Sonographic Assessment of Maternal Portal Vein Diameter in Sudanese Healthy Pregnancy Women.

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Abstract: Background: The portal vein (PV) and hepatic artery are the main sources of blood supply of the liver. Portal hypertension is a major abnormality of the portal venous system. Studies on hepatic blood flow changes in pregnancy have not been consistent, while some studies have reported no significant changes in hepatic blood flow during pregnancy, despite a marked increase in cardiac output, others have demonstrated an increase, and this increase has been attributed to a preferential increase in portal venous blood flow, so sonography is a good diagnostic tool that plays a significant role in diagnosis and follow-up patients with portal hypertension.
Objective: to assess portal vein diameter in Sudanese healthy pregnant women using ultrasonography.

Methodology: a descriptive, cross section study conducted in Sudanese refugee camp in chad adare city in Dar AL-hechma Medical Center at ultrasound (US) departments during the period From April 2025 to October 2025, aimed to assess the normal portal vein diameter (PVD) in healthy pregnant women. The study also examined the relation between PVD and Maternal/Fetal Characteristics where the researchers used it for comparison. The problem of study was that normal PVD had variable measurements in grayscale US. Using advanced US equipment (EDAN - Acclarix LX3), data was collected by data collection sheet include demographic data and US finding, then it presented and discussed and statistically the results analyzed by statistical package for social science (SPSS).The sample size include 150 Sudanese healthy pregnant women, came for obstetrical US follow up, their mean age was 25.25±4.5 years, average weight was 63.36±14.42 kg, height was 1.64±0.06 meters, Body Mass Index (BMI) was 23.24±4.66 and average Gestational Age (GA) was 23.60±10.20 weeks.

Result: The study found that Portal Vein Diameter (PVD) was 10.31± 1.44mm, moreover a significant positive correlation was found between PVD and GA (r=0.210, p=0.010), and No significant correlation detected between PVD and height ,weight ,BMI and Parity.

Conclusion: The study established baseline normal values for normal range of PVD in Sudanese healthy pregnant women and revealed significant positive correlation between PVD and GA.

Keywords: Portal Vein, Portal Vein Diameter, Ultrasound, Gestational Age, Parity, Age, Body Mass Index, Height, Weight.

Introduction:

The portal vein (PV) and hepatic artery are the main sources of blood supply of the liver. About three quarters of the liver blood flow is from the portal vein, while the remaining one quarter comes from the hepatic artery. The superior mesenteric vein and splenic vein meet at the level of the second lumbar vertebra, behind the pancreatic neck, to form the portal vein (PV). [1] There is a paucity of published literature on portal vein diameter in pregnancy. What abounds in the literature is portal vein diameter in nonpregnant individuals. Portal hypertension is a major abnormality of the portal venous system. It usually occurs due to an increase in portal venous pressure, which subsequently leads to resistance of blood flow through the portal vein into the hepatic circulation. Liver disease in pregnancy is uncommon, but could be a serious illness when it occurs. [1]

Studies on hepatic blood flow changes in pregnancy have not been consistent. While some studies have reported no significant changes in hepatic blood flow during pregnancy despite a marked increase in cardiac output, others have demonstrated an increase, and this increase attributed to a preferential increase in the portal venous blood flow. [2]

The normal portal vein diameter varies between 7 mm and 15 mm. Some authors have reported 13 mm as the upper limit of the portal vein diameter, and a value greater than that is suggestive of portal hypertension. The normal portal venous pressure varies between 5 mmHg and 10 mmHg. A portal venous pressure of greater than 15 mmHg may be suggestive portal hypertension. [1]

Sonography plays a major role in the assessment of portal hypertension. Because of its availability, lack of ionizing radiation and rapid assessment. Even if the additional use of Doppler modalities improves the assessment of patients suspected of having portal hypertension, gray scale assessment of portal vein diameter is important in initial evaluation. Knowing the normal portal venous dimension in a specified population is so crucial. [3].

Methodology:

A descriptive cross sectional study design, conducted in Sudanese refugee camp - chad adare city in Dar AL-hechma Medical Center at the US departments between April 2025 and October 2025. Using Edan Acclarix LX3 US machines with trans abdominal probe, frequencies 2 to 5 MHz. Applied on pregnancy women whom admitted to obstetric US during specific duration of the study. The sample size included 150 participants, calculated by used the known formula:

$$n = \frac{Z^2 \times p \times (1-p)}{d^2}$$

Where: N = required sample size.

Z=Z-score for the chosen confidence level (e.g., 1.96 for 95% confidence Intervals).

P = 0.5 (conservative estimate). d = Margin of error (acceptable precision, e.g., 5%=0.05).

N=z^2 ×p×1-p÷d^2=1.96×1.96×0.5× (1-0.5) ÷ (0.05×0.05) =150.

