RESEARCH ARTICLE

IDENTIFICATION OF DIFFERENT LIVER DISEASES BY USING IMAGERY TECHNIQUES: A REVIEW.

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Manuscript Info

Abstract

The aim of this study is to characterize the different liver diseases which are related to infect liver tissue and other infected part like spleen, pancreas, and stomach. The methods used are preprocessing ,segmentation, feature extraction, texture analysis which is depend upon the collection of Computed Tomography(CT) scans, MRI(Magnetic Resonance Imaging) and Ultrasounds(US) of different patient collected from the hospitals.

MRI is playing an important role in analyzing the liver disease patients due to its high soft tissue resolution, lack of ionizing radiation and ability to provide functional data. Imaging techniques like ultrasonography, CT scans, MRI are used to get the enhanced image of infected part of liver so that can easily characterized and detect the particular disease in liver patient. Diffusion Weighted Imaging (DWI) is used to identify the lesion in the liver and Perfusion Weighted Imaging (PWI) is used to identify the volume and functioning of the cirrhotic liver.

Introduction:-

Liver is the largest vital organ of our body located in the upper right quadrant of the abdomen, below the diaphragm which performs a wide range of functions including the removal of endogenous and exogenous material from the blood ,carbohydrate , homeostasis, detoxification of various metabolites, protein synthesis, urea function and immune functions .Liver could be involved by several serious diseases like fatty liver, cirrhosis ,hepatocellular carcinoma .Others can be the result of drugs, poisons or too much drinking of alcohol called fatty liver .If liver forms the scar tissue due to long duration of illness called cirrhosis and HCC develops in patients with chronic liver diseases .Classic symptoms of liver diseases such as nausea, vomiting, abdominal pain ,jaundice, fatigue so for detecting ,diagnosis and monitoring these liver diseases apply the Invasive techniques which is used for diagnosis the abnormality in liver patient with the help of MRI, CT scans, ultrasound**.** MRI produces the 3D detailed anatomical images without use of damaging radiations. Often used for detect, diagnosis and treatment monitoring**.** CT scans is fast and painless use special x-ray equipment and computers to produce the images and have more detailed information image then x-rays. Ultrasound uses sound waves to produce images of inside the body. It does not use ionizing radiation because it captures in real time and they can show the structure and movement of body internal organ. Liver diseases affect one in five Indians. People do not realize the liver disease in earlier but the critical condition can be converted in liver cancer.

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Critical Analysis:-

Francesco Agnello, Marco Dioguardi Burgio et al(2016)[1]: This paper describe the optimal MRI study protocol of the liver and the differences in stage of enhancement between cirrhotic and normal liver by using gadoxetic acid. Authors also illustrate the differences in steps of enhancement of between gadoxetic acid and extracellular contrast agents and they also discussed how to obtain and recognize an adequate hepatobiliary phase.

There are some merits and demerits of using gadoxetic acid.
- Using gadoxetic acid is higher hepatobiliary results in greater enhancement of liver parenchyma.
- Demerits of liver magnetic resonance imaging (MRI) with gadoxetic acid are the highest cost: the price of gadoxetic acid is almost twice that of gadobenate dimeglumine.

Mohamed E. M. Garelnabi, Mohammed A. Ali Omer et al(2016)[2]: In this review researchers, characterize and identify HCC using classification depending on the basis of disparity of grey level of plain, arterial and venous phases in CT images.
- Different important parameters have been considered for precise qualitative characterization of hepatic diseases like texture features, grey scale, fractal dimension estimators or shape descriptors, combined with a classifier.

Yoon Jin Lee, MD Jeong Min Lee et al(2015)[3]: This paper shows that MRI has higher overall per-lesion sensitivity extent than CT and can be more effectible with the use of hepatobiliary-specific MR contrast agents, even in challenging situations such are end-stage liver disease and lesions smaller than 1 cm.

Ozum Tunçyurek, M. Onur Turkkan et al(2014)[4]: In this paper evaluated fibrosis and cirrhosis in cases with non alcoholic fatty liver disease by means of transient elastography and revealed that data equivalent to biopsy could be collected, that could not reach this result with the method of strain elastography.

Karthik Kalyan,Binal Jakhia et al(2014)[5]: In this study, five feature classifiers have been investigated for diagnosing the liver diseases. The accuracy of the classifier was based upon the feature set that has been used, selected training samples and classifier's ability to learn from the training samples. Five sets of features such as GLCM, GLRLM, intensity histogram, invariant moments, and mixed features were extracted.

