Ultrasound Investigation of Parametric Values of Portal Vein Diameter in Healthy Subjects and Patients with Chronic Diffuse Liver Disease

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ABSTRACT

Introduction: Portal vein in healthy subjects and in patient with chronic diffuse liver disease was investigated by the combination of real-time technique and Doppler impulsive system. Patients and methods: Control group consisted of 99 healthy subjects of median age of 36,8, and with life raging span from 14 to 77 yrs. Experimental group consisted of 55 patients with histologically proved liver disease approximately aged 48,1 yrs. And with life span from 11 to 77 yrs. In 15 patients, portal hypertension was proved, by the measurement of Wedged hepatic venous pressure (WXVP). Results: VP diameter was normally distributed in healthy subjects, variable with E(X) = 11,202 mm and SD = 1, 2534. The mentioned variable was also normally distributed in experimental group with E(X) = 10, 8 mm and SD = 1, 4832. VP diameter in healthy subjects did not statistically significantly differ from that one of the patient with chronic diffuse liver disease, which in contradictory to the generally accepted concepts. According to our results, portal vein diameter should not be taken as a parameter of portal hypertension.

Key words: ultrasound, portal vein, diameter, chronic diffuse liver disease.

1. INTRODUCTION

Investigation of portal circulation in healthy subjects and in liver diseases patients has engaged for many years the attention of investigators (1). In distinction from other blood vessels systems, portal vein (VP) is a part of circulation which does not allow a simple catheter approach (2). Therefore, it is very little known about the influence of various pathologic occurrences upon it. In distinction from the majority of upper abdomen blood vessels, portal vein system is very convenient for real-time measurement and impulse Doppler technique (3). According to some authors VP diameter of healthy subjects varies from 8 to 25 mm, and by ultrasonic technique, can be well presented on slope subcostal sections.

By measuring of VP diameter by the combination of ultrasonic real-time technique and impulsion Doppler system, the authors wanted to prove non aggressive application as a reliable diagnostic method in every day practice and to investigate whether there is any influence of pathologic occurrences in liver upon VP diameter. Besides, the authors wanted to investigate the possible VP diameter variations connected with sex and age of healthy examinees compared with possible changes of the mentioned parameter in patients with chronic diffuse liver diseases.

2. MATERIAL AND METHODS

Examinees were divided into two main groups. The first one, control group, included 99 healthy subjects of median age of 36,8 yrs. and life span from 14 to 77 yrs. In this group there were 17 male and 82 female examinees. The second group was experimental one and consisted of 55 patients with histologically diffuse chronic liver disease.

<table>
<thead>
<tr>
<th>Group</th>
<th>No. of examinees</th>
<th>Male No %</th>
<th>Female No %</th>
<th>Median Life span</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>99</td>
<td>17 17,7%</td>
<td>82 82,3%</td>
<td>36,8</td>
</tr>
<tr>
<td>Experimental</td>
<td>55</td>
<td>36 64,7%</td>
<td>19 35,5%</td>
<td>48,1</td>
</tr>
<tr>
<td>Grand total</td>
<td>154</td>
<td>53 34,4%</td>
<td>101 65,6%</td>
<td>40,8</td>
</tr>
</tbody>
</table>

Table 1 Basic characteristics of control and experimental group examinees
Median age was 48.1 yrs. with span from 11 to 77 yrs. in this group there were 36 males and 19 females. The basic characteristics of both groups are presented in Table 1.

The examinees of the experimental group were divided into subgroups according to the histological diagnosis. There were six subgroups differentiated and presented in Table 2. Measurements of portal vein diameter in the control and experimental group respectively were accomplished with the combination of real-time technique and Doppler system on Toshiba Sonolayer-L SAL-50A and PULSED DOPPLER UNIT SDL-01A apparatus with PLD 362A transducers.

<table>
<thead>
<tr>
<th>Histologically proved diagnosis</th>
<th>No. of examinees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic persisting hepatitis</td>
<td>7</td>
</tr>
<tr>
<td>Chronic active hepatitis</td>
<td>12</td>
</tr>
<tr>
<td>Active liver cirrhosis</td>
<td>9</td>
</tr>
<tr>
<td>Decompensated liver cirrhosis</td>
<td>16</td>
</tr>
<tr>
<td>Liver cirrhosis (without signs of activity or decompensation)</td>
<td>5</td>
</tr>
<tr>
<td>Liver steatosis</td>
<td>6</td>
</tr>
<tr>
<td>Total No. of examinees</td>
<td>55</td>
</tr>
</tbody>
</table>

Table 2: Experimental group divided into subgroups according to histological diagnosis

Under the control of ultrasound, and by the real-time technique, blood vessel was first located, and then internal diameter of the vessel was measured by calipers. For Doppler measurement a special transducer was applied. It was directed towards the scope of measured accommodating sensitive volume sample, so that the complete vessel was included. For each measurement, an average of three readings was taken.

3. RESULTS

Statistical elaboration of the data obtained showed that the age of the control group was normally distributed with E(X) = 36,838 yrs. and SD = 10,828. The mentioned parameter was also normally distributed in experimental group with E(X) = 48,145 yrs. and SD = 11,019.

It is obvious that the median age of experimental group the age was higher than in the control one. This investigation has not established the statistically and correlatively essential connection between the age and portal vein diameter.

