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COMPARISONS OF LIVER PARENCHYMA TEXTURAL FEATURES FROM B- MODE ULTRASOUND WITH FIBRO SCAN RESULTS

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Abstract:

Texture analysis is considered very helpful in staging and classification of fibrosis. Liver ultrasound is used to analyze the texture features in different position of patients to identify the fibrosis.

Methodology:

Fibrosis quantification can be done with the help of ultrasound which is also effective and low cost. The study was conducted in the Radiology Department of Lahore General Hospital from the period of March 2019 to July 2019.Total of 100 patients were involved in the study. The position in diagnosis represents the left and right ROIs. The negative and positive predictive values were 100 and 90%.The parameters of sensitivity and specificity indicates the 80% and 100 %.

Key words: *Fibrosis, Texture, B-mode, parenchyma*

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INTRODUCTION:

The liver disease in Pakistan has increased considerably due to the hepatitis c and other reasons. Liver disease is also widespread in the world. The treatment and diagnostic options also improved due to the improvement in technology and awareness creation among masses about the healthy life .Liver function disturbs due to the disease. In the patients with cirrhosis the risk of liver cancer increases and hence can lead to mortality. The normal function of liver disturbs with the development of fibrosis which can lead to the lost of normal microscopic lobular architecture due to the fibrosis and regeneration of nodular can resist the blood flow from liver. This can lead to the cirrhosis stage of liver disease. It is vital for the life of the patient to diagnose, investigate the treatment option and also the complications associated with the treatment. When the liver gradually fails to perform its normal functions the cirrhosis become more visible and should be diagnosed on urgent basis to identify the fibrosis stages using METAVIR Score. It is a diagnostic technique involving biopsy of liver to identify the fibrosis stages for treatment plan. Technology has helped the liver patients to have the option of non invasive method of diagnosis which is cost effective, easily available, and simple and can be repeated multiple times without any danger. The ultrasound images reflect the fibrosis spectrum and also improvement in the fibrosis can be observed even during the therapy. In the developed world the use of ultrasound has increased due to its non invasive and cost effective results. The image obtained in the ultrasound describes the human tissues and organs internal structure and any changes in their pathology. The images of the organs also describe the disease presence and its stages with the help of texture analysis and can detect the variation from the normal textures of the tissues.

A texture analysis is routine dagnostic practice in the Radilogy Department of the Lahore General Hospital and helps to identify the chronic liver disease patients. The GLCM (gray level co occurrence matrix) is the method which is used for the statistical analysis of the patients and is based upon the texture analysis identified as a gray area during texture .The process helps to identify the stages of fibrosis in the chronic liver disease patients. The hepatic fibrosis assessment can be performed either by biopsy or by ultrasound .The biopsy method was frequently used in the past but this has many limitations like its results vary due to the intra and inter observer experience, patients discomfort, sampling error ,complications linked, invasive procedure and involve the cost. Due this method limitation and advancement in the ultrasound technology the non invasive method became the choice of doctors and the patients. This method is reproducible, cost effective and readily available. Ultrasound is helpful in analyzing the abdominal texture and structure. Liver ultrasound helps to screen the patients for different liver diseases and their stages. The image helps to identify the fibrosis and cirrhosis of the liver and can be observed through changes in the vascularised fibrotic septa and through the nodules regeneration. The advancement in the disease can easily be observed through the variation in texture features from the normal tissues and organs. Transient Elastography is used to measure the stiffness of the liver and is considered referral tool for fibro scan. The observation of stiffness and hardness in elasticity images helps to identify the pathological changes from the healthy tissue. The velocity of wave propagation is measured by pulse echo ultrasound. Tissue stiffness is linked with the velocity of wave .If the wave is faster it means the tissue stiffness is high and vice versa. The ultrasound techniques are linked with many advantages like it is easy to perform, painless and provide fast results. For liver stiffness measurement the reproducibility is vital characteristic. Transient elastography is also vital parameter to measure the stiffness but the results may vary due to inter coastal space, BMI and ascites of the patients. In short the ultrasound technique to measure the liver fibrosis is reproducible and accurate for the liver disorder.

METHODOLOGIES:

There are different methodologies to analyze the fibrosis of liver.

One of the methodologies is to use METAVIR Score which is a tool to identify the fibrosis severity through liver biopsy of a patient having hepatitis c. The scale indicates the liver inflammation and the stage of fibrosis. It helps to quantify the necrinflammations. It is a five score scale which helps to assess the fibrosis as shown in the table below.

The METAVIR score is the system which represents a semi-quantitative classifications system and scores both necroinflammatory changes. The fibrosis score is assessed on a five point scale, like we managed observes in the table 1.