Devendra Joshi ,Narendra D Londhe(2013)[6]: In this paper use adaptive thresholding technique for segmentation of liver tumor. Goal is to produce a technique in MATLAB for automatic segmentation by using DICOM images and it is processed and further converted in to jpeg images for segmentation. Authors use the thresholding technique in each slice for the segmentation of Tumour. This method effectively segments the Liver tumour when applied to abdominal CT images which is difficult to segment the tumour accurately.

Katia Passera, Sabrina Selvaggi et al(2013)[7]: This paper represents a first attempt to get a quantitative tool aimed to evaluate the accuracy of Radiofrequency ablation (RFA) treatment. The possibility to visualize the tumor and the correspondent post RFA necrosis in the exact same framework and the definition of some synthetic numerical indexes could help clinicians in ameliorating RFA treatment.

Hai-ying Zhou, Tian-wu Chen et al(2012)[8]: In this paper, the patterns and producing veins of the inflowing vessels of gastric fundic and esophageal varices were shown as correctly on CT-MPR images, which forward demonstrates the advantages of MDCT porto-graphy for evaluating varices.

Ming-Hong Hshiao,Po-Chou Chen et al(2012)[9]:This review paper describe that MRI is safe, fast, and noninvasive diagnostic techniques with high spatial resolution. In this review paper, a new concept dynamic gray level scaling and the filtering out of the artery and portal veins in the region of interest was successfully proceed to MRI of liver cirrhosis. The extracted features of the MRI T2-weigh-ted image give a quantitative measure of the extent of liver cirrhosis.
- Quantitative characters of standard deviation , mean, and entropy in the region of interest have been successfully calculated by the dynamic gray level scaling of T2-weighted MRI with high accuracy.

Marius George Linguraru, William J. Richbourg et al(2012)[10]: This paper brings together the automated segmentation of liver with detection, classification and segmentation of hepatictumors from typical clinical radiological data with variability in imaging acquisition parameters .The proposed method in this paper for the

automated segmentation of the liver, and detection, segmentation, and classification of tumors can be employed as an assisting diagnostic tool robust to morphological changes from normal , pathological anatomical variability, as well as poor image quality or enhancement.

Frydrychowicz, MD,R. Landgraf et al(2011)[11]: This paper demonstrated the feasibility of performing comprehensive anatomic and hemody-namic visualization of hepatic and splanchnic blood flow with a single free-breathing acquisition. Hemodynamic visualization and vessel segmentation included color-coded three-dimensional (3D) streamlines and particle traces. Segmentation quality features was compared with contrast-enhanced multi-phase liver imaging

- To analyze the hemodynamics with respect to visualization character and directionality to relate the image quality to the severity of the liver diseases as expressed by the survival rate following the MELD score [Models for End-stage Liver Disease].
- To underline the potential clinical impact by using presentation of case examples,
- Compared the vessel segmentation quality C-VIPR with contrast-enhanced liver imaging.

Li Wang, Jian-ping Lu(2011)[12]: This reviewed paper shows the 3D contrast-enhanced magnetic resonance angiography is non-invasive imaging techniques that can be completely visualize the hepatic vein, collateral circulation allowing clinicians and inferior vena cava to fully understand the disease before surgery is done. The use of MRA in BCS can potentially help to reduce surgical time and increase surgery success rates in the future.

A Furlan,MD,D Marin(2011)[13]: In this paper authors found, both liver parenchyma and HCC reached their maximum enhancement during the hepatic venous phase. Compared with the hepatic venous phase, the late phase yields a significantly higher detection rate of tumour washout at the time of multiphasic MDCT in patients with cirrhosis.

Nefise Cagla Tarhan, Tugce Hatipogu(2011)[14]: This paper determine whether the different vascularization patterns of HCC nodules observed at the time of three phases of dynamic liver MDCT   correlate with histopathological differ-entiation grades.

Ricardo Ribeiro et al(2011) [15]: In this paper, study demonstrate that combining US liver contour features with laboratorial and clinical parameters can be useful for accurately identifying different stages of diffuse liver disease. Features extracted from the liver contour detected, as well as laboratorial features and clinical, can be used to train supervised classifiers to identify the disease.

