



EXTRA-HEPATIC PART OF PORTAL VEIN – A CADAVERIC STUDY IN ADULTS & FOETUSES

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ABSTRACT **Background:** Variations of the Hepatic Portal Vein are encountered during abdominal surgeries. **Aim:** The present study is an observational study of the extrahepatic part of Portal Vein & its variations on cadavers. **Materials & Methods:** A total of 50 upper abdomen dissections were carried out to delineate extra-hepatic Portal Vein anatomy. **Results:** The mean length of Portal Vein was 5.96cm. The mean diameter of Portal Vein was 1.35cm. The most common type of formation of Portal Vein was Type I, found in 64%. The Right Gastric Vein commonly emptied into the trunk of the Portal Vein. The Left Gastric Vein commonly emptied into the trunk of the Portal Vein in 87.18%. The most common type of Portal Vein termination was Extra-Hepatic, found in 76% of 50 dissections. The Bifurcation pattern was the most common pattern of Portal Vein termination, found in 94% of dissections. **Conclusion:** The findings of the present study highlight the variations that may occur in the hepatic portal venous system in its extra-hepatic part. Sound knowledge of portal venous anatomy is needed for success in the surgeries of the liver & adjacent viscera.

KEYWORDS : anatomy, portal vein, extra-hepatic, branching pattern, variations.

INTRODUCTION

The hepatic portal vein is the principal component of the hepatic portal venous system which carries blood from the abdomino-pelvic viscera (excluding the lower part of the anal canal) and delivers it to the liver. The term “porta” in Latin means “gate/passage”. The name “portal vein” is derived from the notion that it is the passage through which splanchnic circulation is connected to the liver. The portal vein is formed by the confluence of the superior mesenteric vein & splenic vein behind the neck of the pancreas at the level of the second lumbar vertebra. The Portal vein & its tributaries are valveless & accommodate more blood at times of necessity.

Though anatomic variations of portal vein & its tributaries are less common compared to the hepatic arterial system, newer surgeries on portal vein warrant exact knowledge of its course & variations. While surveying earlier literature, there were fewer studies on portal vein dimensions, formation & tributaries. Hence this study was undertaken to throw light on the gross anatomy of the extra-hepatic part of the portal vein.

AIM & OBJECTIVES

This study aims at determining normal anatomic parameters of the portal vein. The objectives of this study were to determine

1. Length of portal vein
2. Diameter of portal vein
3. Type of formation of portal vein
4. Termination of inferior mesenteric left gastric & right gastric veins
5. Termination pattern of portal vein
6. Termination in relation to the liver capsule

MATERIALS & METHODS

The extra-hepatic part of the portal vein was studied by dissection of 50 formalin-fixed cadavers in the Department of Anatomy, Government Medical College Kozhikode. Of 50 specimens, 30 were formalin-fixed adult cadavers used for undergraduate medical education & 20 were formalin-fixed fetuses preserved in the department. In the dissections, efforts were made to ascertain the type of formation of the portal vein, its length & diameter and the mode of its termination.

Exclusion Criteria:

Adult Cadaver/foetuses with any signs of trauma/pathology were excluded from the study.

Observations

1. Length Of Portal Vein

The Length of Portal Vein was measured from its formation to its termination using a ruler. The maximum length observed in adults was 7.4cm and the minimum length was 4.5cm. More than 80% of the observations were in the range of 5-7.5cm. The average length of Portal Vein in adults was 5.96cm. In foetuses, the average length was found to be 1.5cm.

2. Diameter Of Portal Vein

The diameter of Portal Vein was measured just above the site of formation of Portal Vein. The circumference of the Portal Vein was measured with a thread and ruler and the diameter was derived from the formula $c=2\pi r$; so $d=c/\pi$. The minimum and the maximum diameter of Portal Vein observed was 0.95cm and 1.59cm respectively. 96% of the observations were in the range 1-2cm. The average diameter of Portal Vein soon after its formation was 1.35cm in adults. In the foetus, the diameter was in the range of 0.3-0.69cm. the average diameter in the foetus was 0.45cm.

