The Role of Multi-slice CT in the Evaluation of Complications in Hepatic Transplantation Recipients

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Abstract

Radiology has undoubtedly contributed to the development and success of liver transplantation. LDLT requires intensive radiological evaluation, each imaging modality provides a range of information and more than one modality is often needed to obtain the pre-surgical information and to detect intra or post operative complications.

MSCT and MSCTA are the efficient examinations used in the diagnosis of post-transplantation vascular complications involving the hepatic artery, portal vein and hepatic veins when Doppler studies are inconclusive. It can be also used in biliary complications to detect biloma extents and biliary leak as well as help to provide an axis of intervention for biloma drainage.

This study was conducted on a heterogeneous sample of 30 recipients who underwent adult-adult LDLT with special focus on the post-operative MSCT and MSCTA results. Different post-operative complications (including vascular, parenchymal and biliary complications) were traced.

With the advanced techniques of multi-slice CT, we were able to prove that MSCT and MSCTA of the liver is a practical non-invasive method for detecting hepatic vascular and biliary complications as well as parenchymal lesions after liver transplantation giving a chance for proper and swift intervention for the urgent cases.

Key Words

Hepatic-Liver-Transplantation-MSCT-MSCTA-Complications-Recipients.

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INTRODUCTION

Liver transplantation is currently the treatment of choice for patients with severe acute or advanced chronic liver failure for which no other therapy is available. Liver failure can have a number of causes, including autoimmune hepatitis; chronic viral hepatitis; alcoholic liver disease; metabolic diseases (1-antitrypsin deficiency, hemochromatosis, Wilson's disease); cholestatic liver disorders (primary biliary cirrhosis, primary sclerosing cholangitis, biliary atresia); and severe acute liver failure due to viral hepatitis, drug-induced hepatitis (eg, by acetaminophen or isoniazid), or hepatotoxins (Singh et al.,2010).

Patients with hepatocellular carcinoma, cholangiocarcinoma, or inoperable neuroendocrine metastases are also potential candidates for hepatic transplantation. The absolute contraindications for transplantation include acquired immunodeficiency syndrome, extra-hepatic malignant tumors, and active intravenous narcotic drug use or alcohol abuse (Sahani et al.,2004).

The clinical and laboratory manifestations of post-hepatic transplantation complications are often nonspecific and may be masked by immunosuppressive drugs. The role of imaging is often

critical to diagnosis and prompt treatment of transplant complications (Manzarbeitia et al.,2011).

The care of these patients has relied heavily on cross-sectional imaging, and there is a greater demand for accurate evaluation of complications because early diagnosis is critical for graft salvage (Sahani et al.,2004).

Post-hepatic transplantation complications include vascular and biliary complications. Bowel obstruction, post-operative collections, infection and malignant recurrence are also common complications seen in the post-hepatic transplantation patients (Miraglia et al.,2009).

Vascular complications occur in about 9% of liver transplantation cases. Most are arterial, rather than venous, and these may result in graft failure with consequent bile leak, bleeding, or sepsis (Singh et al.,2010).

Biliary complications following hepatic transplantation occur in 6% to 34% of patients with the higher rates in children and are the second most frequent cause of graft dysfunction, exceeded only by rejection. Most biliary complications become evident during the first 3 months after transplantation although some strictures and stones develop months to years later (Singh et al.,2010).

Hepatic transplantation is complicated by bowel obstruction in 1% cases, with adhesions and some form of hernia being the two most common causes, of almost equal frequency (Miraglia et al.,2009).

The transplant patient is also susceptible to a variety of fluid collections including localized ascites, bilomas, hematomas , and abscesses (Federle and Kapoor,2003).

Immunosuppression is the most critical factor that predisposes patients to infection following hepatic transplantation. Drug regimens have evolved in an attempt to achieve more specific control of organ rejection with the least impairment of overall immunity (Federle and Kapoor,2003).

In the early experience with transplantation it was hoped that patients who had malignancy limited to the liver could be cured by hepatic transplantation. Unfortunately, there was an unacceptably high rate of recurrence for patients with cholangiocarcinoma and hepatocellular carcinoma (Caiado et al,2007).

Early diagnosis and confirmation of rejection permit faster and more appropriate clinical intervention (Yeon et al., 2007).

Many imaging modalities were used in the assessment of the post-hepatic transplantation complications including conventional angiography and Doppler studies for the assessment of vascular complications as well as MRI and MRCP for the assessment of biliary complication and ultra-sonography for the assessment of the biliary complications and the post-operative collections (Russ et al,2011).