Marius George Linguraru et al(2010) [16]: The results demonstrated the capability of the techniques to divide or segment the abnormal and normal liver, and spleens with a accuracy comparable to the inner observed variability and error close to the voxel size.

Young-sun Kim et al(2010) [17]: In this paper authors used image fusion and radial multiplanar reformation techniques for 3D analysis of ablative margins. The combination of both techniques enabled authors to evaluate the ablative margin according to quantity. The use of the radial multiplanar reformation technique made possible a complete examination in virtually every directions.

Katsutoshi Sugimoto et al(2010) [18]: Used micro-flow imaging (MFI) of contrast- enhanced ultrasound. Most of the methods, including transient US elastography,), perfusion MRI, conventional US, double contrast material enhanced Magnetic Resonance Imaging(MRI), and diffusion MRI, are limited to the detection of advanced fibrosis. The image characteristics described on the MFI showed good correlation with the degree of liver fibrosis, and thus, the MFI of CEUS is useful for non-invasive staging fibrosis.

Luis Martí-Bonmat et al(2010) [19] : The typical histological features of cirrhosis influence and chronic hepatitis the appearance of liver and must be assessed separately by radiological imaging biomarkers in order to be useful clinically.

Behroze Vachha et al(2010) [20]: In this paper, authors found that
a.   On ultrasound, hemorrhagic cysts seen as hypoechoic lesions with increased through transmission of sound and lack of internal vascularity, suggesting their cystic nature.

b. On Computed Tomography, the main characteristic appearance is a very complex cystic lesion with variable features, which may range from cysts with more complex cystic masses with a thick well-defined fibrous capsule to internal hemorrhagic components, mural nodularity and internal septations. The appearance may show characteristics of biliary cystadenoma or biliary cystadeno carcinoma, but an infected, hemorrhagic cyst or effected does not show any enhancement in contrast

c. On MRI, the signal intensity varies depending on the contents of the complex cyst.

Magali sasso et al(2010) [21]: In this paper authors found that a novel ultrasonic controlled attenuation parameter (CAP) automatically estimates ultrasonic attenuation of the using a sophisticated guidance process .And authors also concluded that CAP is valid non invasive tool for steatosis detection and quantification.

Richard Allen et al(2010) [22]: Assessment of the liver surface using ultrasound consistently had moderate diagnostic correctness across many studies which exhibit good research methodology. Other techniques demonstrated variable or poor to better diagnostic accuracy. US of the liver surface is a useful diagnosing tool in patients at risk of Chronic Liver Disease while assessing whether they should undergo for a liver biopsy or not.

Hersh Chandaranaet al(2009)[23] : In this paper authors found that patients with iron deposition had shorter hepatic T2 values , than those patients without iron deposition (mean T2, 17.7 v/s 32.3 milliseconds with pooled data from both two observer ; $p < 0.0001$). Patient with iron grade 3 or more had lesser T2 values than those with iron grade 2 or minimum (10.1 v/s 20.8 millisecond; $p < 0.0001$). There was a strong negative correlation between hepatic T2 and histopathology iron grade ($r = -0.849$; $p < 0.0001$).

Tian-wu Chen et al(2009) [24]:In this papers authors found that with the development of MDCT, the acquisition of image has become increasingly faster so that high quality of Computed Tomography portography could be obtained to show the entire Porto systemic collaterals within the greater coverage along the z-axis.

Maha Torabi et al(2008) [25]: In this paper authors found that some lesions components remains hypoattenuating in arterial, portal venous, and delayed phase, representing regions of necrotic tissue, hemorrhage, or fibrous tissue with little or no vascularization seen at histologic analysis.

Meng Yin et al(2007) [26]: In this paper authors found that liver stiffness increases systematically with the stage of fibrosis. Also demonstrated that Receiver operating curve (ROC) analysis with a shear stiffness cut off value of 2.93 kPa, the estimated specificity and sensitivity for detecting all grades of liver fibrosis is 98% and 99%.

Giuseppe Brancatelli et al(2006) [27]: This paper demonstrate that both CT and MR provide valuable deep understanding into the extent of hepatic injury from complications and cirrhosis including portal hypertension.

Motoh Iwasa et al(2005) [28]:This study demonstrated that there are many patients with abnormalities in the anterior cingulate gyrus in the Liver Cirrhosis group particularly, they showed significant decrease in blood flow in the anterior cingulate gyrus and in the frontal lobes.

