Scholars Journal of Applied Medical Sciences (SJAMS) **ISSN 2320-6691 (Online)**
Sch. J. App. Med. Sci., 2015; 3(3E):1370-1375 **ISSN 2347-954X (Print)**

(An International Publisher for Academic and Scientific Resources)
www.saspublishers.com DOI: 10.36347/sjams.2015.v03i03.068

Research Article

Study of Variations in the Formation of Portal Vein

Rajashree Sheelawant Raut[1*], B. H. Bahetee[2]
[1]Assistant Professor, [2]Professor and Head, Department of Anatomy, B.J. Govt. Medical College, Station Road, Pune - 411001, Maharashtra, India

***Corresponding author**
Dr. Rajashree Sheelawant Raut
Email: drrautrajashree@gmail.com

Abstract: Portal vein is formed by union of superior mesenteric vein and splenic veins behind the neck of pancreas in front of inferior vena cava and at the level of L2 vertebra. Embryologically portal vein is formed by the selective involution of vitelline veins. Any change in the anastomotic pattern of vitelline veins during development results in many PV variations. Knowledge of variations regarding the formation, termination of tributaries of portal vein, superior mesenteric vein and splenic vein are very useful and important for surgeons performing surgeries on pancreas and duodenum, for liver surgeries and interventional procedures. It is helpful for radiologists while performing radiological procedures. There is paucity of literature available on these variants. Considering its importance, the study was conducted on total 40 embalmed cadavers (22 males and 18 females) during routine dissection in dept. of Anatomy, B.J. Govt Medical College, Pune. The different types of portal vein formation were noted. Present study showed predominant type II in 47.5% population, type Ia in 30% and type Ib in 22.5%. Few cases showed inferior mesenteric vein and either colic or jejunal vein opening directly into commencement of portal vein.
Keywords: Portal vein, Variation in formation, Variant termination of tributaries.

INTRODUCTION

The portal vein drains blood from the abdominal part of alimentary tract except the lower part of rectum and anal canal. It also receives veins from spleen, pancreas and gallbladder. It is formed by union of superior mesenteric and splenic veins behind the neck of pancreas in front of inferior vena cava and at the level of L2 vertebra [1].

It measures 8cm in length and 2cm in width. From its formation the trunk of portal vein passes upward and slightly to the right behind the neck of pancreas and first part of duodenum. It then enters the free margin of lesser omentum and reaches porta hepatis to divide and distribute branches to liver [1].

Knowledge of variations regarding the formation, termination and tributaries of portal vein, superior mesenteric vein and splenic vein are very useful and important for surgeons performing surgeries on pancreas and duodenum and also for liver surgeries and interventional procedures. It is helpful for radiologists while performing radiological procedures [2-4].

Very few literatures are available regarding the study of variations in the formation of portal vein. Although few studies are there in other population, it is not much studied in Indians. Objective of the present study is to study the variations in the formation of portal vein and its tributaries in relation with termination of inferior mesenteric vein, colic veins, jejunal veins in Indian population and compare its incidence with the previously published data and also aimed to study its clinical correlation.

MATERIALS AND METHODS

The study was conducted on total 40 embalmed cadavers (22males and 18 females) during routine dissection in dept. of Anatomy, B.J.Govt Medical College, Pune in the duration of last 2 years. The ages of the cadavers were ranging between 40 to 80 yrs.

The superior mesenteric vein, the splenic vein, inferior mesenteric vein and formation of portal vein of all the cadavers were exposed during routine dissection. The variations in the formation of portal vein, termination of IMV, jejunal veins, colic veins were noted and photographs were taken accordingly. The variations noted were classified according to standard classification method as stated before in previous literature [5]. The incidence obtained in the present study was compared with the previous data available.

RESULTS

The different types of portal vein formation noted were as follows [5].

Type I – Portal vein is formed by confluence of superior mesenteric vein and splenic vein.
Type II – Portal vein is formed by confluence of superior mesenteric vein, inferior mesenteric vein and splenic vein.

Type I –Subtype according to termination of inferior mesenteric vein.
Type Ia – Inferior mesenteric vein terminate into splenic vein (normal).
Type Ib – Inferior mesenteric vein terminate into superior mesenteric vein.

Table 1: Sex distribution of the cadavers according to different types of portal vein formation

Type		Male	Female	Total	Total
Type I	**Ia**	9	3	12	
	Ib	6	3	9	21
Type II		7	12	19	19
Total		22	18	40	40

Table 2: Percentage of male and female cadavers for type I and II

Type	Male	%	Female	%	Total	%
I	15	37.5	6	15	21	52.5
II	7	17.5	12	30	19	47.5

Table 3: Percentage of male and female cadavers for type Ia and Ib

Type I	Male	%	Female	%	Total	%
Ia	9	22.5	3	7.5	12	30
Ib	6	15	3	7.5	9	22.5

Of total 40 cases (22 males and 18 females), 21 showed type I formation whereas 19 showed type II formation. Of 21, 12 showed type Ia formation (9 males+3 females) and 9 showed type Ib formation (6 males+3 females). Out of all 52.5% showed type I formation and 47.5% showed type II formation. In present study in type I formation male predominance is seen whereas in type II formation female predominance is seen.

