INTRODUCTION

An increasing number of patients with chronic liver disease (CLD), advanced liver disease, or even end stage liver disease (ESLD) require surgery. Reasons for this development are an aging population, better long-term survival of patients with liver cirrhosis, and continuously improving outcomes after surgery as well as in critical care medicine ***(Deiner and Silverstein, 2011).***

Based on structural and/or functional alterations, patients with chronic liver disease or end stage liver disease may present with several organ dysfunctions besides known liver insufficiency. Several excellent and recently published updates and reviews have addressed hepatic encephalopathy, portopulmonary hypertension, hepatorenal syndrome, cirrhotic cardiomyopathy and coagulopathy in liver disease ***(Tripodi and Mannucci, 2011).*** Thorough medical history and physical examination are essential to detect preexisting liver disease and possible complications there ***(Fox et al., 2011).***

The risk of morbidity and mortality in patients with liver disease depends on the type of surgery and the severity of liver dysfunction, the latter expressed by Child-Turcotte-Pugh (CTP) classification and/or model of end stage liver disease (MELD) scores. For instance, emergency surgery reflects an

independent risk factor for mortality, and is associated with postoperative decompensation of liver function ***(Cho et al., 2011).***

The decreased ability of the liver to metabolize drugs and the increased susceptibility to narcotics in preexisting encephalopathy needs to be considered when choosing the type and the dose of anesthetic. So, the anesthetic requirement is lower in patients with liver insufficiency. Thus, the dose of anesthetic necessary for deep anesthesia might vary and is probably mostly overestimated in liver insufficiency. Especially in patients with pre-existing encephalopathy, bispectral index monitoring represents a useful tool to guide the depth of anesthesia ***(Okawa et al., 2011).***

Whether or not neuroaxial anesthesia should be performed in hepatic patients is a matter of considerable debate. Regional anesthesia may be successfully applied, but no evidence exists to support better survival under this regimen ***(Fox et al., 2011).***

Postoperative ICU admission should be anticipated for patients with advanced liver disease. In some circumstances, postoperative artificial ventilation may be appropriate, but in general, sedative drugs should be discontinued early and patients allowed to recover from anesthesia so that neurological assessment can be performed ***(Ziser et al., 1999).***

AIM OF THE WORK

To discuss recent knowledge in anesthetic management for patients with advanced liver disease undergoing emergency operation aiming to reduce intra operative and post operative complication.

Chapter (1):

ANATOMY OF THE LIVER

The liver is the largest organ of the human body, weighs approximately 1500 g, and is located in the upper right corner of the abdomen. The organ is closely associated with the small intestine, processing the nutrient-enriched venous blood that leaves the digestive tract. The liver performs over 500 metabolic functions, resulting in synthesis of products that are released into the blood stream (e.g. glucose derived from glycogenesis, plasma proteins, clotting factors and urea), or that are excreted to the intestinal tract (bile). Also, several products are stored in liver parenchyma (e.g. glycogen, fat and fat soluble vitamins) ***(Bismuth, 1982).***

Almost all blood that enters the liver via the portal tract originates from the gastrointestinal tract as well as from the spleen, pancreas and gallbladder. A second blood supply to the liver comes from the hepatic artery, branching directly from the celiac trunk and descending aorta. The portal vein supplies venous blood under low pressure conditions to the liver, while the hepatic artery supplies high-pressured arterial blood ***(Lewis and Gray, 2000).***

Since the capillary bed of the gastrointestinal tract already extracts most O_2, portal venous blood has a low O_2 content. Blood from the hepatic artery on the other hand, originates directly from the aorta and is, therefore, saturated with O_2. Blood from both vessels joins in the capillary bed of the liver and leaves via central veins to the inferior caval vein ***Figure (1) (Sear, 2002).***

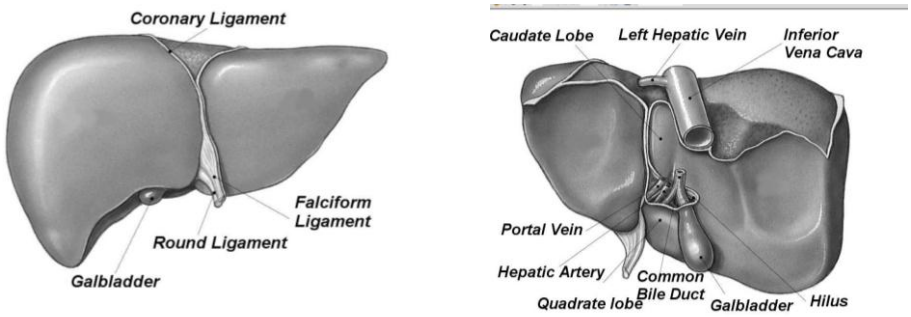

Figure (1): Anatomy of the liver ***(Agur et al., 1999).***

Basic liver architecture

The major blood vessels (portal vein and hepatic artery), lymphatics, nerves and hepatic bile duct communicate with the liver at a common site, the hilus. From the hilus, they branch and rebranch within the liver to form a system that travels together in a conduit structure, the portal canal from this portal canal, after numerous branching, the portal vein finally drains into the sinusoids, which is the capillary system of the liver. Here, in the sinusoids, blood from the portal vein joins with blood flow from end-arterial branches of the hepatic artery.

