patient's body mass index and degree of fatty infiltration. Study recommended that transabdominal ultrasonography should use as routine examination for high risk patient affected with fatty liver disease.
Keywords: fatty liver, infiltration, ultrasonography

INTRODUCTION

The liver is an intraperitoneal structure situated in the right upper quadrant of the abdomen and bounded superiorly by the diaphragm. The size and shape of the liver are highly variable [1]. The liver is the largest and most important metabolic organ in the body; it can be viewed as the body's major biochemical factory. Its importance to the digestive system as its secretion of bile which aid fat digestion and absorption. The liver also performs a variety of functions not related to digestion, including the following; metabolic processing, detoxifying or degrading body wastes and hormones, synthesizing plasma proteins, excreting cholesterol and bilirubin [2].

Fatty infiltration is a benign process and may be reversible with correction of the process, although it has been shown that fatty infiltration of the liver is the precursor for significant chronic disease in a percentage of patients. The patient is usually asymptomatic; however, some patients may present with jaundice, nausea and vomiting, and abdominal tenderness or pain [3]. Courses of Fatty liver includes obesity, excessive alcohol intake (alcohol stimulates lipolysis), poorly controlled hyperlipidemia, diabetes mellitus, excess corticosteroids, pregnancy, total Parenteral Hyper alimentation (nutrition), severe Hepatitis, glycogen Storage Disease, cystic Fibrosis, pharmaceutical and chronic Illness [3]. Fatty infiltration can be affect whole liver (diffuse) or specific area (focal). Also can be classified as mild, moderate and sever. Sonography of fatty infiltration varies depending on the amount of fat and whether deposits are diffuse or focal [4].

Ultrasound is a useful but imperfect tool in evaluating diffuse liver disease. Sonography can show

hepatomegaly, fatty infiltration of the liver, and cirrhosis, all with good but imperfect sensitivity and specificity. Increased parenchymal echogenicity is a reliable criterion for diagnosing fatty liver. Ultrasonography is a cost-effective imaging technique for the diagnosis of hepatic steatosis in clinical practice, Ultrasonography has a reasonable accuracy in detecting moderate-to-severe hepatic steatosis although it is less accurate for detecting mild hepatic steatosis, operator-dependent, and rather qualitative. Ultrasound elastography increasingly used to evaluate the degree of liver fibrosis in patients with NAFLD and to differentiate NASH from simple steatosis [5].

OBJECTIVES

To evaluate fatty liver infiltration in Sudanese population using ultrasonography.

MATERIAL & METHODS

This was Descriptive cross-sectional study. Sample frame was compromised of 141 confirmed fatty livers by ultrasound. Selection of participants was done through random probability sampling technique on patient with fatty liver disease. Study variables were, age –sex –BMI, history of disease (diabetic-hypertensive), patient habit (alcoholic or none), size of liver, echogenicity of liver and type and degree of fatty liver infiltration. Data was collected by data collection sheet which designed to include all variable that satisfy the study. Ultrasound scanning reports of the liver following international scanning guidance and protocol for ultrasound scan. The researcher performed some ultrasound scanning for the patients of the sample and the other scans done by working radiologist and technologist on hospitals and centers. A total of 141 patients with confirmed fatty liver disease by ultrasound at different Hospitals in Khartoum where were screened for any intra-abdominal abnormalities by abdominal ultrasonography (US), all of 141 are adult patients from different age group, after taken their weight and height to calculate their body mass index using following formula: BIM= {Weight in kg ÷ (Height in m) 2} = (kg/m2**)** [36].

RESULTS AND DISCUSSION

Out of 141; 86 cases (61%) were female and 55 cases (39%) were male, the percentage of female patients was reported to be as high as 75%; however, in subsequent studies, the percentage fell to roughly 50% [38]."Also may relate to that one reason for the gender difference in obesity may be that fluctuations in reproductive hormone concentration throughout women's lives uniquely predispose them to excess weight gain"[39].This agreed with (Bibek Khadka *et al.;* in 2016) whose found that the incidence increase in female (57.1%). The prevalence was high among the age group (31-60) which represented 49 cases (34, 8%). With (mean age= 48.4, minimum=17, maximum=85, STD=14.39). This result matched with (*Giovanni Targhe, et al.;* in 2007.) and (Carey *et al.;* in 2013) who's found that, the prevalence of NAFLD increased with increasing patient age.

About patients body mass index BMI; most patients on this study are overweight 124 cases (87.9%). Regarding patients habit and history of disease, the study showed that most patients 50 cases (35.5%) were haven't history of diseases, followed by diabetic patients 47 cases (33.3%), then hypertensive patients 22cases (15.6%), patients affected with both diabetic and hypertension was16 cases (11.3%), alcoholic 6 cases (4.3%). The results matched to literature "which showed that most common Causes of Fatty Liver: Obesity, Diabetes mellitus, poorly controlled hyperlipidemia, chronic illness, Excessive alcohol intake [3]. Increase incidence of diabetic patients in the study consistent with literature which found that most common form of liver disease in patients with diabetes was nonalcoholic fatty liver disease (NAFLD). 20-50% patients with NAFLD have diabetes". (15) And lowest frequency of alcoholic consumption in the study may assume to the (religion) Islamic nature of our country. This result consistent with(Emily Carey *et al.;* in 2013) whose found The prevalence of overweight persons (body mass index [BMI] ≥25 kg/m2) in the united states(US) has risen to more than 65% of population; that the most common cause Most patients have associated features of the metabolic syndrome: obesity (47%), diabetes mellitus (28%), and variable incidences of hyperlipidemia (4%) and hypertension. Also aligned with (*Giovanni Targher et al.;* in 2007).Whose found NAFLD is extremity common in people with type 2 diabetes.

Regarding clinical presentation most patients were a symptomatic 76 cases(53.9%) while RUQP in 29 patients (20.6%) is most prevalence symptom in symptomatic patients, this consistent with literature; "Nonalcoholic fatty liver disease usually causes no signs and symptoms (a symptomatic) when it does, they may include: Pain in the upper right abdomen, Fatigue [17].These results aligned with (Emily Carey *et al.;* in 2013) whose found that most cases are a symptomatic and the most common symptoms that bring NAFLD to medical attention are malaise, fatigue, and right upper quadrant pain or diffuse abdominal discomfort.

Corresponding liver size; study found 75 patients with (53%) were normal, while 63 patients with (44.5%) showed liver enlargement, only 3pateints with (2.1%) had shrunk liver. (With; mean=15.45, minimum=10.4, maximum=19.6, std=1.83). This results unmatched to literature; "Fatty infiltration is associated with hepatomegaly [1], attributed to wrong measurement done by radiologist or sonographer technologist in some centers and hospitals. (The measurement wasn't always including all parameter). About degree of fatty infiltration most affected patients 66 with (46.8%) had moderate degree. Disagreed with (Bibek Khadka *et al.;* in 2016) whose found the highest prevalence contributed to mild degree fatty infiltration which observed in 55.1%. Corresponding to other finding associated with fatty infiltration; focal fatty sparing was observed in 2 patients with (1.4%), while 139 patients with (98.6%) hadn't associated finding that attributed to the small sample size.

The study found that there was strong positive relationship between patient habit (alcohol consumption) and history of chronic disease (diabetic and hypertensive) and degree of fatty infiltration with person Chi –square test 0.000. The results agreed with literature "that found alcoholic and diabetic are strong risk factors to develop moderate and severe degree of fatty infiltration and this attributed to duration of disease and heavy drinking alcohol". "Regarding Alcohol; it turns some liver cells into fat and damages others. Repeated heavy drinking scars the liver (cirrhosis) and causes permanent damage which can cause death [40]. Most of the alcohol that people drink is metabolized in the liver. The major pathway for alcohol metabolism involves the enzyme alcohol dehydrogenase (ADH) [41]. Literature realized "that risk factors for rapid progression of NAFLD are type II diabetes, obesity, older age and metabolic syndrome. a prospective study on 148 consecutive diabetic patients without clinical evidence of liver disease. 49 patients had evidence of fatty liver on ultrasound. 32 out of these 49 patients under went liver biopsy. Out of 32 patients undergoing liver biopsy 10% had severe NASH (Grade III & IV fibrosis) [15]. Study found strong correlation between liver size (AP diameter of Rt lobe) and degree of fatty infiltration. This consistent with whose found NAFLD High body mass index, high waist circumference, diabetes and hypertriglyceridemia were associated with high hepatic attenuation and large anteroposterior diameter of the right hepatic lobe. No correlation found between patients body mass index and degree of fatty infiltration with person Chi –square test .687. This contributed to; most patients in the study are overweight 124 patients (87.9%). Week positive correlation found between patients gender and degree of fatty infiltration with person Chi –square test .046

