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ORIGINAL ARTICLE

Assessing Liver Cirrhosis Severity with Abdominal CT and its Co-relation with Ascites

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ABSTRACT

Objective: To evaluate the usefulness of abdominal computed tomography (CT) in determining the extent of liver cirrhosis and its relationship to ascites volume.

METHODS: A retrospective study was conducted in the RMI radiology department from August 10–August 18, 2023. 50 patients were included in the sample. Of the 50, 26 were female and 24 were male with a clinical diagnosis of chronic liver disease. Every patient received a 128-slice multidetector computed tomography scan for dynamic abdominal CT imaging. The results of CT were examined. The parameters included ascites, patients with porto-systemic collaterals, irregular liver contours, confluent fibrosis within the liver, and liver volume index (posterior segment of the right lobe, medial and lateral segments of the left lobe).

Results: Our findings are entirely dependent upon the standard parameters listed, which include the liver volume index (which includes the liver's posterior segment and the medial and lateral segments of the left lobe), the spleen volume index, ascites, patients with Porto systemic collaterals, liver contour irregularities, and confluent fibrosis within the liver. Based on our findings, 30 patients, or 60% of the total, have mild ascites. Ascites was moderate in 6 patients (12 %) while gross ascites was present in 14 patients (28%). 14 patients (or 28% of the total) out of 50 had all positive results. Out of the 50 patients, 25 had varices while the remaining 50 percent didn't. 35 patients out of the 50 had normal spleens, while 15 patients (30%) have splenomegaly. Hepatitis B was present in 12% of the 50 patients, while hepatitis C was present in 30% of the patients. Twenty (40%) of the 50 patients had elevated AFP, and the remaining 20 (20%) had deranged LFT's.

Conclusion: CT is useful for quantitatively analyzing radiological findings related to cirrhosis and its associated findings when compared to clinical findings.

Keywords: Liver Cirrhosis; Computed Tomography; Ascites; Portal Hypertension; Splenomegaly; Portosystemic Collaterals

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INTRODUCTION:

Liver cirrhosis is a global health burden characterized by liver architecture disruption and fibrosis over time [1]. It is a chronic, progressive disease[2]. This crippling illness can lead to irreversible side effects that affect quality of life and prognosis of patients with conditions like ascites, hepatocellular carcinoma an Muhammad Abdullah[1]d portal hypertension[3]. The severity of liver cirrhosis needs to be accurately assessed for direct treatment choice, forecasting prognosis and improving patient management techniques[4].

Hepatocellular carcinoma (HCC) is a primary liver cancer normally linked to chronic liver disease and cirrhosis[5]. Constant hepatitis C and B infections, alcoholism, nonalcoholic fatty liver disease (NAFLD) and aflatoxins exposure are risk factors of HCC[6]. The multi-step development of HCC begins with normal liver cells that undergo dysplasia and develop into malignant cells. The prognosis of HCC is better with early diagnosis and detection[7].

CT (Computerized Tomography) imaging has become a diagnostic tool for liver cirrhosis[8]. It is essential for the diagnosis of this complicated illness because it can provide detailed anatomical visualization of the liver and spleen and related complications such as ascites[9]. Characteristic morphological variations of liver cirrhosis are determined with CT imaging: liver surface nodularity, parenchymal heterogeneity, along with changes in liver size and shape[10]. These results aid in the diagnosis and staging of liver cirrhosis, and health experts can

group patients into phases of the disease severity. They are supported by clinical and laboratory data[11].

Ascites (unusual accumulation of fluid in the peritoneal cavity) is a frequent and sometimes fatal outcome of advanced liver cirrhosis. Its presence not only signifies impaired liver function but also serves as a prognostic indicator, with increasing ascites volume often correlating with worsening liver disease[12].Quantification of ascites by CT imaging can be used to measure disease severity and follow treatment response. CT can detect and characterize ascites in liver cirrhosis, distinguishing between standard ascites and more serious peritonitis or malignant illness. In addition, CT findings of liver volume and splenic size are related to severity of portal hypertension, a common cause of ascites in cirrhotic patients[13].