Once passed through the sinusoids, blood enters the collecting branch of the central vein, and finally leaves the liver via the hepatic vein. The hexagonal structure with, in most cases, three portal canals in its corners draining into one central vein, is defined as a lobule. The lobule largely consists of hepatocytes (liver cells) which are arranged as interconnected plates, usually one or two hepatocytes thick. The space between the plates forms the sinusoid. A more functional unit of the liver forms the acinus. In the acinus, the portal canal forms the center and the central veins the corners. The functional acinus can be divided into three zones: 1) the periportal zone, which is the circular zone directly around the portal canal, 2) the central zone, the circular area around the central vein, and 3) a midzonal area, which is the zone between the periportal and pericentral zone ***Figure (2) (Parks et al., 2000).***

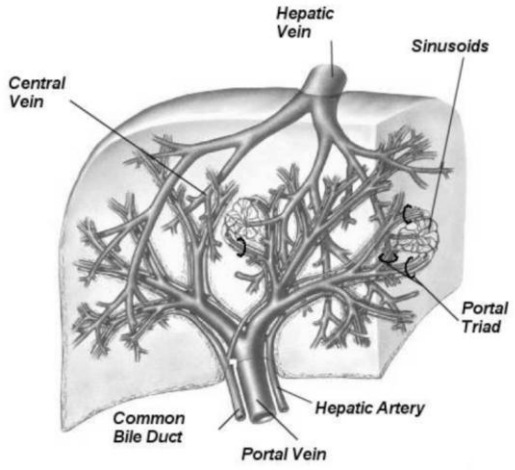

Figure (2): Network of branching and rebranching blood vessels in the liver ***(Guyton, 2006).***

Morphological Anatomy

The first description of the anatomy of the liver is what can be termed the morphological anatomy, based on the surface features of the organ. On the anterior surface, the round ligament and the falciform ligament divide the liver into two lobes: the left and right lobes. On the inferior surface, the umbilical fissure, the gallbladder bed, and the hilus limit the quadrate lobe. Behind the hilus is the spigelian lobe. In total, there are two main lobes and two accessory lobes corresponding to the true definition of a lobe: "part of the parenchyma limited by fissures or grooves". However, this morphological description of the liver is inadequate to guide the surgeon in performing anatomical surgery ***(Strasberg, 1997)***.

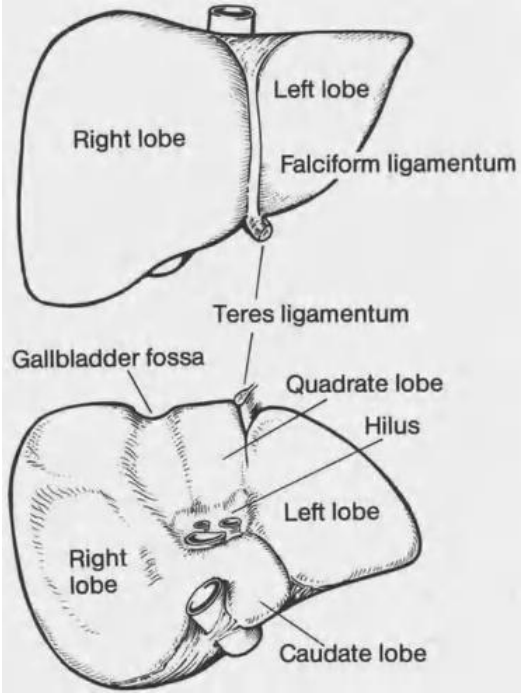

Figure (3): Morphology of the liver ***(Strasberg, 1997)***.

