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Title: Measurement of the Hepatic Venous Pressure Gradient and Transjugular Liver Biopsy

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Author Questionnaire:

1. Microscopy: Does your protocol involve video microscopy? N

2. Does your protocol include software usage? Y

Please upload all screen captured files to your project page.

We have a PC running Windows XP. A screen recording software is not installed. However, we would be happy to allow such a software to be installed on the Windows XP PC.

3. Which non-screen captured steps from the protocol section below are the most important for viewers to see?

2.3., 4.2.-4.4.

4. What is the single most difficult aspect of this procedure and what do you do to ensure success?

Step 2.8. Observe the stasis of the contrast medium and exclude any washout due to insufficient occlusion of the venous lumen by the balloon or the presence of shunts [1-TXT].

Steps 4.3. and 4.4. Instruct the Patient to hold their breath [1] and advance the needle into the liver parenchyma [2]. Pull the trigger of the shooting mechanism to perform the core biopsy [1] and advise the Patient to breathe normally [2].

5. Will the filming need to take place in multiple locations (greater than walking distance)? N

Videographer NOTES:

1) Filmed the screen for all screen shots.
2) Scene-by-scene slating was not possible
3) Recommend to use patient shots from patient 2 and x-ray shots from patient 1.
4) Blur patient data from x-ray screen

Section - Introduction

Videographer: Interviewee Headshots are required. Take a headshot for each interviewee.

1. REQUIRED Interview Statements (Said by you on camera): All interview statements may be edited for length and clarity.

1.1. **Thomas Reiberger**: Diagnosing hypertension in patients with advanced chronic liver disease provides important prognostic information. Assessing the severity of the hypertension and treatment response allows selection of optimized and individualized treatment strategies **[1]**.

1.1.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera

1.2. **Thomas Reiberger**: Measurement of the hepatic venous pressure gradient, or HVPG, is the current gold standard for the diagnosis and monitoring of portal hypertension in patients with advanced chronic liver disease **[1]**.

1.2.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera

OPTIONAL Interview Statements: (Said by you on camera) - All interview statements may be edited for length and clarity.

1.3. **Mattias Mandorfer**: The prognostic value of HVPG and clinical benefits of a decrease in HVPG have been established over a broad spectrum of etiologies of advanced chronic liver disease of different severities **[1]**.

1.3.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera NOTE: Author notes indicate that optional statements were not filmed

1.4. **Mattias Mandorfer**: HVPG measurement provides important insights into the complex interplay between portal hypertension and the related pathophysiological mechanisms that drive the development of clinical events in advanced chronic liver disease **[1]**.

1.4.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera

Ethics title card: (for human subjects or animal work, does not count toward word length total)

1.5. Procedures involving human subjects complied with the guidelines of the Human Research Committee of the Medical University of Vienna and all patients gave written, informed consent for HVPG measurement and transjugular liver biopsy.

Section - Protocol

2. Hepatic Vein Balloon Catheter Placement

2.1. Before placement, flush the balloon catheter with contrast medium **[1]** and inflate and deflate the balloon several times with the catheter tip submerged in saline to check the integrity of the instrument **[2]**. No air bubbles should occur **[3]**.

2.1.1. WIDE: Talent flushing balloon

2.1.2. MED: Talent inflating/deflating balloon

2.1.3. CU: Shot of tip in saline w/ no air bubbles occurring

2.2. Moisten the outside of the balloon catheter with additional sterile saline solution **[1]** before inserting the catheter into the vascular access sheath **[2]**.

2.2.1. CU: Catheter being moistened
2.2.2. CU: Catheter being inserted

2.3. Advance the catheter under fluoroscopic guidance into the inferior cava vein, or IVC (I-V-C), **[1]**, using slight rotations to align the tip of the catheter toward the back of the Patient to advance from the right atrium to the IVC **[2]**.

2.3.1. CU: Catheter being advanced with fluoroscope visible in frame
2.3.2. SCREEN: Catheter being rotated/advanced toward back of patient/from right atrium to IVC NOTE: Authors said they would provide static images for this

2.4. **[1]**.

~~2.4.1. MED: Talent instructing Patient to inhale/Patient inhaling deeply~~

2.5. To advance the catheter from the IVC into the hepatic vein, repeatedly move the tip of the balloon catheter to the right toward the suspected area of the junction of the hepatic veins and the IVC to obtain access to the hepatic veins **[1]**.

2.5.1. SCREEN: Tip being moved toward junction/hepatic veins NOTE: Videographer filmed the screen for all SCREEN shots. Please blur any patient identifying information on the screen shots

2.6. Advance the catheter to a stable position that allows repeat measurement of the free hepatic venous pressure at a 2-4-centimeter distance from the opening of the junction into the IVC with sufficient space for the inflated balloon **[1]**.

2.6.1. SCREEN: Catheter being advanced then shot of catheter in stable position

2.7. **Thomas Reiberger**: An appropriate "wedge" positioning of the balloon catheter in the hepatic vein is critical to obtaining reliable readings and should be confirmed by fluoroscopy and dye injection **[1]**.

2.7.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera

2.8. To check the adequacy of the vein occlusion, inflate the balloon with about 2 milliliters of air and about 5 milliliters of contrast dye until the hepatic vein distal to the inflated balloon can be visualized **[1]**.

2.8.1. SCREEN: Balloon being inflated with air and/or dye, then vein being visualized

2.9. Observe the stasis of the contrast medium and exclude any washout due to insufficient occlusion of the venous lumen by the balloon or the presence of shunts **[1-TXT]**.

