

Neuromodulation: Indication-Approach-Complications-Outcomes

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Approaches to Neuromodulation

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PLAN:

What should I do before the OR?



Know the Patient

- Know the patient
 - Pain patterns
 - Trial notes, Spinal MRI/CT
 - IPG placement
 - Antibiotics
- Anesthesia plan
 - Sedation with wake up
 - GA with monitoring
 - Meet electrophysiologists





What should I do before incision?

- Communicate with Circulating Staff
 - Instruments/sutures
- Fluoroscopy
 - C-arm positioning
 - X-ray staff
 - Radiation protective lead
- Positioning
 - OR bed
 - Special considerations (abdominal protuberance, kyphosis, etc)







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Entry Typically at L1/L2 or C7/T1



Typically, leads for the low back and lower extremities are placed via the L1/L2 interspace

Leads for upper extremity stimulation are placed via the C7/T1 interspace.

Paramedian, interlaminar approach



Walk off Lamina into the Interlaminar Space







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Walk off Lamina into the Interlaminar Space



Advance the epidural needle under fluoroscopic guidance & seat the tip on the superior margin of the lamina that borders the inferior aspect of the interspace to be entered.

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Bathe the lamina with a small amount of local anesthetic to reduce discomfort, and walk the needle over the lamina and into the interlaminar space.

Needle will enter Ligamentum Flavum and Loss of Resistance is used to identify epidural space.

Seldinger wire can test for false loss.



Shallow Angle of Approach Eases Steering of Lead



The needle is directed to enter the spinal space in the midline, with an angle of entry no >45 degrees.

The shallower the angle of attack, the easier it will be to steer the lead



Lead Tip Placement



Loss of Resistance with Air

One needle comes in the kit, but larger patients may require the longer needle

Intermittent fluoroscopy with goal of obtaining loss of resistance with needle tip very close to midline

Lead Tip Placement

Epidural lead must be positioned 2 to 3 mm to the left or right of midline on the same side as the painful region to be covered – stay within the "shadow" of the spinous process

For lower extremity stimulation, successful coverage is usually achieved by placing the lead between the T8 and the T10 vertebral levels

Upper extremity stimulation usually requires lead placement between the occiput and the C3 vertebral levels

If the lead ventures too far from midline, stimulation of the exiting nerve roots will result

If the lead is placed too low, overlying the conus medullaris (at or approximately below L1/L2), unpredictable patterns of stimulation may occur



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Lead Tip Placement







Lead Tip Placement







Steer Slowly While Staying Near Midline



The electrode contains a wire stylette that has a slight angulation at the distal tip.

The electrode can be directed medially or laterally as it is advanced by using a slight twisting motion on the proximal electrode that changes the direction of the tip.

Advance under live, pulse mode fluoroscopic guidance.

Advance slowly and back up if the lead goes significantly off midline.



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Test Adequacy of Coverage & Record Lead Location





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Secure That Lead!



Use a nephrostomy tube dressing.

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Suture.

Steristrip/Hypafix/Tegederm.

Remember that for obese patients, the skin will move the lead inferior.

Studies have documented 1/2 to 1 vertebral body migration when patients stand up.



Two Leads Placed at Adjacent Levels







Two Leads Placed at the Same Level







EXECUTE:

What do I need? What do I need to know?



What do I need to know?

- Incision
 - Mark it out
 - Local anesthesia
 - #15 blade, #3 handle
 - Belly of blade
 - Firm, fluid incision
 - Countertraction





Incise Around Epidural Needle & Dissect to Fascia



Following initial lead placement, withdraw the epidural needle ~1 to 2 cm but leave it in place around the lead within the subcutaneous tissues to protect the lead during the subsequent incision and dissection.

Make a 5- to 8-cm incision parallel to the axis of the spine from cephalad to caudad, extending directly through the needle's skin entry.

Divide the subcutaneous tissues using blunt dissection until the lumbar paraspinous fascia is visible surrounding the needle shaft.



What do I need to know?