Non-pregnancy women, diabetic, hypertensive and who has chronic liver disease patients were excluded.

The data collected from patient's history and data collection sheet including following variables: Patient information (age, Weight, height,BMI), GA, Parity and PV measurement, in area and duration of the study. Firstly, we collected data from patient by met, discussed, assessed for interobserver variability and reliability, like age and parity. With the patient standing on the Frankfort plane, the height measured using a wall-mounted stadiometer. A weighing scale used to determine weight (kg). The last normal menstrual period, which corresponded with their first

trimester US scan, used to determine GA. All US examinations performed transabdominally from xiphisternum to the pelvic brim lying in supine and right anterior oblique positions for US examination. Taking GA according to trimesters, in first trimester we using CRL or BPD and second and third trimester we using BPD or FL.

Moreover, to calculate PVD transducer placed in epigastrium in both transverse and longitudinal planes, where PV crosses anterior to inferior vena cava, with the calipers placed between the inner margins of the echogenic walls of the vessel at the location where PV crosses prior to the inferior vena cava. Then data analyzed by using statistical package for social science version 16.We grant an ethical approval from hospital as well as verbal consent from patients including in this study, the collected data used for this study only and the data of patient or their personality not disclosed under any circumstances.

Results

Table1: show Frequency Distribution of Participants by Age Category:

N=150	Frequency	Percent
15 to 20	32	21.3%
21 to 25	55	36.7%
26 to 30	37	24.7%
31 to 35	20	13.3%
36 to 40	6	4.0%

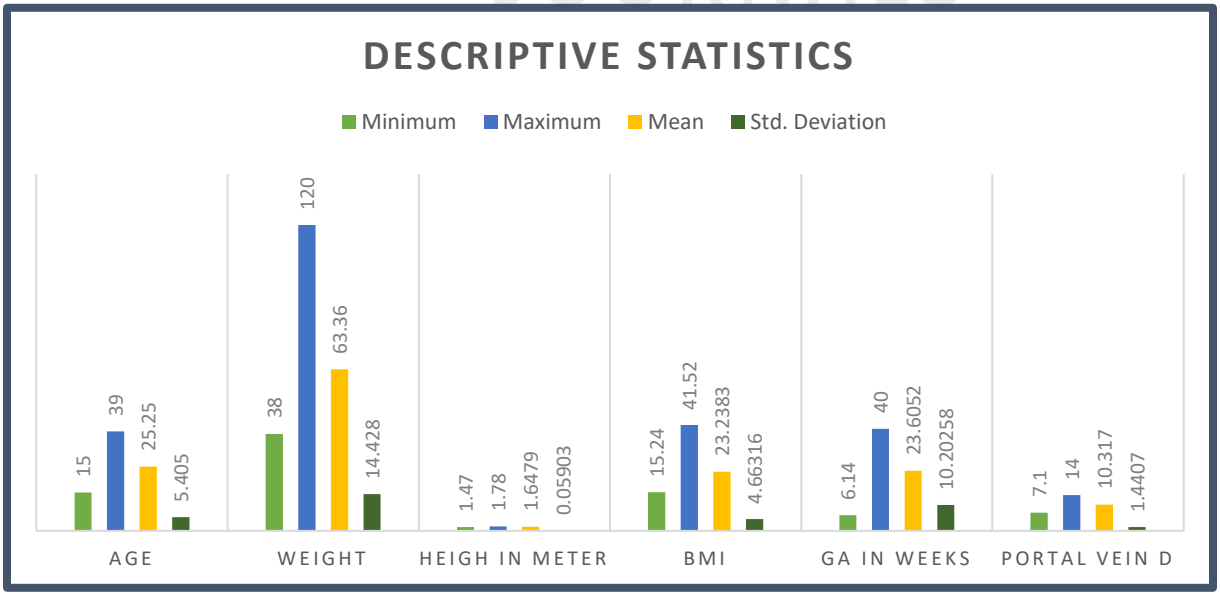

Figure 1: Descriptive Statistics of Minimum, Maximum, Mean and Stander Deviation of age, weight, height, BMI, gestational age and portal vein diameter.

