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Original Research Article

Demographic Determinants of Focal Liver Lesions: MRI-based Characterization of Benign and Malignant Hepatic Lesions

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Abstract:

Background: Focal liver lesions (FLLs) represent a wide spectrum of hepatic abnormalities ranging from benign lesions to primary and metastatic malignancies. Accurate characterization of these lesions is essential for appropriate clinical management. Magnetic resonance imaging (MRI) plays an important role in the detection and differentiation of benign and malignant liver lesions.

Aim: To evaluate benign and malignant focal liver lesions with special reference to age and gender distribution among the study population.

Methods: This prospective observational study was conducted at a tertiary imaging center over a period of two years. A total of 50 patients with focal liver lesions detected on imaging underwent MRI evaluation. Patients of all age groups and both genders were included after applying predefined inclusion and exclusion criteria. Demographic details, clinical history, and imaging findings were recorded. The final diagnosis was established using imaging characteristics, clinical correlation, biopsy where required, and follow-up findings.

Results: Among the 50 patients studied, 35 (70%) were males and 15 (30%) were females. The majority of cases were in the 51–75 year age group. Of the total lesions, 16 (31%) were benign and 34 (69%) were malignant. Malignant lesions were more common in patients above 50 years of age, while younger patients showed a relatively balanced distribution of benign and malignant lesions.

Conclusion: MRI is a reliable modality for the evaluation of focal liver lesions and helps in distinguishing benign from malignant lesions while considering demographic parameters such as age and gender.

Keywords: Focal liver lesions, Magnetic resonance imaging, Benign liver lesions, Malignant liver lesions, Hepatocellular carcinoma.

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Introduction

Focal liver lesions (FLLs) constitute a diverse group of hepatic abnormalities that are increasingly detected due to the widespread use of advanced imaging modalities such as ultrasonography, computed tomography (CT), and magnetic resonance imaging (MRI) [1]. These lesions may be broadly categorized as benign or malignant, each demonstrating distinct epidemiological, clinical, and radiological characteristics. Common benign lesions include hepatic hemangioma, focal nodular hyperplasia, hepatic adenoma, and simple cysts, whereas malignant lesions mainly comprise hepatocellular carcinoma, intrahepatic cholangiocarcinoma, and metastatic tumors [2]. Accurate differentiation between benign and malignant lesions is essential because it significantly influences patient management, treatment decisions, and prognosis. Demographic factors such as age and gender play an important role in the occurrence and distribution of focal liver lesions, with benign tumors often reported more frequently in younger females and malignant lesions more prevalent in older males [3]. Understanding these demographic patterns improves diagnostic suspicion and radiological interpretation. The present study aims to evaluate benign and malignant focal liver lesions with special emphasis on age and gender distribution among the study population.

Methods

It was a prospective observational diagnostic study conducted to evaluate benign and malignant focal liver lesions with special reference to demographic parameters such as age and gender. The study was carried at GSL Medical College, Rajahmundry. The study was performed over a period of two years between January 2021 and December 2022. Ethical approval was obtained from the Institutional Review Board prior to the commencement of the study, and all procedures were conducted in accordance with

standard ethical guidelines. A total of 50 patients with focal liver lesions were included in the study after fulfilling the predefined inclusion and exclusion criteria. Patients of all age groups and both genders who were detected to have FLLs on ultrasound, CT, or incidentally on MRI were considered eligible for inclusion in the study.

The sample size for the study was determined using Mahajan's allowable error formula ($n = 4pq/e^2$) based on the expected prevalence of liver pathology cases detected on MRI in the institution. Based on the available institutional data, the minimum required sample size was calculated to be 50. Patients with lesions less than 1 cm in size were excluded to avoid partial volume errors during imaging analysis. Additionally, lesions showing hemorrhagic or necrotic components were excluded to prevent false diffusion restriction during interpretation. Patients who had received prior chemotherapy or radiotherapy and those with contraindications to MRI such as cardiac pacemakers, cochlear implants, or metallic aneurysm clips were also excluded from the study. Informed consent was obtained from all participants after explaining the nature and purpose of the study and the MRI scanning procedure.

As part of protocol, the demography such as age, gender clinical history were recorded. All patients underwent MRI examination using a Siemens Magnetom Avanto 1.5 Tesla scanner. The final diagnosis of lesions was established using imaging characteristics, correlation with other modalities such as ultrasound or CT, tissue biopsy when indicated, and clinical follow-up of benign lesions for 6–12 months. Statistical analysis was performed using SPSS version 21, and results were expressed using descriptive statistics, with significance considered at $p \leq 0.05$.

Results

Among the study population, 35 (70%) were male, indicating a higher prevalence of FLLs. The age of the patients ranged between 1 to 82 years, with the majority of cases occurring in the 51–75 year age group (60%), followed by 26–50 years (34%), 1–25 years (4%), and 76–100 years (2%). A history of extrahepatic malignancy was present in six patients, including gall bladder carcinoma (n=4), prostate carcinoma (n=1), and pancreatic carcinoma (n=1). Additionally, 22 patients had chronic liver disease with suspected hepatocellular carcinoma, while 16 patients had no prior history of malignancy or chronic liver disease and were evaluated for incidentally detected focal liver lesions. Based on MRI evaluation and final diagnosis, 16 lesions (31%) were benign and 34 lesions (69%) were malignant. Age-wise analysis revealed that patients <50 had a relatively balanced distribution of lesions, with 47% benign and 53% malignant lesions. However, in patients >50 years, malignant lesions were significantly more common, accounting for 77%, whereas benign lesions constituted only 23%.

