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Original Research

Ultrasound in the Detection of Chronic Liver Disease

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ABSTRACT:

Ultrasound imaging is a widely used, noninvasive diagnostic tool for liver diseases, offering real-time visualization of liver tissue structure and abnormalities. However, accurately characterizing liver conditions based on ultrasound images remains challenging due to variations in image quality and interpretation. This study proposes a system for analyzing and categorizing normal, fatty and heterogeneous liver conditions using textural analysis of ultrasound images, optimizing the selection of regions of interest (ROI) to improve diagnostic accuracy. The study aimed to determine the prevalence of liver diseases diagnosed via ultrasound between 2017 and 2024, categorizing cases based on age and sex. Data were collected from the Tobruk Liver Disease Center and included 59 patients diagnosed with liver disease: 26 males (44.07%) and 33 females (55.93%). The study focused on four primary liver diseases: fatty liver, cirrhosis, hepatitis C virus (HCV), and liver cancer. Cases not diagnosed via ultrasound were excluded. Diagnosis was performed using

high-resolution ultrasound devices to assess liver tissue characteristics, size, the extent of steatosis or fibrosis, and the presence of abnormal masses. However, this study did not incorporate advanced imaging techniques such as Doppler ultrasound, histogram analysis, B-mode (Brightness Mode), M-mode (Motion Mode), elastography or harmonic imaging, which could have enhanced measurement precision. The results revealed that cirrhosis was the most prevalent condition (61.02%), followed by fatty liver (18.64%), viral hepatitis (5.08%), liver cancer (6.78%) and hepatomegaly (15.25%). Additional associated conditions included kidney stones (5.08%), splenomegaly (23.73%) and gallstones (6.78%). Notably, six cases (10.17%) were classified as normal. The most affected age group was between 50 and 70 years, though cases were also observed in children aged 1–10 years. The study highlights a significant increase in liver disease cases over the analyzed period, emphasizing the need for improved screening and early detection strategies to enhance patient outcomes.

KEYWORDS: Ultrasound, Chronic Liver Disease, Cirrhosis, Diagnostic Accuracy.

INTRODUCTION

Chronic liver diseases (CLD) represent a significant public health issue globally, contributing to high rates of morbidity and mortality. The progression of CLD, including conditions such as fatty liver, cirrhosis and hepatocellular carcinoma (HCC), is often slow and asymptomatic in the early stages, which poses challenges in diagnosing these diseases before they reach advanced stages (De Siervi et al., 2023; Moon et al., 2020).

Early detection is crucial as it allows for timely management, reducing the risk of complications such as liver failure, cirrhosis, and liver cancer. While liver biopsy remains the gold standard for diagnosing and staging CLD, it is an invasive procedure with associated risks, including complications and discomfort. Moreover, liver biopsy is not suitable for routine screening, especially in high-risk populations (Abeysekera et al., 2022; Ginès, Castera, Lammert, Graupera, Serra-Burriel, et al., 2022; Yeom et al., 2015).

This has led to the need for a less invasive, cost-effective and widely accessible alternative. Among the various diagnostic

techniques, ultrasound imaging has gained recognition as a promising tool for the detection and management of liver diseases (Wang et al., 2020).

Ultrasound is non-invasive, inexpensive, widely available and well-tolerated by patients, making it an attractive option for diagnosing liver abnormalities. It can detect early signs of liver damage, such as fibrosis and cirrhosis, by visualizing structural changes in the liver, such as the presence of vascularized fibrotic septa and regenerating nodules. Ultrasound can also identify complications associated with CLD, such as portal hypertension and liver lesions. However, despite its advantages, ultrasound has limitations in accurately detecting and staging liver diseases, especially in the early stages (Del Prete et al., 2012; Yeom et al., 2015).

The diagnostic accuracy of ultrasound needs to be better understood to optimize its use in clinical practice and provide reliable results for high-risk patients (Allan, 2010).

