Brain Biopsy

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RESOURCES

YIELD & ACCURACY

BIOPSY NEEDLES

PROCEDURE

STEREOTACTIC

INSTRUMENTS

See >>
Karl Storz NeuroEndoscopes and Instruments >>

INDICATIONS

1. Brain tumors - definitive tissue diagnosis necessary for treatment planning. see p. Onc1 >>
2. Differentiating residual tumor from radiation necrosis (coagulative necrosis and vasculopathic changes).
4. Rare viral encephalitides (esp. rabies, Creutzfeldt-Jakob disease). see p. Inf9 >>
5. Vasculopathies (e.g. granulomatous angitis).

N.B. do not biopsy vascular lesions!

Indications for open biopsies
1) prominent blood vessels
2) hemorrhage within lesion
3) contemplated resection (during same procedure)

YIELD & ACCURACY

Diagnostic yield - percent of biopsies that obtain a histopathologic diagnosis (i.e. ability to obtain diagnostic tissue).
• 82-99% in nonimmunocompromised (NIC) patients vs. 56-96% in AIDS patients.
• yield rate is higher for lesions that enhance with contrast on CT or MRI (nic patients - 99% vs. 74%).

Diagnostic accuracy - proportion of biopsies that agree with the “gold standard” of surgical resection or autopsy.

BIOPSY NEEDLES

NASHOLD BIOPSY NEEDLE (INTEGRA)

• has a side window-type cutter at its tip - window is opened and closed by rotating the inner cannula within the outer cannula, using the upper and lower hubs.
• needle length - 249 mm
• outer diameter – 2.0 mm
• side cutting window – 10 mm

1. Set the depth stop on the outer cannula to the target length.
2. With the cutting window closed (see “Cutting Window Use”), insert the NBND.
3. At the target, open the cutting window.

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2. With the cutting window closed (see “Cutting Window Use”), insert the NBND.
3. At the target, open the cutting window.
4. A apply a slight vacuum with a syringe attached to the Laser.
5. Draw a tissue sample into the open window.
6. Close the cutting window and shear off a tissue sample inside the inner cannula.
7. Withdraw the inner cannula (or entire assembly, if procedure is complete) containing the tissue sample.
8. If desired, reposition the needle and repeat the procedure from step 1.

**PROCEDURE**

- avoid MANNSITOL if lesion is small – may shift target!!!
- head secured in a 3-point Mayfield headholder (if using O-arm – radiolucent frame, including pins, is ideal but not necessary)
- carried out under general anestheisia (in adults, local anestheisia is possible).

**STEREOTACTIC NAVIGATION GUIDANCE**

- Use CTA / MRA whenever available to plan trajectories away from vessels.
- to improve tumor biopsy results:
  1. **MRI with maps** (choline/creatine ratio) superimposed on MRI - where is necrosis, where is tumor
  2. **pMRI (PWI)** - will see if it is enhancing piece of necrosis (no perfusion) or real tumor (perfusion?)

**REGISTRATION**

- Medtronic Stealth frameless navigation: registration → set target (definite) and skull entry (preliminary) points.
- May use alternative high accuracy registration – **registration with O-arm** (optional) - may place one bone fiducial to verify navigation accuracy after registration:
  - need to use Stealth “dogbone” to attach radiolucent Mayfield (with radiolucent pins) to table; “dogbone” has two starbursts for attachment of two Vertek arms; “dogbone” uses different separate screw to attach to table frame!!!
  - N.B. attach “dogbone” from outside (not from Mayfield inside) – easier to reach for Vertek arm during the case.
- O-arm is needed for registration only: attach passive cranial frame, spin O-arm and may remove O-arm; remove passive cranial frame and use sterile one during surgery (leaving nonsterile one on arm is needed for registration only: attach radiolucent Mayfield (with radiolucent pins) to table; “dogbone” has two starbursts for attachment of two Vertek arms; “dogbone” uses different separate screw to attach to table frame!!!)

**Entry points and trajectories:**
- o thalamus – slightly lateral to Kocher’s point.
- **Target**
- Note: probe tip on Stealth corresponds to needle tip. actual biopsy window is marked by lines on probe on Stealth screen (when on trajectory views only)

**VERTEK®/PASSIVE BIOPSY KIT WITH VERTEK PROBE**

- **Vertek Probe (9733157)** - has 70 mm shaft (vs. 50 mm in Navigus probe); may need to add to instrument list on Cranial software module (as likely only Navigus Probe is there).
- **Op310 (2)**

**TRAJECTORY GUIDE KIT WITH NAVIGUS PROBE**

Navigus® Probe (9733157)
• 14 mm bur hole with perforator; t remove (Kerrison or matchstick drill) bony shelf (esp. at direction of biopsy)

• biopsy assembly base with 3 cortical screws:
  o angled (freedom 5° and 25°)
  o straight (freedom 10° in all directions)
• most accurate assembly: transparent holder (pops into socket), white cap
• insert Navigus Probe: set new entry → align to trajectory → lock trajectory on Steleth (by pressing Steleth pedal) – note distance to target on screen.
• insert grey needle hole
• open dura using monopolar cautery touching biopsy needle (becomes dirty – maybe to avoid this?) and then spinal 14 G needle.
• perform biopsy
• remove biopsy needle (with closed window) and entire biopsy assembly.
• place Gelfoam in bur hole, followed by cranial plate.
• closure with bur hole cover