Discussion

The findings of the present study demonstrated that FLLs were more frequently observed in male, accounting for 70% of the study population. This male predominance has been reported in several previous studies evaluating hepatic lesions, particularly malignant tumors such as hepatocellular carcinoma (HCC). Chronic liver disease, viral hepatitis, alcohol-related liver disease, and metabolic liver disorders are more common among males and contribute to the higher incidence of malignant hepatic lesions in this group. Epidemiological studies indicate that the global incidence of HCC is significantly higher in males compared with females, with male-to-female ratios ranging between 2:1 and 4:1. Hormonal factors, lifestyle risk factors such as alcohol consumption, and higher prevalence of hepatitis infections among males are believed to play a significant role in this gender disparity. These findings are consistent with the results of the present study, which showed a predominance of focal liver lesions among males undergoing MRI evaluation for hepatic abnormalities [4 – 6].

Age distribution is another important factor influencing the occurrence of focal liver lesions. In the present study, the majority of patients were in the 51–75 year age group (60%), followed by the 26–50 year age group (34%). Only a small proportion of patients were younger than 25 years or older than 75 years. Similar age distribution patterns have been reported in previous imaging-based studies of hepatic lesions. Malignant liver tumors, particularly hepatocellular carcinoma and metastatic lesions, are more commonly diagnosed in middle-aged and elderly individuals due to long-standing liver disease and cumulative exposure to risk factors such as viral hepatitis, alcohol consumption, metabolic syndrome, and environmental toxins. Several population-based studies have demonstrated that the peak incidence of hepatocellular carcinoma occurs after the age of 50 years, which supports the findings of the present study [7 – 9].

The present study also revealed that a significant proportion of patients had underlying liver disease or extrahepatic malignancy. Six patients had a history of extrahepatic malignancy, including gall bladder carcinoma, prostate carcinoma, and pancreatic carcinoma, suggesting the possibility of metastatic liver lesions. The liver is one of the most common sites for metastasis due to its dual blood supply and rich sinusoidal network, which allows circulating tumor cells to lodge within the hepatic parenchyma. Metastatic liver disease frequently arises from primary malignancies of the

gastrointestinal tract, pancreas, breast, lung, and genitourinary system. Previous research has shown that metastatic lesions constitute a large proportion of malignant focal liver lesions detected on imaging, especially in patients with known primary malignancies. Therefore, clinical history plays an important role in differentiating primary hepatic tumors from metastatic lesions during radiological evaluation [10].

Another important observation in the present study was that 22 patients had chronic liver disease with suspected hepatocellular carcinoma. Chronic liver disease is the most important risk factor for the development of hepatocellular carcinoma worldwide. Conditions such as chronic hepatitis B infection, hepatitis C infection, alcoholic liver disease, and non-alcoholic fatty liver disease lead to progressive hepatic fibrosis and cirrhosis, which significantly increase the risk of malignant transformation. Studies have reported that approximately 80–90% of hepatocellular carcinoma cases develop in the background of chronic liver disease or cirrhosis. In the current study, all patients with hepatocellular carcinoma had underlying chronic liver disease, highlighting the strong association between these two conditions. Early identification of focal liver lesions in patients with chronic liver disease is therefore essential, as early detection of hepatocellular carcinoma significantly improves treatment outcomes and survival rates [11, 12].

With regard to the nature of the lesions, the present study showed that 31% of focal liver lesions were benign, while 69% were malignant. This higher proportion of malignant lesions may be attributed to the tertiary referral nature of the imaging center where patients with suspected hepatic malignancy are commonly referred for advanced imaging. Age-wise analysis demonstrated that patients younger than 50 years had a relatively balanced distribution of benign and malignant lesions, whereas malignant lesions were significantly more common in patients older than 50 years. This finding highlights the importance of considering patient age as a key clinical parameter when evaluating focal liver lesions. In younger patients, benign lesions such as hemangiomas, cysts, and focal nodular hyperplasia are commonly encountered, whereas malignant lesions are more prevalent in older individuals due to prolonged exposure to carcinogenic factors and chronic liver disease. Advanced imaging techniques such as MRI, particularly diffusion-weighted imaging and contrast-enhanced sequences, play a crucial role in differentiating benign from malignant lesions and guiding appropriate clinical management [13].

Conclusion: The present study demonstrated that FLLs were more commonly observed in males and predominantly occurred in individuals > 50 years. Malignant lesions constituted a greater proportion of cases compared to benign lesions. Hepatocellular carcinoma was the most frequent malignant lesion and was strongly associated with underlying chronic liver disease. In younger patients, benign lesions such as cysts and hemangiomas were relatively more common, whereas malignant lesions predominated in older age groups. MRI proved to be a valuable non-invasive imaging modality for the evaluation and characterization of focal liver lesions, enabling differentiation between benign and malignant lesions and assisting clinicians in planning appropriate management strategies.

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