

Variations in the Formation of Hepatic Portal Vein: A Cadaveric Study

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ABSTRACT

Background: Portal vein drains blood from the abdominal part of alimentary tract, spleen, pancreas and gall bladder to the liver. It is normally formed by the union of superior mesenteric and splenic veins behind the neck of pancreas. Knowledge of variations regarding the formation of portal vein is very useful for surgeons to perform pancreas and duodenum and liver surgeries and for the interventional radiologist for catheter-based interventions. The objectives of this study are to disclose the variations in formation of hepatic portal vein and to measure the length of portal vein in cadavers.

Methods: A descriptive cross sectional study was carried out on 40 embalmed cadavers in the Department of Human Anatomy, KIST Medical College, Lalitpur Nepal after taking ethical approval. The pattern of portal vein formation and its tributaries were identified and photographs were taken. The pattern of portal vein formation was classified as: Type I: Portal vein formed by the confluence of superior mesenteric and splenic vein ; Type II: portal vein formed by the confluence of superior mesenteric, splenic and inferior mesenteric vein . Data was analyzed by using SPSS version 20.

Results: Type I pattern of portal vein formation was observed in 31 cadavers (82.5%) while Type II pattern was observed in 5 cadavers (12.5%). Average length of portal vein was 50.58mm.

Conclusions: Portal vein shows variations in the pattern of formation which should be taken into consideration during pancreatico-duodenal surgeries and in the interpretation of abdominal angiographs.

Keywords: Length; portal vein; variations.

INTRODUCTION

Portal vein drains blood from the abdominal part of alimentary tract, spleen, pancreas and gall bladder to the liver.¹ Embryologically, the portal vein is formed by anastomotic venous channel around the duodenum. Obliteration of these anastomoses can result in following variations.²

Type I - Portal vein (PV) is formed by confluence of superior mesenteric vein (SMV) and splenic vein (SV). Type II -PV is formed by confluence of SMV, inferior mesenteric vein (IMV) and SV. Type Ia - Inferior mesenteric vein terminate into splenic vein (normal). Type Ib - Inferior mesenteric vein terminate into superior mesenteric vein.³

Knowledge of variations regarding the formation of portal vein is very useful for surgeons to perform pancreas, duodenum and liver surgeries and for the interventional radiologist for catheter-based interventions.^{4,5}

The objectives of this study are to disclose the variation in formation of hepatic portal vein and to measure the length of portal vein in cadavers.

METHODS

A descriptive cross-sectional study was conducted in the Department of Anatomy, KIST Medical College and Teaching Hospital, Lalitpur, Nepal. After obtaining ethical approval from Institutional Review Committee (Registration No.2076/77/4), data was collected from 40 embalmed cadavers (37 male and 3 female) from August to September 2019. Properly dissected adult human cadavers of both sexes with intact blood vessels were included in the study. Cadavers with damaged hepatic portal, splenic, superior mesenteric and inferior mesenteric veins were excluded from the study. The cadavers were dissected following the steps of Cunningham's dissection manual vol.2. Abdomen was opened. Then, the mesentery was dissected to expose

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the superior mesenteric vein. It was running along with superior mesenteric artery. Stomach was lifted above and pancreas was dissected to expose the splenic vein as well as to search the site for formation of portal vein. Inferior mesenteric vein was also identified. Other tributaries of portal vein were also exposed. Liver was completely exposed but not removed. Procedures were followed in accordance with the ethical standards of handling of cadaver for teaching and learning purpose.

Altogether, 40 embalmed cadavers were enrolled in the study by convenience sampling method. Specimens were numbered from 01 to 40. Portal vein was studied in respect to its length and formation. Length of portal vein was measured from its site of formation to the termination into right and left branches near the porta hepatis in the liver. Inferior surface of the liver was accessed by retracting the liver. Variations in formation of portal vein in cadavers were tagged and photographs were taken. The variations noted were classified according to standard classification method as stated before in previous literature.⁶ Length of portal vein was measured by using digital vernier caliper at a measuring accuracy of 0.001 mm. All the observations were recorded and tabulated. The data was analyzed with the help of SPSS version 20 software. The descriptive data analysis was done to find mean and standard deviation of length of portal vein.

RESULTS

In 45% (18 out of 40 cadavers), formation of portal vein was observed to be normal that is type I a pattern, by joining the superior mesenteric vein with splenic vein and inferior mesenteric vein was draining to splenic vein (Figure 2A). Figure 1 depicts the observations in pattern of formation of portal vein.

It was observed that in 37.5% (15 out of 40 cadavers), portal vein was also formed by the union of superior mesenteric and splenic vein but the inferior mesenteric vein drained to superior mesenteric vein instead of draining to splenic vein (Figure 2B). So total Type I pattern was observed in 82.5% (33 out of 40 cadavers).

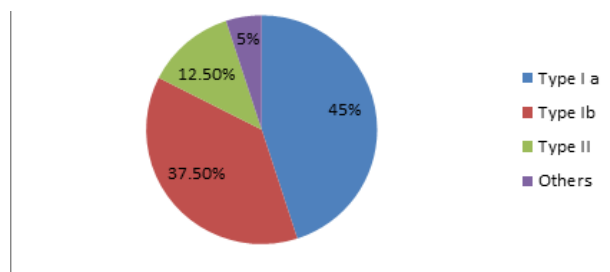


Figure 1. Pie chart depicting the the formation of Hepatic portal vein.

In this study 12.5% (5 out of 40 cadavers) showed the formation of portal vein by the confluence of superior mesenteric, splenic and inferior mesenteric veins (Figure 2C).

