**1. Introduction**

MRI (magnetic resonance imaging) is a powerful medical imaging technique that uses magnetic fields and radio frequency waves to produce internal images of the human body. Proton density fat fraction MRI is a special MRI method used to evaluate liver disorders, especially in terms of assessing fat accumulation in the liver. PDFF MRI is based on the principle of magnetic resonance of hydrogen nuclei in the human body. Our bodies contain many hydrogen atoms, mainly in the form of water and fat. These hydrogen atoms will give different signals in response to magnetic fields and radiofrequency waves. Liver disorders, such as steatosis or fatty liver, are characterized by the accumulation of fat in liver cells. MRI PDFF is used to measure the amount of fat in the liver and calculate the proton density fat fraction (PDFF) in the organ. These results provide information about the extent to which the liver is affected by fat accumulation.1,2

The main advantage of MRI PDFF is its ability to provide very precise information about the amount of fat in the liver, even in small amounts. This is a non-invasive method that is more accurate than blood tests or liver biopsy. PDFF MRI is a non-invasive procedure, meaning no needles or surgical procedures are required. In addition, it does not involve radiation, making it safer than other methods, such as CT scans. PDFF MRI can be used to diagnose liver disorders such as non-alcoholic steatosis (NASH), alcoholic fatty liver, cirrhosis, and other liver diseases. Additionally, it is also used to monitor patient progress and
response to treatment. Patients undergoing MRI PDFF must undergo special preparation, including fasting, before the examination, especially if a more accurate evaluation of liver fat is required. Results from PDFF MRI can help physicians in planning appropriate treatment for patients with liver disorders, as well as to monitor the effectiveness of ongoing therapy. Although PDFF MRI is very useful in the assessment of liver disorders, especially those related to fat accumulation, it is important to remember that the results should be evaluated by a medical professional who is experienced in radiology or hepatology. As an advanced diagnostic tool, PDFF MRI can aid in the early assessment and management of liver disease, as well as reduce the need for invasive procedures.3-5

2. Methods

The literature search process was carried out on various databases (PubMed, Web of Sciences, EMBASE, Cochrane Libraries, and Google Scholar) regarding MRI (Magnetic Resonance Imaging) Potential of Proton Density Fat Fraction for Hepatic Impairment Assessment. The search was performed using the terms: (1) "MRI" OR "Proton" OR "Density" OR "Fat Fraction" AND (2) "MRI" OR "hepar." The literature is limited to clinical studies and published in English. The literature selection criteria are articles published in the form of original articles about MRI (magnetic resonance imaging) proton density fat fraction potential for hepatic impairment assessment. Studies were conducted in a timeframe from 2013-2023, and the main outcome was proton density fat fraction MRI (magnetic resonance imaging) potential for hepatic impairment assessment. Meanwhile, the exclusion criteria were studies that were not related to Potential MRI (magnetic resonance imaging) proton density fat fraction for hepatic impairment assessment, the absence of a control group, and duplication of publications. This study follows the preferred reporting items for systematic reviews and meta-analysis (PRISMA) recommendations.

![Identification of studies via databases and registers](chart.png)

Figure 1. PRISMA flowchart.
3. Results and Discussion

Basic principles of proton density fat fraction MRI

MRI PDFF (proton density fat fraction) is based on the magnetic resonance properties of hydrogen nuclei in the human body. The human body contains many hydrogen atoms, especially in water molecules (H₂O) and in fat molecules (triglycerides). The hydrogen atom, which consists of one proton and one electron, has magnetic resonance properties that are very important in the context of MRI. In an MRI, the patient is placed inside a strong external magnetic field. This field causes the hydrogen nuclei in the patient's body, especially protons, to be polarized (following the direction of the magnetic field) and produce a magnetic moment. During an MRI procedure, radiofrequency (RF) waves are applied to the patient's body. These RF waves are used to “interfere” with the proton's magnetic moment, causing it to fluctuate. After interference by RF, the magnetic moment of the proton begins to return to its initial state, which is called relaxation. There are two types of relaxation: longitudinal relaxation (T₁) and transverse relaxation (T₂). MRI detects the signals produced during this re-relaxation. Because these signals originate from different types of tissue, such as water and fat, different tissue components respond differently to magnetic fields and RF waves. Since signals from water and fat have different characteristics in terms of relaxation time and frequency spectrum, MRI devices can separate the signals from these two components and create separate images that reflect the distribution of water and fat in the body's organs, including the liver. By exploiting differences in the response of hydrogen nuclei to magnetic and RF fields, PDFF MRI can measure proton density fat fraction (PDFF), which reflects the amount of fat in certain body organs, such as the liver. This provides important information in the assessment of liver disorders associated with fat accumulation.