<table>
<thead>
<tr>
<th>Group</th>
<th>Pair of variables</th>
<th>Correlation coefficient</th>
<th>Z-transformation</th>
<th>Significance of connection based on Z-transformation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>Age–portal vein diameter</td>
<td>0.042</td>
<td>0.681</td>
<td>Non existing</td>
</tr>
<tr>
<td>Experimental</td>
<td>Age – portal vein diameter</td>
<td>0.099</td>
<td>0.473</td>
<td>Non existing</td>
</tr>
</tbody>
</table>

Table 3: Matrix of correlation coefficients and Z-transformation of pair variables age-portal vein diameter in control and experimental group

Matrix of correlation coefficient and Z-transformation of variables pairs in control and experimental group is shown in Table 3.

According to the Komogorov-Smirnov test, portal vein diameter in control group is normally distributed variable with E(X) = 11,202 mm and SD = 1,2534 and the same was the case in the experimental group with E(X) = 10,8 mm and SD = 1,4832. With 99% reliability it can be expected that the healthy subjects will have E(X) between 10,87 and 11,53 mm, that is the variant between 1,117 and 2,344.

With 99% of probability, it is expected that the examinees in experimental group will have portal vein diameter between 10,27 and 11,33 mm with variant between 1,405 and 3,833. Minimal value of portal vein diameter in the control group was 9 mm, and maximal 16 mm, while minimal value of portal vein diameter in experimental group was 8 mm, and maximal one 15 mm.

The results of measurements showed that portal vein diameter in healthy subjects statistically significantly differed from the one in patients with chronic diffuse liver disease.

Adequate statistical testing showed that portal vein diameter in healthy subjects significantly differed considering sex. Usually, healthy women have lower mean values of portal vein diameter than healthy men, so that in this group the diameter in men was 12,06 mm and in women 11,02 mm.

Statistically significant difference of portal vein diameter, considering sex, in experimental group was not found. The comparison of portal vein diameter between the control and experimental group did not give any statistical difference.

In Table 4 mean differences and SD variables of body surface and portal vein diameter in both groups are presented.

<table>
<thead>
<tr>
<th>Group</th>
<th>Body surface (m²)</th>
<th>Portal vein diameter (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>E(X)</td>
<td>SD</td>
</tr>
<tr>
<td>Control</td>
<td>1,347</td>
<td>0,194</td>
</tr>
<tr>
<td></td>
<td>11,20</td>
<td>1,2534</td>
</tr>
<tr>
<td>Experimental</td>
<td>1,426</td>
<td>0,245</td>
</tr>
<tr>
<td></td>
<td>10,80</td>
<td>1,4832</td>
</tr>
</tbody>
</table>

Table 4: Medium and standard deviations of variables of body surface and portal vein diameter in control and experimental group

4. DISCUSSION

In this investigation a special attention was paid to the choice of examinees. The intention was that the control group should follow certain variables (sex, age) to be as close as possible to the experimental one (Table 1). Total number of 55 examinees in the experimental group, although relatively small, was still enough for the scientific investigation (4).

The results showed that the variable of portal vein diameter in the control group was normally distributed with E(X) = 11,202 mm and SD = 1,2534. Similar values were found by the other authors too (5, 6, 7). The same variable in experimental group was also normally distributed with E(X) = 10,8 mm and SD = 1,4832. From these results it could be concluded that portal vein diameter in healthy persons, significantly differ liver disease, which is contrary to the so far generally accepted attitudes (8, 9, 10, 11, 12, 13, 18, 19, 20).

Only Brunella D. et al stated that by the investigation of portal hypertension in children, by means of ultrasound, the difference in portal vein diameter between the group

of patients with portal hypertension and the control group, was not found.

According to other authors there are some statistical differences in portal vein diameter in healthy subjects and patients with chronic diffuse liver disease.

Bolondi L. et al. (12) said in their study that portal vein diameter in healthy persons was less than 1.3 cm, and that in 47% of patients with portal hypertension it was the same or greater than 1.3 cm.

Elwetovski M. et al (13), in their papers gave the data that in 57% of patients with portal hypertension, the extension of portal vein was not found. Our investigations show that there is no statistically significant difference portal vein diameter between healthy subjects and patients with chronic diffuse liver diseases, and therefore, portal vein diameter should not be taken as a parameter of portal hypertension, respectively chronic diffuse liver disease.

To our opinion the reason the portal vein diameter in patients with chronic diffuse liver disease does not extend due to the following factors: The existing very rich inter-section of intra- and extra-hepatal flow of portal vein and blood regurgitation into splanchnic pool;

Relatively low pressures in portal vein system, in normal conditions as well as in pathologic ones, that are very well known from up-to-date investigations

The well known fact that collaterals open already at the pressure of 2 kPa (15mmHg).

Because of all the mentioned before, and according to our opinion, high pressures in portal vein that would create the conditions for its dilatation do not develop. Comparing portal vein and pulmonary artery which are of relatively similar consistency, it is obvious that pulmonary artery only extends slightly at pressures higher than 35 mmHg. In portal hypertension, pressures higher than 35 mmHg are rarely found, which was proved by measuring wedged hepatic venous pressure (WHVP) in our patients too.

In the control group the difference of portal vein diameter, considering sex, was not found. So in this group portal diameter in male patients was statistically significantly different, than one in females. These data were not found in literature (15, 16, 17) except in Moriyasu F. and Ban N. (6) who in healthy subjects (N=36) found the difference of portal vein diameter between men and women where the mean value in men (N=18) was 1.22 ± 0.24 cm and in women (N=18) 0.97 ± 0.18 cm.

In the experimental group no statistically significant difference, considering sex, was found, which may be due to a small number of subjects. The comparison of portal vein diameter, considering sex in both groups did not give statistically significant difference. Investigating correlation between age and portal vein diameter, both in healthy and in sick subjects, we found that there is no statistically.

**CONFLICT OF INTEREST: NONE DECLARED**

**REFERENCES**