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**INTERNATIONAL JOURNAL OF  
 ADVANCED RESEARCH (IJAR)**

Article DOI: 10.21474/IJAR01/2278  
 DOI URL: <http://dx.doi.org/10.21474/IJAR01/2278>



### RESEARCH ARTICLE

#### MAPPING OF PORTAL VEIN IN LIVE LIVER DONORS.

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#### Manuscript Info

##### Manuscript History

Received: 29 September 2016  
 Final Accepted: 30 October 2016  
 Published: November 2016

##### Key words:-

Living donor liver transplantation, Multi-detector computed tomography, portal vein, liver donor, Cheng's classification

#### 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.

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#### 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<sup>1</sup>. 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<sup>2</sup>. 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

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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<sup>22</sup> classification.

**Table no 1:- CLASSIFICATION OF PORTAL VEIN BY Cheng et al<sup>22</sup>**

Cheng's Classification of Portal vein	
TYPE	DESCRIPTION
I	Classical portal vein anatomy
II	Trifurcation of portal vein
III	RPPV from MPV +LPV and RAPV as a common trunk
IV	RPPV from MPV+ RAPV from LPV
V	Absent LPV
VI	Absent RPV
VII	MPV continued to the RPV and horizontal segment of the LPV absent

### 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%).

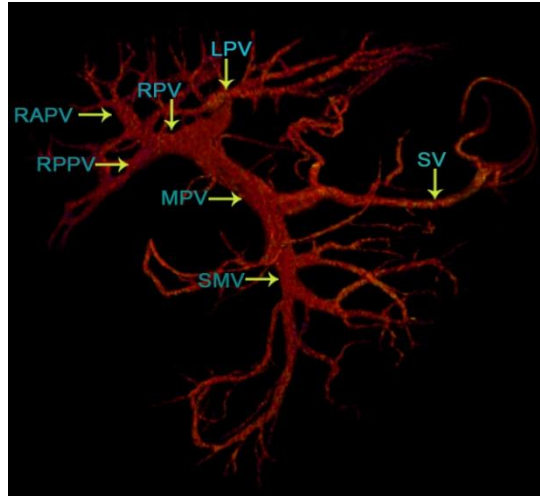
### Discussion:-

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, anaesthetical 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<sup>2</sup>. For assessing the results of the present study on the variants of portal vein, we use the classification done by Cheng<sup>22</sup>.

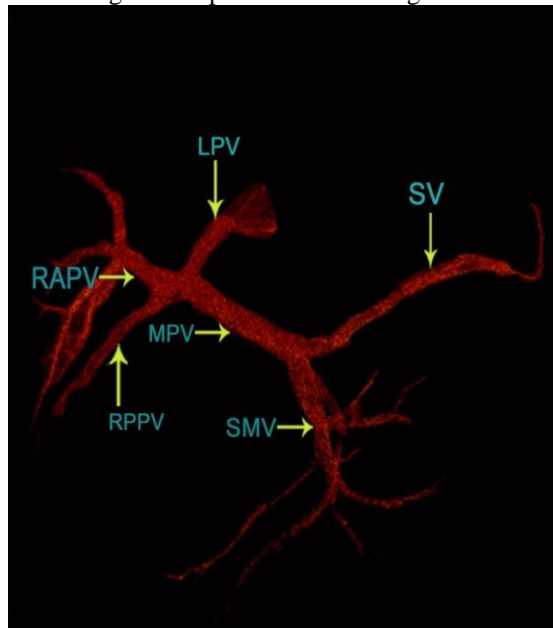
**Table no 3:- Comparison of Percentage of variants in the present study with that obtained from Cheng et al's study**

CLASSIFICATION OF THE PORTAL VEIN		
Type	Percentage in the present study	Percentage in CHENG'S STUDY
I	86.00%	70%
II	8.00%	14%
III	5.00%	6%
IV	1.00%	6%
V	0	0.29%
VI	0	0.29%
VII	0	0.15%

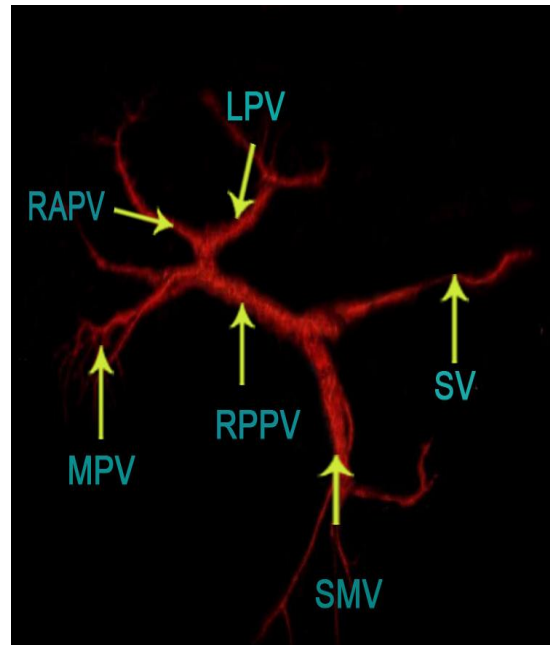
In our study a conventional anatomy of the portal vein (type I) is identified in 258 cases (86%). The most common variants seen are trifurcation pattern - type II (8%). Next common variant is type III (5%). Cheng<sup>22</sup> reported type I anatomy in 70%, type II in 14% type III in 6% and type IV in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



**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*)



**Fig 3:-** MDCT VR image of the Portal vein showing RPPV arises from the MPV and the LPV and RAPV arises as a common trunk

