Role of Microwave Ablation of Hepato-cellular Carcinoma

Essay

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Introduction

Hepatocellular carcinoma (HCC) is the fifth most common cancer in men and eighth most common cancer in women worldwide, resulting in at least 500 000 deaths per year. It accounts for 90% of all liver cancers ***(Jelicl and Sotiropoulos, 2010).***

It is four to eight times more common in men and usually associated with chronic liver injury [hepatitis B (HBV), hepatitis C (HCV) and alcoholic cirrhosis] ***(Jelicl and Sotiropoulos, 2010).***

Median age at diagnosis is between 50 and 60 years. Rarely, it can also occur in patients with normal liver parenchyma ***(Jelicl and Sotiropoulos, 2010).***

In general, cirrhosis of any etiology is the major risk factor for hepatocellular carcinoma. About 80% of patients with newly diagnosed hepatocellular carcinoma have preexisting cirrhosis ***(Jiao et al., 2012).***

If left untreated, liver cancer has a poor prognosis with more than 90% of patients dying of the disease within 5 years of diagnosis ***(Jiao et al., 2012).***

AASLD (American Association Study of Liver Diseases) guidelines recommend ultrasound examination with alpha fetoprotein (AFP) measurement for patients with high-risk cirrhosis for screening of hepatocellular carcinoma. In light of available knowledge, a 6-month scheduled surveillance appears the preferable choice ***(Jordi Bruix and Sherman, 2001).***

The treatment of every patient with HCC should always be discussed and planned by a multidisciplinary team. The treatment plan should be based on the presence or absence of liver cirrhosis, extent of disease, growth pattern of tumor, hepatic functional reserve and patient's performance status ***(Jelicl and Sotiropoulos, 2010).***

Managements of HCC include liver transplantation, surgical excision as well as loco-regional therapies. Since the institution of the MELD (Model for End-Stage Liver Disease) score, HCC has become the primary indication in up to 22% of all liver transplantations in the United States. If possible, surgical removal of the tumor is standard treatment for liver cancer and gives the patient their best chance at long-term survival. Unfortunately, the majority of patients with liver cancer are not surgical candidates. As a result, minimally invasive therapies such as image-guided local ablation therapies and trans catheter tumor therapy can be used to improve the prognosis of such patients ***(Bruix and Sherman, 2001).***

Local ablation is optimal for non-surgical HCC and is mostly considered as a minimally invasive procedure. Tumor ablation is achieved with the use of chemical substances (ethanol, acetic acid) or modification of the temperature of tumor cells (radiofrequency, microwave, laser, and cryoabation) ***(Bruix and Sherman, 2001).***

Microwave ablation is rapidly being rediscovered and developed for clinical use. The term “ablation” refers to the destruction of a material; both radio frequency and microwave ablation ablate tissue by heating it to cytotoxic temperatures ***(Brace, 2010).***

While RF energy is the most familiar heat source for tissue ablation, it has certain limitations that may hamper its efficacy. Microwave energy may be able to overcome the technical limitations of RF energy but has technical hurdles that must be overcome as well ***(Brace, 2010).***

A result of the technical development of local-regional approaches for HCC during the recent decades , a recent trial comparing the combination of chemoembolization and local ablation suggested that this approach offered an improvement in survival as compared to chemoembolization or ablation alone ***(Bruix and Sherman, 2001).***

Aim of the Work

This essay aims at reviewing the role of microwave ablation (alone or combined with other interventional procedures) in the treatment of HCC.

Anatomy

A) General features and position:

The liver is the largest abdominal organ .It lies in the upper right part of the abdominal cavity. It occupies most of the right hypochondrium and epigastrium, although it frequently extends into the left hypochondrium. The liver has an overall wedge shape, weighting from 1.4 - 1.6 kilogram in male, and from 1.2 -1.4 kilogram in female. Its greatest transverse measurement is from 20 - 22.5 cm. Vertically, near its lateral or right border, it measures about 15 - 17.5 cm, while its greatest anteroposterior diameter on a level with the upper end of the right kidney is from 10 - 12.5 cm. The narrow end of the wedge lies towards the left hypochondrium ***(Jones and Hardy, 2001).***

The liver is enclosed in a thin, fibrous hepatic capsule (of Glisson) that lies just beneath the visceral peritoneum. From the hepatic capsule, septa project inward into hepatic parenchyma ***(Gosling et al, 2002).***

B) Hepatic surfaces and relations:

The liver has superior, anterior, right, posterior and inferior surfaces, and has a distinct inferior border. However, superior, anterior, right surfaces are continuous with no definable borders (Fig.1,2).

