

## Original Research Article

# Investigation of formation variation of portal vein with multidetector computed tomography

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### ABSTRACT

**Background:** To determine the types, frequency and clinical implications of formation of variations of portal vein with routine abdominal multi detector CT.

**Methods:** MDCT images of 265 patients without any pathology were evaluated. Types and frequencies of formation variations of portal vein were determined.

**Results:** Portail vein formation variations were observed in 186 (70.15%) of our study population. Normal portal vein was detected in 79 (29.8%) images. These variations were classified according to frequency. Normal anatomic structure was determined as type 1. Type 1 was observed in 79 (29.8%) images. As type 2 variation, left gastric vein flows into splenic vein instead of portal vein (60.75%). The type 3 of portal vein variation as uniting of superior mesenteric vein, inferior mesenteric vein and splenic vein at the same trunk to form portal vein was determined 9.43%.

**Conclusions:** This study, which was performed to determine the anatomical variations of portail vein, makes the type 2 variation rate higher than the other studies. This information is different from the classical anatomy information. In addition, we are able to make the radiologists and surgeons highly capable of both recognition and functionality of the results.

**Keywords:** Anatomy, Gastric vein, MDCT, Portail vein

### INTRODUCTION

Portal vein carries nutrient-rich blood from gastrointestinal system organs to liver. This vein is composed of lienal vein and superior mesenteric vein at collum level of pancreas. Inferior mesenteric vein, left gastric vein, right gastric vein, para-umbilical vein, cystic vein, superior pancreatico-duodenal vein flow to hepatic portal vein. Venous drainage of all gastrointestinal system except anal canal and inferior part of rectum flows to portal vein. Venous drainage of spleen, pancreas

and gall bladder also flows to portal vein. Portal system is a functional system which enables the nutrients absorbed from intestines to reach liver. Differently from venous system, it begins at capillary of small intestine and ends at venous capillaries of liver.<sup>1,2</sup>

Venous flow of some organs is both into systemic veins and portal system. This venous net which is defined as porto-caval venous anastomosis is located under esophagus, around rectum, in para-umbilical region and around the organs which are located in posterior wall of

abdomen and not completely covered by peritoneum.<sup>3,4</sup> These anastomoses are of great importance with regard to clinical practice. Portal hypertension develops as the result of elevated blood pressure in portal vein and its branches. These anastomoses are surgically opened in diseases like portal vein thrombosis, cirrhosis and cholangio-carcinoma which are the complications of portal hypertension.<sup>5,6</sup> In this study, we aimed to investigate the veins which form portal vein using multi detector computed tomography (MDCT) technique and to make a classification according to types. Being aware of these variations is quite important for reducing risk.

## METHODS

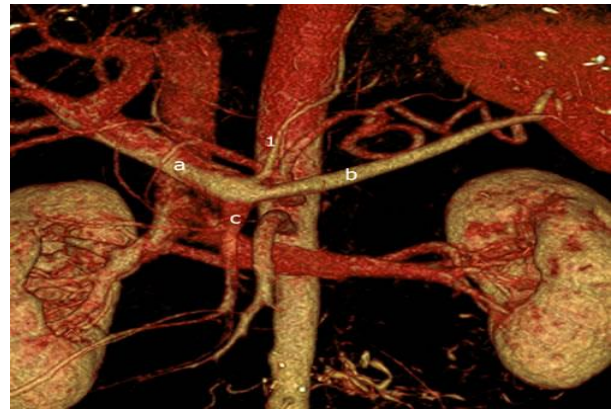
This retrospective study was conducted between August 2014 and June 2016 with the approval of Medical Ethics Committee numbered 2012/91 at Mevlana University Faculty of Medicine. Of 278 subjects, 13 subjects (4.67%) who did not have clear images were excluded, and 265 subjects (95.32%) with excellent images were included. Tomography images of 265 patients and who underwent routine abdomen MDCT imaging at Radiology Department of Selcuk University Medical School were analyzed. Examinations were done using 256-sections double tube CT device (Siemens, Somatom, Definition Flash, Germany), at routine 3mm section thickness and with 1mm section interval after reconstruction and at 1mm section thickness. The study included non-surgical subjects with no pathology. Superior mesenteric vein and lienal vein which form portal vein were analyzed with multi-planar reconstruction (MPR), maximum intensity projection (MIP) and 3D volume rendering images, and variations were detected. No statistical analysis was performed in the study.

## RESULTS

A total of 265 abdominal MDCT images were analyzed in the study. Normal portal vein was detected in 79 (29.8%) images. Remaining 186 (70.15%) images were accepted as variation. These variations were divided into the types from 1 to 3 in an array ranked from the most frequent to the least frequent. In contrast to the previous studies, the incidence of type 2 was found to be higher than the incidence of type 1.