Table 2: Frequency Distribution of Participants across BMI Classifications:

	Frequency	Percent
Underweight	18	12.0%
Healthy Weight	86	57.3%
Overweight	32	21.3%
Obesity	14	9.3%

Table 3: Frequency distribution of Participants by Obstetric History (Gravida and Parity):

N=150	Frequency	Percent
Nulliparity	22	14.7%
Primiparous	39	26.0%
Multiparous	73	48.7%
Grand multiparous	16	10.7%

Table 4: frequency Distribution of Participants by Trimesters of Pregnancy:

N=150	Frequency	Percent
1st Trimester	31	20.7%
2nd Trimester	58	38.7%
3rd Trimester	61	40.7%

Table 5: Frequency Distribution of Portal Vein Diameter (PVD) Measurements:

N=150	Frequency	Percent
Less than 8	6	4.0%
8 to 10	95	63.3%
11 to 13	42	28.0%
More than 13	7	4.7%

Table 6: Correlations between Portal Vein Diameter and Maternal Variables:

N=150		Age	Weight	Height in meter	BMI	Gravid a & Parity	GA in weeks
Portal Vein D	Pearson Correlation	.083	.146	.107	.143	.131	0.210**
	Sig. (2-tailed)	.315	.074	.191	.081	.111	0.010
	N	150	150	150	150	150	150
**. Correlation is significant at the 0.01 level (2-tailed).							
*. Correlation is significant at the 0.05 level (2-tailed).							

Table 7: Linear Regression Analysis of Gestational Age Predicted by Portal Vein Diameter:

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	8.275	5.929		1.396	.165
	Portal Vein D	1.486	.569	.210	2.611	.010
a. Dependent Variable: GA in weeks						

GA by PVD= a + B x (PVD).

a= Constant.

B = 1.486

Table 8: The Distribution of Portal Vein Diameter (PVD) Across Trimesters, Age Groups, and BMI Classifications.

		PVD Ranges				Total
		Less than 8	8 to 10	11 to 13	More than 13	
Trimester	1st Trimester	2	23	6	0	0.461
	2nd Trimester	1	37	16	4	
	3rd Trimester	3	35	20	3	
Total		6	95	42	7	
Age Ranges	15 to 20	0	23	7	2	0.504
	21 to 25	3	37	14	1	
	26 to 30	2	23	9	3	
	31 to 35	1	10	8	1	
	36 to 40	0	2	4	0	
Total		6	95	42	7	
BMI Ranges	Underweight	1	13	4	0	0.645
	Healthy Weight	4	54	22	6	
	Overweight	1	21	9	1	
	Obesity	0	7	7	0	
Total		6	95	42	7	

Correlation is significant when P=Value < 0.05

Discussion:

The study consisted of 150 pregnant women, with a mean age of 25.25±5.4 years ranging from 15 to 39 years, average weight was 63.36±14.42 kg, height was 1.64±0.06 meters, BMI was 23.24±4.66, indicating a predominantly healthy weight group, average GA was 23.60±10.20 weeks, showing a wide distribution across all trimesters and mean PVD was 10.31±1.44 mm with measurements ranging from 7.1 to 14 mm. (Figure 1), this result agree with Peter Chibuzor Oriji et al, and Enefia Kelvin Kiridi, et al [1,2], whom they found that PVD were measured 10.43 ± 1.58 mm and 10.4 ± 1.6 mm respectively, and disagree with Studies done by Awadia Gareeballah1, et al, Salah Albagir et al, Enefia Kelvin Kiridi et al and Sibgha Aqeel1 et al in mean PVD because all studies of them had done in both male and female groups and as non gravida women.(4,5,6, 7)

The sample was predominantly composed of young adults. The largest age group was 21 to 25 years, comprising 55 individuals (36.7%), followed by the 26 to 30 years' group with 37 participants (24.7%), those aged 15 to 20 years accounted 32 participants (21.3%), while the older cohorts of 31-35 years and 36-40 years were smaller, with 20 (13.3%) and 6 (4.0%) participants respectively.(Table 1)

The majority of participants fell within a healthy BMI range. Specifically, 86 individuals (57.3%) classified as having a Healthy Weight. A significant portion, 32 participants (21.3%), were classified as Overweight, while 18 individuals (12.0%) were Underweight. The smallest group was those with Obesity, comprising 14 participants (9.3%). (Table 2) these results dis agree with studies done by Peter Chibuzor Oriji, et al and other study done by Enefia Kelvin Kiridi, et al; this may be due to the difference in sample size and methodology of the various studies. [1, 2]

The sample consisted predominantly of participants with previous childbirth experience. "Multiparous" women (2 to 5 births) formed the largest group with 73 participants (48.7%). "Primiparous" women (one birth) were the next largest group with 39 individuals (26.0%). "Nulliparous" women (no previous births) accounted for 22 participants (14.7%), and "Grand multiparous" women (6 or more births) were the smallest group with 16 participants (10.7%).

The participants were distributed across all stages of pregnancy. The "3rd Trimester" was the most represented with 61 participants (40.7%), closely followed by the "2nd Trimester" with 58 participants (38.7%). The "1st Trimester" had the fewest participants with 31 individuals (20.7%). (Table 4).

The PVD measurements were highly concentrated within a specific range. The vast majority of participants, 95 individuals (63.3%), had a PVD measurement between 8 and 10 mm. Another 42 participants (28.0%) had a PVD in the 11 to 13 mm range. Only a small number of participants had a PVD measurement below 8 mm 6 participants, (4.0%) or above 13 mm 7 participants, (4.7%). (Table 5).

