INTRODUCTION
The role of imaging in the detection, characterization, and follow up of diffuse liver disease has increased due to advances in cross sectional imaging. This presentation focuses on the main metabolic and storage diseases affecting the liver.

1. Steatosis

Hepatic steatosis results from a variety of abnormal processes including increased production or mobilization of fatty acids (eg. Obesity, steroid use) or decreased hepatic clearance of fatty acids due to hepatocellular injury (e.g. Alcoholic liver disease, viral hepatitis). Histopathologically, the hallmark of all forms of fatty liver is the accumulation of fat globules within the hepatocytes. The distribution of steatosis can be variable, ranging from focal, to regional, to diffuse. Diffuse steatosis is common and estimated to occur in approximately 30% of obese patients. Patients with steatosis are usually asymptomatic although some individuals may present with right upper quadrant pain or abnormal liver function parameters.

Non-alcohol related liver steatosis is also known as non-alcoholic fatty liver disease (NAFLD). Histopathologic findings of NAFLD vary from steatosis alone to steatosis with inflammation, necrosis and fibrosis. At the most severe end of the NAFLD spectrum resides non-alcoholic steatohepatitis (NASH), with or without cirrhosis. Histopathologic findings of NASH include steatosis (predominately macrovesicular), mixed lobular inflammation, and hepatocellular ballooning. Unlike steatosis alone, NASH may progress to cirrhosis.

By CT diffuse fatty change is easily identified. The attenuation value of normal liver is usually on average 8 HU greater than that of spleen on non-contrast CT images. In patients with fatty change, however, an abnormally decreased density will be demonstrated, typically 10 HU and 25 HU less than the spleen on non-contrast CT and contrast-enhanced CT images, respectively. The diagnosis of hepatic steatosis is more reliably made on non-contrast images. Undoubtedly the most sensitive technique to detect fatty change of the liver is the use of in-phase and out-phases gradient echo MR pulse sequences. (Fig.1)
Hepatic fatty change is, however, not always uniform but can present as a focal area of steatosis in an otherwise normal liver (focal steatosis) or as subtotal fatty change with sparing of certain areas (focal sparing). On imaging, several features allow the correct identification of focal fatty change or focal spared areas: (1) the typical periligamentous and periportal location, (2) lack of mass effect, (3) sharply angulated boundaries of the area, (4) nonspherical shape, (5) absence of vascular displacement or distortion, and (6) lobar or segmental distribution.

2. Iron Overload

Iron overload states are categorized in hemochromatosis, where the iron accumulates preferentially within the hepatocytes, and hemosiderosis, where it is deposited in the Kupffer cells.

a. Primary Hemochromatosis

Hereditary or primary hemochromatosis is an autosomal recessive disorder of iron metabolism characterized by abnormal absorption of iron from the gut with subsequent excessive deposition of iron into the hepatocytes, pancreatic acinar cells, myocardium, joints, endocrine glands, and skin. In addition, the reticuloendothelial system (RES) cells in patients with primary hemochromatosis are abnormal and unable to store processed iron effectively. As a consequence, patients with primary hemochromatosis don’t accumulate iron into the RES. Clinical findings of cirrhosis and its complications (portal hypertension, development of HCC) predominate in patients with long-lasting disease.

On CT excessive storage of iron into the hepatocytes will result in an overall increased density. However, this CT appearance of a hyperdense liver is nonspecific since similar features can be seen with gold deposition and in Wilson’s disease, type IV glycogen storage disease, and following amiodarone administration. Performing non-contrast CT in patients with suspected hemochromatosis is important because excessive iron cannot be detected in the setting of enhancing parenchyma.

MRI is far more specific than any other imaging modality for the characterization of iron overload due to the magnetic susceptibility effect of iron. The superparamagnetic effect of accumulated iron in the hepatocytes results in significant reduction of signal intensity on T2-weighted images. Comparison of the signal intensity of liver with that of paraspinal muscles provides a useful internal control. Hepatocellular carcinomas, complicating 35% of patients with advanced hemochromatosis, are usually easily detected on both T1-and T2-weighted images due to the background of decreased signal intensity of the liver.
b. Hemosiderosis

In patients with hemosiderosis or siderosis, either due to transfusional iron overload states or dyserythropoiesis (e.g., thalassemia major, sideroblastic anemia, pyruvate kinase deficiency, chronic liver disease), the excessive iron is processed and accumulates in organs containing reticuloendothelial cells, including liver, spleen, and bone marrow.

By CT, there is diffuse, increased attenuation of liver and spleen (Fig. 2). In MRI, the extrahepatic signal intensity changes in the spleen and bone marrow allow MR imaging to distinguish primary hemochromatosis from hemosiderosis. Although in general the clinical significance of transfusional iron overload states is negligible, patients with chronic hemosiderosis can develop symptoms similar to those of the primary form as well as cirrhosis and HCC.

3. Wilson Disease

Wilson disease, also known as hepatolenticular degeneration, is a rare autosomal recessive abnormality of copper metabolism characterized by accumulation of toxic levels of copper in the brain, cornea (Kayser-Fleischer rings), and liver, the latter due to impaired biliary excretion. Hepatic deposition of copper, predominantly seen in periportal areas and along the hepatic sinusoids, evokes an inflammatory reaction resulting in acute hepatitis with fatty change. Subsequently, chronic hepatitis may result in liver fibrosis and eventually macronodular cirrhosis.

Due to the high atomic number of copper, a hyperdense liver may be seen on unenhanced CT scans. However, this finding is not universally present and usually only nonspecific signs such as hepatomegaly, fatty change, and in advanced cases, cirrhosis are observed. During the early stage of the disease due to the paramagnetism of ionic copper, MR imaging can be valuable by demonstrating focal copper depositions as multiple nodular lesions, typically appearing hyperintense and hypointense on T1- and T2-weighted images, respectively.

4. Amyloidosis

Amyloidosis consists of deposition of fibrils of protein-mucopolysaccharide complexes throughout the body and is classified based on the biochemical composition of the amyloid fibrils. Primary amyloidosis is due to the deposition of immunoglobulin light chains and is associated with multiple myeloma and monoclonal gammapathy. Secondary amyloidosis is due to deposition of amyloid A protein and is associated with chronic infection, rheumatoid arthritis and malignancies. Exceeded only by the spleen and kidney, the liver is the third most common solid organ prone to this deposition.

Hepatic amyloidosis has a nonspecific imaging appearance. The most common finding is diffuse hepatomegaly. CT sporadically demonstrates focal areas of low attenuation within the liver corresponding to sites of amyloid deposition (amyloid pseudotumor).
REFERENCES