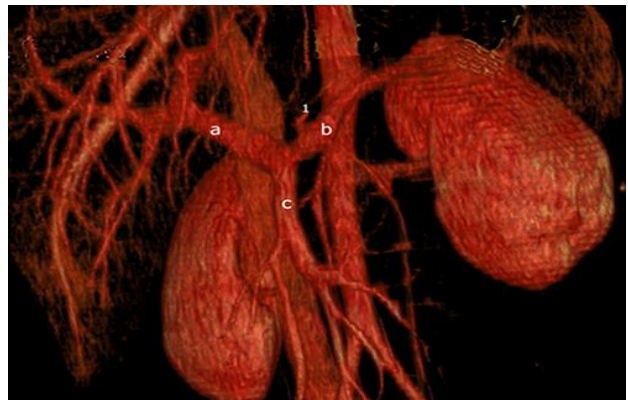
Portal vein is formed by conjunction of superior mesenteric vein and lienal vein. Left gastric vein flows into portal vein.<sup>7</sup> This formation is described as normal anatomy in classical books. In our study, 79 images (29.8%) showed normal anatomic structure (Figure 1) type 1 is named.

In the type 2 group, portal vein is formed by conjunction of superior mesenteric vein and lienal vein but left gastric vein flows into lienal vein instead of portal vein (Figure 2). This type was detected in 161 images (60.75%).



(a. Portail vein, b. Lienal vein c. Superior mesenteric vein, 1. Left gastric vein)

**Figure 1: Type 1 portal vein is formed by conjunction of superior mesenteric vein and lienal vein.**



(a. Portail vein, b. Lienal vein c. Superior mesenteric vein, 1. Left gastric vein)

**Figure 2: Type 2 left gastric vein flows into lienal vein instead of portal vein.**



(a. Portail vein, b. Lienal vein c. Superior mesenteric vein, 1. Left gastric vein)

**Figure 3: Type 3 inferior mesenteric vein, lienal vein and left gastric vein formed portal vein through joining with the same root.**

In type 3 group, portal vein formation was different from other groups. Inferior mesenteric vein, lienal vein and left gastric vein formed portal vein through joining with the

same root (Figure 3). This variation type was detected in 25 images (9.43%).

**DISCUSSION**

Limited number of studies is available in literature about portal vein formation. Multi detector computed tomography (MDCT) is an effective and safe imaging technique which enables us to understand vascular anatomy.<sup>8,9</sup> We have detected variations in the ratio of 70.15% in our study which was conducted through analysis of 265 MDCT images, that high ratio is seen rare.

Left gastric vein’s flowing into portal vein is accepted as a normal anatomic formation in classical textbooks.<sup>7</sup> We have detected that left gastric vein flows into portal vein in the ratio of 29.8% (Type 1) (Figure 1). This ratio was 43.7% in the study of Miyaki et al, 46.15% in the study of Li et al and 39% in the study of Sakaguchi et al (Table 1).<sup>10-12</sup> Varices may develop due to portal hypertension in the veins which flow into portal vein. Varices are most common in left gastric vein. Drainage variations of this vein are common.<sup>1,13,14</sup> We consider that detection of portal variations in routine examinations before abdominal surgery could reduce potential risks.

**Table 1: Ratio of types in literature.**

	Type 1	Type 2	Type 3
Sakaguchi et al <sup>12</sup>	39%	46.3%	
Miyaki et al <sup>10</sup>	43.7%	35.2%	21.2%
Li et al <sup>11</sup>	46.15%	30.77%	
Our study	29.8%	60.75%	9.43%

Left gastric vein’s flowing into lienal vein is accepted as a variation in classical textbooks (type 2). We have detected that left gastric vein flows into lienal vein in the ratio of 60.75%. This high ratio reveals that classical anatomy knowledge should be reviewed. In the previous studies, this ratio was found as 35.2% by Myaki et al, 30.77% by Li et al, 46.3% by Sakaguchi et al (Table 1).<sup>10-12</sup> Differently from literature, left gastric vein’s flowing into lienal vein was found higher than its flowing into portal vein which is accepted as normal. The area around left gastric vein is a difficult area for lymph node drainage during gastrectomy. Therefore, detecting the exact location of left gastric vein is important.<sup>13</sup>

Another variation was inferior mesenteric vein, lienal vein and left gastric vein’s joining with the same root and forming portal vein (type 3) which was in the ratio of 9.43%. In literature, only Miyaki et al were seen to define this variation in the ratio of 21.2% (Table 1). Varices which are found in portal vein systemic collateral system are detected in cirrhosis.<sup>2</sup> These varices may present with severe symptoms in presence of venous variations.<sup>15</sup> Therefore definition of variations is important.

In literature, systematic classification of variations is recommended.<sup>14</sup> In previous studies, hepatic variations of portal vein were analyzed. Location and diameter were examined in extra-hepatic analyses. No studies could be encountered about formation typing of portal vein, typing was first defined in our study.

Knowing vascular anatomy is of great importance for the surgeons before gastric resection of gastric cancer patients.<sup>11,14</sup> Timely diagnosis and selecting the proper method is of vital importance due to fatal complications of portal vein thrombosis like mesentery infarct.<sup>5</sup>

Vascular anatomy and variations can be easily detected with MDCT method which has rapidly developed in recent years. This enables to explain many clinical symptoms and reduces the risks of surgical interventions. This study which was conducted for detecting anatomic variations of portal vein has revealed that classical anatomy knowledge should be updated as it is the first study which classifies veins according to variation and detects the high ratio of type 2 variation. We also consider that the results could significantly contribute to radiologists and surgeons both for diagnosis and surgical approaches.

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