Ultrasound Guided Procedures: Tips and Techniques for both Common and Uncommon Indications

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Learning Objectives
- Patient selection and preparation
- Image optimization
- Standard techniques in difficult biopsies
- Advanced techniques

US vs. CT
- Advantages of US guided biopsy
  - No ionizing radiation
  - Faster and less expensive
  - Portable
  - May enhance safety
- When to do CT
  - Improved visualization of structures difficult to see with US*
  - Adrenal and intraparenchymal masses
  - Calcified masses
  - Gas filled collections
  - Lung lesions not abutting the pleura
  - Certain pelvic masses or collections

Patient Preparation
Planning is Essential to Success and may be risk stratified*
- Lab work*
  - INR < 1.5
  - Platelets > 50,000/mL
  - May need to use FFP or platelet transfusion in selected cases
- Stop Anticoagulation*
  - ASA – 325mg 5-7 days off
  - In most cases, biopsy can be performed safely on aspirin**
  - Plavix – 5-7 days
  - Coumadin – 5-7 days, may need to bridge with heparin
  - Heparin – 4-6 hours, Lovenox 12-24 hours
  - Newer agents and special concerns
- NPO 6 hours prior to procedure if using sedation

Procedure

- Pain Control/Sedation
  - Liberal local anesthesia with lidocaine – 10-20 mL
  - Moderate Sedation
  - Versed and Fentanyl

- Needle safety is critical
- Needle guide is helpful but not always necessary (superficial biopsies)
- Image optimization
  - Key feature of biopsy = should do this prior to becoming sterile
  - Use highest possible frequency probe
  - Assistant can change the parameters on the machine

Optimizing Technique

- Keys to success
  - Seeing the needle
    - Sound beam should be perpendicular to needle
    - Can try to move inner stylet without moving outer needle
  - Image optimization
    - Key feature of biopsy – should do this prior to becoming sterile
    - Use highest possible frequency probe
    - Assistant can change the parameters on the machine

Procedure: Multiple Passes vs Coaxial Technique

- Multiple Passes
  - May have higher success rate because can biopsy different areas of lesion*
  - Performed during suspended respiration in liver to minimize "tearing" of capsule, may be difficult in sedated patients
  - Focal discrete punctures may bleed less

- Coaxial Technique*
  - Can be helpful in challenging cases to place an introducer and then obtain multiple samples through a "single hole"
  - Less trauma to adjacent tissue
  - Theoretically less risk of tumor seeding
  - Potential shearing of capsule
  - Larger puncture hole
  - Repetitive sampling of same area

Post procedure

- Imaging
  - Personal preference to image post biopsy
  - Most bleeds are small and asymptomatic
  - Atwell et al. found that overall risks of major bleeding and death due to percutaneous biopsy are low (0.5% and 0.02% respectively)

- Monitoring
  - Observe for 3-4 hours in holding area after intra-abdominal biopsy
  - Transplant biopsies are observed by transplant surgery team following biopsy
  - Superficial lymph node biopsies and thyroid biopsies do not require observation

Complications

- Serious complications are infrequent
- Intra-abdominal bleeding is the most serious complication
- Rarely requires intervention beyond monitoring and supportive care
- Hitted rate <5% for 14g and smaller needles
- Pneumothorax
- Damage to bowel or adjacent vessels infrequent
- Infection (<1%)

Neck

- Thyroid Biopsy
  - Generally performed with FNA
  - Performed with on site cytology
- Lymph Node Biopsy
  - May be FNA or core
  - Hard to access nodes in superior mediastinum may also be sampled from neck/supraclavicular region
- Mass/Other
  - Superficial or deep neck masses

Chest

- Biopsy in the chest with US is an accepted technique for lesions involving the chest wall, abutting or involving the pleura.
  - Chest Wall
  - Pleural
  - Lung Parenchyma

- Post-Biopsy complications i.e. pneumothorax may also be recognized/excluded quickly with US.