Table 1 METAVIR Score for liver Fibrosis for Diagnostic and treatment Options

METAVIR	Cut off Value Fibro scan	Stiffness of liver kPa
F0	-----	No Fibrosis
F1	Portal fibrosis without septa, Mild fibrosis	Less than 7.1 kPa
F2	Portal Fibrosis with few septa, Moderate Fibrosis	7.1 to 8.8 kPa
F3	Severe Fibrosis with lot of septa	9.1 to 9.6 kPa
F4	Cirrhosis	12.5 to 14.6 kPa

From the table above it is clear that the patient's diseases stages are scaled according to the results of the biopsy and the treatment plans are made according to the stage of the disease.

Texture Analysis with Ultrasound:

In ultrasound the images of the liver are observed, the texture of tissues and organs are analyzed and variations are evaluated .It helps to identify the differences in the health tissue and the pathological changes due to disease. For the statistical analysis the Gray level co occurrence matrix is used. In this matrix the number of columns and rows of the matrix are made equal to the gray areas in the image. This is similar to the relative frequency where the two pixels are separated by the distance of a pixel one with intensity indicated as I and the other intensity indicated j. The statically values are verified by changes observed in the gray level area with the presence of displacement distance d and e as a particular angle. Five measures are helpful in defining the gray level co occurrence matrix which is contrast correlation, entropy, angular second moment and inverse difference moment

B-mode ultrasound is widely used in the screening of patients to identify the progression of fibrosis. The study involved 100 patients with different stages of fibrosis and pathologies according to the stages suffering from hepatitis c, cirrhosis and hepatitis B. The age group of the patients was from 30 years to 70 years. All the patients followed the protocol of clinical examination, laboratory tests and the ultrasound examinations. Patients with obesity, ascites and decompensated cirrhosis were excluded from the study. The data was collected from the intercostals space and patient was laid in the dorsal decubitus position having right arm in the maximal abduction. Transducer with ample gel was placed at the skin between the ribs at right lobe of the liver. The portion of a liver with 6 cm thickness was observed in the fibro scan. The depth of measurement under the skin was 65 mm to 25 mm. The measurement which was not supported by the vibrations was rejected by the software of the ultrasound. The maximum measurements performed on every patient in study were 10.The results of the scans were represented in kPa (kilopascal). The liver stiffness was measured by the median value. Repeated measurements helped in the quantitative analysis. P value was calculated which was 0.01 which is highly significant. Liver stiffness measurement was observed by the ROC curve. The subject was assesses by the non invasive marker indicating values less than, greater than and equal to according to the cut off values .The true positive value indicate the sensitivity and the true negative value indicate the specificity. ROC curve shows the sensitivity and also the specificity of the cut off values. Transient elastography is a technique which helps to measure the liver stiffness.

RESULTS AND DISCUSSIONS:

From the sample selected there were 65 % male participants and the ratio of female patients were 35%..The results of fibro scan indicate the presence of the cirrhosis among 15 percent of the selected sample. It indicates positive correlation with texture, surface and size of the live with the ultrasound findings.

Table 2 Fibro scan identifying cirrhosis

Stages	Cut off Value Fibro scan	N (%)
F0	-----	28%
F1	Portal fibrosis without septa, Mild fibrosis	22%
F2	Portal Fibrosis with few septa, Moderate Fibrosis	15%
F3	Severe Fibrosis with lot of septa	20%
F4	Cirrhosis	15%

The hepatomeglay among the patient of F3 were 65 % of the patients of F3 have normal liver size and the remaining 35 % of the F3 patients have enlarged liver.F4 patients also observe hepatomegaly. The significant value of the fibro scan and the hepatic size was P < 0.001 which is statistically highly significant. When the liver was analyzed for the hepatic surface the F3 patients showed the regular hepatic surface as shown in the table below and the patients of F4 were having both regular surface and irregular surface. Irregular surface was present among 40 percent of the cirrhosis patients. While the results of ultrasound indicates the irregularity in the surface in all cases of cirrhosis

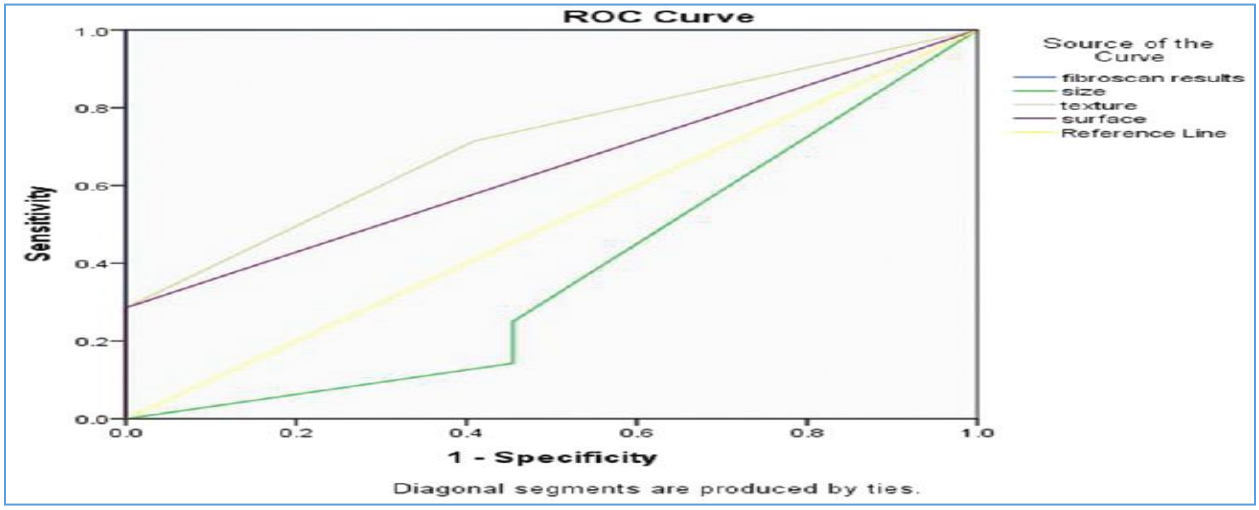
The positive correlation was observed between the hepatic echo texture and the fibroscan.70 percent of the patients had texture bright and the 30 % have the coarse echogenic .In the patients of F 3 cirrhosis was not detected. The patients of F4 have coarse echogenic texture in 45 percent of the patients. Some patients also showed bright texture and cirrhosis at the same time represented the 26 % of the F4 patients.