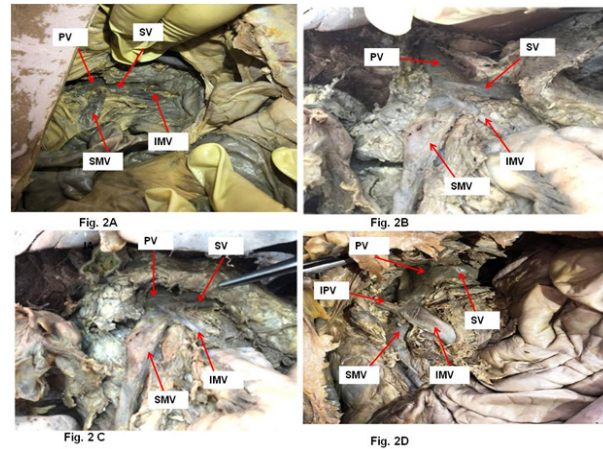


Figure 2A. PV formed by joining SMV with SV and IMV is draining to SV, Figure2B. PV formed by joining SMV with SV but IMV is draining to SMV, Figure2C. PV formed by the confluence of SMV, SV and IMV, Figure 2D. PV formed by joining SMV with SV but IMV is large and draining to SMV in the site where IPV is draining.

Five percent (2 out of 40 cadavers) showed that portal vein was formed by the confluence of four veins. They are splenic, superior mesenteric, inferior mesenteric and first jejunal vein. In one cadaver (2.5%), inferior mesenteric vein is large and draining to superior mesenteric vein in the site where inferior pancreaticoduodenal vein is draining (Figure2D).

This study did not show the absence of portal vein in any cadaver. Mean length of portal vein was 50.58±10.22 mm ranging from 33.9 to 78mm.

DISCUSSION

With advancement of hepatobiliary and pancreatic surgeries, knowledge of the variation in the anatomy of portal vein and its tributaries has great importance because iatrogenic portal vein injury following pancreatico-duodenectomy may lead to massive postoperative hemorrhage which may be life threatening.⁶

This study did not report any congenital absence of portal vein as reported in the study by Arson et al.⁷ The prevalence of Type Ia formation of portal vein ranged from 30%-58.4% in different studies.⁸ This data for classical termination of inferior mesenteric vein is supported by our study in which Type Ia pattern of formation of portal vein is 45%. Prevalence of type Ib pattern of portal vein in this study is 37.5 % which is

Table 1. Comparison of present study with previous studies on variations on portal vein formation.

SN	Name of the study	Type Ia	Type Ib	Type II	Other type of variation
1	Raut et.al ²	30%	22.5%	47.5%	
2.	Chaijarookhanarak et al ¹⁰	58.46%	26.15%	15.38%	
3.	Kanasker N et al ⁹	58.3% ^z	25%	12.55%	4.2% Portal vein formed by the confluence of superior mesenteric vein, splenic vein, and colic vein
4.	Kaur H et al ¹	40%	50%	10%	
5.	Mugunti J et al ³	35.7%	38.9%	26.2%	
6.	This study	45%	37.5%	12.5%	5% splenic, superior mesenteric, inferior mesenteric and first jejunal vein

similar to the findings of Mugunti et al., but quite higher as compared to the findings of Raut et al., which is 22.5%.^{2,3} Type II pattern of formation of portal vein is observed in 12.5% in this study. This finding is supported by the findings of Chaijarookhanarak et al., Kanasker et al., ; Kaur et al.,^{1,9,10} Comparisons in the pattern of formation of portal vein with other studies is given in the table 1.

According to Benninger et al., new terminology for the normal pattern of formation of portal vein is splenomesenteric vein. To use the term “splenomesenteric” vein, inferior mesenteric vein should join splenic vein at least 3 cm before joining of superior mesenteric vein. Splenomesenteric vein is just a venous channel formed by the confluence of splenic and inferior mesenteric vein which involve in the formation of portal vein. He suggested this name because of its high percentage of incidence. When inferior mesenteric vein directly joins superior mesenteric vein then this common vein is termed as “common mesenteric vein”. The splenomesenteric vein is also termed as “Benninger vein”. This three cm length of portal vein is in danger during pancreatitis, different surgeries of pancreas leading to vascular complications, surgeries for pancreatic cancer and also conditions like cholangiocarcinoma.¹¹

In this study portal vein makes an angle of 5-15 degree angle with vertical plane during its course. The clinical significance of this formation of angle of portal vein on magnetic resonance (MR) angiogram can be put as that, flow areas exist and may lead to signal loss while performing MR angiography on the portal system. Signal loss is a very common occurrence at the portal confluence; where mixing of blood takes place from splenic vein and superior mesenteric vein which commonly meet together at nearly right angles.¹²

In the present study, the mean length of portal vein is 50.58mm which is smaller than mentioned in the text.¹³ This may be due to the short stature of Nepalese population as compared to the European population. This finding is supported by the finding of Raut et

al.³ Comparisons of length of portal vein in different populations is done in table 2.

Table 2 .Comparison of present study with previous studies on average length of portal vein

SN	Name of the study	Mean length of portal vein (mm)
1	Chaijaroonkhanarak et al ¹⁰	66.1
2	Kaur et al ¹	62.9
3	Raut et al ²	46.9
4	This study	50.58

The sample was comprised of very few numbers of females, thus the comparison of differences in prevalence of variation between sexes could not be done. Further studies with equal numbers of males and females are required. The findings of this study can be compared with the radiological study which brings the scope for further study.

CONCLUSIONS

Portal vein shows variations in the pattern of formation. Type Ia pattern is the most common pattern of formation of portal vein followed by type Ib and type II. Therefore this should be taken into consideration during pancreatico-duodenal surgeries and in the interpretation of abdominal angiographs.

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