



Science

## **SPLENIC SIZE RELATION TO THE PORTAL VEIN DOPPLER ANALYSIS IN SUDANESE LIVER TRANSPLANTS**

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### **Abstract**

The purpose of this study was to identify the specific Doppler criteria for the portal vein as well as the spleen length or volume in liver transplants. A relative study was done after performing venous Doppler sonographic studies in 45 liver transplant cases (4 whole liver, 41 lobar) with no known vascular complications. The ultrasonic Doppler study were targeted to the portal vein flow direction, flow velocity in Doppler level and the caliber in gray scale level. Average gray scale and color flow mapping appearances as well as normal monophasic wave character was found. The following Doppler parameters were evaluated: for the portal veins, venous pulsatility index. There were no cases of portal vein obstruction found in our sample (neither stenosis, nor occlusion). Mean portal vein velocity was (less than 55 cm /s), the splenic length was (13.7±1.5). The relation between the portal venous index, and the splenic length was built. Both are useful parameters for diagnosing liver transplants complications.

**Keywords:** Spleen; Portal Vein; Liver Transplants; Doppler Ultrasonography.

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### **1. Introduction**

Liver transplantation is the only curative treatment for end-stage liver disease. The common indications for liver transplantation include cirrhosis secondary to alcoholic liver disease, hepatitis, hepatocellular carcinoma, non-alcoholic steatohepatitis, cholestatic and metabolic diseases, and fulminant hepatic failure, in Sudan bilharzia is still the main cause. Over the last few decades, advancement in surgical techniques and perioperative management has greatly improved the

outcomes of liver transplantation. Early detection of vascular complications by postoperative Doppler imaging has played a vital role in decreasing the incidence of graft failure. Here, we discuss the color Doppler imaging findings after liver transplantation for accurate and early detection of vascular complications.

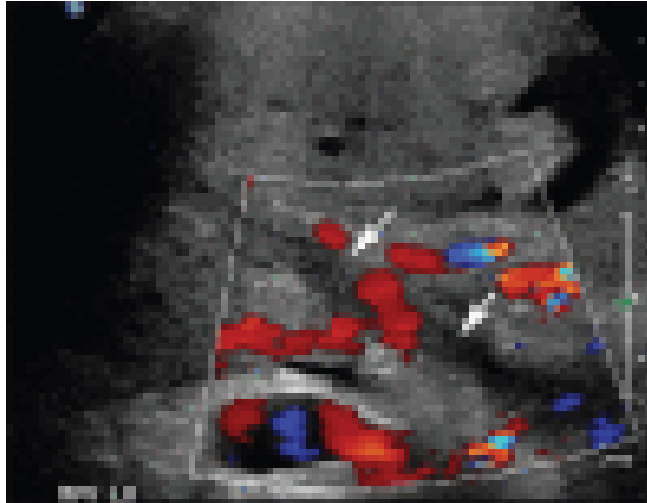


Figure 1: Portal vein thrombosis. Doppler ultrasound of the main portal vein following liver transplant shows echogenic thrombus within the main portal vein with lack of color-filling, consistent with portal vein thrombosis (arrows).

### **Role of Doppler Ultrasound in Postoperative Evaluation**

Vascular complications are a common cause for allograft failure after hepatic transplantation. (Duffy JP, et al 2009). Early detection and treatment of vascular complications help reduce the incidence of graft failure. Doppler ultrasound is a noninvasive test that allows real time dynamic evaluation of the allograft vasculature and is extensively used in the postoperative evaluation of allografts. Gray-scale ultrasound of the right upper quadrant precedes Doppler interrogation of the allograft vasculature. Along with evaluation of the hepatic parenchyma, attention is paid to the presence any perihepatic fluid collection. Perihepatic fluid collections may represent postoperative hematomas, seromas or bilomas. Superinfection of any fluid collection can cause abscess formation. Pneumobilia can be present in patients with bilioenteric anastomosis. Presence of biliary dilation may indicate development of biliary stenosis. Doppler examination of the liver transplant involves interrogation of the main hepatic artery and its intrahepatic branches, main portal vein and its branches, hepatic veins, and the IVC.

