



Normal Main Portal Vein Diameter – Is the Upper Limit Of 13 Mm Low?

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ABSTRACT

Objective: We aimed to compare the normal main portal vein diameter measured in computed tomography with the commonly used upper limit value.

Methods: Computed tomography examinations performed between March 2015 and April 2018 in our department were scanned from the archive system. Mean portal vein diameters were measured on axial contrast-enhanced and non-enhanced abdominal CT scans of the patients without any known disease.

Results: 500 main portal vein measurements were performed from 276 individuals. In the non-enhanced images (n = 243), the mean diameter of main portal vein was 15.03 ± 1.72 mm and in the post-contrast enhanced images (n = 257) the mean diameter of the main portal vein was 15.05 ± 1.71 mm. These values showed a significant difference from the widely accepted upper limit of 13 mm (95% confidence interval for non-enhanced images: 1.81-2.25 mm higher, $p < 0.001$, 95% confidence interval for post-contrast images: 1.84-2.26 mm higher, $p < 0.001$). The mean main portal vein diameter measured from contrast tomography images was 0.26 mm wider than the mean main portal vein diameter measured at non-enhanced images (95% confidence interval: 0.23-0.29 mm, $p < 0.001$).

Conclusion: The mean normal portal vein diameter measured in computed tomography (15.05 mm) was significantly higher than the accepted upper limit of 13 mm ($p < 0.0001$). The mean main portal vein diameter in contrast-enhanced tomography was 0.26 mm larger than the mean main portal vein diameter measured in the non-enhanced examination.

Keywords: Computed tomography, mean diameter, portal vein, portal hypertension, upper limit

INTRODUCTION

An increase in the diameter of the portal vein indicates portal hypertension. Studies have shown that the frequency of esophageal varices increases as the portal vein diameter gets bigger (1).

Ultrasound (US) examination is an important diagnostic method for detecting portal hypertension (2–4), and most studies on portal vein diameter performed measurements with US. In these studies, main portal vein diameter values are between 9.6 and 12.5 mm in healthy individuals (5-7). The upper limit values for the diameter of a normal portal vein reported in these studies were between 11.7 mm and 14 mm. Furthermore, literature indicates that the commonly accepted normal upper limit value of the diameter of the main portal vein is 13 mm (8-10). However, when evaluating abdominal computed tomography (CT) examinations in our daily routine, we observed that the main portal vein diameter was higher than this commonly accepted value mentioned above in many CT examinations, and we thought that it was important to determine whether the upper limit value of the main portal vein diameter is larger than the previously mentioned values. In this study, we aimed to compare the nor-

mal main portal vein diameter measured by CT scans with the commonly used upper limit value.

METHODS

The study was conducted retrospectively with the approval of the Ethics Committee of our university (Decision No: 2018/245). In this retrospective study, computerized tomography examinations performed at Department of Radiology of Gaziantep University Medical School between March 2015 and April 2018, were scanned from the archive system and the main portal vein diameter measurements were obtained from non-contrast and contrast-enhanced tomography images of patients without any known disease. Patients with liver diseases or liver enzyme disorders were excluded from the study.

Imaging Technique

CT imaging was performed on a 64-slice CT device (LightSpeed VCT-XTe; General Electric Company, Milwaukee, USA). The scan area was between the level of the diaphragm and the symphysis pubis. The following were the CT configurations: shooting parameters 100 kV; 450 mAs; section thickness 5 mm; and