Table 1: Frequency distribution of patient Age group

Age group	Frequency	Percent	Valid Percent	Cumulative Percent
15- 30 years	16	11.3	11.3	11.3
31- 45 years	49	34.8	34.8	46.1
46-60 years	49	34.8	34.8	80.9
61- 75 years	20	14.2	14.2	95.0
more than 75 years	7	5.0	5.0	100.0
Total	141	100.0	100.0	
Mean= 48.4468, minimum = 17, maximum = 85, std= 14.39465				

Table 2: Frequency distribution of Patient gender

Gender	Frequency	Percent	Valid Percent	Cumulative Percent
Male	55	39.0	39.0	39.0
Female	86	61.0	61.0	100.0
Total	141	100.0	100.0	

Table 3: Frequency distribution of Patient Habit and History of Diseases

History	Frequency	Percent	Valid Percent	Cumulative Percent
Alcoholic	6	4.3	4.3	4.3
Diabetic	47	33.3	33.3	37.6
Hypertensive	22	15.6	15.6	53.2
Diabetic and Hypertensive	16	11.3	11.3	64.5
No History of Disease	50	35.5	35.5	100.0
Total	141	100.0	100.0	

Table 4: Frequency distribution of patient Body Mass Index

BMI	Frequency	Percent	Valid Percent	Cumulative Percent
Normal	16	11.3	11.3	11.3
Over weight	124	87.9	87.9	99.3
Under weight	1	.7	.7	100.0
Total	141	100.0	100.0	

Table 5: Frequency distribution of patient clinical Presentation

Clinical	Frequency	Percent	Valid Percent	Cumulative Percent
A symptomatic	76	53.9	53.9	53.9
Symptomatic	65	46.1	46.1	100.0
Total	141	100.0	100.0	

Table 6: Frequency distribution of patient sign and symptoms

Sign and symptom	Frequency	Percent	Valid Percent	Cumulative Percent
RUQP	29	20.6	20.6	20.6
Fever	1	.7	.7	21.3
Nausea	3	2.1	2.1	23.4
Vomiting	2	1.4	1.4	24.8
Loss of appetite	3	2.1	2.1	27.0
No	76	53.9	53.9	80.9
RUQP& Fever	3	2.1	2.1	83.0
RUQP & loss of appetite	3	2.1	2.1	85.1
RUQP, Nausea, Vomiting, Loss of appetite	6	4.3	4.3	89.4
Nausea & Vomiting & Loss of appetite	2	1.4	1.4	90.8
Fever.Nausea.Loss of appetite	5	3.5	3.5	94.3
Fever.Nausea.vomiting	3	2.1	2.1	96.5
Nausea & loss appetite	5	3.5	3.5	100.0
Total	141	100.0	100.0	

Table 7: Frequency distribution of patient Liver Size

Liver size	Frequency	Percent	Valid Percent	Cumulative Percent
Normal	75	53.2	53.2	53.2
Enlarge	63	44.7	44.7	97.9
Shrunk	3	2.1	2.1	100.0
Total	141	100.0	100.0	
Mean= 15.45, minimum= 10.4, maximum =19.6, std=1.83262				

Table 8: Frequency distribution of patient degree of fatty infiltration

Degree	Frequency	Percent	Valid Percent	Cumulative Percent
Mild	52	36.9	36.9	36.9
Moderate	66	46.8	46.8	83.7
Severe	23	16.3	16.3	100.0
Total	141	100.0	100.0	

Table 9: Frequency distribution of other finding associated with fatty infiltration

Other	Frequency	Percent	Valid Percent	Cumulative Percent
Focal fatty sparing	2	1.4	1.4	1.4
No other finding	139	98.6	98.6	100.0
Total	141	100.0	100.0	

Table 10: a- Patient Habit and History of Diseases * Degree of Fatty Infiltration Crosstabulation

History	Degree of Fatty Infiltration			Total
	Mild	Moderate	Severe	
Alcoholic	0	1	5	6
Diabetic	15	21	11	47
Hypertensive	10	10	2	22
Diabetic and Hypertensive	4	10	2	16
No History of Disease	23	24	3	50
Total	52	66	23	141

Table 10: b- Chi-Square Tests Patient Habit and History of Diseases * Degree of Fatty Infelteration

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	28.858(a)	8	.000
Likelihood Ratio	24.129	8	.002
Linear-by-Linear Association	10.111	1	.001
N of Valid Cases	141		

a 5 cells (33.3%) have expected count less than 5. The minimum expected count is .98.