Liver

- Random Liver
  - Preferred site is left liver, epigastric area

- Targeted biopsy
  - According to AASLD practice guidelines no need to biopsy liver nodules >1cm with diagnostic features for HCC by imaging
  - Exceptions may be made if imaging features are atypical or tissue is needed for systemic therapy or study requirements.

- Appelbaum et al. found that 3 passes (18g core) would be diagnostic in almost 90% of cases if no cytology service was available

- Always put on color to avoid vasculature
  - HV and PV can be safely traversed if needed

Kidney

- Abscess drain/aspiration
- Tissue sampling is becoming more acceptable
  - Extremely low risk of tumor seeding
  - Useful in suspected lymphoma
  - Useful in suspected metastasis vs HCC
  - Performed prior to RFA
- Nonfocal biopsy
  - Evaluate for nephro lithia

Transplant Kidney

- To assess for rejection
  - Biopsy may be performed at one month post-transplant to assess for early rejection
  - Other biopsies are done as clinically indicated

- Three approaches
  - Cortical tangential
  - Transverse lower pole
  - Lateral parasagittal

Complications of Renal Tx Bx

- Arteriovenous Fistula
  - Elevated velocity in feeding artery
  - Turbulent flow
  - Color aliasing
  - Reverberation artifact

- Pseudoaneurysm
  - To and Fro motion on spectral doppler
  - Yin Yang appearance

Complications of Renal Tx Bx

Case Courtesy of Hisham Tchelepi, MD
Complications of Renal Tx Bx

Pancreas Transplant

- Relatively safe biopsy
- Watch out for bowel
- Color Doppler is important

Technique:
- Two 18 g passes

The choice of which biopsy device to use is based on the requirements for the procedure. There is no financial incentive in choosing a specific device.

Pancreas Transplant

- Choice of needles
  - Bard Monopty Device
    - Fixed 2.2 cm throw
  - Angiotech Biopince Device
    - Adjustable throw: 1.3, 2.3, and 3.3 cm
  - Angiotech Super-Core
    - Adjustable throw: 1.2 and 2.3 cm
  - Can advance needle under real time US before you cut

Peritoneum

- Advantages
  - Ability to compress the tissues
  - Possibility of displacing bowel out of the way
  - Real time needle visualization provides a major advantage over CT

Spleen*

- Not widely performed because of perceived risk of increased complications
- US provides real time guidance and shorter procedure time


Peritoneum

- Challenges
  - Mesentery and omentum are mobile and soft structures
  - Bowel and major vessels are close

Ovarian Serous Adenocarcinoma
Pelvis

- Inguinal Masses or Lymph Nodes can typically be accessed by ultrasound.
- Adnexal Masses
  - Typically avoid this
  - Theoretical concern for risk of seeding
  - Diagnostic accuracy of ovarian cyst aspiration is controversial
  - In special circumstances and when requested by Gyn Onc – we may aspirate or biopsy adnexal mass for diagnosis.
- Abscess

New Techniques: Fusion Imaging

- Useful in interventional procedures
  - Hard to see
  - Hard to get to
- Helps to make biopsy safer and easier on difficult cases

What is Fusion Imaging?

- Fusion imaging combines volumetric anatomic data from CT, MRI or PET with the real time multiplanar capability of US

Fusion Imaging Technique

- Import the image data set into the US machine prior to the case
- Complete DICOM data set can be uploaded via PACS or directly via CD
- To register the US image with the 3D MR or CT data set, a series of common anatomic points or planes are manually identified on both the US image and CT data set
  - Left portal vein is a reliable landmark
  - Can also use umbilicus

Fusion Imaging Display

- US displayed on left, Multiplanar Reformat (MPR) from 3D data set on right
- As US probe is moved, the MPR image tracks in real time
- MPR image can also be overlapped on the US image

Case Courtesy of Hisham Tchelepi, MD

Key Points

- Patient selection and pre-procedure planning increases the probability of success even in difficult cases
- Basic knowledge of ultrasound image optimization is critical
- In most cases careful application of basic tools allows for uncomplicated access/tissue acquisition
- Advanced techniques may be helpful in very challenging cases
References