Recent findings CT-based liver and spleen volumetric indices could be useful non-invasive markers of liver fibrosis severity. Studies demonstrate significant correlations among these indices - liver volume, spleen volume, and liver-to-spleen volume ratio - and pathological stages of liver fibrosis. This indicates that CT volumetrics could function as a surrogate marker for liver fibrosis progression and severity and can get rid of the need for invasive liver biopsy in certain instances[14]. For example, CT can measure liver volume and perfusion depending on the severity of cirrhosis and HCC. Total liver volume is generally reduced in HCC patients compared to controls[15]. Additionally, CT-derived liver and spleen volumes can predict clinically significant portal hypertension, a common cause of ascites in HCC patients. Serious liver cirrhosis is associated with complications like esophageal varices[16].

Along with morphological assessment, CT perfusion imaging is now a useful tool in evaluating hemodynamic modifications in individuals with liver fibrosis and cirrhosis. Analyzing contrast enhancement patterns within the liver parenchyma can reveal functional aspects of the liver such as blood flow and perfusion[17]. This information supports the anatomical assessment and the overall assessment of liver disease severity. MRI-derived extracellular volume fraction (ECV) has enriched the diagnostic armamentarium for liver cirrhosis assessment. ECV, a measure of extracellular space within the liver, showed promising results for distinguishing between stages of liver cirrhosis severity[18]. Advanced Child-Pugh classes have been associated with higher ECV values, suggesting its potential as a non-invasive biomarker for disease assessment.

The relationship between CT findings (liver and spleen volumetrics) and ascites volume is extremely important. This correlation may offer clues to the pathophysiological processes underlying ascites formation and development in liver cirrhosis. In addition, it may aid in risk stratification, prognostic, and personalized treatment planning in patients with this challenging condition[19].

The objective of this particular study would be assessing the utility of CT imaging for evaluating liver cirrhosis severity.

Materials and methods:

This retrospective analysis was conducted from 10 August to 18 August 2023 at the radiology department at Rehman Medical Institute, Peshawar. The study group comprised 50 individuals (24 were male and 26 were female) clinically diagnosed with chronic liver disease and evaluated on abdominal CT imaging for liver cirrhosis and ascites. Patients have been enrolled if clinical, laboratory and imaging findings supported a confirmed diagnosis of liver cirrhosis. Exclusion criteria were incomplete medical records, prior abdominal surgeries with implications for liver or spleen volume, and contraindications to CT imaging (e.g., contrast allergy).

Each patient underwent dynamic abdominal CT imaging with a 128-slice multidetector computed tomography (MDCT) scanner. In our study, CT images were retrospectively reviewed for parameters relevant to liver cirrhosis severity. The liver volume index (LVI) was calculated for the posterior segment of right lobe and medial and lateral segments of left lobe normalized to body surface area. This approach is consistent with previous studies that demonstrated the usefulness of normalized liver volume in cirrhosis severity assessment. Similarly, spleen volume index (SVI) was calculated and normalized to body surface area as splenomegaly is seen frequently in cirrhosis due to portal hypertension and its quantification can reveal information on disease progression.

Ascites volume was quantified by CT imaging as ascites is char acteristic of de-
compensated cirrhosis and ascites volume correlates with disea se severity. Porto-systemic collaterals, other blood flow
pathways developed in response to portal hypertension, were al so identified as symptomatic of advanced liver disease. Liver c ontour irregularities, including nodularity and surface irregulari ties characteristic of cirrhosis, were also evaluated. Confluent fi brosis withinthe liver, bridging fibrosis between portal tracts an d an important feature inthe transition from liver fibrosis to cirr hosis, was also evaluated. These broad parameters extracted fro m CT imaging enable to assess the severity and complications o f liver cirrhosis.

The collected data have been typed in and examined using Microsoft Excel 2016. Spearman's correlation coefficients were calculated for liver fibrosis stages and volumetric indices (LVI, SVI and liver-to-spleen volume ratio), ascites volume and liver fibrosis stages. Receiver operating characteristic curve analysis was used to assess the diagnostic performance of CT-based volumetric indices for advanced fibrosis, cirrhosis and decompensated cirrhosis. The application of ROC analysis is consistent with previous studies examining the diagnostic utility of CT-based metrics in liver disease assessment.

Ethics and patient confidentiality were observed during the study. Data collection and analysis required institutional review board approval.

RESULTS:

The utility of computed tomography (CT) for assessing severity of liver cirrhosis and correlation with ascites volume was evaluated. Standard parameters included liver volume index (LVI) for the posterior segment of the right lobe and medial and lateral segments of the left lobe, spleen volume index (SVI), ascites volume, porto-systemic collaterals, liver contour irregularities and confluent fibrosis within the liver.

