TO DETERMINE THE FREQUENCY OF HEPATIC VEIN VARIANTS IN NORMAL POPULATION: ROLE OF MDCT IN HEPATIC TRANSPLANTATION

Hamna Shakeel, Muhammad Ilyas*, Rabia Waseem Butt, Hassan Burair Abbas**, Anila Abid, Manal Niazi**

Islamabad Medical and Dental College, Islamabad Pakistan, *Pakistan Atomic Energy Commission Hospital, Islamabad Pakistan, **HITEC-Institute of Medical Sciences, Taxilla Pakistan

ABSTRACT

Objective: To determine the frequency of hepatic vein variants in normal population.
***Study Disign*:** Cross sectional study.
Place and Duration of Study: Department of Radiology, PAEC General Hospital, H-11/4 Islamabad, from Jul 2019 Dec 2020.
Methodology: Sample size of 190 patients was calculated using WHO calculator. Patients were selected through non probability consecutive sampling. MDCT Scan was done in venous phase at 65-70s after injection of approximately 2ml/kg contrast material. The scan range was from diaphragm till Ischium using straight gantry plane. Image reconstruction and reformatting in coronal and sagittal images was obtained. Data was analyzed with SPSS program version 20.0. Chi-square test was applied. *p*-value ≤0.05 was considered significant.
Results: Mean age was 35.56 ± 65.9 years with minimum and maximum of 25 & 45 years respectively. One hundred and thirty two (69.5%) patients were male and 58 (30.5%) patients were female respectively. One hundred and four (54.7%) of patients were of type I, 68 (35.8%) of patients were of Type II and 18 (9.5%) of patients were found with type III variant of hepatic vein. In age category (25-35 years.) Forty three, 26 and 7 were found with type I, II and III hepatic veins respectively. While in age category (36-45 years). Sixty one, 42 and 11 patients were found with type I, II and III variant of hepatic vein respectively. Further stratification with respect to age categories among the genders was done and tabulated.
Conclusion: The prevailing patterns of three hepatic vein in this study are 104 (54.7%) of patients were of type I, 68 (35.8%) of patients were of type II and 18 (9.5%) of patients were found with type II, variant of hepatic vein respectively. MDCT accurately assessed the vascular anatomy helpful to the transplantation surgeon.

Keywords: Cirrhosis, Hepatic vein, Liver transplant.

INTRODUCTION

Liver transplantation is one of the greatest medical and surgical advances for the care of patients with hepatic failure. It has become an established treatment for cirrhotic patients with hepatic carcinoma (HCC). In the face of the scarcity of deceased donors livers, living donor transplantation become prevailing nowadays[1].

The advantages of live donor liver transplantation (LDLT) include a lack of preservation injuries and an ability to perform the procedure on an elective basis. When evaluating preoperative donor images, it is important to identify key anatomic variants that will affect the surgical techniques[2]. For instance, hepatic segments cannot be transplanted separately because the transplanted liver tissues require arterial supply, venous drainage, and biliary outflow. The most important is to evaluate hepatic vein variants. Usually right hepatic vein (RHV) is the largest and drains major part of right hemi liver into IVC. The middle hepatic vein (MHV) drains segment IV, LHV predominantly drains segments II and III[3]. Contrast enhanced computed tomography (CECT) has been shown to be a suitable diagnostic tool, and is being used in different centres throughout the world. Multidetector computed tomography (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.

The rationale of the study is to determine surgically significant hepatic vein variantsin potential donors in our test population. Partial liver resection in living donor transplantation and treatment of hepatic tumours is major undertaking nowadays. Hence knowing the variants of hepatic vein variants is useful for both partial hepatectomy and donor operations for transplantation.

