Available Online at http://www.recentscientific.com

ISSN: 0976-3031

International Journal of Recent Scientific Research
Vol. 6, Issue, 7, pp.5234-5236, July, 2015

International Journal of Recent Scientific Research

RESEARCH ARTICLE

QUANTITATIVE ASSESSMENT OF PORTAL VEIN BY COLOUR DOPPLER IMAGING IN PATIENTS WITH VARIOUS LIVER DISEASES IN WEST BENGAL AND REFLECTION OF PATHOPHYSIOLOGICAL HAEMODYNAMICS AND EVALUATION OF PROGNOSIS

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ARTICLE INFO

Article History:

Received 14th, June, 2015
Received in revised form 23th, June, 2015
Accepted 13th, July, 2015
Published online 28th, July, 2015

Key words:

Ultrasound, Portal vein, duplex doppler, congestion index, pulsatility index, resistance index.

ABSTRACT

We conducted a study in West Bengal in K.P.C. medical college on patients with Liver disease with the help of Duplex Doppler Ultrasound and assessed quantitative and semi quantitative indices of portal vein.

We found that it is a safe, noninvasive, inexpensive, excellent investigation of choice in assessing pathophysiological haemodynamics, judging the severity of the disease, effects of several drugs and prediction of prognosis of the disease.

Before conducting the study we took permission from the ethical committee of our college.

INTRODUCTION

Colour Doppler Sonography is the most effective primary investigation of choice in elucidation of Liver pathology. It is a superb, noninvasive inexpensive method and plays a crucial role in diagnosis and management of various Liver diseases. So as per guideline we conducted a Doppler flowmetry study in K.P.C. Medical College over 235 people with taking into account quantitative and semi quantitative data.

MATERIAL AND METHOD

We started our original and honest study after taking permission from our ethical committee over a period of (2012 – 2014) over 235 people. The patients are coming from all over West Bengal like, Kolkata, North and South 24 Parganas, Howrah, Hooghly, Burdwan, Birbhum, Bankura, Midnapore, Nadia, Malda, Murshidabad. After taking consent from all the patients and collecting demographic data like age, sex, religion following questions were asked –

1. For how long they are suffering from this disease.
2. Are they taking any medicines.
3. Any past history of operation or blood transfusion.
4. Any other medical condition associated like – hypertension, diabetes etc.
5. Drug, alcohol addiction, HIV infection.
6. We have taken into account – normal subjects after taking consent from them, to serve as a reference scale.

We studied total 235 people – [4, 15, 16, 22]

1. Normal subjects 100 (N)
2. Patients with acute hepatitis 10 (AH)
3. 40 Patients with chronic active hepatitis (CAH)
4. 80 Patients with liver cirrhosis (LC)
5. 5 Patients with Idiopathic portal hypertension (IPH)

METHOD

We studied the patient as per guidelines – Sabba *et al* 1995.

1. Measure in suspended normal respiration.
2. Longitudinal scan of portal vein.
3. Sample volume at centre of vessel at level of hepatic artery covering 50 percent of vessel diameter.
4. Doppler angle of 55˚ or less.
5. Pulse repetition frequency (PRF) = 4 KHZ wall filter = 100 Hz

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6. Doppler and B mode tracing recorded simultaneously.
7. PV diameter measures from inner anterior to inner posterior wall.
8. Values result from measuring of 3 consistent measurement. [3, 8, 9, 11, 13, 14, 20]

Congestive Index –

$$CI = \frac{\text{Cross sectional area of portal vein}}{\text{Blood flow velocity of portal vein}}$$

$$= \frac{A \times B \times \Pi}{4} \div \frac{0.57\ Vdmx}{\cos\theta}\ (\text{cm} \times \text{sec})$$

A= Short axis of portal vein
B=Long axis of portal vein
Vdmax=maximum velocity obtained from Doppler
θ = angle between ultrasound beam and blood vessels.
Coefficient 0.57 is the ratio of mean velocity to maximum velocity obtained. [5 – 7, 10, 12, 17 – 21]

RESULTS

Observation table – 1 Cross sectional area of portal vein

1	**Normal n=100**	**0.99 ± 0.22 cm^2**
2	Acute Hepatitis n= 10	1.08 ± 0.24 cm^2
3	Chronic Active Hepatitis n= 40	1.32 ± 0.38 cm^2
4	Liver Cirrhosis n= 80	1.55 ± 0.50 cm^2
5	Idiopathic Portal Hypertension n=5	1.59 ± 0.48 cm^2