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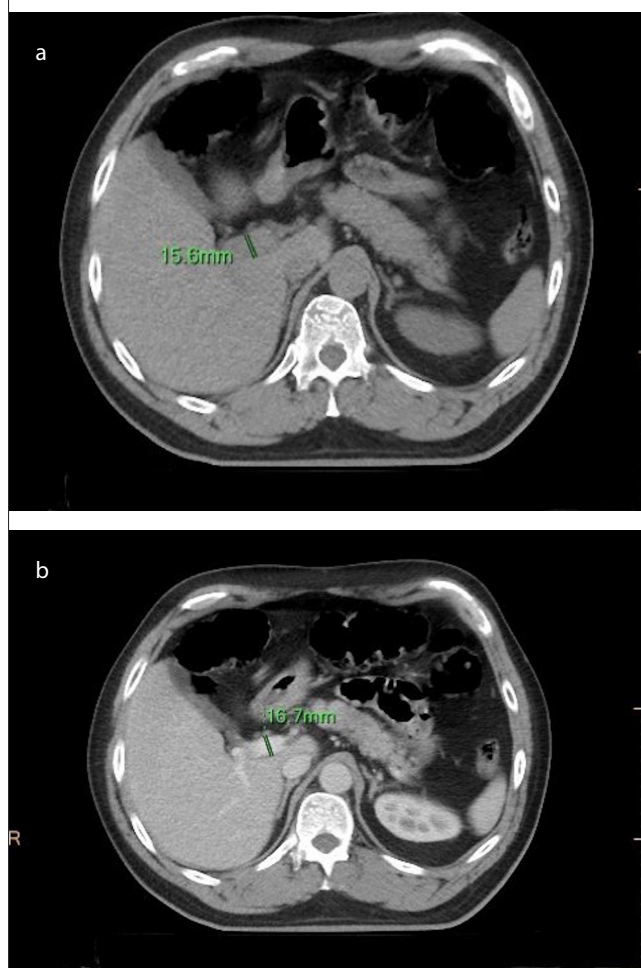


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Table 1. Main portal vein diameter (mm) in non-contrast CT and minimum, maximum, mean and standard deviation values of main portal vein diameters (mm) in contrast-enhanced CT

	Number of patients (N)	Minimum Value	Maximum Value	Mean	Standard Deviation
Main portal vein diameter in non-contrast CT (mm)	243	10.45	22.33	15.0344	1.72951
Main portal vein diameter in contrast-enhanced CT (mm)	257	10.75	20.11	15.0512	1.71864

Figure 1. a, b. Measurements of the diameter of the main portal vein of a 42-year-old man. (a) Diameter of the main portal vein on non-contrast-enhanced CT. (b) Diameter of the main portal vein on contrast-enhanced CT.

**Main Points:**

- The normal diameter of the main portal vein measured on CT examination is different from the commonly accepted normal value of 13 mm.
- The mean diameter of the main portal vein measured using contrast-enhanced CT was larger than that measured using non-contrast-enhanced CT.
- Considering that the mean diameter of the main portal vein on CT is 15.5 mm in healthy subjects, the normal upper limit will be higher than this value.

gantry angle 0°. The dose of the intravenous contrast medium (Iohexol, 350 mg/mL; GE Healthcare, Cork, Ireland) given was 1.5-2 mL/kg.

Evaluation of Images

CT images were evaluated on the workstation via PACS (image archiving and communication system). Portal vein diameter measurements were performed on axial contrast-enhanced and non-enhanced abdominal CT scans. Measurements were made 1 cm distal from the junction of the splenic vein and superior mesenteric vein and at least 1 cm proximal without giving the first branch of the main portal vein. Measured values were recorded in millimeters as shown in Figure 1.

Statistical Analysis

The suitability of the data for normal distribution was tested with the Shapiro-Wilk test. Student's t test was used for comparison of the normally distributed variables in two groups, and Mann-Whitney U test was used for the non-normally distributed variables. Single sample t test was used to test the difference of numerical variables from a standard value, and paired t test was used to compare two dependent measurements. Spearman rank correlation coefficient was used to investigate the relationships between numerical variables. Descriptive statistics mean \pm standard deviation for numerical variables, 95% confidence interval and number and % values for categorical variables. Statistical Package for the Social Sciences for Windows version 22.0 (IBM SPSS Corp., Armonk, NY, USA) was used for statistical analysis and $p < 0.05$ was considered statistically significant.