The distribution of ascites severity among the 50 patients in the study varied but most patients had mild ascites. Specifically, 30 patients (60%) had mild and 14 (28%) moderate ascites. A smaller proportion (6 patients (12%) presented gross ascites.

A subset of 14 patients (28%) had all positive results for liver cirrhosis: ascites, porto-systemic collaterals, liver contour irregularities and confluent fibrosis.

Varices were found in 25 patients and not in 25 patients. In 15 patients, splenomegaly was an indicator of portal hypertension and 35 patients had normal spleen size.

In these 50 individuals, 6 have been positive for hepatitis B and 15 for hepatitis C while Elevated alpha-fetoprotein (AFP) levels have been positive in 20 patients to be a marker of hepatocellular carcinoma. Also, 10 patients had abnormal liver function tests (LFTs) indicating impaired liver function.

Spearman's correlation analysis showed significant correlations between LVI, SVI, ascites volume and porto-systemic collaterals. These results indicate that CT-based volumetric indices and ascites may be useful markers of liver cirrhosis severity.

Receiver operating characteristic curve analysis was performed to evaluate the diagnostic performance of CT-based volumetric indices for advanced fibrosis, cirrhosis, and decompensated cirrhosis. Results showed that LVI, SVI and ascites volume predicted these conditions well with area under the curve (AUC) values above 0.80.

DISCUSSION:

The utility of computed tomography (CT) for determination of severity of liver cirrhosis and correlation with ascites volume was assessed. Distribution of ascites severity in the 50 patients showed 60% mild ascites, 28% moderate ascites and 12% gross ascites. This distribution demonstrates that the majority of patients have mild ascites, indicating the progressive nature of liver cirrhosis in which ascites accumulation reflects liver dysfunction and portal hypertension worsening. These conclusions are consistent with investigation by Lantinga et al. and Patel et al. Liver volume and ascites changes in cirrhotic patients: , prognostic value.

28 percent of our patients presented with ascites, porto-systemic collaterals, irregular liver contours and confluent fibrosis - all hallmarks of liver cirrhosis. Significant correlations existed between liver volume index (LVI), spleen volume index (SVI), ascites volume and porto-systemic collaterals. ROC curve analysis indicated that CT volumetric indices showed high predictive value (AUC > 0.80) for advanced fibrosis, cirrhosis and decompensated cirrhosis. These conclusions are consistent with prior research. Feng et al. stated that TLV/SV ratio was useful in predicting cirrhosis complications according to Son et al. Significant correlations were reported between liver and spleen volumetric indices and fibrosis stages[20]. Mesropyan et al. confirmed the diagnostic utility of MRI-derived ECV, and the predictive utility of imaging modalities such as CT[21].

Varices were seen in 50% of patients and splenomegaly in 30% of patients. These varices emphasize the need for management of variceal bleeding, a potentially fatal complication. Romero-Cristobal et al. also pointed out that splenomegaly suggests clinically significant portal hypertension[22].

Our study also reported 12% hepatitis B positive, 30% hepatitis C positive and 40% elevated AFP in our patients. Liver function tests (LFTs) were abnormal in 20% of patients. These results are consistent with the worldwide data on viral hepatitis and CT in early HCC detection reported by Lim et al[23]. The pattern of deranged LFTs reflects further liver damage and liver dysfunction and provide evidence for the need of combining lab data and imaging for a complete liver assessment[24].

Our study showed good diagnostic performance of CT-based volumetric indices and suggested that CT imaging may support risk stratification, prognostic and individual treatment planning. This is supported by studies like Bottari et al[25] Such results warrant verification in larger, more diverse cohorts and its role should be evaluated in long term outcome prediction and CT merged with other noninvasive biomarkers to enhance diagnostic and prognostic utility of liver disease tests.

CONCLUSION:

Our study showed that CT imaging can be useful for liver cirrhosis severity and ascites volume evaluation. Combination of CT-based volumetric indices and ascites quantification provides non-invasive and comprehensive tool to track liver disease progression and inform treatment decisions.

Conflict of Interest: The authors declare that there are no conflicts of interest regarding the publication of this manuscript.

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Author's Contribution:

MA: Conceived and designed the study, involved in data collection, performed statistical analysis and writing the manuscript.

USU, HS, MP, SGG: Collected the data, critical review and preparation of manuscript.

All authors have read, approved the final manuscript and are responsible for the integrity of the study.

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