3. Type Of Formation Of Portal Vein

The Types of formation of Portal Vein was studied based on classification by Couinaud (1963).¹²

The most common Type of Portal Vein formation was Type I found in 64% (32), followed by Type II in 22% (11). Type III pattern was found in 14% (7). In this study, Type IV pattern was not found.

| Type | Description |
|------|--|
| I | Splenic vein forming a common trunk with IMV that further unites with the SMV. |
| II | SMV and IMV forming a common trunk that unites with the splenic vein. |
| III | Tripod convergence, in which the 3 veins viz. Splenic Vein, SMV and IMV unite to form the hepatic Portal Vein. |
| IV | IMV confluent both with splenic vein and SMV. |

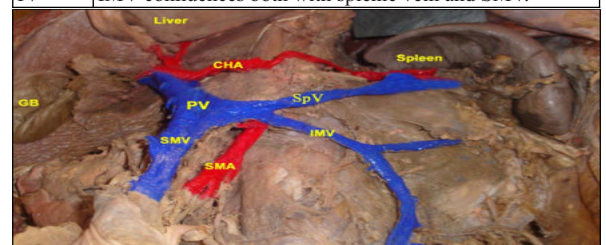


Figure 1: Type I formation of Portal Vein



Figure 2: Type II Formation of Portal Vein

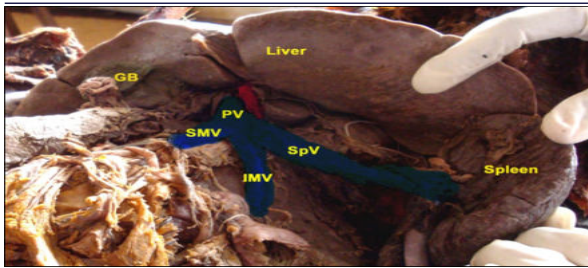


Figure 3: Type III formation Of Portal Vein

4. Termination Of Inferior Mesenteric, Left Gastric & Right Gastric Veins

The IMV was traced to its site of termination. In 64% (32) of 50 dissections, IMV terminated into Splenic Vein. The next common site of its termination is into SMV in 22% (11)(7). In 14% of cases, IMV opened at the confluence of SMV and Splenic Vein. The termination of the left gastric vein (Coronary Vein) in the present study was commonly into Portal Vein, which was seen in 87.18% (34). In 5 (16.67%) adult specimens, Coronary Vein emptied into splenic vein. The termination of the Right Gastric Vein was identified only in 16 dissections in adults. In all observations, Right Gastric Vein was found to terminate in the trunk of the Portal Vein. It was not identified in foetal dissections.

5. Termination Pattern Of Portal Vein

In 94% (adults:29; foetuses: 18), the termination of Portal Vein was bifurcation type (Type I). The trifurcation type (Type II) was observed in 6% (adult:1; foetus:2) of 50 specimens.

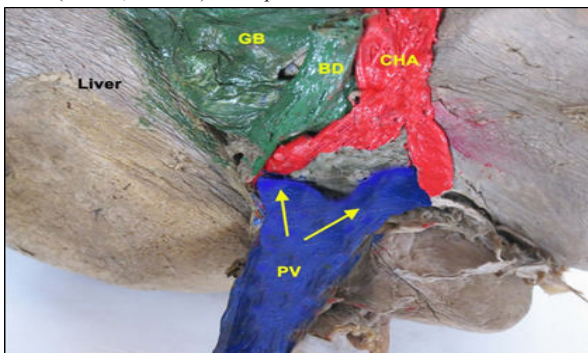


Figure 4: Bifurcation pattern Of Portal Vein

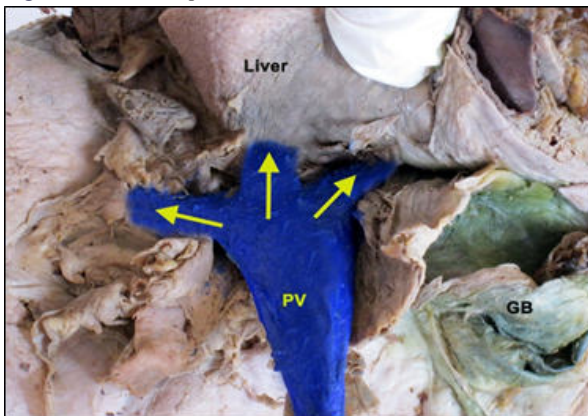


Figure 5: Trifurcation Pattern Of Portal Vein

6. Termination In Relation To The Liver Capsule

The termination of Portal Vein in relation to the liver capsule was studied as extra-hepatic / intra-hepatic. Out of 50 dissections, the termination of Portal Vein was extra-hepatic in 76% (38) and intra-hepatic in 24% (12).

