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THE USE OF COMPUTED TOMOGRAPHY IN THE DIAGNOSIS OF FATTY LIVER AND LIVER CIRRHOSIS

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Abstract:

Background: *Fat accumulation is one of the commonest liver abnormalities among patients undergoing cross-sectional imaging of the abdomen. CT scans is a preferred non-invasive method of diagnosing the presence and severity of fatty liver and liver cirrhosis.*

Objectives: *to review the prevalence of diffuse fatty liver and liver cirrhosis disease and if there a relationship between diffuse fatty liver and liver cirrhosis disease and hepatomegaly, among patients under routine CT scan in KSA.*

Methods: *Medline and PubMed database searches was performed for articles about the role of computed tomography in the diagnosis of fatty liver and liver cirrhosis and prevalence of diffuse fatty liver and liver cirrhosis disease and if there a relationship between diffuse fatty liver and liver cirrhosis disease and hepatomegaly, published in English around the world. The keyword search headings included "normal, liver cirrhosis, fatty liver, diagnosis, radiology and tomography ", and a combination of these will be used. References list of each included study will be searched for further supportive data.*

Results: *Plain computed tomography is an accurate and reliable method that can be used easily to assess hepatic size and density . Current imaging methods such as ultrasound, CT, and MRI have demonstrated their values to serve as noninvasive imaging biomarkers to evaluate NAFLD progression, but they are still relatively limited in the detection of inflammation (NASH), which is more important than steatosis in terms of its high risk for fibrosis, cirrhosis, and HCC. Detection of NASH by imaging remains the future direction in NAFLD. Conclusion: Imaging studies like computed tomography (CT), magnetic resonance imaging and ultrasonography, computed tomography (CT), magnetic resonance imaging (MRI), and magnetic resonance spectroscopy (MRS), with these methods mostly used to quantify hepatic steatosis but the ultimate diagnosis requires liver biopsy*

Key words: *Normal, liver cirrhosis, fatty liver, diagnosis, radiology.*

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INTRODUCTION:

Fat accumulation is one of the most common abnormalities of the liver depicted on cross-sectional images of the abdomen. [1]. There are two common conditions of fatty liver; alcoholic fatty liver disease (AFLD) and nonalcoholic fatty liver disease (NAFLD). Alcoholic fatty liver disease is caused by excess alcohol intake, while the nonalcoholic type is related to insulin resistance and the metabolic syndrome [2,3].

Non-alcoholic fatty liver disease (NAFLD) is defined as the excessive and abnormal intracellular accumulation of lipid in the liver, primarily in the form of triglycerides [1,2]. NAFLD is becoming a global health problem in adults and children, it increases the risk of liver-related and cardiovascular mortality [4].

NAFLD has been known to be strongly associated with obesity, type 2 diabetes mellitus, dyslipidemia and hypertension, all of that are characteristics of metabolic syndrome, and is considered as hepatic manifestation of metabolic syndrome nowadays [5]. NAFLD can also be associated with many causes other than metabolic syndrome; Drugs and toxins, severe weight loss, refeeding syndrome, celiac disease, inflammatory bowel disease, HIV, and hepatitis C [6,7].

The frequent association of nonalcoholic fatty liver disease with components of the metabolic syndrome such as obesity, hyperglycemia, dyslipidemia, and hypertension is well known. However, no prospective study has examined the role of the metabolic syndrome in the development of this disease [8].

Fatty liver considered one of the commonest liver abnormalities among patients undergoing cross-sectional imaging of the abdomen. Focal fatty infiltration and focal fatty sparing of the liver may be confused with multiple liver metastases on both ultrasound and computed tomography (CT) imaging. Radiologists need to be aware of this benign condition so that unnecessary investigations and liver biopsies can be avoided [9,10].

Many previous population based studies have shown varying prevalence of NAFLD ranging from 3% to 46% based on varying diagnostic modalities used and the patient population characteristics. Imaging studies like computed tomography (CT), magnetic resonance imaging and ultrasonography, computed tomography (CT), magnetic resonance imaging (MRI), and magnetic resonance spectroscopy (MRS), with these methods mostly used to quantify hepatic steatosis but the ultimate diagnosis requires liver biopsy [11].