Table 10: c- Symmetric Measures Patient Habit and History of Diseases * Degree of Fatty Infelteration

		Value	Asymp. Std. Error(a)	Approx. T(b)	Approx. Sig.
Interval by Interval	Pearson's R	-.269	.081	-3.289	.001(c)
Ordinal by Ordinal	Spearman Correlation	-.259	.082	-3.160	.002(c)
N of Valid Cases		141			

a Not assuming the null hypothesis.
b Using the asymptotic standard error assuming the null hypothesis.
c Based on normal approximation.

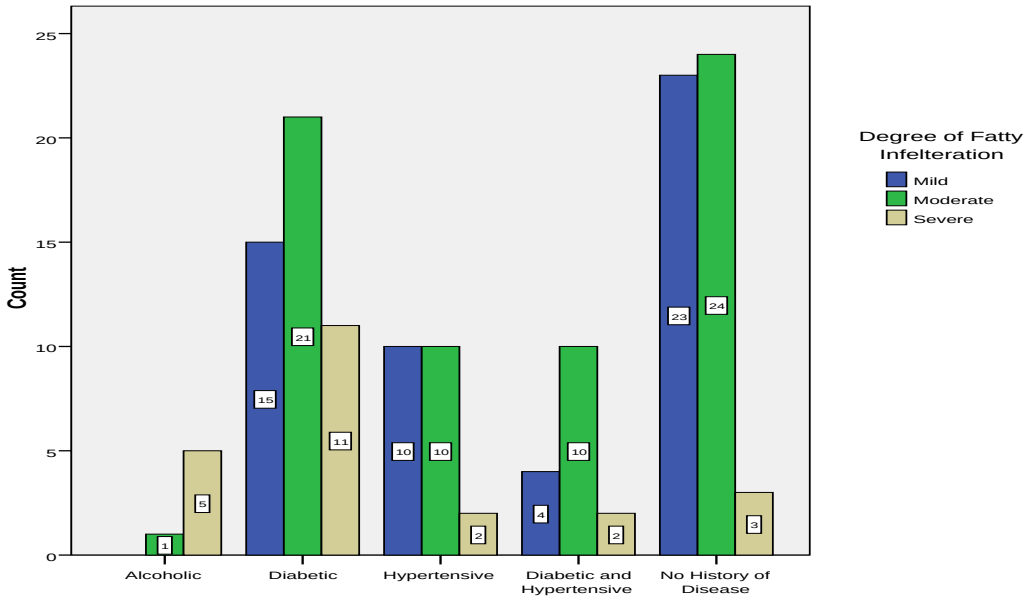

Fig-1: Cross tabs between patient habit, history of diseases and degree of fatty infiltration

Table 11 a- Body Mass Index * Degree of Fatty Infelteration Crosstabulation

BMI	Degree of Fatty Infelteration			Total
	Mild	Moderate	Severe	
Normal	6	6	4	16
Over wieght	46	59	19	124
Under wieght	0	1	0	1
	52	66	23	141

Table 11 b- Chi-Square Tests Body Mass Index * Degree of Fatty Infelteration

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.266(a)	4	.687
Likelihood Ratio	2.567	4	.633
Linear-by-Linear Association	.155	1	.694
N of Valid Cases	141		

a 4 cells (44.4%) have expected count less than 5. The minimum expected count is .16.

Table 11 c- Symmetric Measures Body Mass Index * Degree of Fatty Infelteration

		Value	Asymp. Std. Error(a)	Approx. T(b)	Approx. Sig.
Interval by Interval	Pearson's R	-.033	.090	-.393	.695(c)
Ordinal by Ordinal	Spearman Correlation	-.025	.089	-.294	.769(c)
N of Valid Cases		141			

a Not assuming the null hypothesis.

b Using the asymptotic standard error assuming the null hypothesis.

c Based on normal approximation.