Portal vein stenosis is another complication occasionally seen after transplantation. Clinically significant portal vein stenosis after transplantation is rare and usually occurs in the pediatric and living donor population, due to the small graft vein size. (Wozney P, et al 1986). Portal vein stenosis presenting within six months is likely due to technical reasons and a more delayed presentation is due to neo-intimal hyperplasia. (Saad WE, et al 2012). The presentation is similar to portal vein thrombosis with portal hypertension or hepatic failure. Aliasing and a three-to-four fold increase in velocity is noted at the stenotic segment of the portal vein. (Woo DH, et al. 2007, Nghiem HV, et al. 1996.) A venogram, with measurement of the pressure gradient across the stenotic segment can be performed to assess the functional significance of the narrowing (Figure 2). Portal venous stenosis is treated with catheter-guided angioplasty, and if necessary stenting.

(Funaki B, et al. 2000) Portal vein thrombosis can be a complication of portal vein angioplasty or stenting. (Saad WE, et al 2012).

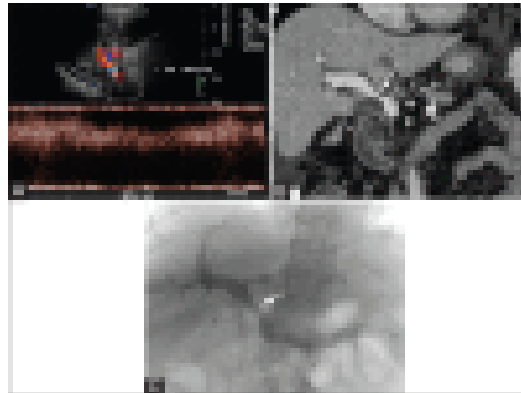


Figure 2: (A) Portal vein stenosis. Doppler ultrasound of the main portal vein following liver transplant shows a focal area of aliasing and increased velocity (149 cm/s). The adjacent segment of the portal vein has a velocity of 40 cm/s. This was considered suspicious.

## 2. Materials and Methods

**Material:** Equipment: Data collection sheets. Couch; pillow; bed sheet; cover; sterile gloves; acoustic gel. Two ultrasound machines of complete capabilities (ALOKA prosound; SSD-3500SX, and TOSHIBA US SYSTEM); with two probes (curvilinear = 3.5-7 MHz and linear = 7.5 -12 MHz).

**Method:** The study done during the period from 1<sup>st</sup> April 2016 to 30<sup>th</sup> July 2017. The design used in this study, was the co-relation study. The waveforms, caliber and velocity of the portal vein is performed plus the splenic size was measured in the objected transplanted livers (45, 4 whole liver, 41 lobar), this was out of only 65 patients in Sudan with transplanted liver, 9 of them was children (age between 1.5 - 65 years.), 76 % Males; 24 % Females, has been tested and enter the study.

**Inclusion criteria in the case:** Sudanese people that underwent liver transplantation, male or a female, adult or a child.

**Exclusion criteria in the case:** very ill or rejected liver transplantation (social and familial purposes).

**Sample size and type:** The data of this study collected from the 345 objects, 300 of them was young normal volunteers selected randomly. The other 45 objects was those with liver transplantation.

**Methods of data collection and technique:** Using the data sheet to collect the data, we perform both transverse and longitudinal ultrasound techniques plus coronal oblique; putting the transducer in four main points:

the mid-line, 2- the mid clavicular line, 3- the anterior and 4- the mid axillary lines all are intercostally line that made a perpendicular imaginary line from the xiphisternum. In addition, sub costal scan is done in the same points.

**Variables of data collection:** The data of this study collected using the following variables: the liver texture in both case and control objects as well as the portal veins pulsatility (systolic velocity + caliber) and the splenic length in the transplanted liver.