Functional Anatomy

Based on the distribution of vessels in the liver, a second anatomy can be described: the functional anatomy. The three hepatic veins divide the liver into four sectors, each receiving a portal pedicle. There are three scissurae: the middle scissura in which runs the middle hepatic vein, the right scissura, and the left scissura ***Figure (3).*** Shows the four sectors separated by the three hepatic veins and receiving the four portal pedicles. The main fissure divides the liver into two parts: the right hemi-liver or more simply the right liver and the left hemi-liver or the left liver. Each of these two livers

receives one of the two branches of the portal vein and is drained by one of the two branches of the bile duct. Distribution of the hepatic artery does not strictly follow this division. The right liver is divided into two sectors by the right hepatic vein, the posterior and the anterior. The left liver is also divided into two by the left scissura, a medial sector and a lateral one ***(Bismuth, 1982).***

It is possible according to the secondary divisions of the portal branches to divide the liver further. Each of the two sectors of the right liver is divided into two segments: an inferior segment and a superior segment. The medial left sector is divided into two by the umbilical fissure, a medial segment and a lateral segment. The left lateral sector is only one segment. The spigelian lobe, which has independent hepatic veins and portal pedicles, is an autonomous segment ***(Bismuth et al., 1982).***

In total the liver is divided into eight segments. Numbers have been assigned to these segments:

The spigelian lobe is segment one; then, moving clockwise, it was found that:

- Segment 2 for the lateral segment (or sector) of the left liver.

- Segment 3 for the lateral segment of the medial sector of the left liver.
- Segment 4 for the medial segment of the left medial sector.
- Segment 5 for the inferior segment of the anterior sector of the right liver.
- Segment 6 for the inferior segment of the posterior sector of the right liver.
- Segment 7 for the superior segment of the posterior sector of the right liver.
- Segment 8 for the superior segment of the anterior sector of the right liver ***Figure (4,5) (Bismuth et al., 1982).***

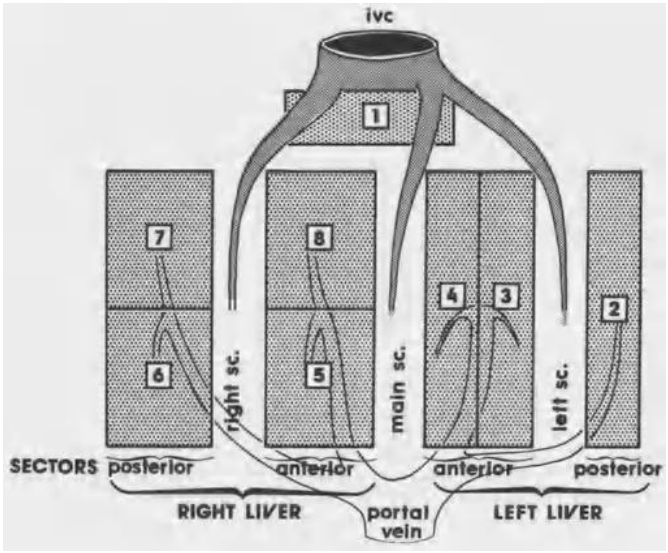

Figure (4): Schematic representation of the functional anatomy of the liver ***(Bismuth et al., 1982).***

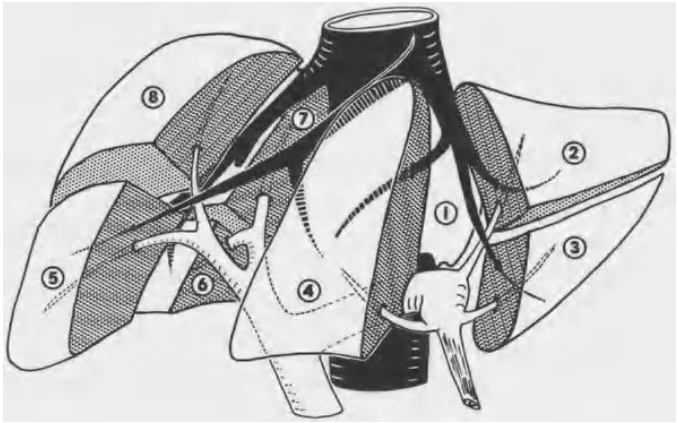

Figure (5): The functional division of the liver and the hepatic segmentation (in vivo position of the liver) ***(Goldsmith and Woodburne, 1957)***

It has been noticed:

That the morphological left lobe, to the left of the umbilical fissura, comprises segments 2 and 3.

The anterior part of segment 4, which is anterior to the hilus, is the quadrate lobe (segment 4 is not equivalent to the quadrate lobe, which is only its anterior part). The segments are usually described on an ex vivo liver placed on a table, and in this setting the posterior sector seems to be lateral to the anterior sector. In vivo, the posterior sector is almost completely behind the anterior sector and is not seen at the anterior surface of the liver.