Liver biopsy is an invasive procedure with its associated complications, sometimes requiring hospitalization and significant bleeding. CT scans have proven to be useful in diagnosing the presence and quantifying the severity of liver fat noninvasively. The Hounsfield Unit (HU) attenuation of liver on CT scans is usually higher than the spleen; when this ratio is reversed, this can be used to diagnose the presence of liver fat [12].

Fatty liver can be diagnosed if computed tomography shows lower density in liver than spleen (attenuation of the liver at least 10 HU less than that of the spleen), or if the attenuation of the liver is less than 40 HU. Ultrasound and CT are also able to suggest the presence of hepatic steatosis based on imaging features, but are unable to accurately quantify hepatic fat content. [13].

In a study aimed to examine the link between liver fat infiltration and abdominal fat amount using plain computer-assisted tomography (CT), he found that plain computed tomography can reliably be used as a survey device for fatty liver disease as his study has added to the evidence of the utility of plain computed tomography in the diagnosis of non-alcoholic steatohepatitis where one of its main findings is the moderate negative correlation between the liver attenuation indices and the body mass index [14].

Key words: Normal, liver cirrhosis, fatty liver, diagnosis, radiology.

OBJECTIVES:

The aim of this study is to review the prevalence of diffuse fatty liver and liver cirrhosis disease and if there a relationship between diffuse fatty liver and liver cirrhosis disease and hepatomegaly, among patients under routine CT scan in KSA.

METHODOLOGY:

Medline and PubMed database searches was performed for articles about the role of computed tomography in the diagnosis of fatty liver and liver cirrhosis and prevalence of diffuse fatty liver and liver cirrhosis disease and if there a relationship between diffuse fatty liver and liver cirrhosis disease and hepatomegaly, published in English around the world. The keyword search headings included “normal, liver cirrhosis, fatty liver, diagnosis, radiology and tomography ", and a combination of these will be used. References list of each included study will be searched for further supportive data.

Table 1: The included studies:

Study	Study Design	Country	Participants (n)	Objective	Duration	Outcome and Conclusion
Jaber Alghazwani et al.	cross sectional retrospective study	Najran, KSA	158 adults	To estimate the prevalence of diffuse fatty liver disease and if there is a relationship between diffuse fatty liver disease and hepatomegaly, among adult patients who underwent a routine KUB CT scan.	from 1 Jan to 31 Mar 2018.	Plain computed tomography is an accurate and reliable method that can be used easily to assess hepatic size and density .The prevalence of fatty liver among adult patients who underwent a routine CT scan in Najran central hospital is about 15.2 % with no age or sex predilection .There is a strong association between hepatomegaly and fatty liver, a relation that might have some implication for patient management.
Gasim Ibrahim Gasim et al.	A cross-sectional study	KSA	50 patients	To examine the link between liver fat infiltration and abdominal fat amount using plain computer-assisted tomography (CT).	January 2015 and April 2016	Twenty-six of the participants were males. The mean (SD) of the age and BMI was 48 (14.9) years and 32.05 (8.3) kg/m2 respectively. The BMI and body Wt had a moderate negative correlation with the liver attenuation indices CTLP, LS ratio, LS diff (r = -0.417, -0.277, -0.312 and 0.435, -0.297, -0.0297), respectively. A very strong negative correlation between fatty liver, LS ratio and CTLP was found (-0.709, -0.575) respectively.
Seung Soo Lee et al.	Review article			To determine the role of radiology in diagnosis of nonalcoholic fatty liver disease.		US is a well-established and cost-effective imaging technique for screening subjects at risk of NAFLD with a reasonable sensitivity and specificity in detecting moderate and severe hepatic steatosis, despite its limited accuracy for mild hepatic steatosis and operator dependency. CT is inaccurate in detecting mild hepatic steatosis and involves a potential radiation hazard, making it inappropriate for assessing hepatic steatosis, especially for longitudinal follow-up of

						patients with NAFLD. CT, however, may be effective in specific clinical situations, such as the evaluation of hepatic donor candidates for transplantation. MRS is currently the most accurate imaging method used to diagnose hepatic steatosis. MRI, if performed and analyzed correctly, has a comparable accuracy to MRS, is more practical, and can cover the entire liver. Technical optimization of MRS and MRI may result in accurate and unbiased hepatic fat quantification. Both MRS and MRI are very reproducible and accurate in quantifying hepatic fat and may replace liver biopsy as the reference standard for research studies. US elastography and MR elastography can diagnose liver fibrosis associated with NAFLD and may play a role in identifying NASH or NAFLD patients who are at greater risk of progressive liver disease.
Irfan Zeb et al.	Cross sectional, population based.	KSA	6,814 asymptomatic participants	Fatty liver disease is a common clinical entity in hepatology practice. This study evaluates the prevalence and reproducibility of computed tomography (CT) measures for diagnosis of fatty liver and compares commonly used CT criteria for the diagnosis of liver fat.	2 years	The overall prevalence of fatty liver (4,175 patients) was 17.2% (using L/S ratio <1.0), with 6.3% (with <40HU cutoff) of the population having moderate to severe steatosis (>30% liver fat content). The prevalence was high in participants with dyslipidemia (70.4%), hypertension (56.8%) and obesity (53%). Diabetic patients had 24.1% prevalence of fatty liver. The prevalence provided by L/S ratio <1.0 (17.2%) was comparable to prevalence provided by <51 HU (17.3%), whereas prevalence obtained by <40HU (6.3%) cutoff corresponded to L/S ratio of <0.8 (6.5%). The measurements of liver and spleen HU attenuations were highly reproducible (0.96, 0.99 and

						0.99, 0.99 for intra- and inter-reader variability, respectively) in a sample of 100 scans.
FatmaKulali et al.	Cross sectional study		225 cases	To evaluate radiologic findings of portal hypertension at computed tomography (CT) of patients with non-alcoholic fatty liver disease for early diagnosis.	July 2011 and November 2012	Total 213 cases, as hepatosteatosis (n = 149) and control (n = 64) groups, were involved in this study. Liver CC span, splenic index and C/RL ratio between two groups were found to be statistically significant (p < 0.01).
Dong Ho Lee et al.	Systemic review	Korea		To determine the role of CT scanning and radiology in diagnosis of nonalcoholic fatty liver disease.		NAFLD having potential to progress into more advanced stage of fibrosis/cirrhosis has been the most common cause of chronic liver disease in Western counties, and the incidence of NAFLD has been known to be increasing. NAFLD is strongly associated with metabolic syndrome characterized by concomitant existence of obesity, diabetes mellitus, dyslipidemia and hypertension. Therefore, NAFLD can be considered as emerging major health problem.
Qian Li et al.	Systemic review			To determine the role of CT scanning and radiology in diagnosis of nonalcoholic fatty liver disease.		Patients with NAFLD are at risk of steatohepatitis and progressive liver fibrosis culminating in cirrhosis, typically over a period of decades. Early diagnosis and risk stratification are essential for effective management. Current imaging methods such as ultrasound, CT, and MRI have demonstrated their values to serve as noninvasive imaging biomarkers to evaluate NAFLD progression, but they are still relatively limited in the detection of inflammation (NASH), which is more important than steatosis in terms of its high risk for fibrosis, cirrhosis, and HCC. Detection of NASH by imaging remains the future direction in NAFLD.

