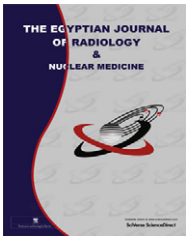
The Egyptian Journal of Radiology and Nuclear Medicine (2012) **43**, 325–336

Egyptian Society of Radiology and Nuclear Medicine

The Egyptian Journal of Radiology and Nuclear Medicine

www.elsevier.com/locate/ejrnm
www.sciencedirect.com



ORIGINAL ARTICLE

Pre-operative hepatic vascular mapping of living donor for liver transplantation using 64-MDCT

Tamer F. Taha Ali [a,*], Mohamed A. Tawab [b], Mona A. EL-Hariri [a], Abdel-Fattah EL-Shiekh [c]

[a] *Department of Radio-diagnosis, Faculty of Medicine, Zagazig University, Egypt*
[b] *Department of Radio-diagnosis, Faculty of Medicine, Al-Azhar University, Egypt*
[c] *Department of General Surgery, Faculty of Medicine, Al-Azhar University, Egypt*

Received 23 February 2012; accepted 27 March 2012
Available online 25 May 2012

KEYWORDS

Multi-detector CT (MDCT);
Angiography;
Liver transplantation;
Hepatic artery;
Hepatic vein;
Portal vein

Abstract *Objective:* The purpose of the present study was to assess the performance of 64-row MDCT angiography in the mapping of hepatic vascular anatomy in potential living liver donors with special attention paid to the anatomical variants, which influence the donor selection and surgical planning.

Material and Methods: Evaluation of 43 potential living donors was performed using 64-row MDCT scanner to obtain hepatic arterial and venous phases. Eleven subjects were excluded as they did not perform the transplantation surgery. The hepatic arterial (HA) anatomy was evaluated and classified according to Michel classification with special attention given to those considered relative or absolute contraindications for donation and those may alternating the surgical procedure. The origin and course of the artery to segment IV were determined. Portal venous (PV) anatomy was assessed and classified according to Cheng classification. Hepatic venous anatomy was evaluated with special attention paid to middle hepatic vein (MHV) anatomy, significant accessory branches crossing dissection line or that may require additional anastomosis.

Results: 64-Row MDCT was done for 43 potential living donors. Eleven subjects were excluded as they did not perform the transplantation surgery. Thirty-two living donors for liver transplantation were enrolled in this study. Standard hepatic arterial anatomy was determined in 19 subjects (59.4%) while 13 candidates (40.6%) showed hepatic arterial variations. The replaced RHA arises from the SMA was the commonest (n = 5, 15.6%). The dominant artery to segment IV was a branch from the left hepatic artery (LHA) in 24 cases (75%) and from right hepatic artery in 8 cases (25%). Classic portal venous anatomy was found in 26 candidates (81.2%) while its variants were

* Corresponding author.
E-mail address: tamerfathi2008@yahoo.com (T.F. Taha Ali).
Peer review under responsibility of Egyptian Society of Radiology and Nuclear Medicine.

ELSEVIER Production and hosting by Elsevier

 http://dx.doi.org/10.1016/j.ejrnm.2012.03.005

detected in 6 cases. Standard hepatic venous anatomy was found in 21 candidates (65.6%). A total of 11 subjects (34.4%) showed hepatic venous variants. 8 cases (25%) had single significant accessory hepatic vein while 3 subjects (9.4%) had two or more significant accessory hepatic veins. MHV confluence was late in 4 candidates (12.5%). An accessory inferior right hepatic vein was the commonest accessory hepatic vein that was detected in 7 cases (21.9%).
Compared to surgical findings, MDCT correctly identified hepatic arterial and portal venous anatomy in all cases with no false positive or false negative cases. Sensitivity, specificity, PPV, NPV and accuracy of MDCT in identification of hepatic arterial and portal anatomy were all 100% while for hepatic venous anatomy, the corresponding values were 83.3%, 100%, 100%, 90.1% and 93.8%, respectively.
Conclusion: 64-Row MDCT is an essential part of pre-operative evaluation of potential liver donors. It is a non-invasive comprehensive evaluation tool that can show the hepatic vascular anatomic details with precise relationship to liver parenchyma.