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:-

1. Dilip K C. Liver Transplantation. New Delhi: Jay Pee Brothers Medical Publishers; 2009. 345-586.
2. Sahani D V. Evaluation of Living Liver Transplant Donors. Method for Precise Anatomic Definition by Using a Dedicated Contrast-enhanced MR Imaging Protocol. *RadioGraphics*. 2004; 24:957–967.
3. Michels NA. Newer anatomy of the liver and its variant blood supply and collateral circulation. *Am J Surg*. 1966; 112(3):337-347.
4. Kishi Y, Sugawara Y, Kaneko J, Matsui Y, Akamatsu N, Makuuchi M. Hepatic Arterial Anatomy for Right Liver Procurement from Living Donors. *Liver Transplantation* .2004,Jan;10:129–133.
5. Covey AM, Brody LA, Maluccio MA, Getrajdman GI, Brown KT. Variant hepatic arterial anatomy revisited: digital subtraction angiography performed in 600 patients. *Radiology* 2002; 224:542-547.
6. Ozsoy M, Zeytunlu M, Kilic M, Alper M, Sozbilen M. The results of vascular and biliary variations in Turks liver donors: Comparison with others international scholarly research network. *ISRN Surg* 2011, <http://dx.doi.org/10.5402/201367083>.
7. Schroeder T, Radtke A, Kuehl H, et al. Evaluation of living liver donors with an inclusive 3D multi-detector row CT protocol. *Radiology*. 2006; 238:900–910.
8. Ahmed A, Nazir R, Pervez R et al. Hepatic Arterial Variations and its Implications on Hepatobiliary Surgery. *European society of Radiology* pages 1-29. DOI: 10.1594/ecr2013/C-0790.
9. Kamel IR, Kruskal JB, Keogan MT, Goldberg SN, Warmbrand G, Raptopoulos V. Multidetector CT of potential right-lobe liver donors. *Am J Roentgenol*. 2001; 177:645– 651.
10. Lopez A R, Moya A, Montalva E et al. Lessons Learned From Anatomic Variants of the Hepatic Artery in 1,081 Transplanted Livers. *Liver Transpl* 2007; 13:1401-1404.

11. El-Badrawy A, El-Nahas M, El-Hendawy. Preoperative Evaluation of Living Donor for Liver Transplantation using 64 MDCT. *Journal of Medicine and Biomedical Sciences*. *Journal of Medicine and Biomedical Sciences* 2010 August; 2078-0273.
12. Kishi Y, Sugawara Y, Kaneko J, Matsui Y, Akamatsu N, Makuuchi M. Classification of portal vein anatomy for partial liver transplantation. 2004, Dec; 36(10):3075-6.
13. Ugurel S, Battal B, Bozlar U, et al. Anatomical variations of hepatic arterial system, coeliac trunk and renal arteries: an analysis with multidetector CT angiography. *The British Journal of Radiology* 2010; 83, 661–667.
14. Elkholy RM, Elshazly H. Role of three-dimensional multidetector computed tomography angiography of hepatic vessels in the evaluation of living donors. *Menoufia Medical Journal* 2014; 27:157–163.
15. Zhuang ZG, Qian LJ, Gong LJ, Zhou Y, Chai WM, Li QG, Xu JR. Multidetector Computed Tomography Angiography in Evaluation of Potential Living Donors for Liver Transplantation: Single Centre Experience In China. *Transplant Proceedings* 2008; 40: 2466-2477.
16. Suzuki T, Nakayasu A, Kawabe K, Takeda H, Honio I. Surgical Significance of anatomic variations of the hepatic artery. *The American Journal of Surgery*. 1971; 122:505-512.
17. Sari S Z, Yılmaz G F, Kervancıoğlu S, Kervancıoğlu R. The Evaluation of Potential Donors: Hepatic Vascular Anatomy in Liver Transplantation with Multislice Computed Tomography. *Gaziantep Med J* 2014;20(3):245-253.
18. Ali TF Taha, Tawab MA, EL.Hariri MA EL Shiekh, AF. Preoperative Hepatic Vascular Mapping of Living Donor for Liver Transplantation using 64 MDCT. *The Egyptian Journal of Radiology and Nuclear Medicine* (2012); 43: 325-336.
19. Tsang LLC, Chen CL, Huang TL, Chen TY, CWang C, Ou HY et al. Preoperative Imaging Evaluation of Potential Living Liver Donors: Reason for Exclusion From Donation in Adult Living Donor Liver Transplantation. *Transplantation Proceedings* (2008); 40:2460-2462.
20. Jin Y G, Yu C H, Lim S H et al . Anatomical Variations of the Origin of the Segment 4 Hepatic Artery and Their Clinical Implications. *Liver Transpl* 2008; 14:1180-1184.
21. Saylısoy S, Atasoy C, Ersöz S, Karayalçın K, Akyar S. Multislice CT angiography in the evaluation of hepatic vascular anatomy in potential right lobe donors. *Diagn Interv Radiol*. 2005; 11:51-59.
22. Cheng YF, Huang TL, Lee TY, Chen TY, Chen CL. Variation of the intrahepatic portal vein; angiographic demonstration and application in living-related hepatic transplantation. *Transplant Proc* 1996; 28:1667–1668.
23. Chen JS, Yeh BM, Wang ZJ, Roberts JP, Breiman RS, Qayyum A, Coakley. Concordance of Second-Order Portal Venous and Biliary Tract Anatomies on MDCT Angiography and MDCT Cholangiography. *AJR* 2005; 184:70–74.
24. Nakamura S, Tsuzuki T. Surgical anatomy of the hepatic veins and the inferior vena cava. *Surg Gynecol Obstet* 1981; 152:43–50.
25. Chan SC, Lo CM, Liu CL et al. Tailoring Donor Hepatectomy per Segment 4 Venous Drainage in Right Lobe Live Donor Liver Transplantation. *Liver Transplantation* 2004 June; Vol 10: No 6; 755–762.