RESULTS:

Plain computed tomography is an accurate and reliable method that can be used easily to assess hepatic size and density . Current imaging methods such as ultrasound, CT, and MRI have demonstrated their values to serve as noninvasive imaging biomarkers to evaluate NAFLD progression, but they are still relatively limited in the detection of inflammation (NASH), which is more important than steatosis in terms of its high risk for fibrosis, cirrhosis, and HCC. Detection of NASH by imaging remains the future direction in NAFLD. Imaging studies like computed tomography (CT), magnetic resonance imaging and ultrasonography, computed tomography (CT), magnetic resonance imaging (MRI), and magnetic resonance spectroscopy (MRS), with these methods mostly used to quantify hepatic steatosis but the ultimate diagnosis requires liver biopsy

DISCUSSION:

Fatty liver disease is characterized histologically by hepatic steatosis, the abnormal accumulation of lipid in hepatocytes. Fatty liver and liver cirrhosis are of the most common abnormalities of the liver. Fat accumulation is usually depicted on cross-sectional images of the abdomen. The estimated prevalence of nonalcoholic fatty liver disease (NAFLD) in Saudi Arabia is 7% to 10% [15]. Although diagnosis of fatty liver and liver cirrhosis is usually straightforward, CT scans provide a non-invasive means of diagnosing the presence and severity of NAFLD [16]. The present study was carried out to review the role of C.T scans in diagnosis of liver diseases specially fatty liver and liver cirrhosis. We aimed to update readers with new data published in this topic around the world and to give them adequate information in such important topic in an attempt to raise awareness and knowledge level about the important role of C.T scans in the diagnosis of these two cases. NAFLD is strictly connected with characteristics of the metabolic syndrome [17]. The amount of intrahepatic fat is closely correlated to the features of the metabolic syndrome [18]. Many previous studies have added to the evidence of the utility of plain computed tomography in the diagnosis of non-alcoholic steato-hepatitis [19, 20]. As previously reported, CT evaluation of hepatic steatosis is based on the attenuation values of the liver parenchyma, evaluated as Hounsfield units (HUs), and dependent on tissue composition, as the attenuation value of fat, usually about -100 HU, is much lower than that of soft tissue, usually about 30-40 HU, attenuation value of liver parenchyma decreases as hepatic steatosis develops and progresses.

A study was done in order to determine the severity of fat content on CT scans performed by Kodama et al. [23], in which they compared unenhanced and contrast enhanced CT scans with histological diagnosis of fatty liver, and they found that liver attenuation 40 HU on non-enhanced CT scans corresponds with about 30% liver fat content whereas liver attenuation 30 HU corresponds to about 50% liver fat content and they depended on their study mainly on measuring the liver attenuation using CT scan.

Another study done by Irfan Zeb. et al. [21], to evaluate the prevalence and reproducibility of computed tomography (CT) measures for diagnosis of fatty liver and compares commonly used CT criteria for the diagnosis of liver fat, they included 6814 asymptomatic participants from a population-based sample and they found the liver-to-spleen ratio (L/S) to be less than 1.0 Hounsfield units (HU) and liver attenuation <40 HU were used for diagnosing and assessing the severity of liver fat content, and the overall prevalence of fatty liver was 17.2% (using L/S ratio <1.0), with 6.3% (with <40 HU cutoff) of the population having moderate to severe steatosis (>30% liver fat content). Another study was conducted by Yajima Y. et al. [22], in which a fifty-three histologically proved cases of various diffuse liver disease were studied for their computed tomography numbers (CTN), the mean CTN was 66.6 +/- 2.6 H in normal control (N), 61.8 +/- 7.0 H in liver cirrhosis (LC), and 44.4 +/- 10.6 H in fatty infiltration (FI), the clear difference was in fatty liver group. In another previous study was performed by Longo et al. [24] to compare magnetic resonance spectroscopy with computed tomography and histological assessment for the diagnosis of fatty liver. They compared liver to spleen ratio with different grades of fatty infiltration of liver and found a good correlation between CT and histology ($R = 0.77$, $p < 0.001$).

However, several factors other than hepatic fat can influence liver attenuation on CT, including the presence of excess iron in the liver and the ingestion of certain drugs such as amiodarone [25, 26]. Although CT may be not accurate for evaluation of NAFLD stage, it can be used successfully to detect moderate-to-severe hepatic steatosis in donor candidates for liver transplantation [26, 27, 28], and CT measurement of fat in the liver may be useful for patients at risk of metabolic syndrome [29, 30].

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