This review explores the role of ultrasound in detecting and diagnosing chronic liver diseases, particularly its ability to predict the severity of liver conditions. The study focuses on determining whether ultrasound can serve as a reliable, cost-effective and accessible diagnostic tool in clinical settings. Additionally, the manuscript seeks to evaluate the diagnostic accuracy of ultrasound in detecting liver fibrosis, cirrhosis and other CLD-related complications, with the ultimate goal of reducing the need for invasive procedures such as liver biopsy. This review will provide insights into the current state of ultrasound technology, its potential applications in liver disease detection, and how it can contribute to better patient outcomes through early diagnosis and improved management strategies.

MATERIALS AND METHODS

Study Design and Participants

This study aimed to analyze the prevalence of liver diseases diagnosed by ultrasound from 2017 to 2024. A total of 59 cases were included, consisting of 26 males (44.07%) and 33 females (55.93%).

Data Collection

Data were collected from the Tobruk Liver Disease Center, focusing on four primary diseases: fatty liver, cirrhosis, hepatitis C virus (HCV), and liver cancer.

Inclusion and Exclusion Criteria

Only cases diagnosed via ultrasound were included. Cases that were not diagnosed by ultrasound were excluded from the study.

Diagnostic Ultrasound Equipment

High-resolution ultrasound devices were utilized to assess liver tissue characteristics, liver size, the extent of steatosis or fibrosis, and the presence of any abnormal masses.

Ultrasound Imaging Techniques

Various ultrasound imaging techniques, including Doppler, histogram analysis, B-Mode (Brightness Mode), M-Mode (Motion Mode), elastography and harmonic imaging, were excluded from the study as they were not part of the diagnostic procedure.

Analysis of Liver Diseases

The study focused on analyzing liver diseases, including cirrhosis (61.02%), fatty liver (18.64%), hepatitis (5.08%), liver cancer (6.78%) and hepatomegaly (15.25%).

Other associated conditions identified in the cases included kidney stones (5.08%), splenomegaly (23.73%) and gallstones (6.78%).

RESULTS AND DISCUSSION

This study analyzed 59 patients diagnosed with liver diseases and related conditions. The cohort included 26 males (44.1%) and 33 females (55.9%), ranging in age from 1 to 85 years. The most common liver disease was cirrhosis (61.0%), followed by fatty liver disease (18.6%), hepatitis C (5.1%), liver cancer (6.8%) and hepatomegaly (15.3%).

Cirrhosis was more prevalent in females, while hepatitis C was more common in males. Liver cancer predominantly affected females and hepatomegaly occurred slightly more in males.

In addition to liver diseases, kidney stones (5.1%) and splenomegaly (23.7%) were observed, as shown in Figure 1. Kidney stones were more common in males, while splenomegaly was equally distributed between sexes.

The study highlighted significant gender disparities in liver disease prevalence and emphasized the need for early detection, prevention and treatment of liver diseases.

Lifestyle changes, such as improved diet and reduced alcohol consumption, were recommended to prevent progression of these conditions.

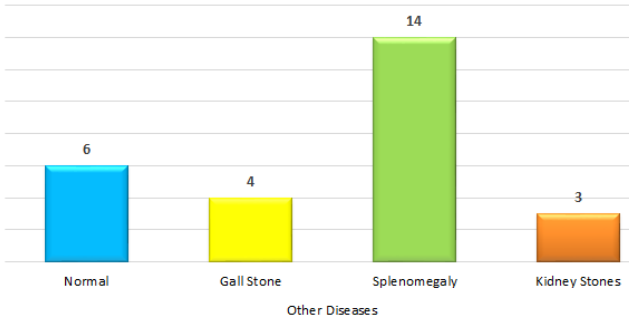

Figure: (1). Other Diseases Distribution

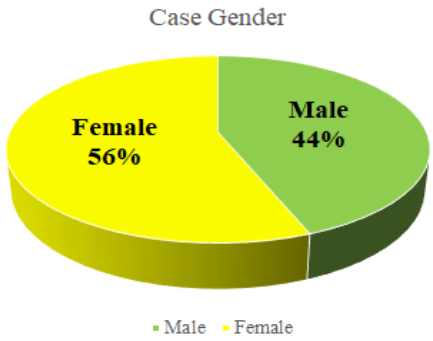

Figure: (2). Gender Distribution

This study revealed a wide age distribution of patients, ranging from 1 to 85 years old. This broad spectrum demonstrates that liver-related conditions are not confined to any particular age group, though certain diseases exhibit notable age-related variations.

