

A STUDY ON TYPE OF BRANCHING PATTERNS OF RIGHT PORTAL VEIN

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ABSTRACT

Introduction: The right hepatic lobe transplantation is usually the procedure of choice to provide adequate liver volume to the recipient. Variant vascular and biliary anatomy is more common in the right lobe. Knowledge of anatomical variants is valuable in preoperative planning, particularly in considering donor candidates for adult-to-adult liver transplantation, whereby typically the right lobe of the donor is transplanted to the recipient. The present study was done to identify the branching patterns of right portal vein and to know their importance in management of living donor liver transplantation surgeries.

Material and Methods: The present study was conducted on 84 liver specimens of human cadavers fixed with 10% formalin, collected from the Department of Anatomy and Forensic Medicine, MMC&RI, Mysore.

Results: Bifurcation of RPV was seen in 30 specimens (35.7%). Trifurcation of RPV was seen in 5 specimens (6%). Quadrification of RPV was seen in 18 specimens (21.4%). Arched pattern of RPV was seen in 15 specimens (17.9%). Premature origin of segment V and segment VIII vein from RPV, then trunk of RPV dividing terminally into segment VI and segment VII vein was seen in 2 specimens (2.4%). Unusual pattern of division of RPV was seen in 10 specimens (12%). In rest of 4 specimens there was no RPV as Right anterior and Right posterior portal veins were directly arising from Main portal vein.

Conclusion: Anatomical variations of the liver vasculature and bile ducts are common and their recognition and management is critical in living donor liver transplantation. Although anomalies of the right lobe are commonly encountered, a relatively limited number of cases will significantly complicate the resection and transplantation. Main advantage of right lobe transplantation is the large size of graft and surgical management of both donor and recipient anatomical variations is considerably simpler than with left sided graft.

KEY WORDS: Liver transplantation; portal vein embolization; hepatectomy; portosystemic shunts.

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INTRODUCTION

Portal vein begins at the level of second lumbar vertebra by the convergence of superior mesen-

teric and splenic vein. The normal anatomy of the portal vein is defined as a division of the main portal vein into two branches—the left

(supplying segments II, III, and IV) and right portal veins; the right dividing secondarily into two branches—the anterior (supplying segments V and VIII) and the posterior (supplying segments VI and VII) portal veins [1].

Variations usually involve right portal vein:

1. Absence of right portal vein with the resulting portal trifurcation in the form of left portal vein, right medial and right lateral portal veins is present in 10-15% of livers.
2. Occasionally right medial vein arises from left portal vein, a variation which is important to remember during left sided liver resection.
3. On a rare occasion portal bifurcation is absent, in which case main portal vein enters the liver giving off right segmental branches and then turns left to supply the left lobe of liver. This is a contra-indication to major liver surgery.
4. Occasionally one or more segmental branches of the right lobe (especially segment IV) arise proximally.

Portal trifurcation has implications for split liver donor liver transplantation, where its presence might be considered as relative contra-indication [2].

Variant vascular and biliary anatomy is more common in the right lobe. Knowledge of anatomic variants is valuable in preoperative planning, particularly in considering donor candidates for adult-to-adult liver transplantation, whereby typically the right lobe of the donor is transplanted to the recipient. Although anomalous anatomy is not always a contraindication for liver donation, knowledge of variant anatomy is critical in ensuring the safety of the donors and aids in selection of suitable candidates. The right hepatic lobe transplantation is usually the procedure of choice to provide adequate liver volume to the recipient [3]. Precise and reliable preoperative imaging of vascular system is mandatory before liver surgeries such as living donor liver transplantations, complex liver resection and interventional radiology with portal vein embolization technique [4].

MATERIALS AND METHODS

The institutional ethics committee of Mysore Medical College and research Institute, Mysore,

India has approved this study. The present study was performed on 84 human liver specimens, irrespective of their age and sex, collected from the cadavers in the department of anatomy and post-mortem cases from the department of Forensic medicine, Mysore Medical College and Research Institute, Mysore.

Descriptive statistics is done by measuring proportions for discrete variable and Mean, standard Deviation, Inter quartile Range, Minimum, Maximum, 95% Confidence Interval for continuous variable.

RESULTS

Bifurcation of RPV was seen in 30 specimens (35.7%). Among the bifurcation, three different patterns were seen.

Bifurcation of RPV into RAPV and RPPV was seen in 26 specimens (31%). Figure 1

Bifurcation of RPV into RPPV and segment V vein with prior origin of segment VIII vein was seen in 3 specimens (3.6%). Figure 2

Bifurcation of RPV into RPPV and segment VIII vein with prior origin of segment V vein was seen in 1 specimen (1.2%). Figure 3

Trifurcation of RPV was seen in 5 specimens (6%). Among trifurcation, two different patterns were seen.

Trifurcation of RPV into RAPV, segment VI and segment VII vein was seen in 2 specimens (2.4%). Figure 4

Trifurcation of RPV into RPPV, segment V and segment VIII vein was seen in 3 specimens (3.6%). Figure 5

Quadrification of RPV was seen in 18 specimens (21.4%). Figure 6

Arched pattern of RPV was seen in 15 specimens (17.9%). Figure 7

Premature origin of segment V and segment VIII vein from RPV, then trunk of RPV dividing terminally into segment VI and segment VII vein was seen in 2 specimens (2.4%) Figure 8

Unusual pattern of RPV branching was observed in 10 specimens as follows (12%).

Trifurcation of RPV into segment V, segment VI and segment VII vein. Segment VIII vein was seen coming from segment VII vein in 3 specimens. Figure 9

Division of RPV into RAPV, RPPV. RAPV was giving segment V and segment VI vein. RPPV was seen giving segment VII and segment VIII vein in 3 specimens. Figure 10

Trifurcation of RPV into segment V, segment VI and segment VII vein. Segment VIII vein was seen coming from MPV in 2 specimens. Figure 11

Trifurcation of RPV into segment VI, segment VII and segment VIII vein. Segment V vein coming from segment VI vein in 1 specimen. Figure 12

In one specimen there was an arched pattern of RPV and segment IV vein was seen arising from RPV. Figure 13

In 4 specimens there was no RPV as Right anterior and Right posterior portal veins were directly arising from Main portal vein.

Fig. 1: Bifurcation of RPV into RAPV and RPPV and its schematic representation.

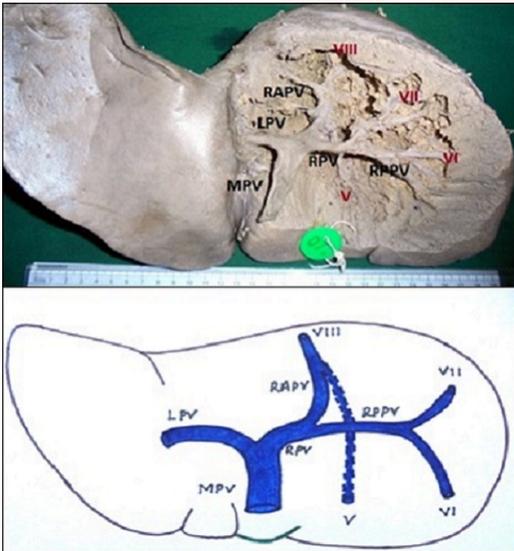


Fig. 2: Bifurcation of RPV into RPPV and seg V vein with prior origin of seg VIII vein and its schematic representation.