**Methods of data analysis:** Using the suitable above-mentioned techniques, these all variables collected to create the data. Finally these data is tabulated, described, represented and analyzed using SPSS version 20, putting in mind that the p value is 0.01 using the chi square test as well as the t-tailed test [ p value is 0.05,  $R^2 < 1$ , when it is near to one it is significant for good relation] to know the significance. The results of this analysis put in a scientific frames and facts from which the medical decision and recommendations is created. **Ethical approval:** Ethical approval has been granted from the hospital and the department of GIT bleeding and liver disease. In addition, consent from the patients was signed and oral agreement after they understand what will be done in the study. This did not include or disclose any [ID] information concerning the patient. Informed consent was obtained from all individual participants; if adult and parents in case of children; included in the study.

### 3. Results

Table 1: shows the sex distribution among the selected objects (patients).

Gender	Frequency
Male	34
Female	11
Total	45

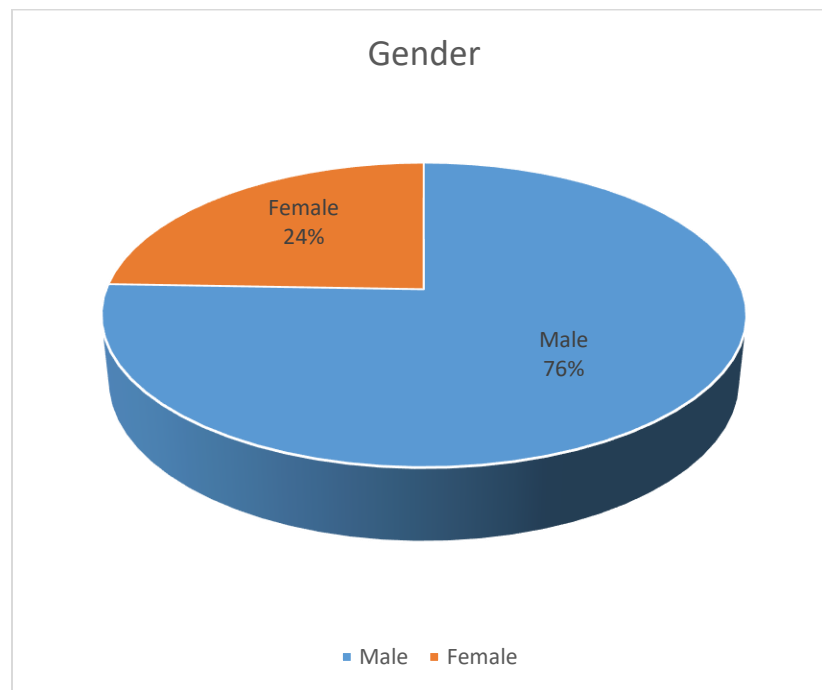


Figure 1: Pie chart represents the sex distribution percentage.

Table 2: shows the frequency distribution of the age groups in liver transplanted patients; the majority was between 34-44 years.

Age groups	Frequency
1-11	10
12-22	6
23-33	9
34-44	<b>13</b>
45-55	3
56-66	4

Table 3: shows the mean and the standard deviation in the transplanted livers of the age, resistive index, PV diameter, and the velocity of the PV; the CBD diameter, spleen length, and liver span.

variables	Mean ± SD	min	max
age	28.8±17.9	1.5	65
RI	0.7±0.1	0.55	0.78
Diameter	<b>12.8±1.4</b>	9	16
Velocity of PV	<b>34.9±11.6</b>	17	55
CBD_BD	3.5±1.2	2	7
Spleen length	<b>13.7±1.5</b>	11	17

Table 4: shows the T-test (2-tailed) in both the portal vein diameter and velocity.

Independent Samples Test		
	t-test for Equality of Means	
	t	Sig. (2-tailed)
Diameter PV	8.849	.000
Velocity PV	17.171	.000

Table 5: shows the frequency distribution of the spleen length.