METHODOLOGY

The cross sectional study included 190 patient on non probability, consecutive sampling. The subjects were adults coming for CECT abdomen done in venous phase with age range between 25-45 years. Those being known cases of HCC, having pancreatic or peri

Correspondence: Dr Hamna Shakeel, Department of Radiology, Islamabad Medical and Dental College, Islamabad Pakistan
Received: 03 Jan 2021; revised received: 25 Mar 2001; accepted: 28 Mar 2021

pancreatic mass lesions, gastric mass lesions or budd chiari syndrome were excluded. The study was approved by the local Ethics Committee and informed consent was obtained from all participants. Patients came for routine abdominal CT scan with serum creatinine level <1.4 mg/dl and fasting for at least 4 hours. Oral contrast was given before examination at 60, 45, 30 and 15 minutes and immediately prior to scan. Scan was done in venous phase at 65-70s after injection of approximately 2 ml/kg contrast material. The scan range was from diaphragm till Ischium using straight gantry plane. Image reconstruction and reformatting in coronal and sagittal images was obtained. Data was analyzed with SPSS program version 20.0. Mean & standard deviation for age was calculated. Frequency and percentage for gender and hepatic vein variants was calculated. Data were stratified for age and gender to address the effect modifier. Post stratification chi-square were applied to check the significance with *p*-value <0.05 enabled as significant.

RESULTS

All the data was collected, analyzed and tabulated through a well-defined proforma. The mean age was 35.56 ± 6.59 years with minimum and maximum of 25 & 45 years respectively. One hundred and thirty two (69.5%) patients were male and 58 (30.5%) patients were female respectively. Determining the types of variant of hepatic veins, 104 (54.7%) of patients were of type I, 68 (35.8%) of patients were of type II and 18 (9.5%) of patients were found with type II variant of hepatic Vein.

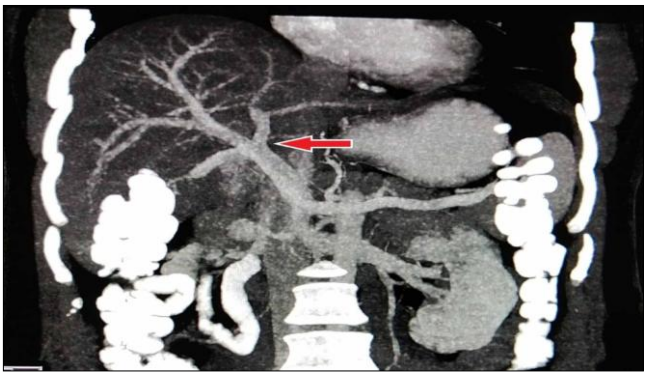

Figure-1: Contrast-enhanced CT MIP reconstructed coronal image showing the trifurcation of the main portal vein.

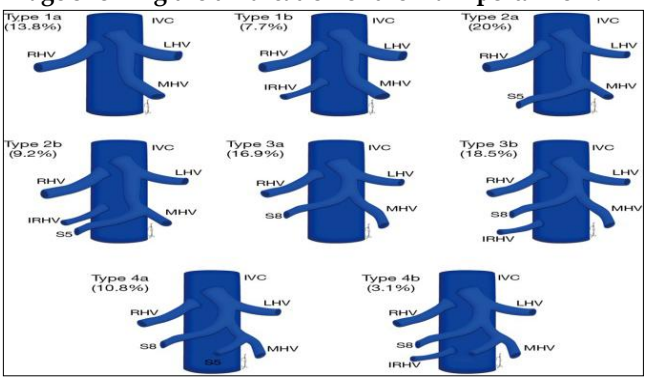

Figure-2: The most common hepatic vein anatomical variants and their incidence.

ients with age 25-35 reported were 14, 8 and 5 with type I, II and III variant of hepatic veins respectively. While patients with age category 35-45 were 15, 15 and 1 patient with type I, II and III variant of hepatic vein respectively (table-II).

