

Overview of Variations in Liver Anatomy and Their Clinical Significance

Neva Coce¹, Luka Filipović-Grčić¹, Robert Režan¹, Mile Planinić², Tinamarel Mandić Paulić¹

¹ Department of Radiology, University Hospital Centre Zagreb, Zagreb, Croatia

² Health Center of Zagreb County, Samobor, Croatia

ABSTRACT

The liver performs numerous vital functions in the human body, including detoxification, nutrient metabolism, and protein synthesis. Although it is typically divided into two main lobes, the right and left, the liver can also exhibit rare anatomical variations that may impact clinical outcomes. These variations include agenesis of the right or left hepatic lobe, accessory hepatic sulci, and variations such as the “Beaver tail” liver, Riedel’s lobe, pseudolipoma of Glisson’s capsule, supradiaphragmatic liver, and ectopic liver tissue.

Modern imaging techniques, such as computed tomography (CT), magnetic resonance imaging (MRI), and ultrasound (US), play a crucial role in identifying and characterizing these variants. A thorough understanding of these anatomical variations is essential for accurate diagnosis, effective treatment planning, and preventing complications during surgical procedures. A multidisciplinary approach and knowledge of liver anatomical variants can improve the quality of care for patients with liver diseases.

KEYWORDS: Liver Anatomical Variants, Modern Imaging Techniques, Clinical Significance, Surgical Implications

SAŽETAK:

PREGLED ANATOMSKIH VARIJANTI JETRE I NJIHOVA KLINIČKA VAŽNOST

Jetra obavlja niz vitalnih funkcija u ljudskom tijelu uključujući detoksifikaciju, metabolizam nutrijenata i sintezu proteina. Iako je tipično podijeljena u dva glavna režnja, desni i lijevi, moguće su i rijetke anatomske varijante koje mogu utjecati na kliničke ishode.

Ove varijante uključuju agenezu lijevog ili desnog režnja, akcesorne sulkuse, te varijacije poput “dabrovog repa”, Riedelovog režnja, pseudolipoma Glissonove kapsule, supradijafragmalnu jetru i ektopično tkivo jetre.

Moderne slikovne tehnike poput kompjutorizirane tomografije (CT), magnetske rezonancije (MR) i ultrazvuka (US) igraju ključnu ulogu pri identifikaciji i karakterizaciji ovih varijanti.

Temeljito poznavanje i razumijevanje ovih varijanti važno je za postavljanje točne dijagnoze, učinkovito planiranje terapije te prevenciju komplikacija tijekom kirurških zahvata. Multidisciplinarni pristup i poznavanje anatomske varijante jetre može bitno pridonijeti kvaliteti skrbi za pacijente s bolestima jetre.

KLJUČNE RIJEČI: anatomske varijacije jetre, modern slikovne tehnike, klinička važnost, kirurške implikacije

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Correspondence:

Luka Filipović-Grčić
luka.filipovicg@outlook.com

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INTRODUCTION

As the largest solid organ in the human body, the liver plays a critical role in numerous vital processes, including nutrient metabolism, protein synthesis, detoxification, and glycogen storage. Despite its primary anatomical division into four lobes – the right hepatic lobe (lobus dexter), the left hepatic lobe (lobus sinister), the caudate lobe (lobus caudatus), and the quadrate lobe (lobulus quadratus) – as well as its eight functional units according to Couinaud classification, the liver can exhibit rare but significant morphological variations. These include the presence of additional lobes or sulci. Among anatomical variants, we distinguish accessory hepatic lobules such as agenesis of the right or left hepatic lobe, “Beaver tail” liver, Riedel’s lobe, supradiaphragmatic liver, and ectopic liver tissue. Additionally, entities include pseudolipoma of Glisson’s capsule and accessory hepatic sulci. (1) Anatomical variations, particularly accessory liver lobes, can influence diagnostic and therapeutic procedures. (2) Radiological techniques such as CT and MRI play an important role in identifying these variations, providing crucial information that may affect treatment decisions, particularly in surgical interventions such as laparotomy for gallbladder surgery or liver transplantation. (3)

This review aims to describe various anatomical variations of the liver, examine their incidence, anatomical presentation, clinical significance, and how they may impact diagnostic outcomes. A better understanding of these variations will allow physicians to improve diagnostic and therapeutic procedures, ultimately enhancing patient care.

AGENESIS OF THE RIGHT OR LEFT HEPATIC LOBE

Agenesis of the right or left hepatic lobe is an extremely rare anatomical variant in which there is a congenital absence of either the right or left hepatic lobe, often accompanied by compensatory hypertrophy of the remaining liver segments. (4,5)

It is essential to distinguish hepatic lobe agenesis from atrophy or hypoplasia caused by disease or injury, as well as from surgical resections that lead to liver lobe reduction. Agenesis of a single hepatic lobe is usually asymptomatic, whereas agenesis of the entire liver is incompatible with life. (5)

Recognizing these anatomical variations is crucial when planning surgical interventions and interpreting imaging findings. (4,5)

ACCESSORY HEPATIC SULCI

Accessory hepatic sulci, also known as secondary or additional grooves on the liver surface, are indentations not typically present in standard liver anatomy. They can appear on any liver surface but are most commonly found on the diaphragmatic surface.