Table – 2 Mean Blood Flow Velocity

1	**Normal n=100**	**15.5 ± 4.0 cm/sec**
2	Acute Hepatitis n= 10	15.1 ± 2.2 cm/sec
3	Chronic Active Hepatitis n= 40	12.5 ± 3.3 cm/sec
4	Liver Cirrhosis n= 80	9.8 ± 2.8 cm/sec
5	Idiopathic Portal Hypertension n=5	11.0 ± 3.5 cm/sec

Table 3 Blood Flow Volume of Portal Vein

1	**Normal n=100**	**900 ± 275 ml/min**
2	Acute Hepatitis n= 10	1000 ± 350 ml/min
3	Chronic Active Hepatitis n= 40	850 ± 250 ml/min
4	Liver Cirrhosis n= 80	850 ± 300 ml/min
5	Idiopathic Portal Hypertension n=5	1050 ± 350 ml/min

Table – 4 Congestion Index

1	**Normal n=100**	**0.070 ± 0.028 cm x sec**
2	Acute Hepatitis n=10	0.072 ± 0.015 cm x sec
3	Chronic Active Hepatitis n=40	0.122 ± 0.088 cm x sec
4	Liver Cirrhosis n=80	0.180 ± 0.075 cm x sec
5	Idiopathic Portal Hypertension n=5	0.188 ± 0.110 cm x sec

Other semi quantitative assessment were taken into account.

Pulsatility Index $PI = \frac{A - B}{}$

Mean

A - Peak systolic velocity
B – Peak diastolic velocity

Mean – Mean of velocity in a set interval of time.

Resistance Index $RI = \frac{A - B}{A}$

DISCUSSION

In the study by F. Moriyasu *et al* they found –
A positive correlation between congestion index CI and portal venous pressure.

They found congestion index reflects the pathophysiological haemodynamics of portal venous system in portal hypertension. They also conducted a comparative study of congestion index of normal subject and patients with liver disease.

These results were like this
cross sectional area –

- Normal subjects – (0.99 ± 0.28 cm^2) (n=85)
- Acute hepatitis - (1.05 ± 0.22 cm^2) (n=11)
- Chronic active hepatitis - (1.22 ± 0.41 cm^2) (n=42)
- Cirrhosis - (1.49 ± 0.49 cm^2) (n=72)
- Idiopathic portal hypertension (1.56 ± 0.45 cm^2) (n=11)

Congestion Index –

- Normal – 0.070 ± 0.029 cm x sec
- Acute Hepatitis – 0.071 ± 0.014 cm x sec
- Chronic active hepatitis – 0.119 ± 0.084 cm x sec
- Liver Cirrhosis – 0.171 ± 0.075 cm x sec
- Idiopathic portal hypertension – 0.180 ± 0.107 cm x sec

In our study with colour doppler flowmetry we also found that–

1. Patient with chronic liver disease, cirrhosis and idiopathic portal hypertension have higher value of cross sectional area.

Whereas people with liver cirrhosis have altered value of mean blood flow velocity and blood flow volume.

2. Congestion index is higher in patients with chronic active hepatitis, Liver cirrhosis, Idiopathic portal hypertension.
3. P.I. of superior mesenteric artery is reduced in patients with Liver cirrhosis.
4. P.I. of portal vein is more important indicator for clinical evaluation of patients with right heart failure.
5. Finally the compliance curve of portal vein – i.e portal vein pressure volume – curve is not linear.

Increased flow volume is compensated by deformity of blood vessel cross-sections from elliptical to round, thereby elevation of portal pressure is minimized.

CONCLUSION

Doppler flowmetry with quantitative data, are excellent, effective, noninvasive, inexpensive method in assessing severity of hepatic disease, evaluating the role and effectiveness of drugs and predicting haemorrhagic risk and elucidating the prognosis.

This study also plays special role in disease affecting portal tract, like Budd-Chiari syndrome, schistosomiasis, malaria, drug toxicity etc.

In post-operative case (like liver transplantation) on day 1,3,5 and 7 and weekly there after, the quantitative flow- study plays excellent role.

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