Management of Pain Devices in the OR and Recovery:
Perioperative considerations, evaluation, and management

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Objectives:

- Identify the different pain devices that an anesthesia provider can expect to encounter in the perioperative setting
- Analyze the use and preferred utility of electrocautery in patients with implanted neuromodulation devices
- Identify the specific preoperative interventions that must be taken for patients with a neuromodulation device or intrathecal drug delivery system (IDDS)
- Examine possible concerns regarding the management of patients with peripheral nerve stimulators (PNS), spinal cord stimulators (SCS), and IDDS in the perioperative period
- Review the effects of MRI on the different SCS and IDD systems
- Assess and review some studies involving these systems and their effects in the pregnant and laboring patient
When a patient with an SCS presents for anesthesia, do I turn off the device? What else should I do?

Should the patient be expected to be able to do this?

Should all devices be interrogated immediately post operatively?
Spinal Cord Stimulation (SCS):

Introduction

- FDA approved for the treatment of:
  - Chronic neuropathic pain of the trunk and limbs
  - Radicular pain from failed back surgery syndrome
  - Complex regional pain syndrome

- Has also been used in the treatment of peripheral nerve pain, peripheral vascular disease, and chronic intractable angina (1)

- With SCS, wire leads with electrical contacts at the distal portion are placed in the epidural space over the dorsal columns
  - The wire is then connected to a pulse generator
  - Prior to implantation, patients undergo an approximately 1-week SCS trial period with percutaneously placed leads
  - Significant pain relief or increased functional status then progress to permanent implantation
There are 2 options for permanent implantation
  ○ Wire leads placed percutaneously through a needle
  ○ A paddle can be placed via an open laminectomy

For both approaches, leads will be tunneled beneath the skin and connected to the pulse generator (IPG) which can reside in the back, 
buttock, or abdomen

There are 5 main companies offering SCS in the united states currently: Boston Scientific, Medtronic, Nevro, St. Jude/Abbott, and Stimwave
SCS: General Intraoperative Management

- When a patient with an SCS presents for anesthesia, it is recommended that the device be **reprogrammed to the lowest amplitude** and **turned off**

- **Patients can do this** with their device controller as long as the battery has been charged and the patient has their controller present (1)
  - Reprogramming ensures that in the event of inadvertent activation, the stimulation will be low and likely unnoticed
  - Turning off the device reduces the risk of accidental reprogramming via electromagnetic interference (2-6)

- The **patient should be able** to turn the device back on post-operatively via their controller

- The device generally **does not need to be interrogated** immediately post operatively (unless monopolar cautery used)
Use in surgery can potentially damage any implanted electronic medical device through four main mechanisms by creating **electromagnetic interference (EMI)**:

1. Turning device on/off
2. Resetting IPG to different frequencies or amplitudes
3. Allowing high levels of current to pass through electrodes to target tissue causing inappropriate stimulation or injury
4. Allowing high current to permanently damage battery
SCS: Electrocautery cont

- **Bipolar cautery is less likely** to create EMI than monopolar cautery as bipolar passes radiofrequency current through 2 tips of the instrument at a very short distance apart.

- All 5 SCS companies recommend use of bipolar electrocautery (2-6).

- If care is taken to ensure the device does not come between the 2 electrodes on the bipolar cautery device, no harm should come to the device or the patient (8).

- If monopolar electrocautery is necessary:
  - Should be used on the **lowest effective setting** AND
  - Grounding pad should be placed as **far as possible from the SCS** on the opposite side of the IPG (g)
  - Also - If monopolar being used, it is recommended that device be interrogated post-operatively to ensure proper functioning
SCS: Neuraxial and Regional Anesthesia considerations

- The presence of SCS is *not an absolute contraindication to neuraxial anesthesia*
- Case reports of patients who developed postdural puncture headache after SCS lead placement were successfully treated with epidural blood patches with the leads *in situ* (10)
SCS: Neuraxial and Regional Anesthesia considerations

- However, depending on the desired level, placement of an epidural without fluoroscopy can be difficult or impossible
  - Epidural catheter for post-operative analgesia often requires placement at the T7-T12 (for adequate coverage of surgical site)
  - These are also the most common levels of SCS for coverage of low back and leg pain
    - Significant risk to damaging the SCS system at these levels
- It is our opinion that the benefits usually do not outweigh the risks at certain levels
SCS: Neuraxial and Regional Anesthesia

- Spinal anesthesia - should not be influenced by the presence of a SCS device as long as pre-procedure x-ray is available to ensure that leads are not present at the desired neuraxial level (1).