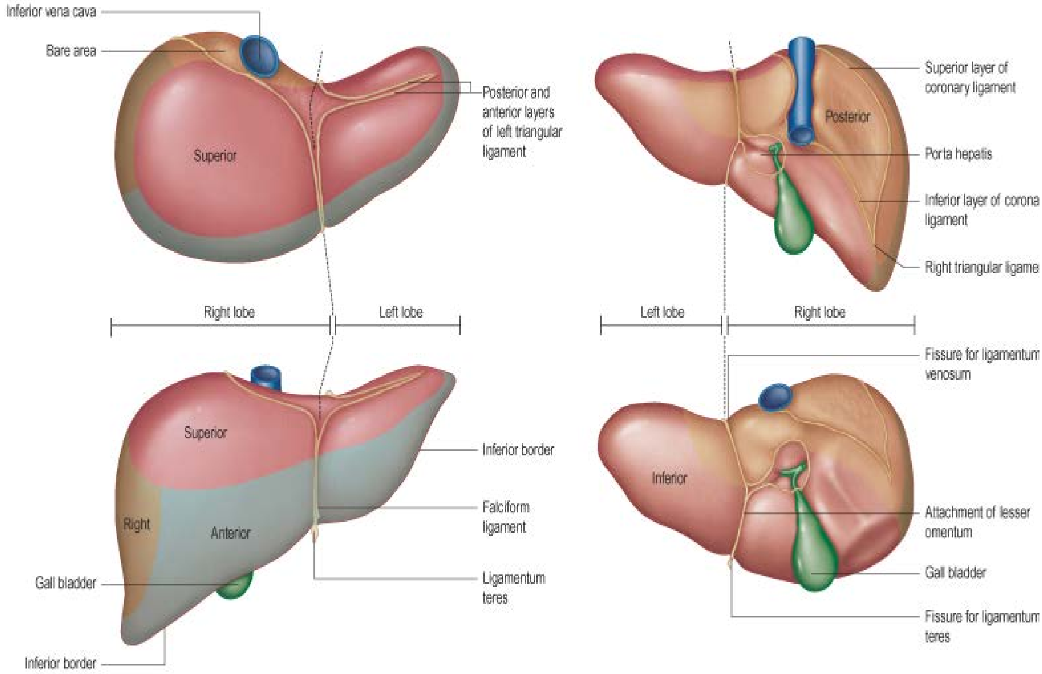

Figure (1): *The surfaces and external features of the liver. Top left, superior view; top right, posterior view; bottom left, anterior view; bottom right, inferior view* ***(Standring, 2005).***

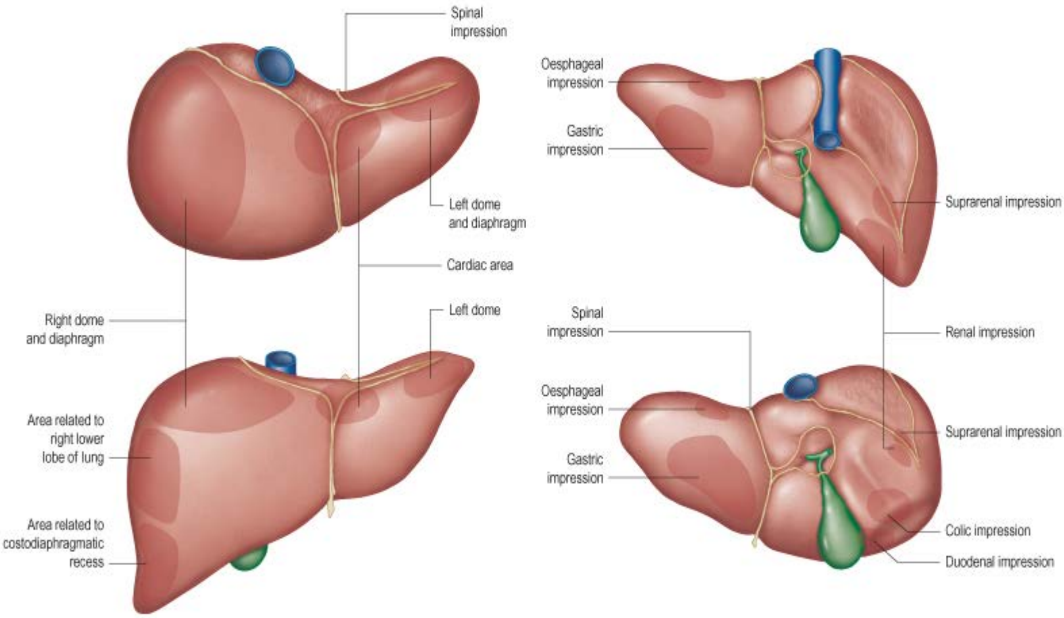

Figure (2)*: Relations of the liver. Top left, superior view; top right, posterior view; bottom left, anterior view; bottom right, inferior view* ***(Standring , 2005).***

1) Superior surface:

The superior surface is the largest surface and lies immediately below the diaphragm, separated from it by peritoneum except for a small triangular area where the two layers of falciform ligament diverge. It is related to the right diaphragmatic pleura, base of the right lung, pericardium, ventricular part of the heart, part of the left diaphragmatic pleura and base of the left lung ***(Standring, 2005).***

2) Anterior surface

The anterior surface is triangular and convex. It is covered by peritoneum except at the attachment of the falciform ligament. On the right, the diaphragm separates it from the pleura and six to tenth ribs and cartilages, and on the left from the seventh and eighth costal cartilages. The median area of this surface lies behind the xiphoid process and the anterior abdominal wall in the subcostal angle ***(Standring, 2005).***

3) Right Surface:

It is covered by peritoneum and lies adjacent to the right dome of the diaphragm which separates it from the right lung, pleura and seventh to eleventh ribs ***(Standring, 2005).***

4) Posterior surface:

The posterior surface is convex, wide on the right, but narrow on the left. A deep median concavity corresponds to convexity of the vertebral column. Much of the posterior surface is attached to the diaphragm by loose connective tissue which forms the so-called ` bare area`. The ` bare area` is an anterior relation of the upper pole of the left suprarenal gland. The inferior vena cava lies in a groove in the medial end of the ` bare area`. To the left of IVC the caudate lobe is present. To the left of caudate lobe, the fissure for the ligamentum venosum is present. The posterior surface over the left lobe bears a shallow oesophageal impression and gastric impressions ***(Standring , 2005).***

5) Inferior surface:

The inferior surface is bounded by the inferior edge of the liver. It is marked near the midline by fissure of ligamentum teres. Posteriorly it is related to the fissure for ligamentum venosum and the gall bladder. Between the fissure for the ligamentum teres and the gall bladder lies the quadrate lobe. The inferior surface of the left lobe is related inferiorly to the fundus of the stomach and the upper lesser omentum. The quadrate lobe lies adjacent to the pylorus, first part of the duodenum and the lower part of the lesser omentum. Occasionally the transverse colon lies between the duodenum and the quadrate lobe. To the right of the gall bladder, the inferior surface is related to the hepatic flexure of the colon, the right suprarenal gland and the right kidney, and the first part of the duodenum ***(Standring , 2005).***

The portahepatis is the area of the inferior surface through which all the neurovascular and biliary structures, except the hepatic veins, enter and leave the liver. It is situated between the quadrate lobe in front and the caudate process behind. The portahepatis is actually a deep fissure into which the portal vein, hepatic artery and hepatic nervous plexus ascend into the parenchyma of the liver. The right and left hepatic bile ducts and some lymph vessels emerge from it. At the portahepatis, the hepatic ducts lie anterior to the portal vein and its branches, and the hepatic artery with its branches lies between the two ***(Gosling et al, 2002).***

C) Hepatic lobes and segmental anatomy of the liver:-

A-Anatomical lobes of the liver:

(1) Right lobe:

The right lobe of the liver is the largest in size and contributes to all surfaces; it exceeds the left lobe by a ratio of 6:1. It occupies the right hypochondrium. Its inferior and posterior surfaces are marked by three fossae; the portahepatis, the gall bladder fossa, and the inferior vena cava. A congenital variant, Riedel's lobe, can sometimes be seen as an anterior projection of the liver ***(Gallego et al., 2002).***

(2) Left lobe:

The left lobe of the liver is the smaller of the two main lobes. It lies in the epigastric and left hypochondrium regions. Its upper surface is convex. Its inferior surface includes the gastric impression and omental tuberosity ***(Gallego et al., 2002).***

(3) Caudate lobe:

The caudate lobe is a small lobe visible on the posterior surface. It is bounded on the left by the fissure for ligamentum venosum, below by the porta hepatis, on the right by the groove for the inferior vena cava. Above it continues into the superior surface. Below and to right, it is connected to the right lobe by a narrow caudate process. In gross anatomical descriptions this lobe is said to arise from the right lobe, but it is functionally separate ***(Standring, 2005).***

(4) Quadrate lobe:

The quadrate lobe is only visible from the inferior surface, it appears somewhat rectangular. It is bounded on the right by the fossa for the gall bladder, on the left by the fissure for ligamentum teres, in front by the inferior border, and posteriorly by the portahepatis. In gross anatomical description it is said to be a lobe arising from the right lobe, however, it is functionally related to the left lobe ***(Gosling et al, 2002).***

B-Segmental anatomy of the liver:

An understanding of the segmental anatomy of the liver is critical for localization and appropriate management of hepatic neoplasms. A variety of definitions have been used to describe the anatomy of the liver segments. The smallest parts of the liver are defined using Couinaud's segmentation system, allowing for a precise identification of the site of liver damage, as well as to plan methods of segment resection that would protect the remaining hepatic tissue ***(Standring , 2005)***.