- Dissection
 - Blunt
 - Minimizes bleeding
 - Increases tissue trauma
 - Sharp
 - Increases bleeding
 - Minimizes tissue trauma

*Gentle blunt instrument dissection and ESU in cut mode



What do I need?

- Dissection
 - Mayo dissecting scissors
 - Cutting dissecting heavy fascia/adhesions
 - Pocket formation
 - Metzenbaum dissecting scissors
 - Delicate tissue
 - Longer handle: blade ratio \rightarrow greater control
- Forceps
 - Non-locking: DeBakey, Adson







What do I need?

- Tissue retractors
 - Weitlaner
 - Self retaining, spreads and holds tissues apart
 - Anchoring leads to fascia midline incision
 - Skin/Senn/Dental
 - Assistant to retract during dissection/hemostasis
 - Army/Navy
 - Exposure pocket for hemostasis/irrigation







Withdraw the Needle Without Moving the Lead



Once the prespinous fascia has been exposed, the stylette and needle are removed, using care not to dislodge the lead

Recommend against live fluoroscopy during needle withdrawal



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Anchor That Lead!



Once the anchor has been positioned over the electrode, tighten silk sutures circumferentially around the anchor so the anchor is firmly secured to the lead.

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The anchor is then sutured to the fascia.

Silk suture is placed through fascia, 3 knots are tied down. The anchor is placed on top of the 3 knots and an additional 3 knots are placed.

Attempts to fasten the anchor to the fascia and the lead with a single set of sutures inevitably lead to a loose anchor.



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Create the Pocket



The skin is incised using a sharp scalpel, and the subcutaneous pocket is then created using blunt dissection

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Using surgical scissors in an opening rather than a closing or cutting motion works effectively

Maximum depth for a rechargeable generator is 1 cm and writing must face up to skin



Create the Pocket

- Minimize tissue trauma
 - tissue approximation, suture tension, knot selection
- Strain Loop midline and at IPG
 - one loop or 3 cm diameter extension
- Place midline cutdown following lead placement?
- IPG
 - 2 cm below skin
 - 4 cm incision, minimize "deadspace"
 - Pocket 1/3 above 2/3 below incision
 - Buttock, flank, lateral hip, abdomen





What do I need to know?

- Tunneling
 - Sharp tipped, malleable metal probe with plastic sleeve
 - 10 to 30 degree curve at distal third
 - Direct from midline to IPG
 - Advance with dominant hand, palpate non-dominant
 - Handle and rod removed, sleeve in-place









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Tunnel Carefully



Bend the tunnelling device and check if it is unidirectional or not.

Continuously palpate the tip of the tunneling device as it is being advanced to ensure the depth of the subcutaneous track is neither too deep nor too shallow.

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Excess depth can lead to entry into the abdominal cavity, whereas too shallow of a tunnel can lead to skin perforation or visible puckering of the skin along the subcutaneous track.

Warn anesthesia five minutes before you will be tunnelling.



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Closing Time



IRRIGATE, IRRIGATE, IRRIGATE

Antibiotics/pouches in the incisions

Coil any excess lead behind the impulse generator, and ensure the pocket is large enough to prevent any tension on the margins of the incision.

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The impulse generator and lead should fit well inferior to the incision, so risk of damage is minimized at the time of subsequent operation for battery change.

Check impedances before closing skin.

What do I need?

• Sutures

- Natural v. Synthetic
- Absorbable v. Nonabsorbable
- Monofilament v. Multifilament
- Deep:
 - 2-0 or 3-0 absorbable, braided
 - Vicryl, Polysorb
 - interrupted v. continuous
- Subcuticular:
 - 4-0 absorbable or nonabsorbable
 - Monocryl or Nylon
 - running subcuticular v. staples





Non-absorbable sutures are made of materials that are not readily broken down by the body's enzymes or by hydrolysis. There are naturally occurring non-absorbable materials e.g., silk, cotton, and steel) and synthetic non-absorbable materials (e.g., nylon and Prolene, Mersilene).



RECOGNIZE & REVISE: Complications..





PLAN, EXECUTE, RECOGNIZE & REVISE

- Know the patient
- Have a plan
- Minimize tissue trauma & infection risk
- Anticipate complications