**BIOPSY**

- set biopsy needle stopper (on special measurement board) to distance to target on screen.
- N.B. maximum needle length is 180 mm (even if distance from skull entry point to target is < 180 mm, remember that Vertek Probe and needle adapter add 70 mm!)
- insert both needles with closed biopsy window
- take core biopsy in four quadrants – rotating biopsy needle each time 90°; insert needle with closed window → open window → apply suction (syringe half with saline is directly attached to needle hub) → slowly close window → pull out needle → flush saline so tissue core moves on Telfa → reinset needle.
- N.B. always flush needle on Telfa as sometimes there is more tissue
- when reinserting inner needle, gently aspirate air (otherwise, air gets plunged into brain).
- may repeat biopsy again (rotate 45°), thus, obtaining total of 8 tissue cores – send for frozen pathology.

**Tissue amount necessary**

- few cells may be sufficient in diagnosis of metastatic carcinoma or lymphoma, whereas even postmortem examination of entire brain may be inadequate to establish precise diagnosis in some degenerative or metabolic diseases.

**Sampling area**

a) mass lesion / defined area on imaging studies
  - possibility of tissue heterogeneity! – multiple biopsies along needle trajectory through entire tumor thickness (to the farthest tumor edge) may provide more complete picture of pathological process.
  - N.B. sampling of only central area (e.g. complete tissue necrosis in tumors or abscesses) may not yield diagnostic tissue?

b) diffuse pathology (no lesion on imaging) - NONHOMOGENEOUS AREAS of cerebrum.
  - N.B. random biopsies may be nondiagnostic
  - type of tissue sampled (gray or white brain matter, leptomeninges) is guided by suspected diagnosis (tissue wedge consisting of cortex, overlying leptomeninges, and underlying white matter provides most useful tissue sample).
  - tissue should be considered potentially infectious (precautions for Creutzfeldt-Jakob disease should be taken).

**Postoperatively**

- immediate postoperative head CT – if normal, may go to the floor / gateway.

**FORAMEN OVALE APPROACH**

**CANCELLATION**

- patient supine under general anesthesia, tube facing down and taped well, under gel donut (Dr. Holloway) or horseshoe headholder (Dr. Broaddus).
- if doing glycerol injection, patient is on the stretcher – may be inadequate to establish precise diagnosis in some degenerative or metabolic diseases.

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**Postoperatively**

- immediate postoperative head CT – if normal, may go to the floor / gateway.
— may feel mandible jerk when needle irritates CNV,
— may cause bradycardia – wait before advancing needle until heart rate recovers (have atrapine ready).
— change fluoroscopy to lateral to verify – needle tip has to be just posterior to clivus
  • verify good position (esp. if unable to get CSF):
    a) inject 0.5 cm³ of saline – should go easily without resistance (but may mean that needle is too far and already in the middle fossa)
    b) insert foramenn ovale electrode through needle – see if it slides along petrous surface (means needle is in Meckel’s cave)
    c) injecting Omnipaque – should fill Meckel’s cave under live fluoroscopy (notice volume of Omnipaque needed – gives idea of cave volume).

Gasserian Ganglion Procedures
— see p. CN5

BRAIN BIOPSY

A. 2 spinal needles:
1. One 18G size 3.5 in spinal needle (attach tracking device to track the tip if using navigation) – cannulate just foramen
2. Second needle is 22G 5 inch spinal needle – wrap SteriStrip on shaft so tip protrudes 1.5* cm from first needle tip (*or whatever distance to tumor)
• insert second needle back and forth several times (to get tissue cores in) then gently aspirate and pass to cytologist for microscopy.

B. Temno coaxial biopsy system

Ready to cannulate foramen ovale:
Temporary attach Tenno syringe for biopsy window calibration prior to cannulation.
Once cannulated, attach Temno syringe with plunger back:

Push on plunger – biopsy tip exposure:
Keep squeezing plunger – will fire biopsy sheath over biopsy tip.
• may skip postoperative head CT.

**PINEAL REGION TUMORS – ENDOSCOPIC APPROACH**

Do ETV first!

A. Use ETV bur hole and flexible endoscope to go through foramen of Monroe posteriorly
B. Use separate more frontal bur hole and rigid endoscope

**PINEAL REGION TUMORS – STEREOTACTIC NEEDLE**

- through parenchyma, avoiding ventricles:
  a) frontal approach (but trajectory through thalamus)
  b) parietal approach (but trajectory may go through sensory cortex)

**COMPLICATIONS**

Removal of nonregenerating brain tissue is accompanied by risk of *permanent neurological deficit*!

• mortality < 0.2-1%
• major hemorrhage - risk 0-3% (0-12% in AIDS - reduced platelet count or function, vessel fragility in primary CNS lymphoma).
  *small hematoma at biopsy site is not unusual and is rarely clinically significant
• edema exacerbation, infection, development of seizure focus, increased neurologic deficit.