Spleen (cm)	Frequency
10-11	3
12-13	22
14-15	14
16-17	6

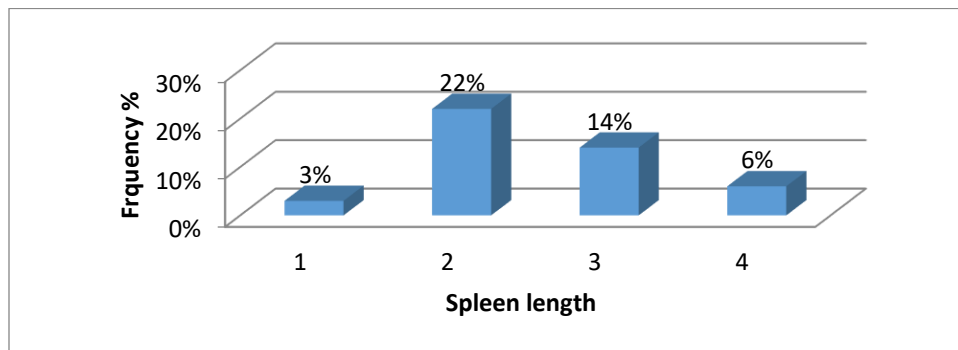


Figure 2: 3-D Bar chart shows the majority spleen volume or length in transplanted livers [22%] that was ranging from (10-20 cm).

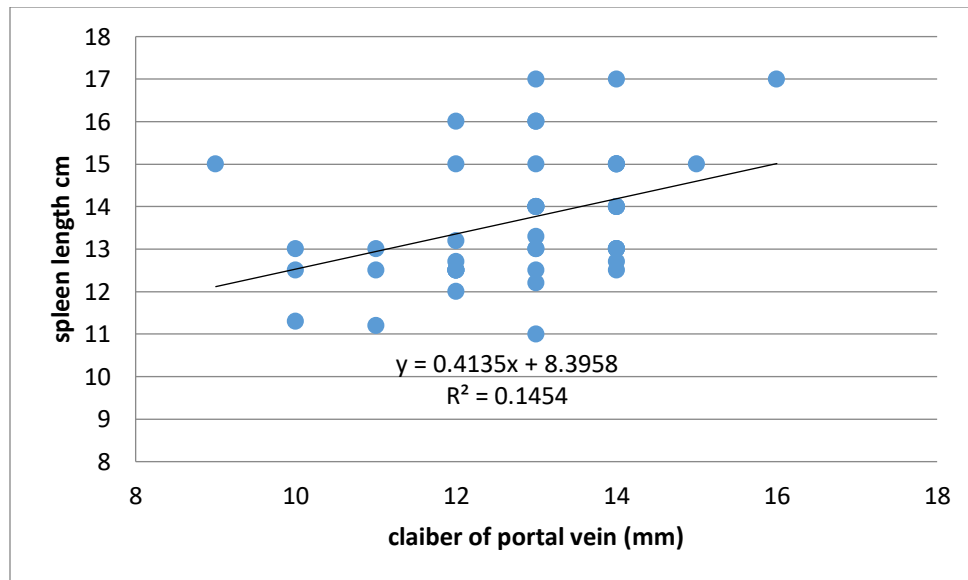


Figure 3: scatter plot chart shows the relation between the spleen length versus the caliber of the portal vein (given by this function;  $y = 0.4135x + 8.3958$ ).

#### 4. Discussion

The study done during the period from 1<sup>st</sup> April 2016 to 30<sup>th</sup> July 2017. The study show that there is strong relation between the portal vein caliber as well as flow velocity on one side and the splenic length or volume on the other side. This is given by the equation ( $y = 0.4 x + 8.3$ ). In addition, both the splenic length and the portal vein flow velocity as well as the caliber go back to near normal with time.

#### 5. Conclusion

The main objective of this study was to evaluate the transplanted liver among Sudanese using Doppler ultrasonography in order to find the main vascular complications that are related to the spleen and the portal vein. No vascular complications was found, however, strong relation between the splenic length in the transplanted liver patients and the portal vein caliber and flow velocity as well.

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