EDITORIAL

Color Doppler and laser velocimetry studies in the assessment of portal hemodynamics and severity of chronic liver disease

In recent years different methods have been adopted to investigate portal hemodynamics. Portal pressure measurements have been obtained using percutaneous transhepatic approach^1^ or by transvenous route. Variceal pressure has been recorded by direct puncture or by placing a manometric capsule over the varix using flexible endoscope. Portal blood flow has been estimated by continuous thermolislation technique. A recent technique to evaluate portal hemodynamics is Doppler flowmetry.

An ideal method to measure biological parameters should be safe, less invasive, reproducible, with high accuracy and acceptable to the patient. New methods are important when they can provide further understanding of the pathophysiology of a disease or provide new diagnostic, prognostic or therapeutic alternatives. In the past decade, measurement of hepatic venous pressure gradient through the transvenous route has gained popularity particularly when evaluating the efficacy of pharmacotherapy in prevention of variceal bleeding, as also for other diagnostic and prognostic purposes in chronic liver disease with portal hypertension. This technique is invasive, and repeated studies will not be acceptable to patients.

Doppler flowmetry has gained popularity among investigators. However, the methodology used in portal flowmetry by echo Doppler is controversial and the clinical application of ultrasonic flowmetry is subject to many limitations. Reproducibility of the method of echo Doppler measurement is still a problem. Factors that are difficult to control and that may influence the interpretation of vessel diameter and Doppler signal include operator subjectivity, patient characteristics and possibly a machine dependence.

The velocity profile will vary in different populations studied. A common source of error is the angle of insonation; for example, a 5° error in measurement of an angle of 60° will lead to a 15% error in the estimation of volume flow. The body habitus of the person under examination is very important for the elimination of this error. Individuals with a flat chest, like the Japanese are reputed to have, are suitable. Patients with cirrhosis, with a small liver situated high up under the ribs, need intercostal scanning, which is difficult due to a limited-access intercostal window. Even if such a window is available, changes due to respiratory movements, particularly in the presence of ascites and respiratory distress, make it difficult to get sufficient time to measure velocity accurately. It is also difficult to visualize a long segment of the portal vein. In about 12% of patients, measurement of flow is not possible even by an expert sonologist because the portal vein is not adequately seen.

Another important issue is the cross-sectional area of the vessel. This measurement is deceptively difficult. For example, if one assumes an elliptical portal vein as circular in cross section, it will lead to a 20%-30% error in measurement. Even in normal individuals, because of low portal pressure, respiratory changes make portal flow unstable and cause greater changes in portal vein diameter and velocity over time.

Inter-observer variability in the results of echo Doppler occur in different laboratories. In one important study, an unacceptable level of inter-observer agreement on results of echo Doppler study was noted. Before accepting it as a method to measure flow, investigators must validate their degree of variability within their patient population.

The other pitfalls in echo Doppler study need consideration. These include the "mirror image" artifact, in which the Doppler signal contained simultaneous and symmetric elements on both sides of the zero baseline; this was identified in 79% of patients. In the "flip" artifact, the Doppler signal would flip from one side of the zero baseline to the other or would indicate a direction of blood flow opposite to that normally expected; this was seen in 43% of patients. The other common problem is obscuration of the portal vein by bowel gas, ascites and obesity. This type of problem was encountered in 71% of patients in the above study. Moreover, the entire procedure may have to be performed again in a patient who is acutely ill, agitated or uncooperative.

Gastric mucosal blood flow may be measured by different techniques, which include clearance techniques, methods based on inert gas elimination, spectrophotometry, and laser-Doppler velocimetry (LDV). The principle of these techniques has been well described elsewhere.

Measurement of gastric mucosal blood flow by LDV is based on the principle of scattering of light by moving red blood cells as they course through the mucosa. This method is reproducible and less invasive. But it also has its limitations: due to contraction and

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relaxation of the stomach wall, continuous contact between the light source and mucosa is not possible; also, contact of the probe with the mucosa may affect the values obtained by producing reduction of blood flow due to pressure or increase due to induced hyperemia.

In this issue of the Journal, Vyas and associates assessed portal hemodynamics by ultrasound color Doppler and gastric mucosal blood flow by LDV. The authors have tried to eliminate the important pitfalls by measuring time-averaged mean velocity, using a transcortical approach, avoiding aliasing and using maximum size of Doppler spectrum. They have tried to correlate portal hemodynamics with gastric mucosal blood flow to see if the latter could be used to assess chronic liver disease.

There has been some debate over gastric perfusion in patients with portal hypertensive gastropathy (PHG). In human and animal models of PHG, gastric mucosal blood flow was reported as decreased in some studies, and increased in others. It is likely that total blood flow to the stomach is increased in PHG, but there may be changes in the distribution of the flow. It has been hypothesized that in PHG there is relatively decreased blood flow to the mucosa and increased flow to the submucosa, muscle and serosal layers. Vyas et al reported decreased mucosal blood flow. However, Chung et al observed increased mucosal blood flow in cirrhosis with portal hypertension.

Some authors have reported that the incidence of PHG correlates with the presence of gastric varices. Vyas et al could have used the opportunity to observe the incidence of gastric varices and the direction of blood flow in esophageal varices in relation to gastric varices. This would have helped in understanding the pathophysiology of gastrointestinal varices and their relation to blood flow.

It is known that after endoscopic variceal sclerotherapy, patients with portal hypertension develop changes in their hemodynamics, particularly in portal pressure, flow and collaterals. Including such patients in the study by Vyas et al may have had some confounding effect.

In spite of its limitations, echo Doppler study has a role in measuring rapid and large changes in portal hemodynamics within a short period of time. Moreover, this technique is helpful in clinical practice for selecting patients for shunt operation, to detect portal vein thrombosis and for post-transplant vessel patency.

A recent study showed that the quantitative measurement of portal velocity or flow has limited utility in predicting severity of liver failure in an individual patient. The authors also opined that the prognostic value of this study regarding the clinical outcome of alcoholic cirrhosis has yet to be established.

Thus, evaluating portal hemodynamics by color Doppler and gastric mucosal blood flow by LDV may be useful for research purposes. The non-invasive nature of this technique makes it attractive. But application of these methods for assessment of chronic liver disease in clinical practice has limited utility. Further studies are needed for validating the methods and to overcome the drawbacks.

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References

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