The analysis revealed that most maternal variables showed no statistically significant correlation with PVD. Correlations with Age (r=0.083, p=0.315), Weight (r=0.146, p=0.074), Height (r=0.107, p=0.191), BMI (r=0.143, p=0.081), and Gravida & Parity (r=0.131, p=0.111) all were showed weak and statistically insignificant relation. The only significant relationship is between GA and PVD, though weak positive correlation was (r=0.210, p=0.010). (Table 6). The values of PVD increased with increase in GA of fetus, this observation is in consonance with reports done by Peter Chibuzor Oriji et al. [1], they said that there was significant relationship between GA and PVD and disagree with there were no statistically significant correlation with PVD with maternal age, Weight, Height, BMI and Gravida & Parity.

The study found that regression model confirms a statistically significant predictive relationship between PVD and G A The unstandardized coefficient (B) for PVD is 1.486, meaning that for every1 mm increase in P V D, GA increases by approximately 1.49 weeks. The model is statistically significant (p = 0.010), constant is 8.275.
The derived regression equation is GA in weeks = 8.275 +1.486 * (PVD). As showed in table (7).
The distribution of PVD measurements across trimester, age and BMI categories showed no statistically significant variations found. P-value was: 0.461, 0.504, and 0.645) respectively, (table8), confirms that these distributions are not significantly different from one another, suggesting that PVD is independent of these demographic and clinical groupings. These results agree with study done by Awadia Gareeballah1, et al. in age and BMI and disagree in weight and height [(4).] Also, agree with study done Salah Albagir et al in age and BMI. [(5).] Furthermore we disagree with study done by Enefia Kelvin Kiridi, et al in BMI (ɼ = 0.41), age (ɼ = 0.43), parity (ɼ = 0.44), weight (ɼ = 0.49) and height (ɼ = 0.27) had a significant relationship (p – 0.001) with portal vein diameter. [(6).]

Conclusion:

The study concluded that the mean PVD was 10.31±1.44 mm. This research has established baseline normal values for normal range of PV diameter in healthy pregnant in Sudan, also revealed significant positive correlation between PVD and GA (r=0.210, p=0.010), and no significant correlation was detected between PVD and height, weight, BMI and Gravida & Parity.

Recommendation:

That Routine evaluation of PVD in antenatal US may be beneficial for early recognition of abnormal portal venous patterns. further Longitudinal studies following the same women across the three trimesters could provide stronger evidence for the pattern of PVD change and Investigating Doppler parameters could add further insight into physiological changes during pregnancy.

Reference:

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Image 1: show pregnant women age 22 years, weight:50kg, height:157cm, multiparous (has three children), GA:26w+3d and portal vein diameter:10.24 at level of measurement anterior to IVC.

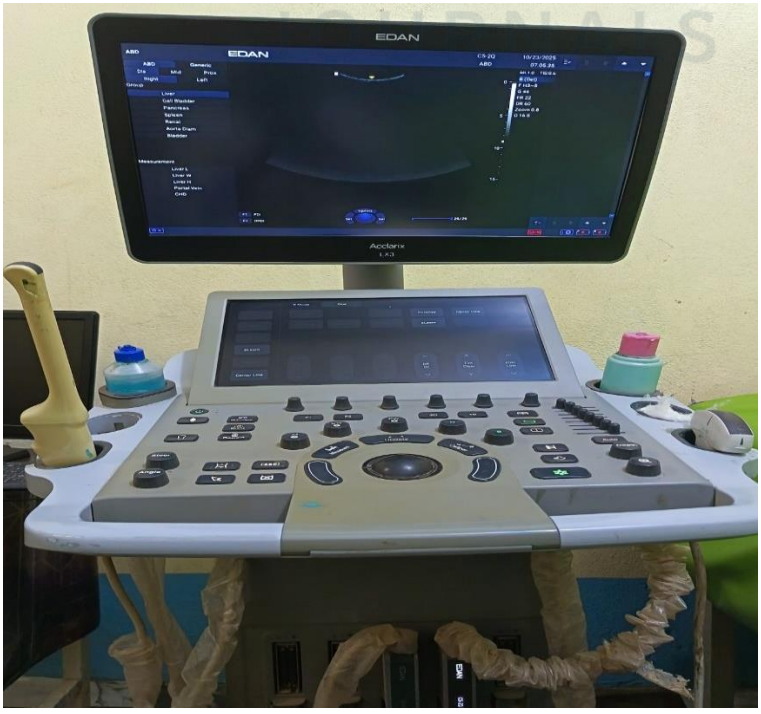

Image2: show (EDAN Diagnostic Ultrasound system (Acclarix LX3)