Of the total 40 cases in 4 cases (10%) portal vein is formed by confluence of superior mesenteric veins, splenic vein, inferior mesenteric vein and colic vein (single vein from transverse colon) .

Out of 40 in 2 cases (5%) portal vein is formed by confluence of superior mesenteric vein, splenic vein, inferior mesenteric vein and jejunal veins. Of these two, one case showed only one tributary of jejunal vein opening into portal vein at its commencement (2.5%) while one showed classically many jejunal tributaries opening into portal vein at its commencement (2.5%).

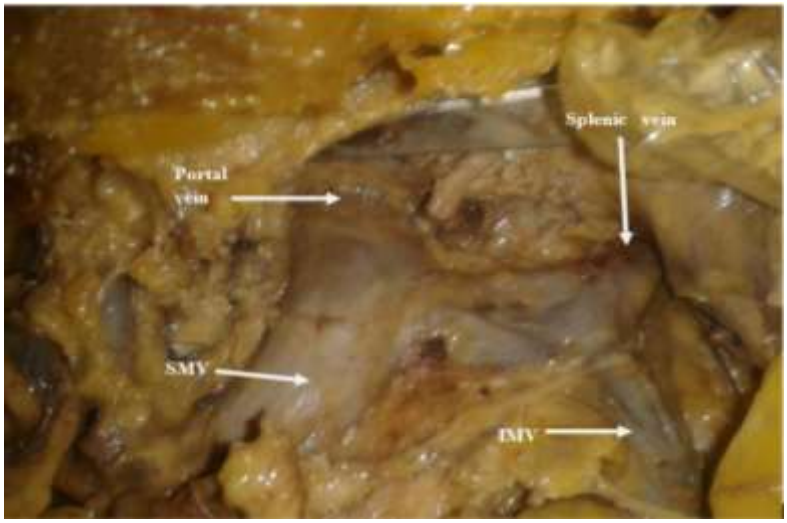

Fig. 1: Showing type Ia formation of portal vein

Fig. 2: showing type Ib portal vein formation

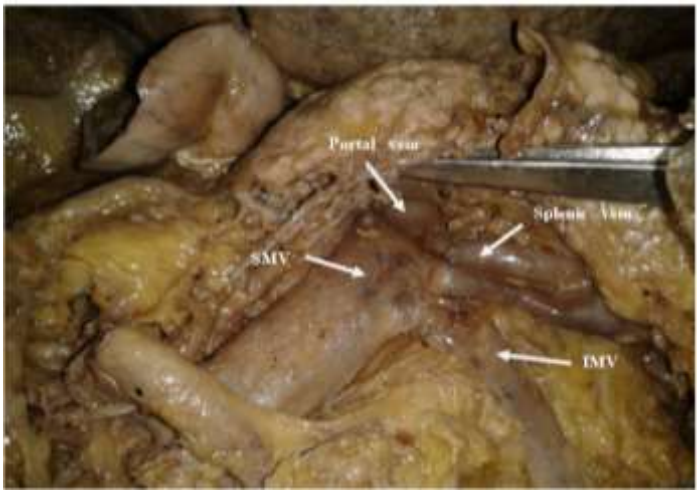

Fig. 3: showing type II portal vein formation

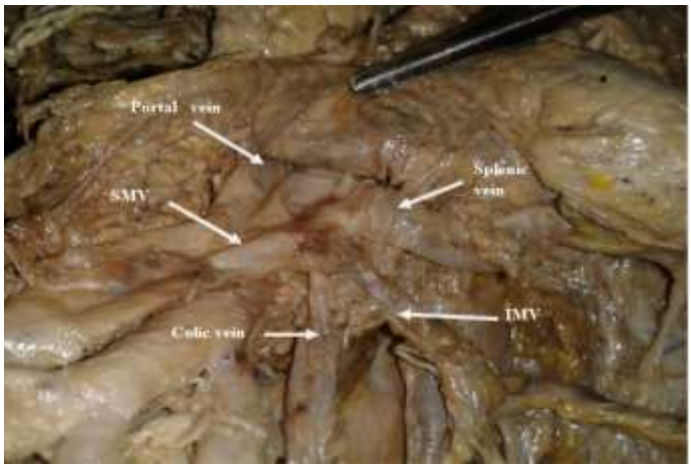

Fig. 4: Showing IMV, colic vein opening directly at confluence of Splenic vein and SMV