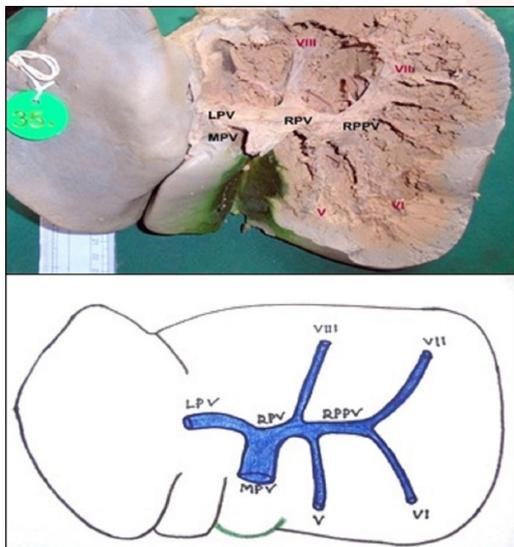


Fig. 3: Bifurcation of RPV into RPPV and seg VIII with prior origin of seg V vein and its schematic representation.

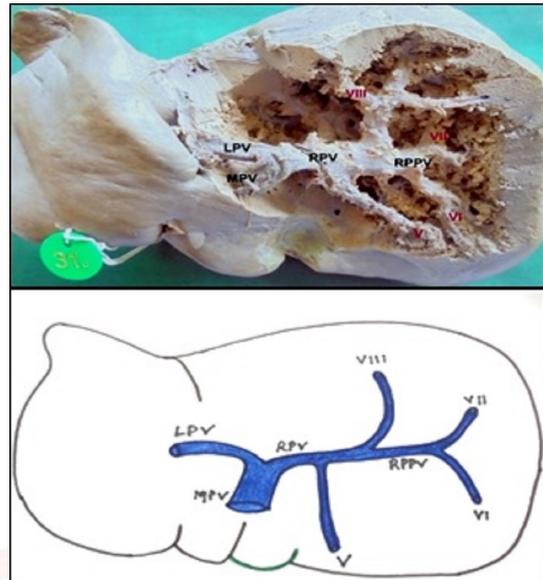


Fig. 4: Trifurcation of RPV into RAPV, seg VI and seg VII vein and its schematic representation.

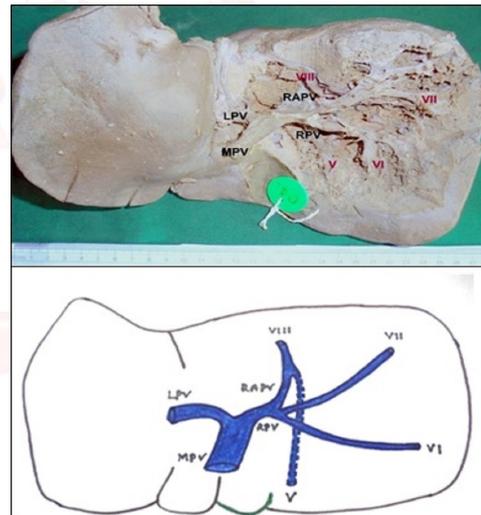


Fig. 5: Trifurcation of RPV into RPPV, seg V and seg VIII vein with schematic representation.

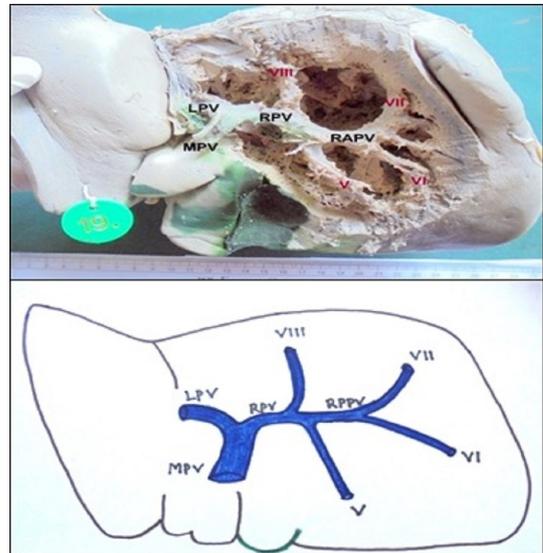


Fig. 6: Quadrification of RPV into seg V, seg VI, seg VII and seg VIII veins with its schematic representation.