1. Introduction

Because of the severe shortage of cadaveric livers, transplantation surgeons are increasingly turning to living donor liver transplantation (LDLT) which was clinically introduced in the early 1990s (1–3). This innovative procedure is complex and allows healthy adults to donate portions of their livers to compatible recipients in a fashion that does not endanger the vascular supply or metabolic function (4,5). The donor safety and preservation of donor health are of primary priority in this procedure, and one of the most important challenges here is the management of the vascular tree during the transplantation surgery so providing clear maps of the hepatic vascularity of the donor and recipient are of paramount importance (5–7). Hence, a detailed pre-operative evaluation of hepatic vascular anatomy is mandatory; the main goal is to provide a vascular arterial and venous "road map," which is critical for surgical guidance to choose the best approach and to identify the anatomy requiring special attention at surgery to avoid bleeding complications (3,5).

The advent of multi-detector-row CT (MDCT) at the end of 1998 made a revolutionary approach to liver imaging (8) that permits high-speed and high-resolution imaging of the entire liver during a single breath-hold. This had the advantages of reducing the motion artifact and the better use of contrast bolus together with accurate vascular mapping and depiction of fine anatomic vascular details (5,7,9). This is enhanced by the multiplanar and multiphasic capabilities of MDCT. Multiplanar capability means that CT images can be analyzed in multiple planes (sagittal, coronal and oblique) attributed to the acquisition of three-dimensional data sets with near-isotropic voxels (10). The multiphasic approach is achieved by fast scanning which ensures accurate vascular phase selection (11,12). However, the advent of 64-row MDCT is considered a second revolution in liver imaging where a 64-MDCT scanner acquires a volume not only a slice, that to be reconstructed along any desirable plane, it provides a full multiplanar capability not achievable even with 16-row MDCT. Scan time is so short that pure vascular phases can be acquired (13).

The purpose of the present study was to assess the performance of 64-row MDCT angiography in the mapping of hepatic vascular anatomy in potential living liver donors with special attention paid to the anatomical variants, which influence the donor selection and surgical planning.

2. Material and methods

2.1. Patients' population

Forty-three potential liver donors were referred for MDCT routine pre-operative work-up for liver transplantation. Eleven subjects were excluded from this study, as surgery was not performed because of the following reasons. The supposed recipients developed contraindications to liver transplantation, including PV thrombosis ($n = 2$) or metastatic hepatoma ($n = 1$). Five candidates were excluded from surgery because of insufficient liver volume ($n = 2$) and moderate fatty liver infiltration ($n = 3$), while 3 subjects deferred surgery. Therefore, the current study included 32 living donors for liver transplantation. They were 18 males and 14 females with a mean age of 34.6 years (age range, 24–57 years). All subjects had no history of any significant medical diseases. This study was approved by our institutional review board and informed consent was obtained.

2.2. MDCT imaging

MDCT and MDCT angiography were performed in the potential donors using 64 multi-detector CT scanner (Somatom Definition, Siemens, Germany), The examination included the acquisition of unenhanced series followed by acquisition of two-phase enhanced images: early arterial and portal phases. The range of examination covered the entire liver. The whole examination took about 75–90 s. For the post-contrast study, the subject received 2 ml/kg of non-ionic low osmolar iodinated contrast medium injected intravenously at a rate of 3–4 ml/s. Computer-assisted bolus-tracking software was used to determine the optimal scan delay for each patient. For the hepatic arterial phase, scanning is automatically triggered at 125 HU in the aorta at the celiac artery level. The venous phase was acquired with an effective delay of 55–65 s after initiation of the contrast material injection. Donors were requested to