DISCUSSION

Length Of Portal Vein

In the present study, the maximum length observed in adults was 7.4cm and the minimum length was 4.5cm. More than 80% of the observations were in the range of 5-7.5cm. The average length of Portal Vein in adults was 5.96cm.

The findings of the present study closely matched that of Bruce E Douglass,¹ Ongaiba,² Wunee Chaijaroonkhanarak.³ The average length observed in the above-mentioned studies were somewhat shorter than that usually stated (Gray's Anatomy⁴: 8cm; Keith L Moore⁵: 7-8cm). The difference may be due to the post-mortem changes in the length of Portal Vein.

Diameter Of Portal Vein

The minimum and the maximum diameter of Portal Vein observed was 0.95cm and 1.59cm respectively. 96% of the observations were in the range 1-2cm. The average diameter of Portal Vein soon after its formation was 1.35cm in adults.

The observations of the present study matched that of Harry K Purcell,⁶ Jaffrey Weinreb,⁷ Hossein Bannazadeh⁸ and Wunee Chaijaroonkhanarak.³ Bruce Douglass stated that the actual diameter of Portal Vein when it is distended with blood (in living state) will be greater than the post-mortem measurement which is that of the collapsed vessel.¹

Pattern Of Formation Of Portal Vein

The formation of Portal Vein was studied based on Couinaud's Classification.⁹

The most common type of Portal Vein formation was Type I found in 64%, followed by Type II in 22%. Type III pattern was found in 14%. In this study, Type IV pattern was not found.

Variations Of Formation Of Portal Vein As Observed By Other Workers

| Name of investigator | Year of study | No. of cases | SMV + Splenic Vein | Type I | Type II | Type III |
|--|---------------|--------------|--------------------|--------|---------|----------|
| Rutherford S Gilfillan ⁸ | 1950 | 54 | 85% | 55.6% | 29% | 15% |
| Harry K Purcell ¹⁰ | 1951 | 100 | 81% | 28% | 53% | 16% |
| Dos Santos Ferreira ¹¹ | 1959 | 50 | 60% | 32% | 28% | 36% |
| Wunee Chaijaroonkhanarak ³⁰ | 2010 | 65 | 84% | 69.1% | 30.9% | 15.38% |
| Present study | 2013 | 50 | 86% | 64% | 22% | 14% |

In the present study, Type I was the most common pattern of Portal Vein formation. It was consistent with the findings of Rutherford S Gilfillan,¹⁰ Dos Santos Ferreira¹¹ and Wunee Chaijaroonkhanarak.³

Harry K Purcell⁶ observed that the most frequent type of Portal Vein formation was Type II, which was observed in 53%, followed by Type I, found in 28%. Type III was observed in the present study is 14 % which was consistent with that of Rutherford S Gilfillan,¹⁰ Harry K Purcell⁶ and Wunee Chaijaroonkhanarak.³ Dos Santos Ferreira (1959)¹¹ observed the Type III pattern in 36%, which was higher than the other studies. None of the above-mentioned studies reported a Type IV pattern.

Termination of Inferior Mesenteric Vein

The IMV was traced to its site of termination. In 64% of 50 dissections, IMV terminated into Splenic Vein. The next common site of its termination is into SMV (22%). In 14% of cases, IMV opened at the confluence of SMV and Splenic Vein.

The findings of the present study were comparable to the findings of Rutherford S Gilfillan.¹⁰

According to Bruce Douglass,¹ the incidence of IMV termination into the splenic vein and the site of confluence was almost equal. In contrast to most studies, Harry K Purcell⁶ reported that in his study, IMV mostly terminated into SMV and was seen in 53%, followed by termination into Splenic Vein found in 28% cases.¹⁰

Termination of Right Gastric Vein

The termination of the Right Gastric Vein was identified only in 16 dissections in adults. In all observations, Right Gastric Vein was found to terminate in the trunk of the Portal Vein. It was not identified in foetal dissections.