- **There is no contraindications** to regional anesthesia for acute pain management in patients with SCS.

- For PNS, DRGS -- use your discretion
  - Previous XR scouting device can be helpful
  - Minimal regional interventions with alter or mechanically interfere with DRGS.
SCS: Neuraxial and Regional Anesthesia

- Infection risk - often cited as a concern and reason to avoid neuraxial / regional anesthesia in a patient with SCS
  - Risks of causing significant seeding of infection to device are negligible during these procedures
  - Seeding to the SCS device requires systemic bacteremia and has been reported from sources such as bowel perforation
  - Infection of the SCS caused by seeding from neuraxial or regional anesthesia has not been reported
  - Of note, the mortality rate associated with infection of spinal implantable electronic devices (including both SCS and intrathecal drug delivery systems) is 1.83%
    - Significantly lower than mortality rates of infections of CIEDs, knee replacements, and hip replacements (4.39%, 4.33%, and 4.22% respectively)
  - Yet neuraxial and regional anesthesia are routinely performed in patients with these hardwares (11).
SCS: Obstetrics Anesthesia

- Both spinal and epidural anesthesia are reasonable at levels required for OB anesthesia and analgesia (typically well below the level of SCS lead entry).

- Risk is dramatically decreased with prior knowledge/x-ray imaging of implant location and technique used.

- It is recommended that patients with SCS present early for anesthesia evaluation to provide adequate time for anesthetic planning.
SCS: Magnetic Resonance Imaging

- In past decade, Boston Scientific, Medtronic, Nevro, St. Jude/Abbott, and Stimwave have all developed SCS models that are labeled full body MRI conditional.

- However, MRI safety recommendations continue to vary significantly between SCS models and companies (12-16):
  - Prior to any MRI the device manufacturer and model should be identified.
  - Appropriate device manual should be consulted.

- Elective MRIs should be postponed until appropriate documentation can be obtained.

- Emergent MRI without available documentation - risks and benefits should be weighed and alternative imaging modalities considered.
Intrathecal Drug Delivery Systems (IDDS): Introduction & Background

- IDDS consists of a metal housing, usually implanted in the abdomen, that holds a bellow containing the drug, battery, and pump.
- Drug is delivered from the metal housing via a catheter into the intrathecal space.
- Currently IDDS are FDA approved for the delivery of baclofen, morphine, and ziconotide—however, many other medications are used off label.
- Most pumps are designed to last 5-7 years and are refilled every 1-6 months depending on drug concentrations and dosing.
IDDS: General Intraoperative Management

- Prior to any procedure that might interfere with the IDDS, communication with the physician managing the pump is recommended
  - GATHER THE INFORMATION

- Device malfunction may cause inadvertent over- or underdosing of intrathecal medications
  - Be familiar with signs and symptoms overdose or withdrawal of relevant medications
IDDS: General Intraoperative Management

- Intraoperatively, temperature and positioning must be approached more carefully to avoid unwanted alterations in dosing
  - At body temperatures over 39°C, pump temperatures can be impacted,
  - Patient can be at risk of increased drug delivery rates and overdose
  - When positioning, avoid excessive bending or twisting as this can kink, occlude, or damage the intrathecal catheter (17)

- According to manufacturer documentation, electrocautery is safe and unlikely to interfere with device function (18)
IDDS: Perioperative Pain Management

- Perioperative pain control in patients with IDDS can be challenging.

- In patients receiving intrathecal opioids at baseline, addition of perioperative opioids can cause respiratory depression:
  - No reliable method to convert intrathecal opioids dosing to IV or PO dosing
  - All patients should have opioid medications titrated carefully and receive appropriate monitoring.

- Patients receiving intrathecal baclofen may have a greater than expected response to opioids due to the synergistic nature of the drugs (17).