Although usually asymptomatic, the presence of accessory sulci can mimic benign or malignant liver lesions during CT imaging studies. (6)

“BEAVER TAIL” LIVER VARIANT

The “Beaver tail” liver variant (Figure 1) is a rare anatomical phenomenon in which the liver extends laterally and anteriorly, adopting a shape reminiscent of a beaver’s tail. This variant is more commonly found in women. Although mostly asymptomatic, it is crucial to differentiate this variant from tumours, hepatomegaly, or other changes that may present with similar radiological findings. Moreover, the presence of this liver variant can complicate hepatic and abdominal surgeries, necessitating careful consideration during surgical planning. (2)



Figure 1: Beaver tail liver. An axial plane of a CT scan of the liver shows an anatomical variant of an accessory liver lobule where a portion of the parenchyma atypically extends laterally to the left and anteriorly, taking on a shape reminiscent of a beaver’s tail.

RIEDEL’S LOBE

Riedel’s lobe (Figure 2) is an elongation of the right liver lobe extending below the lower rib margins down to the iliac crest. First described by Bernhard Moritz Carl Ludwig Riedel in the 19th century, this anatomical variant correlates with hypertrophy of liver segments V and VI. (2)

Previously believed to be more common in women, later studies found that its incidence is equal in both sexes. (7,8) While Riedel’s lobe is typically asymptomatic, it can sometimes be mistaken for a tumour mass during palpation. Additionally, its presence can lead to complications during hepatic surgeries or result in torsion of the lobe or primary and secondary tumour formations. (9)



Figure 2: Riedel's lobe. A coronal CT plane shows an elongation of the right side of the liver extending below the lower rib ends down to the iliac bone, forming an anatomical variant of an accessory liver lobule known as Riedel's lobe.

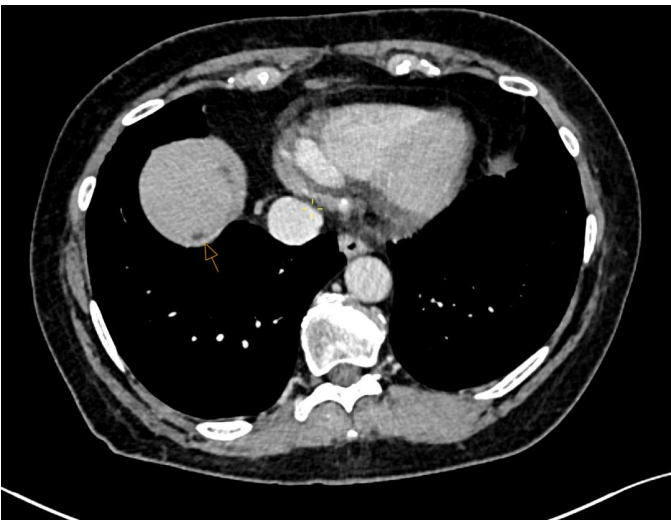


Figure 3: Pseudolipoma of Glisson's capsule. An axial CT plane shows a cluster of normal fatty tissue (arrow) located around the liver within Glisson's capsule, thus forming a distinct entity in the anatomical variation of the liver - Pseudolipoma of Glisson's capsule.



Figure 4: Supradiaphragmatic liver. Coronal CT plane shows an anatomical variant of the liver where a portion of the liver tissue is located above the diaphragm in the thoracic cavity, also known as the intrathoracic accessory liver.

PSEUDOLIPOMA OF GLISSON'S CAPSULE

Glisson's capsule is a thin layer of connective tissue surrounding the liver. A pseudolipoma refers to the presence of fatty tissue resembling a lipoma but consisting of normal fat tissue located within or around the liver, particularly within Glisson's capsule (Figure 3). (10) First described by Rolleston in 1891, pseudolipomas of Glisson's capsule are generally asymptomatic and are often discovered incidentally during imaging studies, intraoperatively, or during autopsy. In most cases, pseudolipomas do not require treatment unless they cause mechanical issues or complicate the diagnostic process by resembling other potentially malignant fatty tissue tumours. (11)

SUPRADIAPHRAGMATIC LIVER

Supradiaphragmatic liver (Figure 4) is a rare anatomical variant where a portion of the liver tissue extends above the diaphragm, sometimes referred to as "intrathoracic accessory liver." The size of the ectopic liver tissue can vary from a small mass to a significant mass occupying space in the thoracic cavity, where it may be mistaken for pulmonary or pleural tumours. Clinically, this variant can impact respiratory function, particularly if the hepatic tissue volume is substantial. Understanding this variation helps avoid potential surgical complications and allows for more accurate treatment planning. (12)

ECTOPIC LIVER TISSUE

Ectopic liver tissue, also known as liver heterotopia, is a rare anatomical variant characterized by the presence of liver tissue outside its usual anatomical location. This tissue can be found in various locations, including the gallbladder, abdominal cavity, or other organs such as the stomach and kidneys. It is crucial to differentiate ectopic liver tissue from primary tumours or metastases. In some cases, ectopic liver tissue has been found to be the site of hepatocellular carcinoma, indicating an increased risk of hepatocarcinogenesis. (13)

CONCLUSION

Liver anatomical variations, while often asymptomatic, can significantly impact diagnostic and therapeutic outcomes. Understanding these variations is essential for accurate diagnosis and surgical planning. Radiological imaging techniques such as CT, MRI, and US are invaluable tools in detecting these variants, enabling better preparation and adaptation of diagnostic and therapeutic procedures. This review serves as an educational resource for physicians, emphasizing the importance of recognizing liver anatomical variations.

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