Nader Binesh et al(2005) [29]: MR spectroscopic results showed a statistically significant decrease in choline (Ch) and myo-inositol (mI) and an increase in glutamate/glutamine (Glx) in patients when compared to healthy controls

Sherif Saadeh et al(2002) [30]:This study indicates that the condition of being severe of hepatic steatosis can be correctly decide radiological imaging only when there is severe (33%) or moderate fatty infiltration of the liver documented by a liver biopsy.

Paola Di Giacomoa, Giovanni Felicib et al(2001)[31]In this review paper authors described that the application of new learning tool for the diagnosis the hepatocellular carcinoma. This method presents the several interesting features of medical diagnosis system.

Table 1:- Imagery techniques used during 2001-2016 for detection of liver diseases

Authors' Name	Techniques Used	Critical Remarks
Francesco Agnelo et al(2016)[1]	Gadoxetic Acid, Magnetic resonance imaging	Radiologists involved in liver imaging need to be familiar with the state-of-art MRI study protocol of the liver and the special characteristics of gadoxetic acid.
Mohamed E. M. Garelnabi et al(2016)[2]	Texture Analysis, K-means	Some HCCs, especially small or well-differentiated lesions, may not be hyper-enhancing on arterial phase images, only 58% of HCCs < 2 cm were hyper-vascular on the arterial phase
Yoon Jin Lee et al(2015)[3]	Magnetic Resonance Imaging (MRI)	MRI showed higher per-lesion sensitivity than multi-detector CT and should be tend to choose imaging modality for the diagnosis of HCCs in patients.
Ozum Tunçyurek et al(2014)[4]	Elastography, hepatosteatosis, ultrasound	elastography technique failed to clearly differentiate between the degrees of hepatosteatosis,which could be differentiated by B-mode Ultrasound.
Karthik Kalyan et al(2014)[5]	Image-Processing , Ultrasound, GLRLM, Neural Network	GLRLM and mixed feature set showed excellent accuracy in training as well as testing.
Devendra Joshi et al(2013)[6]	Automatic segmentation, Adaptive thresholding, Boundaries ,region splitting and merging.	The proposed segmentation method improves the Segmentation performance compared with the conventional process based on a regular gray value
Katia Passera1 et al(2013)[7]	Image Processing ,Radiofrequency ablation (RFA), Fuzzy-C-Means approach	The performance will be slighter lower then when larger dataset of unseen data are considered
Hai-ying Zhou et al(2012)[8]	MDCT	The diameter of the splenic vein can be used to predict esophageal and gastric fundic varices and their patterns.
Ming-Hong Hshiao et al(2012)[9]	Image-processing, MRI	AUC is a widely used measure of accuracy of classification. Higher values of AUC indicate classification, AUC values of SD, mean, and entropy all exceeded 93% ($P < 0.001$).
Marius George Linguraru et al(2012)[10]	contrast-enhanced computed tomography (CT), parameterization, segmentation, shape.	Technique improved significantly the segmentation of cases with large tumors and segmentation errors(P<.001)
Frydrychowicz et al(2011)[11]	Phase contrast imaging; velocity mapping; flow-sensitive MRI	Models for End-stage Liver Disease(MELD score) score may not necessarily reflect the severity of portal hypertension itself
Li Wang et al(2011)[12]	Magnetic resonance angiography—Image processing	When magnetic resonance angiography shows that the occlusion of the inferior vena cava is near to the right atrium, it is not suitable to puncture the jugular vein.
A Furlan et al(2011)[13]	MDCT (Multidetector Computed	Diagnosis of HCC at contrast-enhanced