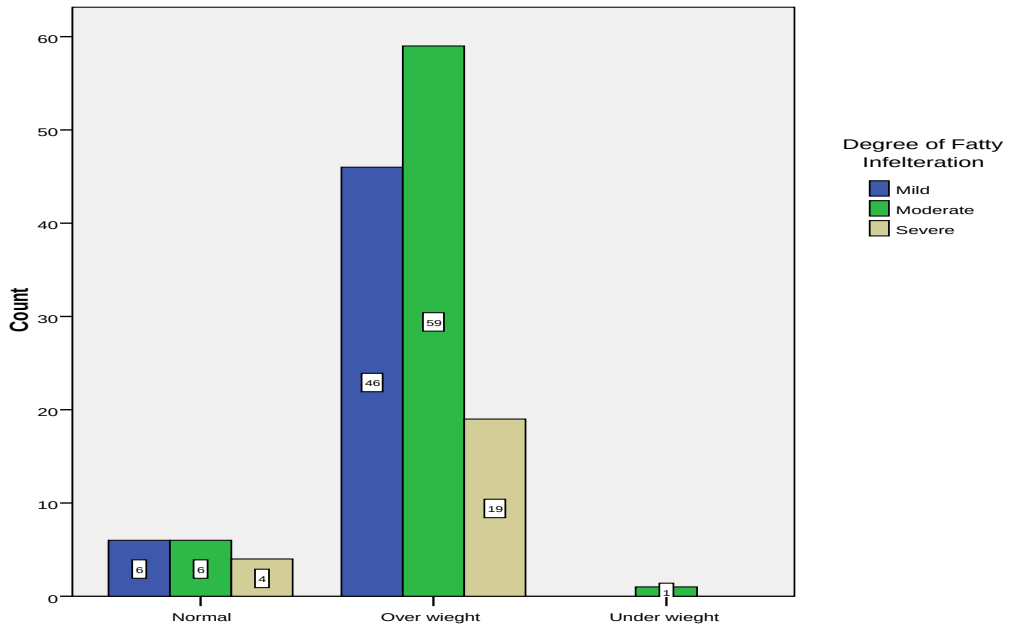

Fig-2: Cross tabs between Body mass index and degree of fatty infiltration

Table 12 a- Cross tabulation of pt sex and degree of fatty infilteration

Sex	Degree of Fatty Infelteration			Total
	Mild	Moderate	Severe	
Male	16	25	14	55
Female	36	41	9	86
	52	66	23	141

Table 12 b- Chi-Square Tests pt sex and degree of fatty infilteration

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6.139(a)	2	.046
Likelihood Ratio	6.036	2	.049
Linear-by-Linear Association	5.242	1	.022
N of Valid Cases	141		

a 0 cells (.0%) have expected count less than 5. The minimum expected count is 8.97.

Table 12 c- Symmetric Measures pt sex and degree of fatty infilteration

		Value	Asymp. Std. Error(a)	Approx. T(b)	Approx. Sig.
Interval by Interval	Pearson's R	-.194	.083	-2.325	.022(c)
Ordinal by Ordinal	Spearman Correlation	-.185	.083	-2.224	.028(c)
N of Valid Cases		141			

a Not assuming the null hypothesis.

b Using the asymptotic standard error assuming the null hypothesis.

c Based on normal approximation.