Table 3 Hepatic Surface in Fibro scan

Hepatic Surface	**F3**	**F4**
Regular	20(100%)	9(60%0
Irregular	0	6(40%)
Total	20(100%)	15(100%)

ROC analysis:

ROC analysis purpose is to compare the results of the texture analysis with fibro scan at the same time. For comparison it is important to define the cut off value .From the METAVIR score the cut off value in the study was selected as 12.5 kPa. It will help to identify the fibrosis level for monitoring purpose or for more performance tests. The cut off value also helps to identify the sensitivity and the specificity of the disease. If the values of the results are below the cut off values it means the disease can excluded and if the values are high it mean the presence of disease. The results of ROC curve from the fibro scan shows that is high in specificity and sensitivity which is shown under the curve area. It is also proximal to the cut off value 12.5 kPa. Fibro san results indicate that the sensitivity was 70 percent and specificity was 41 percent with area under the curve was 0.71 .Regarding the size of the liver the sensitivity was about 26 % and the specificity was 40 % with area which is lying under the curve of 3.9.About the regular and irregular surface the sensitivity was 30 % and specificity was 100 % under the curve area of 65%.While the results of ultrasounds indicate the irregular surface and liver nodule in their images



There are many factors which increases the risk of cirrhosis. It is more common in older males it may be because they have the high rate of hepatitis C infection due to their exposure to external environment .Hepatic size is positive correlated with the fibrosis. When the advance stage of cirrhosis

develops the size of liver shrinks due to the multinodular surface. The hepatic surface is in most cases of the fibro scan was regular but in the later stage of cirrhosis it seems irregular. From the results of the study the cirrhosis cut off value was 12.5 kPa and the ROC was 1.00 where the sensitivity was 80 percent and the specificity was 100%. The prevalence of cirrhosis varies from one region to other due to the hepatitis c infection and hence the results may vary. Friedrich et al and Talwalker Ja et all have published their studies and have suggested that transient elastography is best to analyze and differentiate the cirrhosis with high diagnostic accuracy in fibro scan. Therefore in the specialized clinical practices the fibro scan is considered an excellent diagnostic tool for the inclusion or exclusion of liver cirrhosis among the liver disease patients. In the study the B-mode ultrasound was performed of 100 patients and among them the cirrhosis was identified in 15 patients from the fibro scan. Due to the high sensitivity and specificity the fibro scan is a good option for diagnosing the cirrhosis among the liver diseases induced by the Hepatitis infection.

The sensitivity of the ultrasound in detecting the cirrhosis was 73 %.While in the results of fibro scan the sensitivity of the results are 100 % in detection of fibrosis. From the results obtained it can be said that the ultrasound results overestimate the presence of the cirrhosis and is not sensitive enough to detect the cirrhosis 100%.Therefore the fibro scan due to its high sensitivity is considered best option for identifying the fibrosis among the patients of liver diseases. Ultrasound assessment for liver parenchyma is qualitative in nature and may vary from one operator to other whereas the fibrotic pattern appearance is similar in fibrosis and hence variation in results are lacking.

CONCLUSION:

Fibro scan is a good tool to analyze the texture of liver .Liver stiffness measurement therefore considers a good option for diagnosing the fibrosis and the cirrhosis among the liver disease patients. It is a cost effective and non invasive tool and helps to develop the treatment plan for the practitioners. Significant linear correlation was observed in the fibro scan results where P value is $p < 0.001$. While the correlation significance in the case of B mode ultrasound was 0.05 which is not as significant as the fibro scan P value is considered.

Gray level co occurrence matrix
A statistical method of examining texture that considers the spatial relationship of pixels is the **gray**-level **co-occurrence matrix** (GLCM), also known as the **gray**-level spatial dependence **matrix**. Measures the local variations in the **gray**-level **co-occurrence matrix**.

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