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Liver Structure, Function and its Interrelationships with Other Organs: A Review

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ABSTRACT

The liver is the body's biggest reticulo-endothelial cell network, as well as an important function in the host's ability to fight against infection. The organ is made up of parenchymal and non-parenchymal cells, each with a specific function. Many immune cells are coordinated by the biliary epithelial cells in both innate and acquired immunity, making them an important target in autoimmune liver disease. A multitude of substances can produce inflammation, necrosis, fibrosis, and finally liver cirrhosis, fibrosis, and functional degeneration. In addition, the liver interacts with a slew of different organs. Inquiring into the movement of blood.

INTRODUCTION

A healthy adult's liver is roughly 2.5% of their whole-body weight, or about 1500 grams. Diaphragm surface concavity is connected to the smooth dome-shaped surface of this part. There are seven to eleven ribs deep and a typical liver crosses the midline to pass to the left of the left nipple in the right upper quadrant of the abdomen, where the thoracic cage and diaphragm provide protection(Moore and Dalley,2006).Hepatic metabolism and waste metabolite excretion are two major functions of the liver, It is the body's biggest gland and its largest solid organ at the same time. When compounds are taken from the digestive system, the liver regulates the flow and safety of those substances before they enter the circulatory system.The liver's importance may be shown in the fact that even a brief lack of liver function can result in mortality. Consequently, a review of liver physiology was carried out in order to keep it in top working condition and to preserve excellent health in order to prevent liver disease. Liver disease includes fatty liver, liver fibrosis, and cirrhosis, just to name a few(Allen,2002; Ozougwu, 2014; Ozougwu andEyo, 2014). In the early stages of development, the ventral foregut definitive endoderm is where the cells that will ultimately form the adult liver originate. There are a number of stages in liver development, beginning with competence for the liver formation and progressing through liver specification, growth, and differentiation. Juvenile liver metabolism differs significantly from adult liver metabolism both during development and for a time following parturition(Zaret,1996; Burke et al.,2006; Watt et al.,2007).

Liver Structure

Right, left, caudate, and quadrate are the four lobes that make up the liver, left and right frontal lobes are the most prominent, with the caudate and quadrate lobes being smaller and positioned behind them, anteriorly two ligaments are evident. Left and right lobes are separated by the falciform ligament up above, the spherical tendon, this is seen as a little protrusion on the liver, is inferior to the falciform ligament, the gallbladder is also evident anteriorly on the most inferior section of the right lobe, many more intriguing structures can be seen from the back,the caudate lobe is superior to the right and left lobes, roughly halfway between them, the sulcus for the inferior vena cava is located next to the caudate lobe, the porta hepatis is located just below the caudate lobe, when these two vessels enter the liver, they provide blood to the liver's cells(Allen, 2002).

The liver is the biggest organ in the body, accounting for nearly half of an adult's weight. In terms of structure and histology, the liver may be divided into five systems: hepatocytes and hepatic lobules (1st), hepatic sinusoidal cells (2nd), the biliary system (3rd), the arterial system (4th), and the stroma (5th). Cells in the liver can be divided into parenchymal (also known as hepatocytes) and nonparenchymal (also known as non-hepatocytes) kinds. Non-parenchymal cells, including endothelial cells, Kupffer cells, and hepatic stellate cells, make up around 6.3 percent of the liver tissue volume, with hepatocytes accounting for approximately 78 percent of the volume. In the liver, extracellular space makes up around 16% of the total volume(Saxena et al., 2003; Roskams et al., 2007).

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Hepatic lobules and hepatocytes

It is the liver lobule that serves as the liver's fundamental functioning unit, measuring approximately the size of a sesame seed and about hexagonal in form. In addition to the hepatocyte plates that make up most of the lobule, there are liver sinusoids that branch from the central vein to the portal triads, a central vein, and bile canaliculi (small canals) that are formed by hepatic macrophages between the walls of adjacent hepatocytes (Kupffer cells), Disse The portal triad consists of three vessels: the hepatic portal arteriole, the hepatic portal venule, and the bile duct. Instead of transporting blood to the hepatic vein and the inferior vena cava via the central vein, bile is transported by the bile canaliculi to the portal triad and the bile duct, where it is excreted(Allen, 2002).

