Hepatobiliary Complications in Relation to Total Parentral Nutrition in Surgical Critically ill Patients

An Essay
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بسم الله الرحمن الرحيم
قَالُوا سُبْحَانَكَ لاَ عِلْمَ لَنَا إِلاَّ مَا
عَلَّمْتَنَا إِنَّكَ أَنتَ الْعَلِيمُ الْحَكِيمُ
صدق الله العظيم
سورة البقرة آية (32)

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List of Abbreviations

BZDs	:	Benzodiazepines
EN	:	Enteral nutrition
MB	:	Bottle system
MDCT	:	Multidetector row computed tomography
MRI	:	Magnetic Resonance Imaging
PN	:	Parenteral Nutrition
TPN	:	Total parenteral nutrition
SICU	:	Surgical intensive care unit

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Introduction

Artificial nutritional support is an integral part of the management of critically ill surgical patients in the intensive care unit. ***(Marino and Sutin, 2009).***

During the acute phase of illness, critically ill patients are generally catabolic. The aim of feeding patients is to provide adequate nutritional requirements and minimize protein degradation during acute illness ***(Whiteley et al., 2004).***

Nutrition can be provided either by enteral or parenteral routes. The enteral route consistently has been shown to be more effective in maintaining gastrointestinal integrity and so enteral feeding has been always preferred over parenteral feeding in clinical applications. ***(Whiteley et al., 2004).***

Hepatobiliary complications related to artificial nutrition (which is characterized by elevated serum bilirubin and/ or liver enzymes) have been widely reported, particularly in patients receiving total parenteral nutrition (TPN), and less frequently in patients receiving enteral nutrition (EN) ***(Grau et al., 2007).***

Aim of the work

The aim of this essay is to discuss the incidence and review hepatobiliary complications related to total parentral nutrition in surgical intensive care unit.

Anatomy and Physiology of Hepatobiliary System

The liver is a reddish brown organ with four lobes of unequal size and shape. A human liver normally weighs 1.44-1.66 kg (3.2-3.7 lb), ***(Cotran et al., 2005)***. It is both the largest internal organ (the skin being the largest organ overall) and the largest gland in the human body. It is located in the right upper quadrant of the abdominal cavity, resting just below the diaphragm. The liver lies to the right of the stomach and overlies the gallbladder. It is connected to two large blood vessels, one is the hepatic artery and one called the portal vein. The hepatic artery carries blood from the aorta, whereas the portal vein carries blood containing digested nutrients from the entire gastrointestinal tract and also from the spleen and pancreas.

Two major types of cells populate the liver lobes: karat parenchymal and non-parenchymal cells. 80% of the liver volume is occupied byparenchymal cells commonly referred to as hepatocytes. Non-parenchymal cells constitute 20% of the total number of liver cells but only 6.5% of its volume. Sinusoidal hepatic endothelial cells, Kupffer cells and hepatic stellate cells are some of the non-parenchymal cells that line the liver sinusoid ***(Kmiec, 2001)***

Blood flow

The liver gets a dual blood supply from the portal vein and hepatic artery. Portal vein supply approximately 70% of the liver's blood supply, the portal vein carries venous blood drained from the spleen, gastrointestinal tract, and its associated organs. The hepatic artery supply arterial blood to the liver, accounting for the remainder of its blood flow. 30% of the oxygen is provided from both sources; approximately half of the liver's oxygen demand is met by the portal vein, and half is met by the hepatic artery ***(Sneider et al., 2008).***

Blood flows through the liver sinusoids and empties into the central vein of each lobule. The central veins coalesce into hepatic veins, which leave the liver.