Figure 2 illustrates the gender distribution of patients. The youngest patient in the study, only 1 year old, was diagnosed with liver cirrhosis. Although cirrhosis is uncommon in infants, its occurrence in this case suggests the presence of a congenital or early-onset liver disorder, such as genetic liver diseases, metabolic disorders, or biliary atresia—a condition where bile ducts are absent or blocked, leading to liver damage.

The treatment and its long-term effects on health outcomes should be carefully considered for this infant.

On the other end of the age spectrum, the oldest patient, 85 years old, was also diagnosed with liver cirrhosis. In older adults, cirrhosis often results from prolonged exposure to risk factors like chronic hepatitis, alcohol abuse or non-alcoholic fatty liver disease. The patient's advanced age indicates a long history of liver damage, exacerbated by aging and may be complicated by coexisting conditions, which could affect treatment options.

Most patients were between the ages of 35 and 75 years, highlighting the prevalence of chronic liver conditions among middle-aged and older adults. This aligns with global trends, as liver diseases like cirrhosis, fatty liver disease and viral hepatitis tend to develop over time, often due to lifestyle factors, infections or metabolic disorders.

The natural aging process, combined with ongoing risk factors, increases the vulnerability of middle-aged and older adults to liver complications (Crespo et al., 2016).

The age distribution emphasizes the importance of early detection, preventive management and targeted interventions for liver health across all age groups. Regardless of whether a person is a baby, middle-aged, or elderly, maintaining liver health is crucial for overall well-being and preventive measures must be taken to manage liver conditions effectively at each stage of life (Ginès, Castera, Lammert, Graupera, Serra-Burriel, et al., 2022).

The study used the "UL" diagnosis code for all cases, which likely indicates an ultrasound-based diagnosis. Ultrasound is a non-invasive method for detecting liver diseases like cirrhosis, fatty liver and tumors. However, using a single code without further differentiation has limitations, as conditions like cirrhosis and fatty liver can appear similar on ultrasound, potentially leading to misdiagnosis. Additionally, early-stage liver cancer may be missed. To improve diagnosis, more detailed categorization, including laboratory tests and advanced imaging techniques, is necessary.

The uniform use of the "UL" code compromises diagnostic clarity and affects treatment accuracy. A more thorough diagnostic approach would enable better disease detection and improve patient care. Figure 3 shows the distribution of other diseases diagnosed in the study.

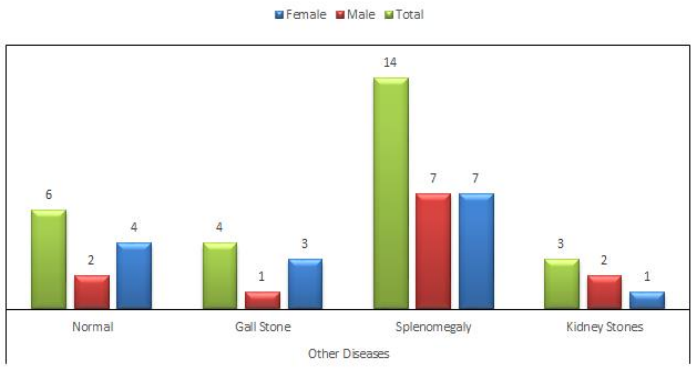

Figure: (3). Type of other diseases distribution

The study reveals a significant prevalence of liver diseases in the patient group, with liver cirrhosis being the most common diagnosis (61.0%). The study found a higher prevalence in females (58.3%) compared to males (41.7%), suggesting possible gender-related susceptibility or differences in healthcare access. Fatty liver disease (18.6%) was common, affecting both genders equally, while hepatitis C was rare (5.1%), with more cases in males (66.7%) likely due to higher risk factors such as intravenous drug use (Levinsson et al., 2024; Smiriglia et al., 2023).