In most countries, the segments and their numbers have become very popular among surgeons. This definition of the segments according to Couinaud's ***(Couinaud, 1957).***

Real Anatomy

Progress has been made in operative ultrasound, which gives the surgeon a precise picture of the anatomy of the liver being operated on ***(Castaing et al., 1985).***

Tracing the vascular distribution inside the liver is the first step in liver resection. By locating precisely the three main hepatic veins, the portal scissurae can be identified and their projections on the anterior surface of the liver marked by small incisions on Glisson's capsule. Operative ultrasound is even more useful for segmental resection as division inside the liver of the main portal branches can be easily located. ***(Castaing et al., 1985).***

Segments can be more precisely defined by injection of dye under ultrasound guidance in the segmental portal branch or by balloon catheter occlusion ***Figure (6,7) (Castaing et al., 1985).***

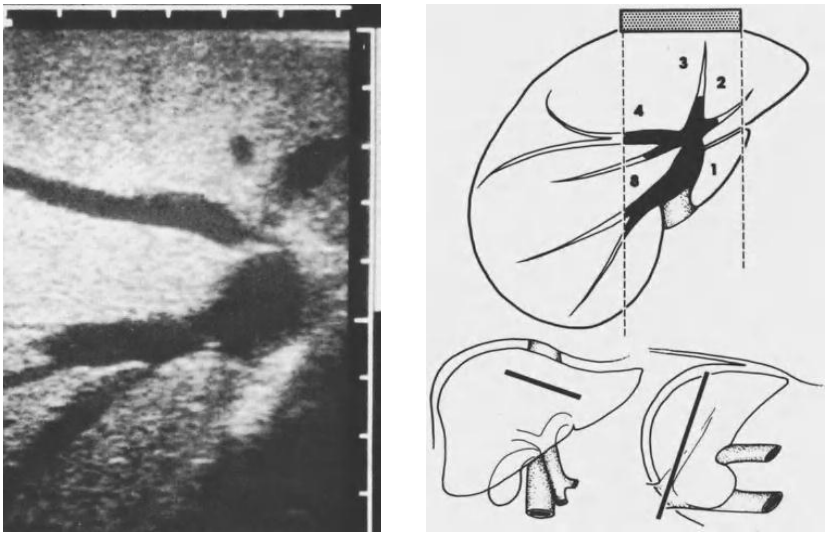

Figure (6): Operative ultrasound anatomy: the three main hepatic veins ***(Castaing et al., 1985).***

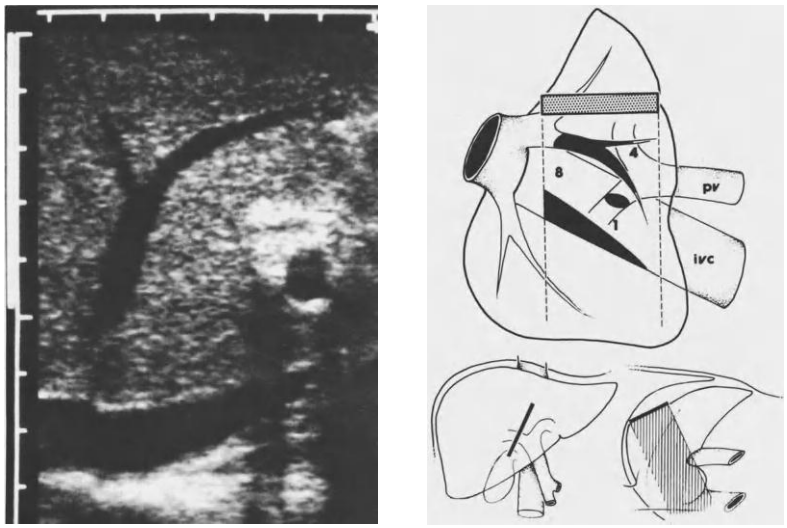

Figure (7): Operative ultrasound anatomy: the main scissura and the middle hepatic vein ***(Castaing et al., 1985).***

Chapter (2):

PHYSIOLOGY OF THE LIVER

The liver, performs many of the functions necessary for staying healthy. Among the most important liver functions are:

- **Removing and excreting body wastes and hormones as well as drugs and other foreign substances:**

Body waste have entered the blood supply either through production by metabolism within the body or from the outside in the form of drugs or other foreign compounds. Enzymes in the liver alter some toxins so they can be more easily excreted in urine ***(Bernal et al., 2002)***.

Synthesizing plasma proteins, including those necessary for blood clotting: Most of the 12 clotting factors are plasma proteins produced by the liver. If the liver is damaged or diseased, it can take longer for the body to form clots. Other plasma proteins produced by the liver include albumin which binds many water-insoluble substances and contributes to osmotic pressure, fibrinogen which is key to the clotting process, and certain globulins which transport substances such as cholesterol and iron ***(Jungerinan and Keitzmann, 1995).***