RESEARCH ARTICLE

Mapping of Portal Vein in Live Liver Donors.

Shruthy KM and Rathi Sudhakaran.

Department of Anatomy, ACS Medical College and Hospital, Chennai, Tamil Nadu, #Department of Anatomy, Amrita School of Medicine, AIMS, Kochi, Kerala.

Abstract

Aim of this study is to document the prevalence of anatomical variations of portal vein from MDCT abdomen images of live liver donors who have attended to a tertiary care hospital in Kochi. Images of 300 live liver donors are assessed and grouped according to the classification done by Cheng et al. for portal vein. The portal venous anatomy was of type I in 86% of the portal phase images obtained, type II in 8% cases, type III in 5% cases, and type IV in 1% cases. Awareness of the rare Type II and Type III variants is important preoperatively and intraoperative to avoid risking the donor’s life.

Introduction:

Liver transplantation has matured from an experimental procedure to an accepted life saving operation for long time of survival in patients with advanced liver diseases who have reached the limits of medical intervention. In LDLT donor safety is paramount and donor evaluation is done to find out whether the donor is suitable for donation and also to evaluate the vascular anatomy, segmental anatomy and the bile duct anatomy. The understanding of internal anatomy of liver has greatly facilitated liver surgery. Preoperative clinical and radiological evaluation of the transplant candidate is critical for appropriate patient selection. The main objective of preoperative imaging is to provide the surgeon with necessary information to plan and perform liver transplantation and exclude donors with whom surgery is not feasible. Multidetector CT proves to be valuable in the evaluation of a potential live liver donor by providing comprehensive information about the hepatic vascular anatomy. Most of our knowledge is based on the data obtained from Western and East Asian studies. We endeavor to analyze the pattern of hepatic vasculature in Indian patients with similar studies in the past.

Materials and methods:

The data required for this retrospective study is collected from the Department of Radiology, Amrita Institute of Medical Sciences, Kochi. This includes the MDCT images of the hepatic vasculature of 300 live liver donors who had undergone hepatectomy during the period 2006-2014. For imaging 64 Multidetector CT scanner (SEIMENS SENSATION CARDIA-64) is used. The pre-contrast series is taken by using a 5 mm slice thickness. An average of 80 ml of low osmolar non-ionic contrast medium (Omnipaque 350mg) is given at 5 ml/sec. The post-contrast CT images are taken at 6s, +20s and +30s for arterial, portal and delayed phase respectively. The images that had undergone three-phase, dual-enhancement are analyzed from their source images and from three-dimensional (3D) post processing images like maximum intensity projections (MIP) and reconstructed image as volume renderings (VR). The MDCT images of each case are reviewed and interpreted with the help of an experienced GI surgeon and Radiologist. The course of the portal vein and hepatic vein is observed and recorded. The normal and variant...
architecture of these vessels are tabulated based on existing standard reference classifications. The classifications used in the study are selected with a view to help in liver resection from LDLT standpoint. Hence we classified the portal vein Cheng et al’s classification.

### Table no 1:- CLASSIFICATION OF PORTAL VEIN BY Cheng et al22

<table>
<thead>
<tr>
<th>Classification of Portal vein (Cheng’s)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Classical portal vein anatomy</td>
</tr>
<tr>
<td>II</td>
<td>Trifurcation of portal vein</td>
</tr>
<tr>
<td>III</td>
<td>RPPV from MPV + LPV and RAPV as a common trunk</td>
</tr>
<tr>
<td>IV</td>
<td>RPPV from MPV + RAPV from LPV</td>
</tr>
<tr>
<td>V</td>
<td>Absent LPV</td>
</tr>
<tr>
<td>VI</td>
<td>Absent RPV</td>
</tr>
<tr>
<td>VII</td>
<td>MPV continued to the RPV and horizontal segment of the LPV absent</td>
</tr>
</tbody>
</table>

**Result:-**
The portal venous anatomy was of type I in 258 cases (86%), type II in 24 cases (8%), type III in 15 cases (5%), and type IV in 3 cases (1%). The hepatic venous drainage of the segment IV was of type I in 43 cases (14.33%), type II in 161 cases (53.67%), type III in 90 cases (30%).

**Discussion:-**
Liver resection has gained importance in the field of surgery as a therapeutic means for several liver diseases. LDLT has added another dimension for liver resection. Success of liver surgeries is not only due to refinements in surgical, anaesthetic and critical care developments but also due to the precision of anatomical assessment. The precise preoperative anatomical road map helps the surgeon make a complex surgery technically feasible. In LDLT, the recipient and the donor, both will be benefitted by the information on minute details of the hepatic vasculature. The advent of MDCT has made it a single stop method preferred technically to assess the information regarding potential liver donors. For assessing the results of the present study on the variants of portal vein, we use the classification done by Cheng22.

### Table no 3:- Comparison of Percentage of variants in the present study with that obtained from Cheng et al’s study

<table>
<thead>
<tr>
<th>Classification of Portal vein</th>
<th>Percentage in the present study</th>
<th>Percentage in Cheng’s study</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>86.00%</td>
<td>70%</td>
</tr>
<tr>
<td>II</td>
<td>8.00%</td>
<td>14%</td>
</tr>
<tr>
<td>III</td>
<td>5.00%</td>
<td>6%</td>
</tr>
<tr>
<td>IV</td>
<td>1.00%</td>
<td>6%</td>
</tr>
<tr>
<td>V</td>
<td>0</td>
<td>0.29%</td>
</tr>
<tr>
<td>VI</td>
<td>0</td>
<td>0.29%</td>
</tr>
<tr>
<td>VII</td>
<td>0</td>
<td>0.15%</td>
</tr>
</tbody>
</table>

In our study a conventional anatomy of the portal vein (type I) is identified in 258 cases (86%). The most common variants seen are trifurcation pattern - type II (8%). Next common variant is type III (5%), Cheng22 reported type I anatomy in 70%, type II in 14%, type III in 6% and type IV in 6%22. In the series by Ozsoy et al conventional anatomy is the most common (78.6%) whereas trifurcation was observed in 12.3%6. Type IV prevalence is 1%. This is supported by similar results obtained from study done by, Sari et al (2.4%)17, Tsang (2.6%)19 and Chen (1.7%)23. We have no cases of Type V, VI, and VII. However Cheng22, in his study reported 0.29% of type V, 0.29% of type VI and 0.15% of type VII23.
Fig no 1: MDCT VR image of the portal vein showing trifurcation pattern (*TYPE II*)

Fig 2: MDCT VR image of the portal vein showing trifurcation pattern (*TYPE II*)
The strength of this study is its sample size, the results were confirmed intraoperatively and this is the first study done in liver donors in an Indian setup. However the limitation of the study is that the study group includes only the donors who underwent liver resection.

Conclusion:

Variations in the hepatic vasculature are frequently encountered and reported in several studies. LDLT is a procedure requiring detailed evaluation of the hepatic vascular anatomy to ensure successful postoperative results. The triphasic CT protocol using 64 Multidetector permits comprehensive and accurate assessment of the detailed hepatic vascular anatomy in liver transplant potential donors, thereby preventing surgical complications arising from vascular variations.

References: