

Lessons learned from performing 100 EUS-guided portal pressure gradient measurement procedures

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Historically, when hepatologists wanted to know the difference between the pressure in the portal vein (PV) and the hepatic vein (HV) (the so-called hepatic venous pressure gradient aka HVPG), they had only one place to turn: interventional radiology. The HVPG is a critical piece of data for patients with cirrhosis, as it can predict the risk of liver decompensation, variceal bleeding, development of hepatocellular carcinoma, and overall survival. Historically, the HVPG was measured via a transjugular route and compared a free hepatic venous pressure to a wedged hepatic venous pressure (to indirectly measure the portal venous pressure).^[1]

EUS is now used to measure the HVPG using a disposable pressure transducer connected to a 25-gauge FNA needle via special tubing (EchoTip Insight; Cook Endoscopy, Winston-Salem, NC). When the HVPG is measured via EUS, it is known as EUS-Portal Pressure Gradient (EUS-PPG). EUS-PPG involves needle access of the HV and PV for direct pressure measurements in real time. EUS-PPG is in limited use in the United States but is gaining traction. Endoscopy has several advantages over traditional IR approaches in that it allows diagnosis and treatment of esophageal and gastric varices, EUS-PPG, and liver biopsy to be performed in a single session (as needed) and avoids a percutaneous approach. EUS PPG has been shown to be essentially identical to HVPG with regard to the ability to accurately measure the pressure gradient of concern.^[2]

Our group previously published our experience with our first 20 EUS-PPG procedures with combined liver biopsy.^[3] This study, along with a separate systematic review and meta-analysis that our group also performed, has helped to demonstrate the safety and efficacy of EUS-PPG.^[4] Currently, we have performed over 100 EUS-PPG cases, almost all of which were combined with EUS-guided liver biopsy (EUS-LB), and many others that also involved treatment of esophageal and gastric varices in a single session. Here are some of the lessons learned from our experience.

- 1) **You must work closely with your referring doctors, hepatologists, and liver transplant team.** Most endosonographers are not hepatologists, let alone transplant hepatologists. Let your hepatology colleagues know what EUS-PPG is and how it can be combined with other liver-directed procedures in a single session. In our center, we can perform EUS-PPG and EUS-LB and treat esophageal varices in under 30 minutes (gastric varices can also be treated, but add more time to the procedure). If your colleagues are not aware that you have these capabilities, they will not refer patients to you appropriately.
- 2) **The patient needs to understand what you are doing, and why.** In our experience, many patients have little to no understanding of cirrhosis, let alone portal hypertension. As such, they may not comprehend why they are undergoing EUS-PPG. We make a real effort to talk with patients for a few minutes before the procedure, explain the fundamentals of portal hypertension and cirrhosis, and explain what we are going to do during the procedure. We also explain the EUS liver biopsy procedure as well. Many patients arrive for EUS-PPG confused and perplexed about what is going to happen, and a few minutes of discussion pays a lot of dividends.
- 3) **You need to understand hepatic vascular anatomy before performing EUS-PPG.** Many endosonographers, even those with extensive experience, have had little to no need to evaluate and interpret hepatic vascular anatomy. To perform EUS-PPG, you must be able to reliably identify the portal vein and its branches, the hepatic veins, the IVC, and other structures. Hepatic and portal vein branches can look similar, and even experts can be fooled. We rely on pulse wave Doppler to confirm the identity of any vessel in question (the portal vein will have a monomorphic waveform, whereas the hepatic vein will have a classic tetraphasic waveform). With time and practice, identifying key vessels can be performed quickly and reliably.
- 4) **Careful evaluation of the liver before starting the EUS-PPG procedure is a worthwhile endeavor.** In general, you will be accessing the PV and a branch of the HV in the left lobe of the liver. Everyone has slightly different vascular anatomy, and some patients undergoing EUS-PPG have previously undergone liver transplant, making their anatomy more challenging to decipher. Sometimes the HV and PV will be very obvious and in places that are very accessible, whereas other times the HV and PV will either be difficult to identify and/or very challenging to access given their distance from the echoendoscope or due to the presence of interposed vessels. Spend time evaluating the liver before passing any needles to be sure you understand the patient's specific anatomy.
- 5) **EUS-PPG should only be performed by skilled endosonographers.** Although a large HV branch or the central PV are well positioned for EUS-PPG; these vessels may sometimes be deep to other vessels or too far away from the transducer to be easily reached. Oftentimes, the closest or most accessible HV or PV

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branch to access for EUS-PPG is very small, perhaps 1–3 mm wide. In my experience, endosonographers with limited experience will struggle to access these vessels easily, whereas experienced operators can almost always pass the needle into these vessels. Remember, once you access these often-small vessels, you need to be able to hold your position for several minutes so that 3 concordant pressure readings can be obtained from each site, so you have to remain in a stable position.

- 6) **Bleeding is rare, but you must always be aware that it can happen and you must be on the lookout for it.** EUS-PPG is a very safe procedure, but you can never forget that you are advancing a needle into some of the largest vessels one in of the most vascular organs in the body. EUS-PPG is performed with a 25-gauge needle, which in and of itself reduces the risk of a vascular injury, but great care must be taken to try not to shear or injure the vessel walls or the liver capsule or parenchyma. During HV and PV measurements, both you and the patient need to be completely still. This is why we perform all EUS-PPG procedures under general anesthesia. Use Doppler to assess your needle track before, during, and after needle passage to ensure that no bleeding has occurred. In our study of our first 20 cases, we had one small episode of bleeding that did not need treatment, but any needle-based intervention on the liver carries a risk of bleeding. Even if you do everything right, bleeding can still occur.
- 7) **Most bleeding after EUS-PPG is not clinically significant.** You may see some bleeding in your needle tracks during and after EUS-PPG. This usually stops within a few minutes and is typically not of concern. Large-scale or clinically significant bleeding can occur, but is rare, and will be accompanied by signs of hemodynamic compromise. Delayed bleeding can also occur, but is rare.
- 8) **Most patients feel no pain, but some patients may be uncomfortable after EUS-PPG, and a few can require hospital admission.** If patients have pain after EUS-PPG, especially if they underwent simultaneous EUS liver biopsy, it can be difficult to know why they are hurting. Are they bleeding? Is the pain from accessing the HV or PV? Was it from puncturing the capsule of the liver? Was it from the liver biopsy? In general, pain from EUS-PPG with or without liver biopsy, if it occurs, is short lived and can be managed with oral acetaminophen or pain medications. We rarely admit patients after EUS-PPG but have done so on a few occasions if we have concerns about adverse events.

- 9) **Although practice patterns vary, we administer antibiotics with EUS-PPG to reduce the risk of bacteremia or abscess formation.** EUS-PPG involves accessing multiple vascular structures, and several transmural needle passes into the liver. Antibiotics in this setting, unless contraindicated by patient characteristics, seem safe and warranted.

- 10) **Communicate the results of the EUS-PPG to the patient in a way that they can understand.** We review the results and give all of our patients copies of their procedure reports and review the results with them. We tell the patient if they do, or do not, have portal hypertension in words they can understand. We also usually mail them a copy of their liver biopsy results afterward. We instruct the patient to follow up with their referring doctor, usually another gastroenterologist or a hepatologist, to close the loop and make sure that the person who ordered the test sees the patient back for further evaluation.

Conflict of Interest

The author is the Co-Editor-in-Chief the journal. The article was subjected to the standard procedures of the journal, with a review process independent of the editor and his research group.

Author Contributions

D. G. Adler contributed solely to the editorial.

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