Around 80 percent of the liver's cells are made up of hepatocytes, which make up 60 percent of the liver's cells and are responsible for the majority of the liver's synthesis and metabolic capacities. Hepatic lobules are the liver's structural and functional unit, and they are made up of a roughly hexagonal arrangement of hepatocyte plates that extend to generate 1-cell thick and 1-cell wide plates.A "sinusoid" is formed as blood travels from the portal tract to the terminal hepatic venule across the two cell plates of the portal tract. At low magnification, the hepatocytes appear to be uniformly distributed throughout the liver.Hepatocytes that are closer to the portal venule than the centrilobular hepatocytes that are closer to the central venule have certain functional differences between the two types of cells.In addition to the portal venule, hepatic arteriole, and bile ducts, the portal tract includes the following: Through the hepatic venule, blood departs the central acinus and enters systemic circulation after traveling through the hepatic sinusoids and perfusing the liver cell plate. To achieve a progressive qualitative modification of blood composition through sequential perfusion of hepatocytes, two structural characteristics must be taken into account: (a) Unique abilities are obtained as a result of separation of the portal tract and the hepatic venule into separate functional compartments, and (b) In this way, sequential perfusions of hepatocytes allow for the gradual alteration of blood composition through consecutive perfusions(Gumucio, 1989; Stapleton et al., 1998; Singh, 2007; Butura, 2008).

Cells of the hepatic sinusoids

Sinusoidal endothelial cells line the sinusoid walls of the liver because of the presence of fenestrae and provide a filtering role. Extracellular matrix components and immunological complexes have a considerable endocytic ability in these cells as well, which allows them to ingest smaller particles and may aid in viral clearance, but they lack phagocytic activity. They may also present antigens and produce cytokines and eicosanoids as antigen-presenting cells, as well as chemokines and lipids(Breiner et al., 2001; Kmiec, 2001).

Nonparenchymal cells present in sinusoids, such as endothelial cells, Kupffer cells, hepatic stellate cells (also known as Ito cells or fat-storing cells), and Pit cells, are together referred to as "hepatic sinusoidal cells". Endocrine cells line the hepatic sinusoids, and their long processes feature holes or fenestrations through which solutes appear to flow freely into Disse's perisinusoidal region. Alcoholics and cirrhotic who have acquired liver fibrosis and lost their endothelial cell fenestrations as well as formed endothelial cell basal membranes have difficulty exchanging solutes between their blood and hepatocytes.Intravascular tissue macrophages, such as Kupffer cells, remove large particles from the blood, whereas endothelial cells take up the smaller particles.Ito or fat-storing cells in the liver store vitamin A and contribute to the development of hepatic fibrosis after damage.In addition to endothelial and fibroblast cells, the pit cells of the liver comprise a small number of non-hepatocyte cells(Hendriks et al., 1985; Wisse et al., 1996; Butura, 2008).

Biliary system

Separation of the duodenal from the septum transverse occurs, from the long stalk of the hepatic diverticulum, which forms the ducts and the gallbladder,around the eighth week of pregnancy, the intrahepatic bile duct system begins to form. Cytokeratins are extensively expressed by hepatoblasts along the portal tract mesenchyme's margins (intermediate cytoskeletal components, of which there are several varieties).Sleeve-like cells surround the portal vein branch and the mesenchyme associated with it. The bile canaliculi receive bile from the hepatocytes. They flow in the same direction as the sinusoids, but in the opposite direction as the blood.It is the liver's role to secrete bile acids, which aid in the absorption of fats and other chemicals from the intestine, to eliminate these compounds in the feces. Ends of biliary canaliculi receive bile through real, epithelial cell-lined bile channels. To get to the gall bladder and small intestine from the liver's portal tract, you need to have biliary cells transporting the bile from

the hepatocytes to these cells (biliary system).Bile duct cells also have a role in the production of bile (ductular component of bile formation).The liver nuclear population is made up of roughly 3.5% biliary epithelial cells (Vijayan and Tan,1997; Crosby et al.,2002;Libbrecht et al.,2002 ; Higashiyama and Kanai,2019).

Vascular system

Liver growth depends on the availability of blood, which is supplied by the symmetrical vitelline veins, which eventually merge to form the portal vein, and then by the placenta which provides the left and right umbilical veins with oxygen and nutrition.In the liver, blood from the left umbilical vein can go in three ways: directly to the sinusoids, via the inferior vena cava, or by retrograde flow, via a junction with the left branch of the portal vein, to the right half of the liver.Prenatal ultrasounds have shown that the nutrient-rich umbilical vein blood supplies the left lobe almost completely, whereas the right lobe only receives half of its blood supply from the umbilical vein and the other half from the nutrient-poor portal vein, according to research conducted on fetuses.As a result, the left lobe is substantially better perfused in pregnancy, and as a result, it is larger and better able to survive hypoxia insults than in adults. Birth changes the ligamentum teres into the ligamentum venosum, which in turn changes into the ligamentum venosus. Later in development, hepatic vessels branch out from the hepatic artery around the hilum and subsequently spread outward into the portal tracts. This pattern is similar to that of developing bile ducts. The artery does not grow into the portal tracts from the hilum, but rather develops prior to the definitive bile duct and may be formed in part from portal elements, particularly myofibroblasts(Libbrecht et al.,2002; Haugen et al.,2004;MartinsandNeuhaus, 2007).