- *Multimodal analgesia* and *regional anesthesia* should be considered.
IDDS: Neuraxial and Regional Anesthesia

- Neuraxial anesthesia is not absolutely contraindicated
- Care must be taken to identify and avoid the entry point of the catheter into the spinal canal via review of prior imaging
- Efforts should be made for:
  - Multidisciplinary planning
  - Utilization of imaging
  - Post-operative monitoring & device interrogation
Successful placement of epidural catheters in 16 children with intrathecal baclofen pumps in situ undergoing planned orthopedic surgery

- The neurosurgical, pain, and regional anesthesia teams determined the appropriateness of epidural placement
- 9 of 16 Epidurals placed fluoroscopically on the day of the procedure; others used LOR and/or ultrasound
- All pumps were interrogated prior to discharge (19) and were all NORMAL.
- There were no major complications following epidural placement
- Conclusion: Epidural catheters can be successfully and safely placed in children with intrathecal baclofen pumps with multidisciplinary planning and advanced fluoroscopic techniques
There are no contraindications to the use of regional anesthesia for acute pain management in patients with IDDS.

In fact, use of opioid sparing pain management modalities is often more important in these complex patients.

An example of this is a case report published describing the successful use of a lumbar plexus and sciatic nerve block as the primary anesthetic for left total knee arthroplasty:

- Patient had cerebral palsy with intrathecal baclofen pump
- A continuous lumbar plexus catheter was used postoperatively for successful pain control.
Several case reports describe successful placement of labor epidurals in patients with intrathecal pumps

1. #1 (1997) 23-year-old G2P0 with a morphine intrathecal pump implanted via direct surgical exposure through a midline incision from the level of L1 to L3
   - Epidural catheter was placed below the level of her scar at the L3-4 level without imaging guidance
   - Inadequate time between presentation and onset of labour prevented use of IDDS
   - Intravenous patient controlled analgesia with fentanyl using a bolus of 25 μg and a lockout of five minutes was ineffective
   - Epidural analgesia using bupivacaine was initiated and resulted in satisfactory analgesia without any significant complications (21).
IDDS: Obstetrics Anesthesia Case Studies

- Study #2 - 28 year-old G2P0 at 28 weeks who received an uncomplicated epidural
  - Evaluated by the anesthesia team in the antenatal clinic where review of x-ray imaging, operative notes, and consultation with her neurosurgeon were completed. Epidural placement was performed without imaging guidance at the level below her IDDS insertion site at L4-5 without complications (22).

- Also, ultrasound can be used as a tool in these cases.
  - A 44-year-old G1 P0 received an uncomplicated epidural for labor analgesia. Ultrasound of the lumbar spine (transverse and longitudinal views) were used to determine epidural depth and to ensure the pump catheter was not in the pathway of the Touhy. Patient also had significant pre-labor planning including review of x-ray imaging to confirm location and entry point of intrathecal catheter, discussion with neurosurgeon, and planned placement of epidural early in labor (23).
These cases demonstrate that epidural placement is feasible in patients with IDDS.

- X-ray imaging should be reviewed to confirm position and entry level of the intrathecal catheter.
- Consultation with patient's neurosurgeon or interventional pain physician should be considered.
- Imaging is not necessary, but ultrasound can be used.
IDDS: MRI

- The Medtronic Syncromed ER, Syncromed II, and the Prometric Flowonix are MRI conditional.

- Prior to any MRI the device manufacturer and model should be identified and the appropriate device manual should be consulted as significant differences exist.
  - For example, Prometric states that the Flowonix pump should be emptied prior to MRI.
  - Failure to do so can result in drug overdose and significant morbidity or mortality.
  - In contrast, Medtronic does not recommend emptying the pump prior to MRI with the Syncromed ER or Syncromed II (17).

- MRI exposure temporarily halts the pump and suspends delivery of intrathecal medications for the duration of the scan (24).

- Prior to any scan determine if drug delivery can be safely suspended or if drug needs to be supplied via an alternate route.

- After completion of the MRI, IDDS should resume normal drug delivery automatically.

- The device should be interrogated after completion of the MRI to ensure that drug delivery has restarted appropriately.

- Special attention should be paid to patients receiving intrathecal baclofen as withdrawal can be life threatening (17).
References:


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