Table-I: Stratification among the variants of hepatic veins with respect to age among male.

n=190		Variant of Hepatic Veins			Total	*p*-value
		Type I	Type II	Type III		
Male	Age (25-35 years)	29	18	2	49	0.03
	Age (36-45 years)	46	27	10	83	
Total		75	45	12	132	

Table-II: Stratification among the variants of hepatic veins with respect to age among female.

n=190		Variant of Hepatic Veins			Total
		Type I	Type II	Type III	
Female	Age (25-35 years)	14	8	5	27
	Age (36-45 years)	15	15	1	31
Total		29	23	6	58

Stratification was done with respect to age and gender categories. In gender category (male) patients with age 25-35 reported were 29, 18 and 2 with type I, II and III variant of hepatic veins respectively. While patients with age category 35-45 were 45, 27 and 10 patients with type I, II and III variant of hepatic vein respectively (table-I). In gender category (gemale) pat-

DISCUSSION

A detailed preoperative evaluation of hepatic vascular and biliary anatomy is mandatory for the surgery to be successful considering the complexity of hepatobiliary system in the ever increasing number of liver transplantation and hepatic resection surgeries in the modern era. The aim is to choose the best surgical

approach, reduce complications and to identify the anatomy requiring special attention during surgery. Diagnostic imaging with Multidetector computed tomography (CT) and magnetic resonance (MR) imaging allows accurate and non-invasive preoperative evaluation of the hepatobiliary anatomy[4,5].

Conventional catheter angiography used previously to assess vascular anatomy is replaced by MDCT[6]. The technique is fast, has fewer potential complications, and allows a great amount of data to be obtained with one, although large, bolus of IV contrast material. Not only Hepatic vessels, liver parenchyma but adjacent organs, and soft tissues can also be assessed and volume determined all the important information for the transplantation team[7].

More so, the data can be evaluated to produce multiplanar impressions, maximum intensity projections, and three-dimensional volume images for viewing and mapping[8]. Multidetector CT (MDCT), a non-invasive technique, has proven correlation with conventional angiography results without some of the negative effects of conventional angiography and reduction both in the cost and the radiation burden to the patient[9,10,11,12].

The most important surgical consideration in the preoperative evaluation of a potential donor for living liver transplantation is the course of the hemihepatectomy plane. The incision made is along a less vascular plane that divides the liver in left and right lobes and care must be taken to ensure adequate metabolic vitality to both of them. The major vessels traversing the hepatectomyplane must be preoperatively identified to avoid damage causing ischemic injury to the graft or the donor liver. A few of these anomalies may require alteration of the surgical procedure or may even contraindicate the surgery from the donors' perspective[13].

An important aspect of successful living donor liver transplantation is maintenance of the balance between the blood supply and venous drainage of the graft. Venous congestion can catastrophically damage the graft, causing its failure. Hence, even small individual hepatic veins, which run along the parenchymal dissection plane, have to be carefully left intact or anastomosed[14]. Thus, the drainage pattern of the middle hepatic vein must be thoroughly evaluated.

The liver drains into the suprahepatic part of the inferior vena cava and retrohepatic inferior vena cava respectively[15]. Out of all the three major hepatic veins, the right hepatic vein is most variable in its size owing to the variable contribution of the middle hepatic vein to the drainage of segments V and VIII as well as presence of an accessory right inferior (30%) and/or middle hepatic vein (10%)[16]. The middle hepatic vein drains some of segment V also but variably intrahepatic venous anastomoses in segment VII have been reported in about 30% of adults[17]. The left hepatic vein drains segments II, III and IV and lies between the left medial and left lateral sectors of the liver. However, smaller veins draining segment II and, occasionally, the superior part of segment IV may directly enter into the inferior vena cava. All these variations in the venous system of the liver are very important during live donor and split liver transplantation.

In short MDCT scans with maximum intensity projections and three-dimensional mappings can accurately assess the vascular anatomy of liver donors prior to transplantation that is helpful to the transplantation surgeon. Vascular variants should be in the knowledge of the liver transplantation team by the radiologists to provide precise information18which might make the surgeon to alter his surgical plan with, in extreme cases, exclusion of candidates because of the vascular anatomy based on CT data.

CONCLUSION

The prevailing patterns of three hepatic vein in this study are 104 (54.7%) of patients were of type I, 68 (35.8%) of patients were of type II and 18 (9.5%) of patients were found with type II variant of hepatic vein respectively. MDCT accurately assessed the vascular anatomy helpful to the transplantation surgeon.

CONFLICT OF INTEREST

This study has no conflict of interest to be declared by any author.