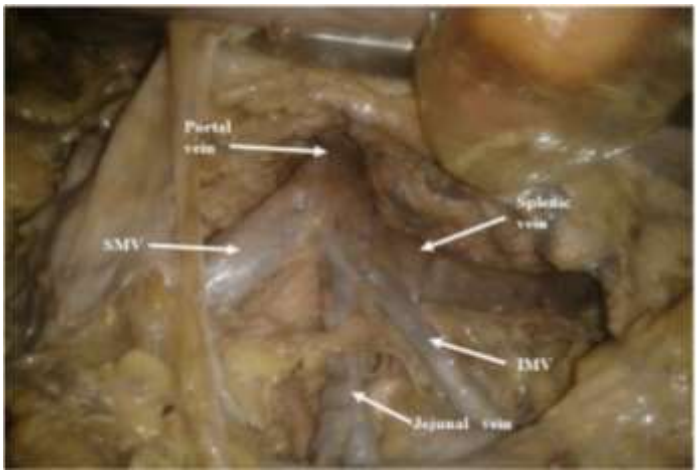

Fig. 5: showing IMV, single jejunal vein opening into junction of Splenic vein and SMV

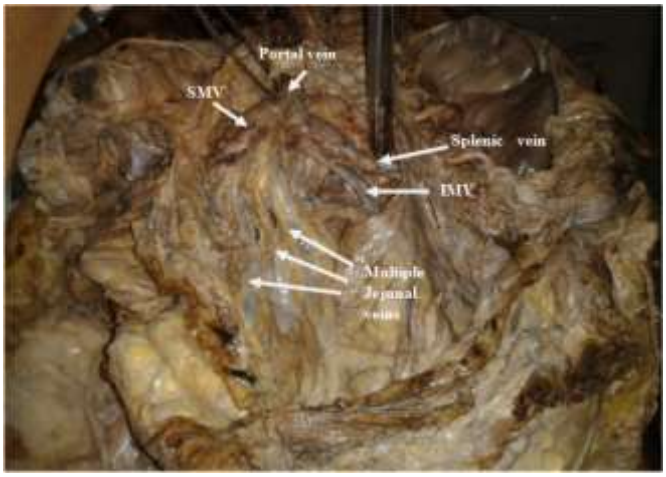

Fig. 6: showing IMV and multiple jejunal veins opening into junction of SMV and splenic veins
Abbreviations: SMV- Superior mesenteric vein, IMV- Inferior mesenteric vein

DISCUSSION

Portal vein is formed by union of superior mesenteric vein and splenic vein while inferior mesenteric normally drains into splenic vein. Benninger described two new terminologies in relation to normal formation of portal vein. He said that inferior mesenteric joins splenic vein to form "splenomesenteric" vein which should be atleast 3cm before joining superior mesenteric to be called as splenomesenteric. He suggested this name due to its high percentage of incidence and clinical relevance. When inferior mesenteric joins directly superior mesenteric instead of splenic vein then this common vein is termed as "common mesenteric vein". The splenomesenteric vein is informally termed as "Benninger's vein". This 3c m length of portal vein is in danger during pancreatitis, vascular complication – venous occlusion, pancreatic cancer, cholangiocarcinoma [6].

While the tributaries of the portal vein very considerably in their point of entrance, congenital anomalies of the portal vein are apparently rare [7].

Table 4: Comparison of present study with previous studies on variations on portal vein formation

Sr. No.	Name of the study	Type I		Type II	Any other type of variation
		Ia	Ib		
1.	Treves [7]	18%	36%	44%	2% -IMV passes in front of splenic vein to the right and enters SMV on its right side.
2.	Douglass *et al*. [7]	38%	29.3%	32.7%	-
3.	Purcell *et al*. [7]	28%	53%	3%	16%- IMV bifurcated to enter both SMV and SPV
4.	Chaijarookhanarak W *et al*. [5]	58.46%	26.15%	15.38%	-
5.	Present study[2015]	30%	22.5%	47.5%	-

As stated above Treves found type II predominantly seen in 44%, Douglass & co-workers found predominance in type Ia as 38%, Purcell & co-workers found type Ib predominantly in 53% whrereas Wunnee Chaijarookhanarak *et al*. found type Ia in 58.46% of population. Present study showed predominant type II in 47.5% population.

Besides the classical types seen , there are some other variations seen in present study as under – Four out of 40 cases showed portal vein formed as confluence of SMV, SPV,IMV and colic vein (transverse colon), mostly single vein (10%). Two out of 40 cases (5%) showed portal vein formed as confluence of SMV, SPV, IMV, jejunal veins –could be single (1 case-2.5%) or multiple (1 case-2.5%).