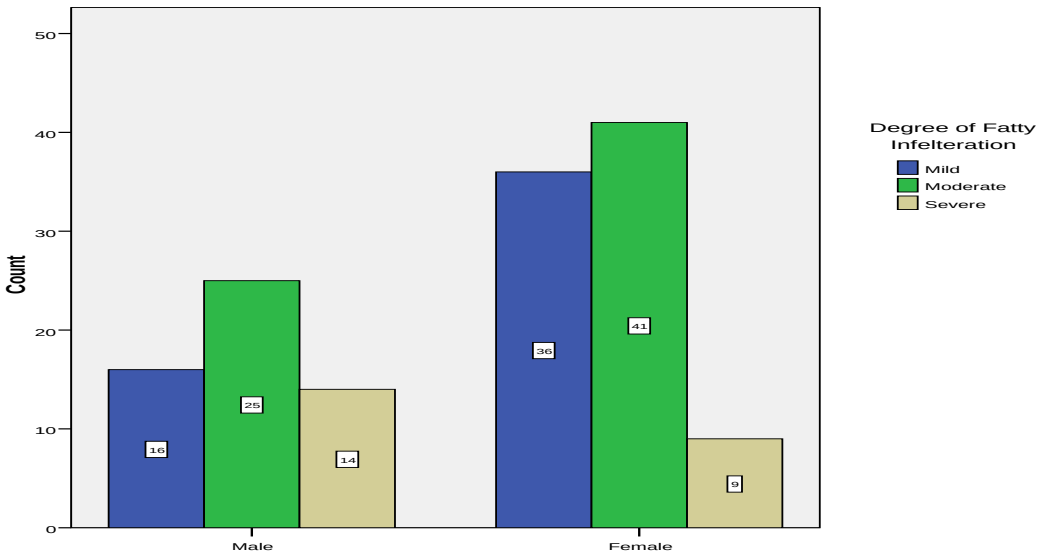

Fig-3: Cross tabs between patient sex and degree of fatty infiltration

Table 13 a- Crosstabulation between Liver Size and Degree of Fatty Infiltration

Liver size	Degree of Fatty Infelteration			Total
	Mild	Moderate	Severe	
Normal	39	32	4	75
Enlarged	12	32	19	63
Shrunk	1	2	0	3
Total	52	66	23	141

Table 13 b- Chi-Square Tests between Liver Size and Degree of Fatty Infiltration

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	24.269(a)	4	.000
Likelihood Ratio	25.865	4	.000
Linear-by-Linear Association	18.114	1	.000
N of Valid Cases	141		

a 3 cells (33.3%) have expected count less than 5. The minimum expected count is .49.

Table 13 c- Symmetric Measures

		Value	Asymp. Std. Error(a)	Approx. T(b)	Approx. Sig.
Interval by Interval	Pearson's R	.360	.074	4.545	.000(c)
Ordinal by Ordinal	Spearman Correlation	.379	.074	4.833	.000(c)
N of Valid Cases		141			

a Not assuming the null hypothesis.
b Using the asymptotic standard error assuming the null hypothesis.
c Based on normal approximation.

CONCLUSION

The study concluded that ultrasound can evaluate fatty liver infiltration and provides excellent details about the type and degree of fatty infiltration and determination the size of liver in fatty infiltratirated patients. The females more affected by fatty liver infiltration than males. The prevalence is high among the age group (31-60). Most patient had high BMI, the overweight were 124 patients. Most patients were not alcoholic and haven't history of diabetes or hypertension patient, while diabetic are predominant risk factor. Most patients were a symptomatic, while most common complaint in symptomatic patient was RUQP.

Most patients affected by diffuse fatty infiltration and the most prominent other ultrasound finding were focal fatty sparing. Liver size in most patients was normal, and hepatomegaly is predominant other size feature. Most patients had moderate degree of fatty infiltration; also there was strong positive relation between patient habit (alcohol consumption) and history of disease (diabetic and hypertension) and degree of fatty infiltration and liver size.

Recommendations:

Weight loss by eating appropriate portions, eating healthy choices, Exercising regularly generally reduces hepatic steatosis. Physicians should actively check for the presence of NAFLD in those who are overweight and/or diabetic. Primary noninvasive evaluation such as ultrasound should be used to confirm the diagnosis of fatty liver disease, to avoid risks and costs of a liver biopsy. Because the prognosis of NASH depends on risk factors (eg, obesity, insulin resistance, type 2 diabetes, hypertension), these conditions have been the focus of treatment. Certainly warranted to look for and actively manage the metabolic syndrome (obesity, diabetes, hyperlipidemia, and hypertension). Prevention of obesity and its complications should be a major public health goal. Because of potential role of elastography techniques in the evaluation of patients with NAFLD, should be use as routine in liver evaluation. Patients with NAFLD should not consume heavy amounts of alcohol. Histological evaluation is the gold standard and should be considered. Finally study recommended that transabdominal ultrasonography

should be used as routine examination and screening tool in high risk patient.

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