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ORIGINAL ARTICLE

Role of multislice CT and magnetic resonance cholangiography in preoperative evaluation of potential donor in living related liver transplantation

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KEYWORDS

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Abstract *Purpose:* The aim of this study was to evaluate the role of multislice CT (MSCT) and magnetic resonance cholangiography (MRC) in evaluation of potential donors in living related liver transplantation.
Patients and methods: Twenty-five potential donors included in our study. All potential donors underwent 1st step medical examination and laboratory investigations to enter the 2nd step investigations with MSCT for calculation of the hepatic parenchymal CT density, reconstruction of hepatic vascular anatomy and CT volumetry. Magnetic Resonance cholangiography (MRC) and intra-operative cholangiography (IOC) were done on only 23 patients for biliary tree assessment.
Results: Of the 25 patients evaluated by MSCT, 23 patients (92%) were accepted. Two patients (8%) were excluded from surgery because of anatomical criteria, regarding portal vein variants based on CT findings. One showed right anterior portal vein arising from left portal vein and the other showed trifurcation of the main portal vein.
Conclusion: Multislice CT is a valuable tool in the evaluation of potential living liver donors that provides complete information on the hepatic vascular anatomy, the liver parenchyma, and volumetric measurements. MRC with a 3.0-T MR system demonstrates the preoperative biliary evaluation very well with a high accuracy rate.

1. Introduction

Living related liver transplantation (LRLT) is a widely accepted therapeutic option because there is a persistent

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shortage of cadaveric liver transplants. In this procedure, the healthy adults donate a portion of their liver to compatible recipients who suffer from terminal liver disease (1).

In patients with end-stage liver disease, living donor liver transplantation is considered to be an effective, life sustaining surgical treatment. Teamwork between the transplant surgeon and the radiologist is mandatory for successful liver transplant. The hepatic vascular anatomy is extremely variable; thus, preoperative imaging of potential liver donors is mandatory as it helps in selection of the donor and planning for proper surgical approach (2).

Anatomic variations involving the biliary and hepatic vascular anatomy are common. Biliary variants represent 24–57% of the population while arterial variants of the liver represent between 31% and 49%. Portal vein variants are less common, affecting 16–26% of the population. In considering donor candidates for adult-to adult liver transplantation, anatomical variants evaluation is valuable in preoperative planning. Abnormal anatomy is not always contraindication for liver donation, but evaluation of the variant anatomy is critical to ensure that the donors will be safe and aid in selection of appropriate candidates (3).

Multi-detector CT (MDCT) is a comprehensive, non-invasive and accurate imaging modality that allows an accurate assessment of liver parenchyma, hepatic vascular anatomy and graft volume in donors of LRLT. Before liver resection or transplantation, CT angiography enables surgeons to understand the celiac trunk anatomy, hepatic arteries anatomy, and hepatic and portal venous system. Additional significant information obtained from these images includes MDCT portal venography that displays the whole portal venous system (4).

Accurate pre-operative assessments of hepatic volumetrics were considered one of the most important factors needed for the surgeons especially in living related liver transplantation (LRLT). Volumetry of the hepatic graft and remnant is essential and is usually done with cross-sectional MSCT or MRI. The main advantage of CT over MRI is based on a higher spatial resolution and various post-processing possibilities. Minimum graft volume was required to provide sufficient functional hepatocytes to the recipient (5).

Detailed preoperative evaluation of the biliary anatomy of the donor in LRLT can decrease the postoperative recipient morbidity and increase the donor safety. MR cholangiography is useful for the preoperative evaluation of biliary anatomy in LRLT donor candidates (6).

The aim of this study was to evaluate the role of multislice CT (MSCT) and magnetic resonance cholangiography (MRC) in evaluation of potential donors in living related liver transplantation.

2. Patients and methods

This study was conducted on 25 potential donors, 22 of them were male and 3 were female, with age range from 20 to 38 years. The study was done at private centers for preoperative assessment.

All potential donors underwent 1st step medical examination and laboratory investigations to enter the 2nd step investigations for living donors' liver donation operations. All the potential donors underwent multislice multi-phasic CT with CT angiography of the hepatic vasculature.

Two donors were refused after MSCT because of portal vein variants; one showed right anterior portal vein arising from left portal vein and the other showed trifurcation of the main portal vein (Fig. 3), then 23 from 25 potential donors underwent magnetic resonance cholangiopancreatography (MRCP).

Twenty-three accepted donors were opened surgically for liver transplantation, and consequently were available for comparison with MSCT volumetry, angiography and MRCP results. Intra-operative cholangiography was done as our gold standard for biliary assessments and results compared with MRCP.

2.1. Technique of triphasic CT using the multi-phase acquisition during single breath hold

CT scans were acquired with a 64 channel multi-detector row CT scanner (Aquilion; Toshiba medical systems). Potential donor's laboratory data were initially revised with particular interest in the results of the renal function tests. All potential donors were instructed to fast for food for six to eight hours prior to examination.

The donors were taught how to hold breath during examination when requested, to ensure their cooperation.

Donors were positioned supine on the CT table in the "Head first" position with his arms resting comfortably above the head. An 18–20 gauge catheter was placed into a superficial vein within the ante-cubital fossa.

One scout was acquired in antero-posterior view. The examination is planned on these scouts from the level of the top of the right diaphragmatic copula (Hepatic Dome) till 20 cm caudally in precontrast and post contrast sequences.

The pre-contrast series is taken by using a 10 mm nominal section thickness, a gantry rotation period 0.6 s, and a table speed of 15 mm per rotation. X-ray tube voltage was 120 kV, and the current was 280–300 mA.

The post-contrast series following the injection of contrast medium using an automatic pump with a volume ranging between 120 and 150 ml according to the donor's weight (1.5–2 ml/kg) at a flow rate 4–5 ml/s. The contrast medium used was low osmolar non-ionic contrast medium (Ultravist 370 mg).

CT was performed by using a 2.5 mm nominal section thickness, a gantry rotation period 0.6 s, and a table speed of 15 mm per rotation. X-ray tube voltage was 120 kV, and the current was 280–300 mA.

Donors were requested to hold their breath during the precontrast phase and the four phases of acquisition for about 8–10 s each and were allowed to breath quietly after that. The arterial dominant phase starts about 18–20 s post-injection till the end of the 20 cm distance then after a delay of 8sec, and the portal dominant phase is started similarly as the 1st one (about 40 s post-injection).

Then the 3rd and 4th phases (venous phase) are started after a delay of 10 s from the end of the 2nd phase to the end of the whole examination.

Sections were reconstructed at 2.5 mm which is the nominal section thickness. All images were transferred to the workstation for post processing.