The jejunal veins normally run dorsal to SMA but if they run ventral to it, should be kept in mind while mobilizing SMV during pancreaticoduodenectomy. During pancreatic resections with venous reconstruction, the SMV & its tributaries must be ligated carefully [2].

Embryologically, the portal vein is formed in the second month of gestation by selective involution of the vitelline veins, which have multiple bridging anastomoses anterior and posterior to the duodenum-cranial intrahepatically, middle behind duodenum, caudal in front of duodenum. Superior mesenteric vein joins with right vitelline vein and splenic vein joins with the left vitelline near its anastomosis. The proximal ventral anastomosis becomes left branch of portal vein, the dorsal anastomosis becomes the portal vein. The distal ventral anastomosis usually disappears. Alterations in the pattern of obliteration of these anastomoses can result in several variants. A prepancreatic portal vein is formed when the caudal ventral anastomosis persists instead of the middle one [8, 9].

Portal vein variants are asymptomatic but knowledge of these variants helps in accurate diagnosis of cross sectional imaging, also important to avoid surgical hazards like portal vein ligation, resection, intraoperative haemorrhage. Thus it reduces the complication rates of surgical and radiological interventional procedures [3].

Besides the variants in portal vein formation and its tributaries, the angle formed by the portal vein with the vertical plane is also studied and types mentioned accordingly [10].

3 types mentioned in previous literature.

- Oblique tract –most common- 60%- portal vein makes an angle of 45^{o} with the vertical plane.
- Vertical Tract -35%- portal vein makes an angle of 10^{o}-30^{o} with vertical plane.
- Horizontal -35%- portal vein makes an angle of 75^{o}-80^{o} with the vertical plane.

CONCLUSION

Though variations in the portal vein formation and termination of its tributaries are common, its congenital anomalies are rare. Of the three types described present study showed type Ia in 30%, type Ib in 22.5%, type II in 47.5% population. Thus type II is predominat in population. Also male predominance seen in type I and female predominance seen in type II could be incidental finding and not having any clinical significance. About 4 cases (10%) showed colic vein and IMV draining into portal vein while 2 cases (5%) showed jejunal veins and IMV draining into portal vein. Also the pattern of termination of tributaries of superior mesenteric vein needs to be kept in mind before operation to prevent intraoperative haemorrhage. Thus preoperative knowledge of all these variations is equally important so as to avoid any complications thereafter.

REFERENCES

1. Datta AK; Essentials of Human Anatomy. In Thorax and abdomen. 7th edition, Current Books International, Kolkata, 2006; 244-247.
2. Nayak SB, Aithal AP, Melanie RD, Guru A, Kumar N; Unusual jejunal tributaries of the splenic vein and their surgical importance: a case report. OA Case Reports, 2013; 2(4): 36-37.
3. Manjunatha YC, Beeregowda YC, Bhaskaran A; An unusual variant of the portal vein , Journal of Clinical Diagnostic Research, 2012; 6(4): 731-733
4. Gorantla VR, Potu BK, Pulakunta T, Vollala VR, Addala PK, Nayak SR; Anomalous formation of the portal vein: a case report. Jornal Vascular Brasileiro, 2007; 6(4): 399-401.
5. Chaijaroonkhanarak W, Woraputtaporn W, Amarttayakong P, Umka J, Brown K, Pannangrong W, Namking M; Length, Diameter and Variations in Types of Portal Vein Formations in Northeastern Thais. Srinagarind Medical Journal (SMJ), 2010; 25(4): 323-327.
6. Benninger B; Splenomesenteric vein: formally recognising a clinically relevant section of the portal venous drainage system. Folia Morphologica, 2013; 72(1): 63-66.
7. W.Henry Hollinshead; The Stomach, Duodenum, Pancreas and Spleen. Anatomy for Surgeons. Volume 2 Thorax, Abdomen and pelvis, 2nd edition, Medical Department, Harper and Row Publishers, New York, Evanston, San Francisco, London, 1971: 448-449.
8. Covey AM, Brody LA, Getrajdman GI, Sofocleous CT, Brown KT; Incidence, patterns, and clinical relevance of variant portal vein

anatomy. AJR Am J Roentgenol, 2004; 183(4): 1055-1064.

9. Chitra PS, Maheshwari K, Anandhi V; Prepancreatic formation of portal vein associated with prepancreatic superior mesenteric artery and splenic vein. International Journal of Anatomical Variations, 2014; 7: 35-36.
10. Sztika DORINA, Zahoi DE, Motoc A, Ureche MF, Daescu E; Anatomical variations of the hepatic portal vein associated with incomplete celiac trunk. Rom J Morphol Embryol, 2011; 52(2): 695-698.