Biliary flow

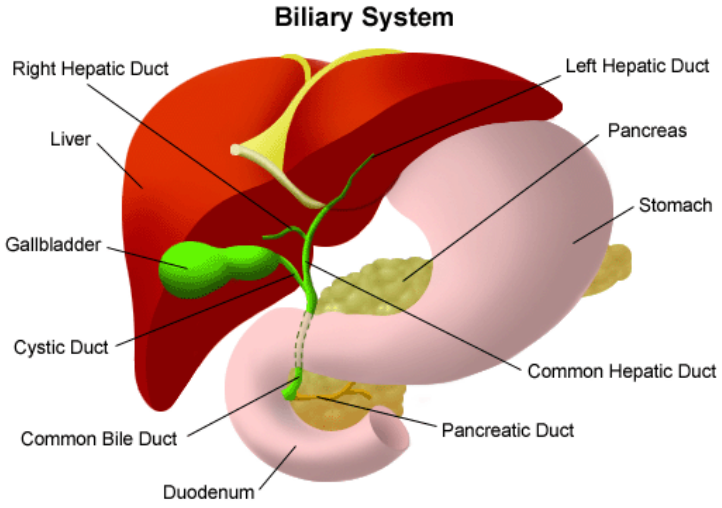

Fig. (1): Anatomy of hepatobiliary system

The biliary tree

The term *biliary tree* is derived from the arboreal branches of the bile ducts. The bileproduced in the liver is collected in bile canaliculi, which merge to form bile ducts. Within the liver, these ducts are called *intrahepatic* (within the liver) bile ducts, and once they exit the liver they are considered *extrahepatic* (outside the liver). The intrahepatic ducts eventually drain into the right and left hepatic ducts, which merge to form the common hepatic duct. The cystic duct from the gallbladder joins with the common hepatic duct to form thecommon bile duct.

Bile either drains directly into the duodenum via the common bile duct, or be temporarily stored in the gallbladder via the cystic duct. The common bile duct and the pancreatic ductenter the second part of the duodenum together at the ampulla of Vater.

Surface anatomy

Peritoneal ligaments

Apart from a patch where it connects to the diaphragm (the so-called "bare area"), the liver is covered entirely by visceral peritoneum, a thin, double-layered membrane that reducesfriction against other organs. The peritoneum folds back on itself to form the falciform ligament and the right and left triangular ligaments.

These "lits" are in no way related to the true anatomic ligaments in joints, and have essentially no known functional importance, but they are easily recognizable surface landmarks. An exception to this is the falciform ligament, which attaches the liver to the posterior portion of the anterior body wall.

Traditional gross anatomy divided the liver into two lobes (left and right), if viewed from the parietal surface; but if observed on the visceral surface it is divided into four lobes with the addition of the caudate and quadrate lobe.

The falciform ligament is visible on the front (anterior side) of the liver. This divides the liver into a left anatomical lobe, and a right anatomical lobe.

If the liver is flipped over, to look at it from below (the visceral surface), there are two additional lobes between the right and left. These are the caudate lobe (the more superior) and the quadrate lobe (the more inferior).

On the visceral surface a functional anatomy dictates how the liver is organized. One must view an imaginary line that passes to the left of the vena cava all the way forward and sections the gallblader into two halfs. This line is called Cantlie's Line. This line divides the liver in left and right. Other anatomical landmarks exist, such as the ligamentum venosum (ligamentum of Arancio) and the round ligament

(ligamentum Teres) that further divide the left side of the liver in two sections. Now an important anatomical landmark, the transverse fissure of the liver divides this left portion of the liver into four segments which will be numbered starting at the caudate lobule as I in an anti-clock manner. From this visceral view we can see 7 segments because the 8th segment is only visible in the parietal view. Each of the lobes is made up of lobules; a vein goes from the centre, which then joins to the hepatic vein to carry blood out from the liver.

On the surface of the lobules, there are ducts, veins and arteries that carry fluids to and from them.

Functional anatomy

Correspondence between anatomic lobes and Couinaud segments

Couinaud segments	Segment*
1	Caudate
2, 3	Lateral
4a, 4b	Medial
5, 6, 7, 8	Right

* or lobe, in the case of the caudate lobe

Each number in the list corresponds to one in the table.

1. Caudate
2. Superior subsegment of the lateral segment
3. Inferior subsegment of the lateral segment
4a. Superior subsegment of the medial segment
4b. Inferior subsegment of the medial segment
5. Inferior subsegment of the anterior segment
6. Inferior subsegment of the posterior segment
7. Superior subsegment of the posterior segment
8. Superior subsegment of the anterior segment

The central area where the common bile duct, hepatic portal vein, and hepatic artery proper enter is the hilum or

"porta hepatis". The duct, vein, and artery divide into left and right branches, and the portions of the liver supplied by these branches constitute the functional left and right lobes.

The functional lobes are separated by an imaginary plane (historically called Cantlie's line) joining the gallbladder fossa to the inferior vena cava. The plane separates the liver into the true right and left lobes. The middle hepatic vein also demarcates the true right and left lobes. The right lobe is further divided into an anterior and posterior segment by the right hepatic vein. The left lobe is divided into the medial and lateral segments by the left hepatic vein. The fissure for the ligamentum teres also separates the medial and lateral segments. The medial segment is also called the quadrate lobe. In the widely used Couinaud (or "French") system, the functional lobes are further divided into a total of eight subsegments based on a transverse plane through the bifurcation of the main portal vein. The caudate lobe is a separate structure which receives blood flow from both the right- and left-sided vascular branches.***(Strunk, 2009)***

Physiology

The various functions of the liver are carried out by the liver cells or hepatocytes. Currently, there is no artificial organ or device capable of emulating all the functions of the liver. Some functions can be emulated by liver dialysis, an experimental treatment for liver failure. The liver is thought to