REFERENCES

1. Adam R, Mc Master P, O'Grady JG, Castaing D, Klempnauer JL, Jamieson N, et al. Evolution of liver transplantation in europe: report of the european liver transplant registry. Liver Transplantat 2017; 9(12): 1231-43.
2. Marcos A. Right-lobe living donor liver transplantation. Liver transplantat 2017; 6(6B): s59-63.
3. Burrel M, Llovet JM, Ayuso C, Iglesias C. MRI angiography is superior to helical CT for detection of HCC prior to liver transplantation: an explant correlation. Hepatol 2018; 38(4): 1034-42.
4. Sahani D, Mehta A, Blake M, Prasad S, Harris G, Saini S. Preoperative hepatic vascular evaluation with CT and MR angiogra-phy: implications for surgery. Radiograp 2018; 24(5): 1367-80.
5. Sahani D, D'souza R, Kadavigere R, Hertl M, McGowan J, Saini S, et al. Evaluation of living liver transplant donors: method for precise anatomic definition by using a dedicated contrast-enhanced MR imaging protocol. Radiograp 2018; 24(4): 957-67.
6. Kamel IR, Kruskal JB, Pomfret EA, Keogan MT, Warmbrand G, Raptopoulos V. Impact of multidetector CT on donor selection

and surgical planning before living adult right lobe liver transplantation. Am J Roentgenol 2017; 176(1): 193-200.
7. Limanond P, Raman SS, Ghobrial RM, Busuttil RW, Saab S, Lu DS. Preoperative imaging in adult-to-adult living related liver transplant donors: what surgeons want to know. J Comput Assisted Tomograp 2019; 28(2): 149-57.
8. Singh AK, Cronin CG, Verma HA, Boland GW, Saini S, Mueller PR. Imaging of preoperative liver transplantation in adults: what radiologists should know. Radiograp 2018; 31(4): 1017-30.
9. Taguchi K, Anno H. High temporal resolution for multislice helical computed tomography. Med Phys 2019; 27(5): 861-72.
10. Chan JF, Tso WK, CHAN F, Lo C, Fan S. Preoperative evaluation of potential living donors for liver transplantation: the role of helical computed tomography-angiography. In Transplantat Proceed 2018; 30(7): 3197-98.
11. Pannu HK, Maley WR, Fishman EK. Liver transplantation: preoperative CT evaluation. Radiograp 2019; 21(1): S133-46.
12. Sahani D, Saini S, Pena C, Nichols S, Prasad SR, Hahn PF, et al. Using Multidetector CT for Preoperative vascular evaluation of liver neoplasms: technique and. in presented annual meeting Radiolog 2016; 21(2): 31-35.
13. Guiney MJ, Kruskal JB, Sosna J, Hanto DW, Goldberg SN, Raptopoulos V. Multi–detector row CT of relevant vascular anatomy of the surgical plane in split-liver transplantation. Radiol 2016; 229(2): 401-407.
14. Kamel IR, Lawler LP, Fishman EK. Variations in anatomy of the middle hepatic vein and their impact on formal right hepatectomy. Abdominal Imag 2016; 28(5): 668-74.
15. Camargo AM, Teixeira GG, Ortale JR. Anatomy of the ostia venae hepaticae and the retrohepatic segment of the inferior vena cava. J Anat 1996; 188(Pt-1): 59-62.
16. Fang CH, You JH, Lau WY, Lai EC, Fan YF, Zhong SZ, et al. Anatomical variations of hepatic veins: three-dimensional computed tomography scans of 200 subjects. World J Surg 2012; 36(1): 120-24.
17. Hribernik M, Trotovšek B. Intrahepatic venous anastomoses with a focus on the middle hepatic vein anastomoses in normal human livers: anatomical study on liver corrosion casts. Surg Radiol Anat 2014; 36(3): 231-37.
18. Cahalane AM, Mojtahed A, Sahani DV, Elias N, Kambadakone AR. Pre-hepatic and pre-pancreatic transplant donor evaluation. Cardiovas Diagn Therap 2019; 9(1): S97-100.