Multi-detector row CT (MDCT) is recently accepted as a practical noninvasive diagnostic method in various complications following liver transplantation. The excellent spatial and temporal resolution combined with post-processing of the imaging data using a variety of three-dimensional reformatting techniques such as maximum intensity projection (MIP), shaded surface display, and volume rendering (VR) allows MDCT to depict both hepatic anatomy and pathology efficiently and accurately (Yeon et al., 2007).

Moreover, MDCT has several advantages over other imaging modalities. Compared with catheter angiography, CT angiography is noninvasive and cost effective. Unlike sonography, CT angiography is not as dependent on the operator's skill performing the study or on the patient's body habitus. Additionally, CT is more useful in detecting extra-hepatic complications, such as pseudo-aneurysm or dissection and in monitoring sequential complication

of hepatic pathology including hepatic ischemia, infarct, bile duct necrosis , bile leaks and abscesses (Yeon et al., 2007).

So multi-slice CT and CT angiography of hepatic transplant recipients presenting with graft dysfunction yield valuable information that can be used to guide further management of the post-transplantation complications (Russ et al,2011).

AIM OF WORK

The aim of this work is to highlight the importance of multi-slice CT and CT angiography in the detection and evaluation of the different post-operative complications in hepatic transplantation recipients. Such assessment will aid in the early detection and proper management of the different vascular and biliary complications as well as the parenchymal lesions.

NORMAL ANATOMY OF THE LIVER

Gross liver anatomy: (Pérez & Lima,2007)

The liver, the largest organ in the body, is found in the right upper quadrant of the abdomen. It is relatively much larger in the fetus and child. The liver assumes the shape of the cavity it occupies, a shape that is unrelated to its function. Thus it has two surfaces- the diaphragmatic surface and the visceral surface.

The diaphragmatic surface is smooth and flat posteriorly and has a smooth, rounded upper surface with a large dome for the right hemi-diaphragm and a smaller dome for the left hemi-diaphragm (Fig. 1). A depression between these marks the site of the central tendon and the overlying heart.

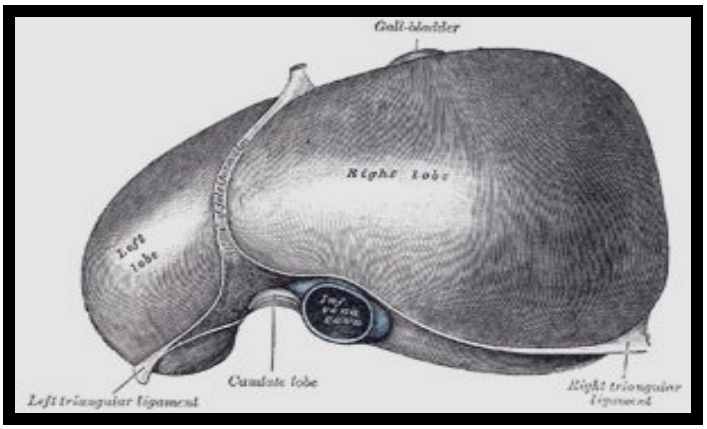

Fig. 1– The superior surface of the liver (Gray's anatomy, 2000).

The diaphragmatic surface ends anteriorly in the inferior border of the liver. This lies at the costal margin laterally to within about 4cm from the midline, the site of the gall-bladder notch. Medial to this , the inferior border ascends less obliquely than the costal margin and lies below it as it crosses the midline to meet the costal margin of the left side at approximately the eighth costal cartilage. The lateral extent of the left lobe is variable-it may extend only to the midline or may surround the stomach or spleen to reach the left lateral abdominal wall.

In addition to the notch for the gall bladder, the inferior border is marked by a notch for the ligamentum teres. This ligament is the obliterated remnant of the left umbilical vein, which carries blood from the placenta to the fetus. It passes, with small para-umbilical veins, from the umbilicus to the inferior border of the liver in the free edge of a crescentic fold of peritoneum called the falciform (meaning 'sickle-shaped')ligament. This meets the liver just to the right of the midline. The site of attachment of the falciform ligament is used as an anterior marker to the sagittal plane of division of the liver into anatomical left and right lobes.