Couinaud based his work on the distribution of the portal and hepatic veins (table 1).The Couinaud classification of liver anatomy divides the liver into eight functionally independent segments , Segment 4 is sometimes divided into segment 4a and 4b according to Bismuth. Each segment has its own vascular inflow, outflow and biliary drainage. In the centre of each segment there is a branch of the portal vein, hepatic artery and bile duct. In the periphery of each segment there is vascular outflow through the hepatic veins. The liver is divided by the 'principal plane' into two halves of approximately equal size. The principal plane is defined by an imaginary parasagittal line from the gallbladder anteriorly to the inferior vena cava posteriorly. The usual functional division of the liver into right and left lobes lies along this plane. Right hepatic vein divides the right lobe into anterior and posterior segments. Middle hepatic vein divides the liver into right and left lobes (or right and left hemiliver). Left hepatic vein divides the left lobe into a medial and lateral part. Portal vein divides the liver into upper and lower segments. The left and right portal veins branch superiorly and inferiorly to project into the center of each segment. The left portal vein divides the left lobe of the liver into the superior segments (2 and 4A) and the inferior segments (3 and 4B). the right portal vein divides the right lobe of the liver into superior segments (7 and 8) and the inferior segments (5 and 6). Segment I corresponds to the gross anatomical caudate lobe ***(Standring , 2005)*** (fig3).

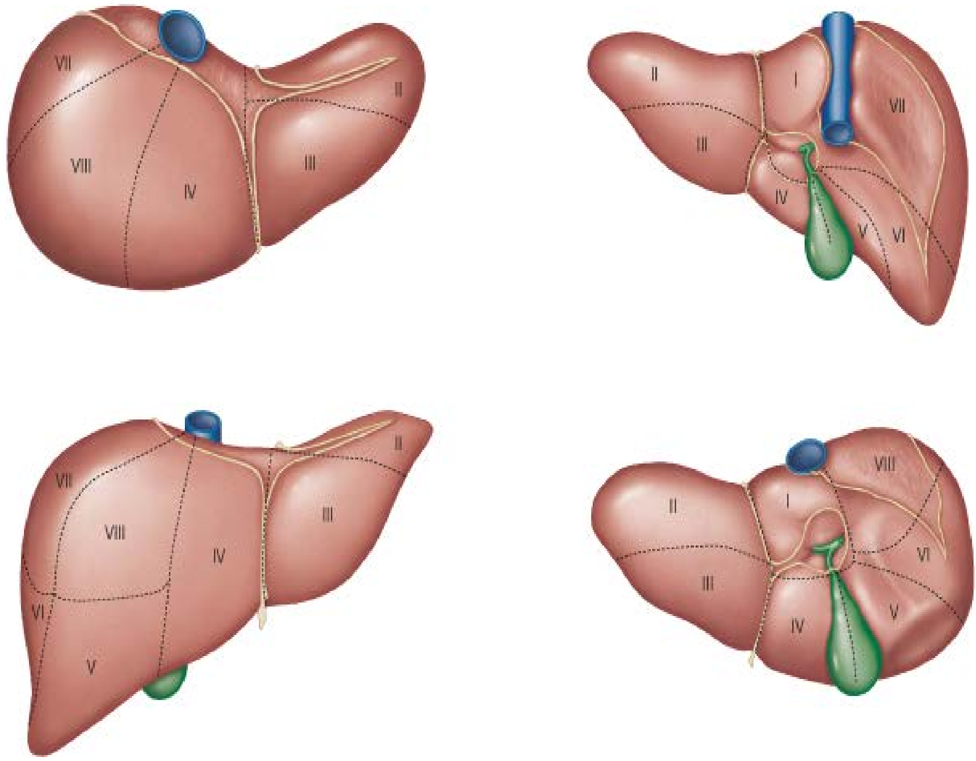

Figure 3: *Showing Segmentation of the liver - Couinaud.*

Top left, superior view; top right, posterior view; bottom left, anterior view; bottom right, inferior view. The segments are sometimes referred to by name - I, caudate (sometimes subdivided into left and right parts); II, lateral superior; III, lateral inferior; IV, medial (sometimes subdivided into superior and inferior parts); V, anterior inferior; VI, posterior inferior; VII, posterior superior; VIII, anterior superior ***(Standring , 2005).***

Bismuth's classification became more popular among surgeons. This classification is very similar to the Couinaud classification. According to Bismuth three hepatic veins divide the liver into four sectors, further divided into segments. These sectors are termed portal sectors as each is supplied by a portal pedicle in