The finding of the present study was in disparity to that of other studies. Bruce Douglass,¹ in his study stated that the right gastric vein was very difficult to identify due to its small calibre. He identified it in only 76 out of 92 specimens.⁹ In his study, he detected that the termination of

the Right Gastric Vein was into the Portal trunk in 75% and into SMV in 22.3%. Rutherford S Gilfillan¹⁰ observed that the Right Gastric Vein emptied into the Portal trunk in 68%. The author also reported the termination of RGV into the junction of SMV and Splenic Vein in 8% and Splenic Vein in 24%.

Termination Of Coronary Vein

The termination of the Coronary Vein was identified in all dissections in adults and 9 dissections in fetuses. The termination of Coronary Vein in the present study was commonly into Portal Vein, which was seen in 87.18%. The above finding was parallel to the observations of Rutherford S Gilfillan¹⁰ and that of Harry K Purcell⁶. Bruce Douglass¹ noticed the termination of Coronary Vein into Portal Vein in only 24.4%.⁹

In the present study, the termination of Coronary Vein into the junction of Splenic Vein and SMV was not observed. Rutherford S Gilfillan¹⁰ Bruce Douglass¹ and Harry K Purcell⁶ reported an occurrence of the same in 8%, 58.9%. and 6% respectively.

Termination Pattern Of Portal Vein

The most common type of Portal Vein formation was Type I found in 64%, followed by Type II in 22%. Type III pattern was found in 14%. In this study, Type IV pattern was not found.

Variations Of Formation Of Portal Vein As Observed By Other Workers

| Name of investigator | Year of study | No. of cases | SMV + Splenic Vein | Type I | Type II | Type III |
|--|---------------|--------------|--------------------|--------|---------|----------|
| Rutherford S Gilfillan ⁸ | 1950 | 54 | 85% | 55.6% | 29% | 15% |
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| Dos Santos Ferreira ¹¹ | 1959 | 50 | 60% | 32% | 28% | 36% |
| Wunee Chaijaroonkhanarak ³⁰ | 2010 | 65 | 84% | 69.1% | 30.9% | 15.38% |
| Present study | 2013 | 50 | 86% | 64% | 22% | 14% |

Termination Of Portal Vein In Relation To The Liver Capsule

The termination of Portal Vein in relation to the liver capsule was studied as extra-hepatic / intra-hepatic. Out of 50 dissections, the termination of Portal Vein was extra-hepatic in 76% and intra-hepatic in 24%.

The findings of the present study were in agreement with that of Rutherford S Gilfillan¹⁰. He observed that the termination of Portal Vein was extra-hepatic in 85% and intra-hepatic in 15%. Scott R Schultz¹² and Munguti¹³ described Portal Vein termination as extra-hepatic intra-hepatic and junctional. The junctional type was observed in 25.8% (Scott R Schultz¹²) and 46% (Munguti¹³) respectively.

CONCLUSION

The present study is a gross anatomical study on Portal Vein emphasizing its extra-hepatic course and its variations. A total of 50 upper abdomen dissections were carried out to delineate extra-hepatic Portal Vein anatomy. The remarkable findings in the present study are summarised below:

- 1) The mean length of Portal Vein from its formation to its termination at Porta-Hepatis, in adults, was 5.96cm and in fetuses was 1.47cm respectively.
- 2) The mean diameter of Portal Vein just after its formation, in adults, was 1.35cm and in fetuses was 0.5cm respectively.
- 3) The most common type of formation of Portal Vein was Type I which was found in 64% of 50 dissections.
- 4) In 64% of 50 dissections, IMV drained into Splenic Vein.
- 5) In all the identified cases, RGV or Pyloric Vein emptied into the trunk of Portal Vein.
- 6) The LGV or Coronary Vein mostly emptied into the trunk of Portal Vein as observed in 87.18% of 50 dissections.
- 7) The most common type of Portal Vein termination was Extra-Hepatic Type, found in 76% of 50 dissections. The Bifurcation pattern was the most common pattern of Portal Vein termination, found in 94% of 50 dissections

The findings of the present study emphasise the variations that may occur in the hepatic portal venous system in its extra-hepatic part. This study warrants the need for a sound knowledge of portal venous anatomy for success in the upper abdominal surgeries.

Abbreviations Used:

PV-Portal Vein; Sp V-Splenic Vein; IMV-Inferior Mesenteric Vein; SMV-Superior Mesenteric Vein; CHA-Common Hepatic Artery; Sp A-Splenic Artery; SMA-Superior Mesenteric Artery.

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