The posteroinferior , or visceral , surface of the liver is marked by an 'H- shaped arrangement of structures. The crossbar of the 'H' is made by the horizontal hilum of the liver called the porta-hepatis. This is the entry site of the right and left hepatic arteries

and portal veins, and also the exit of the right and left hepatic ducts. There are also autonomic nerves and lymph vessels. The gall bladder in its bed together with the IVC in a deep groove or tunnel form the right vertical part of the 'H'. These are separated by the caudate process, which connects the caudate lobe with the right lobe of the liver. The left vertical part of the 'H' is formed by the ligamentum teres so far as its attachment to the left portal vein in the left extremity of the porta hepatis. This is continuous with the fissure for the ligamentum venosum, a deep fissure lined by peritoneum. At its base lodges the ligamentum venosum, the obliterated remnant of the ductus venosus, which shunts blood in the fetus from the left umbilical vein to the IVC, bypassing the liver. At the upper end of the fissure, the ligamentum venosum curves laterally to attach to the left hepatic vein or the IVC (Fig. 2).

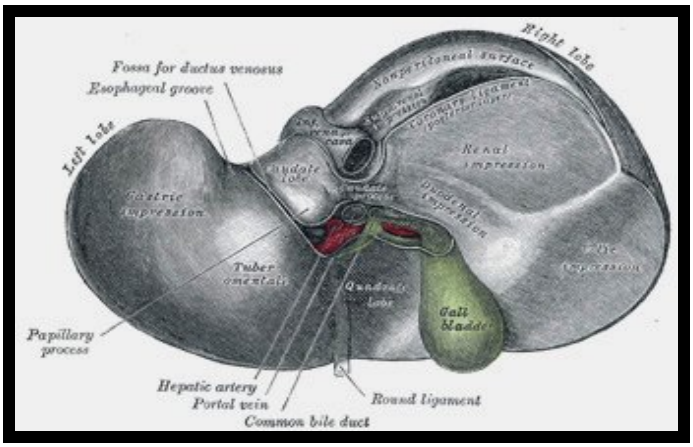

Fig. 2– Inferior surface of the liver (Gray's anatomy ,2000)

The visceral surface of the liver lies in contact with, and is slightly moulded by (Fig 3):

- The oesophagus , stomach and lesser omentum on the left;
- The pancreas (through the lesser omentum) and the duodenum in the midline; and
- The right kidney and adrenal and the hepatic flexure of the colon on the right.
- The peritoneal attachments of the liver determine the distribution of free gas and of pus in this part of the peritoneal cavity .

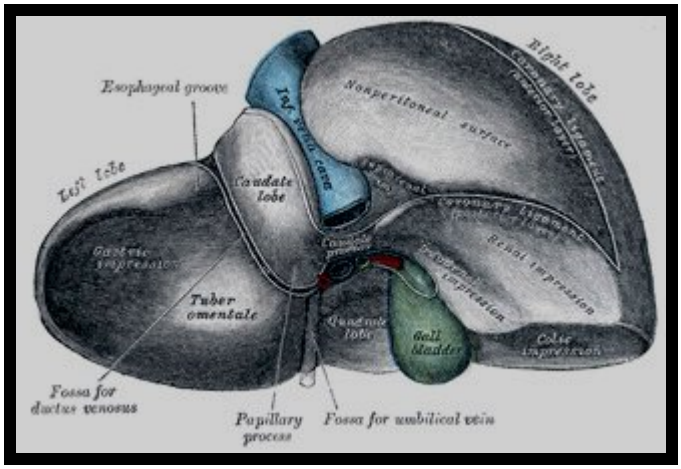

Fig. 3– Posterior and inferior surfaces of the liver (Gray's anatomy, 2000)

Lobes of the liver: (Ryan & McNicholas,1994)

The liver is described anatomically as having a large right lobe and a small left lobe, which are separated anteriorly by the attachment of the falciform ligament and on the visceral surface, by the grooves for the ligamenta teres and venosum. Two further lobes are described- the caudate lobe posteriorly between the IVC and the fissure for the ligamentum venosum, and the quadrate lobe anteroinferiorly between the gallbladder bed and the fissure for the ligamentum teres. These are part of the anatomical right lobe.

Occasionally the lower border of the right lobe , a little to the right of the gallbladder, may project downwards for a considerable distance as a broad tongue- like or bulbous process called Reidel's lobe. This is not a true lobe. The anatomical division into right and left lobes has no morphological significance. If instead the is divided according to the area of supply of the right and left hepatic arteries then true morphological left and right lobes are found , each is supplied by the right or left portal vein and drained by the right or left hepatic duct.

There is little or no anastomosis between right and left branches of these structures. The plane of division between these lobes, called the principal plane, is marked on the visceral surface by the IVC and the gall bladder bed. There is no external marking