

Neuraxial drug delivery

- Intrathecal morphine 100 g versus 150 g for post-cesarean delivery analgesia: a retrospective cohort study (2020-2022)
- A Low-Dose Oxytocin Protocol Decreases Quantitative Blood Loss in Elective Cesarean Sections: A Single-Center, Retrospective Cohort Study
- Determination of the MEC90 of Oxycodone for Preventing Perioperative Shivering in Pregnant Patients Undergoing Caesarean Delivery with Neuraxial Anaesthesia: A Biased-Coin up-and-Down Sequential Allocation Trial
- Uterine contraction frequency after initiation of labour epidural analgesia using electrohysterography monitoring: a prospective pilot study
- Continuous ropivacaine wound infiltration versus epidural morphine after unplanned caesarean delivery: A noninferiority randomised controlled study
- Effect of labor analgesia using programmed intermittent epidural boluses on postpartum depression symptoms: A randomized controlled trial
- Nebulized dexmedetomidine in the treatment of obstetric post-dural puncture headache: two case reports
- A perspective: neuraxial therapeutics in pain management: now and future

Neuraxial Drug Delivery is the administration of medications directly into the neuraxial space, targeting the spinal cord and its surrounding areas, specifically the epidural or intrathecal spaces. This method provides localized and efficient pain management or treatment for specific conditions, minimizing systemic drug exposure.

Mechanism of Action

Medications delivered to the neuraxial space act on nerve roots, the spinal cord, or the cerebrospinal fluid (CSF) to modulate pain signals or deliver targeted therapy.

Routes of Administration

Epidural (Extrathecal):

Location: The space outside the dura mater but inside the vertebral canal.

Common Uses: Pain relief during childbirth, postoperative analgesia, and chronic pain management.

Technique: Drugs are delivered via a catheter for intermittent or continuous infusion.

Intrathecal (Subarachnoid):

Location: The CSF-filled space beneath the arachnoid membrane.

Common Uses: Severe chronic pain (e.g., cancer pain), [neuraxial anesthesia](#) for surgeries, or spasticity management.

Technique: A single injection or continuous infusion using an implanted pump.

Combined Spinal-Epidural (CSE):

Combines the rapid onset of intrathecal drugs with the prolonged effect of epidural infusion.

Medications Used

Local Anesthetics:

Block nerve transmission to induce anesthesia.

Examples: Bupivacaine, Ropivacaine, Lidocaine.

Opioids:

Act on opioid receptors in the spinal cord for potent pain relief.

Examples: Morphine, Fentanyl, Sufentanil.

Adjuvants:

Enhance the effects of primary drugs or manage side effects.

Examples: Clonidine (alpha-2 agonist), Dexmedetomidine, Ketamine.

Steroids:

Used for anti-inflammatory effects in conditions like radiculopathy.

Example: Methylprednisolone.

Spasmolytics:

Baclofen for spasticity in multiple sclerosis or spinal cord injury.

Novel Agents (Experimental/Specific):

Ziconotide (non-opioid calcium channel blocker) for severe chronic pain.

Indications

Anesthesia: For surgeries (e.g., cesarean section, lower limb operations).

Acute Pain Management: Labor and postoperative pain.

Chronic Pain Management: Cancer pain, refractory back pain.

Spasticity: Intrathecal Baclofen for conditions like cerebral palsy or multiple sclerosis.

Inflammatory Conditions: Epidural steroids for radiculopathy or spinal stenosis.

Advantages

Localized Effect: Reduces systemic side effects.

Efficient Pain Management: Especially for severe or refractory cases.

Reduced Drug Dosages: Compared to oral or intravenous routes.

Prolonged Relief: Continuous infusion provides sustained effects.

Risks and Complications

Infection:

Meningitis, epidural abscess.

Bleeding:

Epidural hematoma causing neurological deficits.

Neurological Injury:

Direct trauma or drug neurotoxicity.

Cardiovascular Effects:

Hypotension or bradycardia due to sympathetic blockade.

Drug-Specific Side Effects:

Opioids: Respiratory depression, itching.

Local Anesthetics: Nerve damage or systemic toxicity.

Devices and Technology

Epidural Catheters:

For continuous or intermittent drug delivery.

Intrathecal Pumps:

Implanted devices for chronic drug administration (e.g., Baclofen pumps).

Advancements:

Programmable pumps, micro-dosing systems, and nanotechnology for targeted delivery.

Neuraxial drug delivery for pain management and other spinal pathology is widely employed and is the subject of a large volume of ongoing research with several thousand papers appearing in the past 5 years alone on neuraxial delivery. Several learned texts have been recently published. A number of considerations have contributed to this widespread interest in the development of the use of neuraxial therapeutics to manage pain¹⁾.

see [Drug delivery device](#).

¹⁾

DeAndres J, Dickenson AH, Hayek S, Linninger A, Yaksh TL. A perspective: neuraxial therapeutics in pain management: now and future. *Front Pain Res (Lausanne)*. 2024 Dec 10;5:1505019. doi: 10.3389/fpain.2024.1505019. PMID: 39720319; PMCID: PMC11666549.

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Last update: **2024/12/26 10:32**