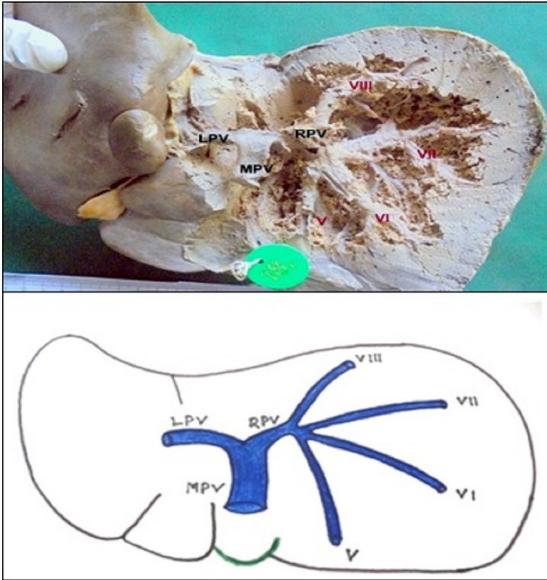


Fig. 9: Trifurcation of RPV into seg V, seg VI and seg VII vein with seg VIII vein arising from seg VII vein and its schematic representation.

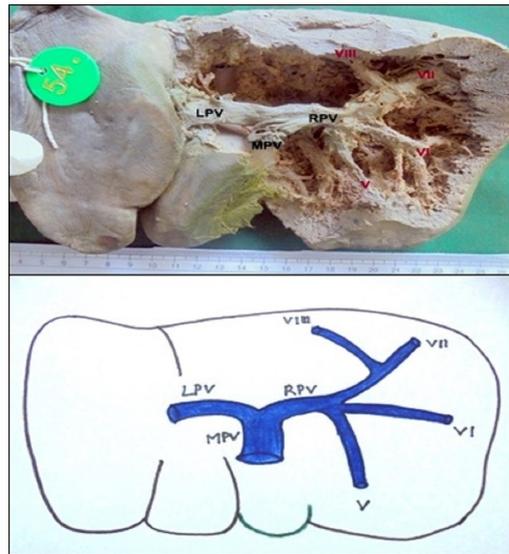


Fig. 7: Arched pattern of RPV and its schematic representation.

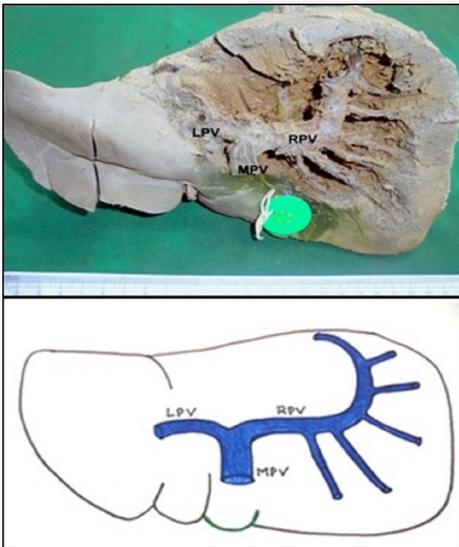


Fig. 10: Division of RPV into RAPV and RPPV. RAPV giving seg V and seg VI vein with RPPV giving seg VII and seg VIII vein with its schematic representation.

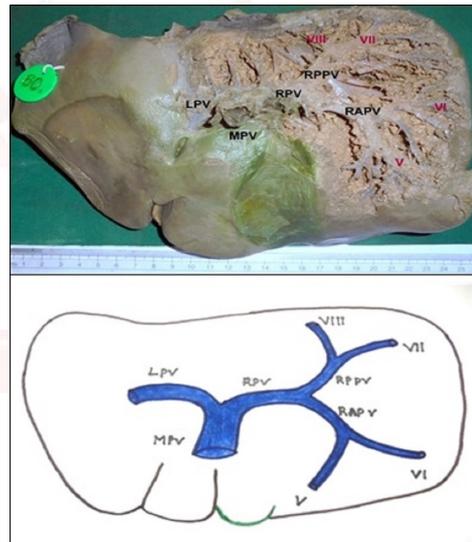


Fig. 8: Termination of RPV into seg VI and seg VII vein with prior origin of seg V and seg VIII vein from RPV and its schematic representation.