Distribution of liver-related diseases, showing that liver cancer (6.8%) was more common in females (75%), which is atypical compared to global trends (Nevola et al., 2023). Hepatomegaly (15.3%) and splenomegaly (23.7%) were also prevalent, indicating complications from cirrhosis. Kidney stones and gallstones were less frequent, with gallstones showing a female predominance (Rodriguez Gatta et al., 2024). The "normal" category (10.2%) was more common in females, likely representing individuals screened for liver disease with no major findings as shown in Figure 4.

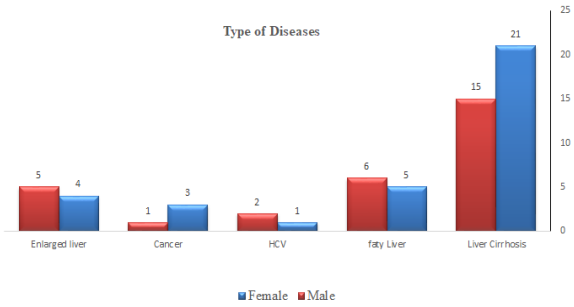

Figure: (4). Type of Liver-Related diseases distribution.

The age range of patients, from 1 to 85 years old, shows that liver diseases can affect individuals at any age, though chronic liver diseases predominantly affect those between 35-75 years.

The consistent use of the "UL" diagnosis code points to ultrasound as the primary diagnostic tool, which, while effective for detecting structural changes, lacks specificity for identifying the cause or severity of liver conditions.

The most significant limitation is the fact that the study is based on a very small sample (59 cases) of patients with no detailed clinical histories, risk factors or treatment outcomes. This limits the possibility of establishing causality and evaluating the change in a patient's condition. The diagnostic code of "UL" is another insecure point, since the description can include basically everything from acute to chronic or even diagnoses that might not be the truth echoed scan results.

CONCLUSION

This study highlights the significant burden of chronic liver diseases, particularly liver cirrhosis, among the patient group. Cirrhosis, often resulting from long-term liver damage due to viral infections, excessive alcohol consumption, metabolic disorders, or autoimmune diseases, is the most prevalent condition observed. This finding emphasizes the need for public health interventions such as early detection, lifestyle modifications, and

broader access to medical care to prevent progression to severe stages like liver failure. The high incidence of cirrhosis underscores the importance of focusing on early diagnosis and treatment strategies.

The study also reveals a substantial presence of other liver-related conditions, such as fatty liver disease and splenomegaly, both of which are linked to metabolic disorders, sedentary lifestyles, and obesity. The increasing prevalence of fatty liver disease stresses the importance of preventive strategies like diet regulation, exercise, and effective management of diabetes. The presence of splenomegaly, often associated with portal hypertension and chronic liver conditions, further highlights the systemic nature of liver diseases.

This study provides valuable insights into the prevalence and gender-specific distribution of liver diseases. The higher prevalence of liver cirrhosis and liver cancer in females, contrary to common epidemiological trends, suggests that country-specific risk factors—such as genetic predisposition, environmental chemicals, and healthcare access—might play a crucial role in disease manifestation. These findings urge further research to explore gender-based variations and develop tailored prevention and treatment strategies. The study also emphasizes the economic burden of liver diseases, particularly in terms of healthcare costs and long-term treatment needs. Early detection and prevention can significantly reduce healthcare expenditures by minimizing the progression to more severe liver conditions, such as cirrhosis or liver failure. Public health campaigns focused on hepatitis prevention, lifestyle changes, and better access to medical care are critical for addressing these challenges.