Innervation

Celiac ganglia sympathetic and parasympathetic neurons supply the liver with autonomic nervous system input, which is transmitted by the vagus nerve into the liver sinusoids.While parasympathetic nerve fibers can be seen in and around the hepatic artery and portal vein, there is very little cholinergic innervation beyond the portal tract. According to certain hypotheses, gap junctions may also provide direct electrical connection between cells, so removing the need for nerve innervation. Glucose mobilization into the circulation is promoted by adrenaline, whereas metabolic activity is increased by cholinergic stimulation(McCuskey and Robert,2004).

Liver Function

The liver is the most important organ for maintaining metabolic balance, the following are its key functions: 1) Regulation of food intake and processing from the intestines.2)Protein, carbohydrate, and fat synthesis and biotransformation.3) Bile excretion and removal of hydrophobic substances.4) Regulation of energy metabolism. 5)Immunological function .6) Drug metabolism .7) Fluid balance regulation. 8)Endocrine functions and growth and development mediation.The liver is responsible for the production of 15% of the body's total protein, with the great majority of these proteins ending up in the bloodstream. Proteins are produced after transcription factors activate genetic promoter sequences. Proteins are released into the blood from the sinusoidal aspect of the hepatocytes after translation and modification. Protein synthesis is regulated by nutritional condition and hormone secretion.As part of the acute-phase response, Creactive protein is the most often tested marker. There are several proteins made in the liver, including albumin, among other things, ceruloplasmin; coagulation and fibrinolytic proteins; complement; and protease inhibitor proteins. Amino acids are recycled to make new proteins even if proteins themselves are not retained in the liver(Moore and Dalley ,2006;Guyton, 2006). Hepatocytes absorb glucose, fructose, and galactose from the portal blood. The liver, which is influenced by hormones such as insulin (which decreases glucose output) and glucagon (which increases glucose output) and thus plays an important role in blood glucose regulation, converts glucose to glucose-6-phosphate, which is then used to replenish glycogen stores or to make triglycerides.Glycogen is liberated (glycogenolysis) or glucose is produced from substrates such as lactate (gluconeogenesis).Glucose absorption is lowered and glucose generation from glycogenolysis is elevated in stressful or fasting situations, Many children with severe liver disease are unable to keep their blood sugar levels stable during prolonged fasts because the liver is required for the metabolism of cholesterol and lipoproteins, which is required for the synthesis of steroid hormones and bile a, and hypoglycemia is a sensitive test of liver function and a symptom of severe hepatic necrosis, which means the liver is no longer functioning.When it comes to cholesterol homeostasis, the enzyme 3-hydroxy-3-methylglutaryl coenzyme A (HMG CoA), which

synthesizes cholesterol from scratch in addition to absorption from lipoproteins and chylomicrons, which boost hepatic cholesterol, regulates the quantity formed in the body.When biliary excretion and catabolism are inadequate, it is possible to have increased plasma cholesterol levels due to cholestatic liver illness, such as biliary atresia or Alagille's syndrome, in which cholesterol is either free or stored as cholesterol ester in the liver(Moore and Dalley,2006;Guyton, 2006).

The Liver's Interactions with Other Organs

In addition to the liver's role in the circulatory system, many other organs get oxygenated blood from the heart via the hepatic arteries, which are located far from the celiac trunk and the abdominal artery. As a result, blood pumped by the heart is sent to the liver where it is processed.An important part of digestion occurs in the liver, where bile is produced, which is subsequently sent on the smaller intestines via the hepatic portal venous artery(Allen, 2002; Ozougwu, 2014).

The liver's bile duct is fed by the gallbladder, which acts as a reservoir for excess bile.Many blood proteins are created by the liver, illustrating its link to other organs, and the liver has a supply of nerves, displaying its connection to the nervous system, the liver is abundant in lymph glands, which provide fluid drainage and support for the immune system. Finally, because liver illness is typically accompanied by problems in the kidneys, this suggests that the liver and kidneys are linked. The liver plays a critical role in maintaining the body's physiologic balance (Allen, 2002).

CONCLUSION

Liver functions include detoxification, digestion, and regulation of the body's metabolic rate. Fatty liver, hepatitis virus infections, and alcohol all contribute to liver disease. It's possible to die from liver failure if you have cirrhosis (liver scarring).As a result, it is imperative that the causes affecting it be identified and counteracted.

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