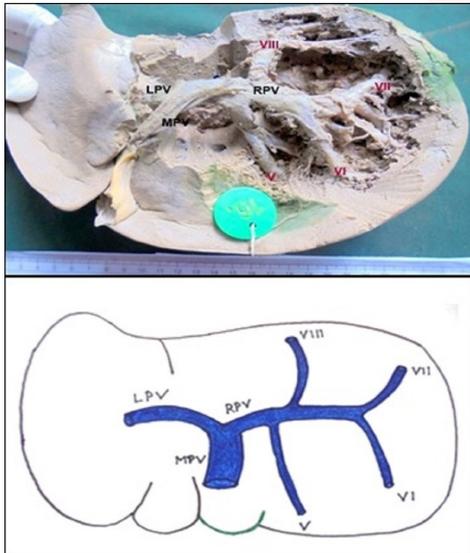


Fig. 11: Trifurcation of RPV into seg V, seg VI and seg VII veins with the origin of seg VIII vein from MPV and its schematic representation.

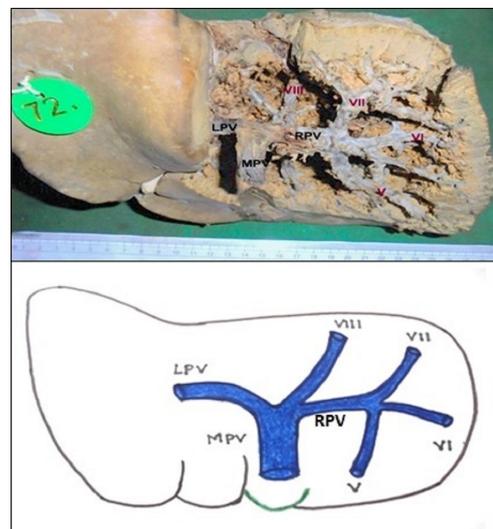


Fig. 12: Trifurcation of RPV into seg VI, seg VII and seg VIII veins with seg V vein arising from seg VI vein and its schematic representation.

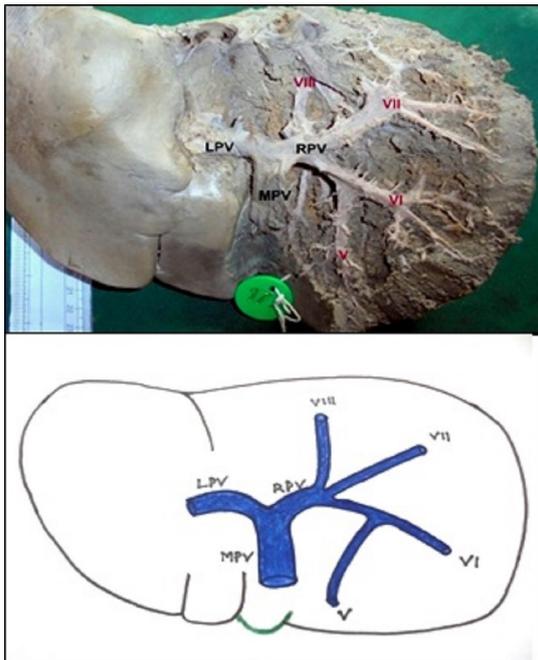


Fig. 13: Origin of seg IV vein from RPV and its schematic representation.