The study calls for further research to investigate the role of viral hepatitis, alcohol consumption, metabolic risk factors, and genetic predispositions in liver disease development. Longitudinal studies on treatment effectiveness and disease progression are necessary to better understand the response to different therapeutic strategies. A cross-disciplinary approach involving genetics, epidemiology, and healthcare policies could help develop more precise and effective treatments. Ultimately, this research has the potential to shape better treatment protocols, improve patient outcomes, and reduce the overall public health burden associated with liver diseases.

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ETHICS

We have ethical approval from the research studies office of Tobruk University .

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الملخص

يُعد التصوير بالموجات فوق الصوتية أداة تشخيصية غير جراحية واسعة الاستخدام لأمراض الكبد، حيث يُتيح رؤية آنية لبنية أنسجة الكبد وتشوهاتها. ومع ذلك، لا يزال تحديد توصيف دقيق لأمراض الكبد بناءً على صور الموجات فوق الصوتية أمرًا صعبًا نظرًا لاختلاف جودة الصورة وتفسيرها. تقترح هذه الدراسة نظامًا لتحليل وتصنيف حالات الكبد الطبيعية والدهنية وغير المتجانسة باستخدام التحليل النسيجي لصور الموجات فوق الصوتية، مع تحسين اختيار مناطق الاهتمام (ROI) لتحسين دقة التشخيص . هدفت الدراسة إلى تحديد معدل انتشار أمراض الكبد المُشخصة بالموجات فوق الصوتية بين عامي 2017 و2024، وتصنيف الحالات بناءً على العمر والجنس. جُمعت البيانات من مركز طبرق لأمراض الكبد، وشملت 59 مريضًا مُشخصين بأمراض الكبد: 26 ذكرًا (44.07%) و33 أنثى (55.93%). ركزت الدراسة على أربعة أمراض كبدية رئيسية: الكبد الدهني، وتليف الكبد، وفيروس التهاب الكبد الوبائي سي(HCV) ، وسرطان الكبد. استُبعدت الحالات التي لم تُشخص بالموجات فوق الصوتية. تم التشخيص باستخدام أجهزة الموجات فوق الصوتية عالية الدقة لتقييم خصائص أنسجة الكبد وحجمها ومدى تدهنها أو تليفها، ووجود أي كتل غير طبيعية. ومع ذلك، لم تتضمن هذه الدراسة تقنيات التصوير المتقدمة مثل الموجات فوق الصوتية دوبلر، وتحليل الهيستوغرام، ووضع السطوع(B) ، ووضع الحركة(M) ، والتصوير المرن، والتصوير التوافقي، والتي كان من شأنها تحسين دقة القياس. كشفت النتائج أن تليف الكبد كان الحالة الأكثر انتشارًا (61.02%)، يليه الكبد الدهني (18.64%)، والتهاب الكبد الفيروسي (5.08%)، وسرطان الكبد (6.78%)، وتضخم الكبد (15.25%). وشملت الحالات المصاحبة الإضافية حصوات الكلى (5.08%)، وتضخم الطحال (23.73%)، وحصوات المرارة (6.78%). والجدير بالذكر أن ست حالات (10.17%) صُنفت على أنها طبيعية. كانت الفئة العمرية الأكثر تأثرًا تتراوح بين 50 و70 عامًا، مع ملاحظة حالات أيضًا لدى أطفال تتراوح أعمارهم بين سنة وعشر سنوات. تُسلّط الدراسة الضوء على زيادة ملحوظة في حالات أمراض الكبد خلال الفترة التي شملها التحليل، مما يُؤكّد على ضرورة تحسين استراتيجيات الفحص والكشف المبكر لتحسين نتائج المرضى.

الكلمات المفتاحية: الموجات فوق الصوتية؛ أمراض الكبد المزمنة؛ تليف الكبد؛ دقة التشخيص.