	Tomography)	MDCT requires the existence of nodule hypervascularity and venous washout are demonstrated
Nefise Çagla Tarhan et al(2011)[14]	Computed Tomography, spiral computed	Conventional angiography is considered to be the gold Standard for demonstrating the vascularity of HCC lesions
Ricardo Ribeiro et al(2011) [15]	Used Ultrasound Imaging	Combining features further improves the classifiers performance.
Marius George Linguraru et al(2010) [16]	Used Computed Tomography	Segmentation can still suffer from errors induced by adjacent organs, partial volume effects and variations in contrast in-take during enhancement.
Young-sun Kim et al(2010) [17]	Used CT scans and fusion, and image fusion or radial multiplanar	If image fusion or radial multiplanar reformation technique is unavailable ,utilization of either technique – for instance image fusion of conventional coronal or sagittal maultiplanar- can be used.
Katsutoshi Sugimoto et al(2010) [18]	Contrast-enhanced ultrasound (CEUS);CEUS with MFI(micro-flow imaging) has been used.	The MFI of CEUS is useful for non-invasive staging fibrosis.
Luis Martí-Bonmati et al(2010) [19]	Used Magnetic Resonance Imaging	A biopsy is not necessary if clinical and radiological data suggest cirrhosis
Behroze Vachha et al(2010) [20]	Using CT scans, MRI and Ultrasounds for liver cysts	Imaging characteristics cannot definitely distinguish biliary cystadenoma from biliary cystadenocarcinoma. Therefore, the optimal management of these masses is surgical resection.
Magali sasso et al(2010) [21]	Using ultrasonic controlled attenuation parameter (CAP); CAP is a noninvasive, immediate, objective and efficient method to detect and quantify steatosis.	CAP automatically estimates the ultrasonic attenuation of the liver using a sophisticated guidance process. CAP is actually an estimate of the ultrasonic attenuation at 3.5 MHz.
Richard Allen et al(2010) [22]	Using Ultrasound Imaging for Cystic Liver Disease(CLD)	Paper research was restricted to ultrasound images only. Ultrasound of the liver surface is a useful diagnostic tool in patients at risk of CLD when assessing whether they should undergo a liver biopsy or not.
Hersh Chandaranaet al(2009)[23]	Used MRI sequence in the detection and quantification of hepatic iron deposition in patients with liver disease.	MRI with hepatic T2 measured within a breath hold have excellent sensitivity and specificity in the diagnosis of the presence of and quantification of hepatic iron
Tian-wu Chen et al(2009) [24]	Used 64-row Multidetector Computed Tomography (MDCT).	Multidetector CT overcomes the limitations of conventional spiral CT because its data acquisition is several times faster than with conventional helical CT scanners .
Maha Torabi et al(2008) [25]	Used Multiphase helical computed tomography (CT)	Multiphase helical computed tomography (CT) allows evaluation of the liver during both the arterial and the portal venous phases of contrast

		enhancement and therefore is an important modality for the detection and characterization of hepatic neoplasms.
Meng Yin et al(2007) [26]	Used Magnetic Resonance Elastography (MRE) for detecting liver fibrosis	MRE is a safe, non-invasive technique with excellent diagnostic accuracy for assessing hepatic fibrosis.
Giuseppe Brancatelli et al(2006) [27]	Used Magnetic Resonance Imaging(MRI) and Computed Tomography(CT)	CT and MR are quite accurate in detection and characterization of larger (>2 cm) lesions,
Motoh Iwasa et al(2005) [28]	Used Single Photon Emission Computed Tomography (SPECT)	Reduced blood flow in the anterior cingulate gyrus is frequently observed in Liver Cirrhosis (LC) patients.
Nader Binesh et al(2005) [29]	Magnetic resonance spectroscopy (MRS) has been used	Demonstrated the feasibility of evaluating the two-dimensional L-COSY (Correlated Magnetic Resonance Spectroscopic) sequence in a clinical environment.
Sherif Saadeh et al(2002) [30]	Used Ultrasonography (US), computerized tomography (CT), and magnetic resonance imaging (MRI).	Radiological modalities are unable to distinguish between NASH (nonalcoholic steatohepatitis) and other forms of NAFLD (nonalcoholic fatty liver disease)
Paola Di Giacomoa et al(2001)[31]	Supervised learning, Liver ultrasounds,Lsquare	In future error distribution can be reduced by establishing the new confidence level of diagnosis.

Conclusion and Future Scope:-

Through this study we got to know about several Liver disease and how these diseases can be detect radiologically. We found that HCC(Hepatocellular Carcinoma) , Cirrhosis, FLD (Fatty Liver Disease) and NAFLD (Non Alcoholic Fatty Liver Disease) are the most common liver diseases. The most common Imagery technique to detect these diseases is CT(Computed Tomography. MRI (Magnetic Resonance Imaging) is mostly used for the diagnosis of tumor development because of its ability to reliably depict HCC. And Ultrasound (US) is the best way for detecting cystic appearance in Liver.

We can enhance the quality of CT images by using HRCT (High Resolution CT). We can try to detect lesions less than 2cm in size using MRI and CT.

Acknowledgement:-

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