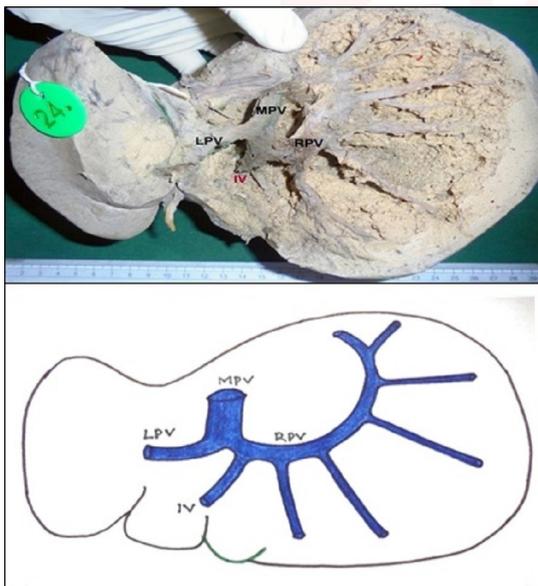


Table 1: Comparison of termination patterns of RPV with previous studies.

Studies	Bifurcation	Trifurcation	Quadrification
Munguti J et al. [5]	61%	20.80%	18.20%
Atasoy C and Ozyurek E [8]	83.20%	12.20%	0%
Present study	35.70%	6%	21.40%

Table 2: Comparison of trifurcation patterns of RPV with previous studies.

Studies	Trifurcation of RPV	
	RAPV, segment VI and segment VII	RPPV, segment V and segment VIII vein
Atasoy C and Ozyurek E [8]	3.50%	0%
Koc Z et al. [6]	0.10%	0%
Present study	2.40%	3.60%

DISCUSSION

The right portal vein is involved in majority of variations involving portal venous system. Such variations increase the risks of vascular injury during surgical procedures such as hepatectomies, split or living donor transplantation and other complex interventional procedures such as portal vein embolization and placement of transjugular intra hepatic portosystemic shunts [5].

Embryologically the portal vein is formed during 2nd month of gestation by selective involution of vitelline veins. These vitelline veins develop multiple bridging anastomoses both anterior and posterior to the developing duodenum. Any deviation in the anastomotic pattern of the vitelline veins during their development results in several portal vein variants [6].

Although anomalous anatomy is not always a contraindication for liver donation, knowledge of variant anatomy is critical in ensuring the safety of the donors and aids in selection of suitable candidates. The right hepatic lobe transplantation is usually the procedure of choice to provide adequate liver volume to the recipient [3].

Anatomical variations of the liver vasculature and bile ducts are common and their recognition and management is critical in living donor liver transplantation. During surgical planning for donor lobectomy any variants affecting the right lobe of liver including trifurcation of MPV and abnormal right portal vein configuration pattern are surgically important as it would lead to multiple anastomosis or orifices at surgery.

Main advantage of right lobe transplantation is the large size of graft and surgical management of both donor and recipient anatomical variations is considerably simpler than with left sided graft.

Ramification pattern of intrahepatic portal vein in right lobe of liver might be important for surgeons. Even for relatively small Hepatocellular carcinoma, minimal operative procedures of hepatectomy are required to preserve maximum residual functions. Furthermore, since Hepatocellular carcinoma is often accompanied by intra portal tumor thrombi, it is important to

remove systematically the region including the tumor thrombi in the portal vein [7].

CONCLUSION

Awareness of portal vein variations is critically significant in surgical resection and transplantation. Thorough knowledge of these variations is necessary during pre-treatment planning in order to reduce the incidence of complications. Along with MPV, RPV also shows considerable rate of variant branching with several different patterns, some of which may influence decision making regarding right lobe surgery. Resection of any portion of the liver should not be performed on the basis of any common pattern of ramification of portal vein. It should be well planned and clear identification of sub segments of liver is necessary before surgery. It is essential for surgeons and radiologists to be aware of the anatomical basis of intra-hepatic portal venous system to ensure safe hepatic surgery and to carry out radiological interventions.

ABBREVIATIONS

RPV - Right portal vein

RAPV - Right anterior portal vein

RPPV - Right posterior portal vein

MPV - Main portal vein

Conflicts of Interests: None

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