Evaluation of fat accumulation in the liver

Liver disorders, such as steatosis (fatty liver), are characterized by the accumulation of fat in liver cells. This fat buildup can occur due to various factors, including excessive alcohol consumption (alcoholic fatty liver) or non-alcoholic conditions such as obesity, insulin resistance, and metabolic syndrome. MRI PDFF is used to measure the amount of fat in the liver very accurately. This provides quantitative information about how much fat is contained in the patient’s liver. PDFF MRI results calculate the proton density fat (PDFF) fraction in the liver. This is the percentage of fat in the liver compared to other components, such as water. This information helps in assessing the extent to which the liver has been affected by fat accumulation. PDFF results can be used to classify the level of steatosis or fatty liver. The degree of steatosis is usually categorized as zero (no fat), mild, moderate, or severe, depending on the PDFF fraction. This helps doctors to understand the severity of the patient's condition. In addition to diagnosis, PDFF MRI is also used to monitor changes in a patient’s liver fat levels over time. This is useful in measuring the effectiveness of treatments, such as lifestyle changes or medications, and allows doctors to make appropriate recommendations. One of the main advantages of PDFF MRI is its ability to provide highly accurate information about liver fat levels without the need for invasive procedures or radiation exposure, as occurs with other methods such as liver biopsy. With the help of MRI PDFF, doctors can quickly and accurately evaluate the level of fat in a patient’s liver, which is important in the diagnosis and management of liver disorders related to fat accumulation, including the necessary preventive measures to prevent further progression of the condition.

Precision and accuracy

PDFF MRI has very high accuracy in measuring the proton density fat (PDFF) fraction in the liver. This allows excellent detection and monitoring of fat accumulation, even in small amounts. PDFF MRI is a non-invasive method that does not require needle insertion or liver tissue sampling, as occurs with a liver biopsy. This reduces the risk of complications associated with invasive procedures. A PDFF MRI does not involve radiation exposure, as occurs with a CT scan. Therefore, it is a safer option for patients, especially if repeat examinations are required. Apart from measuring fat in the liver, MRI also allows...
visualization of other organs in the patient’s body. This can help in detecting problems that may be related to liver disorders, such as tumors or inflammation. MRI PDFF can be used to monitor changes in liver fat levels over time, which is useful in measuring response to treatment. This allows lifestyle changes or appropriate medications to be implemented if necessary. Although there is some preparation required before undergoing a PDFF MRI, it is not as complex or as demanding as the preparation required for some other types of examination, such as a liver biopsy. Combining high accuracy, non-invasive nature, and the non-use of radiation, PDFF MRI is an invaluable tool in the assessment and monitoring of liver disorders related to fat accumulation, as well as in planning appropriate treatment for the patient.16-20

4. Conclusion

Proton density fat fraction (PDFF) MRI is a medical imaging technique that focuses on the magnetic resonance of hydrogen nuclei in the human body. This is a very effective method in the assessment of liver disorders related to fat accumulation, such as steatosis or fatty liver. PDFF MRI has very high accuracy in measuring the amount of fat in the liver, even in small amounts, thus providing very precise information about the level of fat accumulation. This is a non-invasive method that does not require a liver biopsy or more invasive examination, thereby reducing the risk of complications and discomfort for the patient. It does not involve radiation exposure, which makes it safe for repeated examinations and preferable to methods such as CT scans. PDFF MRI can be used to diagnose fat-related liver disorders, as well as to monitor changes in liver fat levels over time. This is important in patient management and assessment of treatment effectiveness.

5. References