RESULTS

A total of 500 main portal veins were measured from a total of 276 individuals, 124 of which were female (55.1%) and 152 were male (44.9%). The mean age was 54.05 ± 14.8 years (range 21-88). The mean diameter of the main portal vein was 15.03 ± 1.72 mm in the non-enhanced examinations ($n=243$), and 15.05 ± 1.71 mm in the mean examination in contrast-enhanced examinations ($n=257$). This value was significantly different from the commonly accepted 13 mm (95% confidence interval for non-contrast CT: 1.81-2.25 mm higher, $p < 0.001$; 95% confidence interval for contrast CT: 1.84-2.26 mm higher, $p < 0.001$). The mean diameter of the main portal vein measured by contrast-enhanced tomography was 0.26 mm wider than the mean diameter of the main portal vein in non-enhanced examination (95% confidence interval: 0.23-0.29 mm, $p < 0.001$). Table 1 shows the minimum, maximum, mean and standard deviation of the main portal vein diameter (mm) in non-enhanced CT and the main portal vein diameters (mm) in contrast-enhanced CT.

DISCUSSION

In this retrospective study, the mean main portal vein diameter (15.05mm) measured on computed tomography was significantly higher than that of the commonly accepted upper normal limit, which is 13 mm. The mean main portal vein diameter measured from contrast-enhanced tomography was 0,26 mm wider than that of the non-contrast series.

In our study, the normal main portal vein diameter measured on CT examination was significantly different from the commonly accepted 13 mm. Considering that we found the mean main portal vein diameter to be 15.5 mm in healthy subjects on CT, we expect that the upper normal value will be higher than this value. For this reason, it will be useful to perform CT studies to assess the predictive value between healthy and diseased people.

In the literature, there have been studies performed with ultrasound and found that the mean portal vein diameter was lower in healthy subjects (5-7).

In a retrospective study conducted by Stamm et al. (11), who studied the mean portal vein diameter via CT evaluation similar to how it was performed in our study, the mean portal vein diameter was found to be 15.5±1.9 mm in contrast and non-enhanced CT series of 191 healthy subjects, which is quite close to that of measured in our study, with the average value of 15.05 mm. In the present study, the mean diameter of the main portal vein measured by contrast-enhanced tomography was 0.26 mm wider than the mean diameter of the main portal vein in non-enhanced examination (95% confidence interval: 0.40-0.71 mm, $p < 0.0001$). In our study, there was a difference between the mean portal vein diameters measured in non-enhanced and contrast-enhanced imaging, which was slightly lower than in the present study (1.84-2.26 mm $p < 0.001$).

In general, during abdominal CT examination, the patients are asked to take deep breaths just before CT imaging begins, which is done so in our department as well, and CT scans are performed while the patient is still holding his or her breath. In studies conducted with ultrasound examination in the literature, it is noticed that in some of these studies, the measurements were taken during normal respiration (12) and in some other studies, the respiratory phase of the measurement of the patient was not specified (5, 7). The discrepancies of the values of mean portal vein diameter may be due to these different methodologies applied during ultrasound and CT examinations. It may be suggested that, while performing studies for the evaluation of mean portal vein diameter, it may be of great benefit to use similar methods which may lead to more accurate results and reduce measurement variations.

Although this study was performed by using a large number of subjects, it has some limitations too. The first one is that none of the subjects who were included in the study had any established or suspected liver disease, but still, in some of the subjects, liver function tests had not been performed. In addition, although the upper limit of normal mean portal vein was evaluated, this study did not include the patients with liver diseases and thus it was not possible to determine a predictive value differentiating the normal and pathological mean portal vein diameter values.

Other studies conducted in the future, may prove useful to determine such a value.

As a conclusion, in this study it was found that the mean portal vein diameter with the value measured as 15.05 mm on computed tomography, was significantly higher than the generally accepted upper limit value of 13 mm ($p < 0.0001$) and the mean diameter of the main portal vein measured by contrast-enhanced tomography was 0.26 mm wider than that of the main portal vein in non-contrast imaging.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Gaziantep University School of Medicine (2018/245).

Informed Consent: Due to the retrospective design of the study, informed consent was not taken.

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