2.9.1. SCREEN: Shot of contrast medium stasis, then washout being excluded **TEXT: Reposition balloon catheter if significant washout observed**

2.10. Then deflate the balloon and flush the lumen of the catheter with saline **[1]**.

2.10.1. SCREEN: Balloon being deflated and lumen being flushed

3. Hepatic Venous Pressure Gradient (HVPG) Hemodynamic Reading Assessment

3.1. To assess the hepatic venous pressure gradient, use an infusion line to connect the vascular lumen of the balloon catheter to the pressure transducer **[1]** and begin recording the free hepatic venous pressure with the tip of the balloon 2-4 centimeters from the opening of the hepatic vein to the IVC **[2]**.

3.1.1. WIDE: Talent connecting line to transducer
3.1.2. SCREEN: FHVP being recoded

3.2. The waveform of the curve must be stable without variations over time **[1]**.

3.2.1. SCREEN: Shot of stable waveform of curve

3.3. Inflate the balloon and continue recording the wedged hepatic venous pressure until the measurement becomes a stable horizontal line with no variations over time **[1-TXT]**.

3.3.1. SCREEN: Balloon being inflated/WHVP becoming stable horizontal line **TEXT: HVPG = Mean of 3 calculations (WHVP – FHVP)**

3.4. After repeating the free and wedged hepatic venous pressures at least three times, record pressure in the IVC **[1]** at the level of the ostium of the hepatic vein as well as the right atrial pressure **[2]**. NOTE: Shots were likely split, 3 measurements fimed

separately

3.4.1. SCREEN: IVC pressure being recorded
3.4.2. SCREEN: RAP being recorded

3.5. **[1]**.
~~3.5.1. CU: Catheter being removed~~

4. Transjugular Core Liver Biopsy

4.1. Before beginning the biopsy procedure, flush the biopsy needle introducer sheath with sterile saline **[1]** and advance the biopsy needle introducer sheath into a hepatic vein as demonstrated for the balloon catheter **[2]**.

4.1.1. WIDE: Talent flushing sheath
4.1.2. SCREEN: Sheath being advanced into vein

Added step: 4.1a:
Gently advance the 16-gauge needle through the biopsy needle introducer sheath into the hepatic vein **[1]**. NOTE to VO: Please record 4.1a
4.1a.1. NOTE: Should be a shot to match, probably not slated as 4.1a.1

4.2. To load the transjugular core liver biopsy needle, pull the grip until the shooting mechanism is loaded **[1]** and then advance the core biopsy set through the biopsy needle until the tip of the core biopsy set approaches the end of the biopsy needle in the hepatic vein. **[2]**.

4.2.1. CU: Grip being pulled
4.2.2. SCREEN: Needle being advanced through introducer sheath

4.3. Instruct the patient to hold their breath and advance the core biopsy set into the liver parenchyma **[2]**.

~~4.3.1. MED: Talent asking Patient to hold breath/Patient holding breath~~
4.3.2. SCREEN: Needle being advanced into liver parenchyma

4.4. Pull the trigger of the shooting mechanism to perform the core biopsy **[1]** and advise the Patient to breathe normally **[2]**.

4.4.1. SCREEN: Biopsy being obtained OR CU: Trigger being pulled
4.4.2. MED: Talent instructing patient to breathe/Patient breathing normally

4.5. Remove the needle without removing the needle introducer sheath **[1]** and harvest the liver sample **[2]**.

4.5.1. CU: Needle being removed
4.5.2. CU: Liver sample being collected **TEXT: Repeat for each additional liver specimen as necessary**

4.6. When all of the biopsies have been obtained, inject 5-10 milliliters of contrast medium over the catheter introducer sheath to rule out perforation of the liver capsule and remove the biopsy needle introducer sheath **[1]**.

4.6.1. SCREEN: Contrast medium being injected

~~4.6.2. CU: Needle sheath being removed~~

4.7. **[1]**.

~~4.7.1. CU: Pressure/gauze being applied~~

Section – Results

5. Results: Representative Pressure Tracing of Free and Wedged Hepatic Pressure Readings

5.1. In patients with ascites due to cirrhosis, that is, portal-hypertensive ascites, the HVPG values are usually expected to be at least greater than or equal to 10 millimeters of mercury **[1]**.

5.1.1. LAB MEDIA: Figure 3E: JoVE Video Editor please add horizontal line or similar emphasize across graph from 10,0 on y axis

Section - Conclusion

6. Conclusion Interview Statements: (Said by you on camera) - All interview statements may be edited for length and clarity.

6.1. **Thomas Reiberger**: Adequate training for developing the central venous access (steps 2.3.-2.8.) will significantly reduce the risk of procedural complications **[1]**.

6.1.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera

6.2. **Mattias Mandorfer:** Non-invasive imaging tools are unable to accurately assess the severity of portal hypertension in patients with CSPH or to monitor the evolution of portal hypertension after etiological and medical therapies **[1]**.

6.2.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera

6.3. **Mattias Mandorfer:** The measurement of HVPG has replaced the direct measurement of portal pressure and was essential in the development of current pathophysiological and risk stratification concepts **[1]**.

6.3.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera NOTE: May have not been filmed.

6.4. **Thomas Reiberger**: Major complications related to HVPG measurements or transjugular liver biopsy are rare and mostly related to the central venous access. The use of ultrasound-guided access may further reduce these risks **[1]**.

6.4.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera