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A review of neurological complications in obstetric regional anaesthetic practice

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Abstract

Neurological complications from obstetric regional analgesia or anesthesia are uncommon but can have severe consequences, necessitating early detection to prevent permanent damage. Monitoring post-block recovery is crucial due to varying and occasionally extended recovery times, reducing the risk of missing underlying issues.

These complications are rarely seen in obstetric central neural blocks but can result from the labor process or emerge spontaneously.

Determining the exact cause of these complications is often challenging, and regional blockade is often initially suspected. While complete prevention is improbable, measures like strict aseptic techniques can reduce their occurrence. Continuous monitoring post-neural blockade is essential to spot potential issues early. Prompt diagnosis and appropriate treatment usually lead to complete recovery, even in cases involving epidural hematomas or abscesses.

In obstetric patients, neurological complications are rarer than in general surgical patients. However, late pregnancy can predispose patients to other complications due to engorged epidural veins and distorted anatomical landmarks.

In conclusion, obstetric regional anesthesia, while generally safe, can lead to neurological complications that require careful management. Vigilance in monitoring recovery, early detection, and timely intervention are essential. While these complications are infrequent, they can have serious consequences.

INTRODUCTION

While life-changing neurological complications following CNB (central neuraxial block) are rare, prompt recognition and appropriate management are crucial to reduce the risk of permanent neurological impairment.

It's essential to highlight that most postpartum neuropathies are a result of normal labor. Various factors, including fetal compression in the pelvis, patient positioning, and instrumental deliveries, can lead to neurological issues. However, anesthetists caring for obstetric patients should remain vigilant because neurological complications can occur following regional anesthesia, albeit infrequently.

Neuraxial analgesia is widely used for labor pain and cesarean deliveries. [1]Neurological complications following regional anesthesia are a known concern but are infrequent, with varying reported incidence rates.[2] Some complications are reversible and result from needle or catheter trauma or intraneural injection of local anesthetic.[3]In rare cases, serious neurological complications, such as epidural hematoma or abscess, can occur, especially if they develop after discharge[4]. Rapid detection and management are crucial, as permanent neurological impairment may result if not addressed promptly, especially within 8–12 hours in the case of epidural hematoma.

In conclusion, while neurological complications are rare, they require vigilance. It's also worth noting that neurological dysfunction can sometimes coincide with the childbirth process, making diagnosis and management more complex.

INCIDENCE

Neurological issues following childbirth can affect up to 1 in 100 women, with most stemming from non-anesthetic causes, often resolving spontaneously within days to weeks. [5]

Anesthetic-related injuries are typically transient, resolving within a year, with a reported incidence of 1 in 3900 for temporary neurological deficits.[6] Permanent harm following obstetric central neuraxial block (CNB) occurs at an estimated rate of 1 in 80,000 to 1 in 320,425, although these events are exceedingly rare.[7] Such injuries have devastating consequences for both mothers and healthcare providers.[8]

Serious neurological complications are infrequent in obstetric patients receiving neuraxial anesthesia, compared to general surgical patients.[9] Pregnant individuals generally have better health and face a lower risk of complications like epidural abscess due to their healthier status. The incidence of spinal epidural hematoma (SEH) is considerably lower in obstetric patients. However, late-pregnancy engorged epidural veins and altered anatomical landmarks may

predispose obstetric patients to different complications, such as epidural vein cannulation and spinal level misidentification.

Peripheral nerve injuries, maternal nerve palsies, nerve root or cord damage, cranial nerve palsies, spinal cord damage, and other complications can occur but are rare. Quick detection and appropriate management are crucial, particularly for conditions like epidural hematoma and epidural abscess, which require urgent intervention to prevent permanent neurological damage. Proper assessment, monitoring, and adherence to guidelines are essential to address these rare but critical complications.

PATHOPHYSIOLOGY

To understand nerve injury, it's important to grasp the anatomy of nerves. Nerve fibers are encased in different layers of connective tissue. The innermost layer, called the endoneurium, organizes individual axons into fascicles.[10] Surrounding these fascicles is another connective tissue layer called the perineurium. The outermost layer, known as the epineurium, envelops the entire nerve. Nerves receive blood supply from both intrinsic and extrinsic circulations.

Nerve damage can occur through various mechanisms, including compression, stretching, ischemia (lack of blood flow), exposure to chemical toxins, and penetrating injuries. Nerve injuries are typically classified using internationally recognized systems. Seddon's classification identifies three types of nerve injury: neuropraxia, axonotmesis, and neurotmesis, based on the severity of tissue damage and prognosis. [11]

Postpartum neuropathies can result from nonanesthetic and anesthetic causes. Nonanesthetic causes are often related to the positioning of the fetus during childbirth, maternal positioning during delivery, and the use of instruments during delivery. Anesthetic causes are primarily associated with complications arising from regional anesthesia procedures.

Clinical features of nonanesthetic postpartum neuropathies vary depending on the underlying cause. Compressive neuropathies can occur due to direct pressure from the fetal head, excessive hip flexion, or instrumental delivery. Ischemic neuropathies are the result of prolonged and severe hypotension, which compromises the arterial blood supply to the spinal cord, particularly affecting certain sensory and motor functions.[12] Peripheral nerve lesions are often associated with prolonged labor and forceps use and may lead to temporary or long-lasting nerve damage.

Specific nerves can be affected during childbirth. For instance, the lateral cutaneous nerve of the thigh may be injured, causing numbness in the anterolateral aspect of the thigh. Postpartum foot drop can occur due to damage

to the lumbosacral nerve trunk or the common peroneal nerve, leading to unilateral foot drop and sensory deficits. Other nerves, such as the femoral nerve and obturator nerve, can also be damaged during childbirth, resulting in distinct clinical manifestations.

Nerve root damage can occur due to direct needle or catheter trauma or intraneural injection of local anesthetic. Symptoms may include skin hypoaesthesia in the dermatome supplied by the affected nerve root and occasional muscle weakness. While most patients recover within weeks, some may experience chronic pain.

Neuraxial anesthesia, commonly used during labor and cesarean section, requires careful monitoring of sensory and motor block levels.[13] Monitoring motor block, in particular, can help detect and manage any complications. In cases where extensive neuraxial block persists postoperatively, a thorough evaluation and potential imaging may be necessary to rule out serious complications like epidural hematoma or abscess.[14] A risk assessment should consider factors like coagulopathy, abnormal vasculature, immune status, and other potential causes of complications.

Clinical Characteristics of Postpartum Neuropathies Due to Anesthetic Causes:

Trauma

Postpartum neuropathies related to anesthesia can have various clinical features, with trauma being one of the common causes. Traumatic nerve injuries associated with central neuraxial blocks (CNBs) frequently occur near the nerve root close to the site of instrumentation. Needles, catheters, or injectate substances used during anesthesia procedures can directly damage the spinal cord or conus medullaris.[15]

The initial symptoms of traumatic nerve injuries may become apparent during the insertion of the needle.[16] Most cases related to traumatic nerve injuries are associated with paresthesia during insertion[17]. It's important to note that transient paresthesia is not uncommon during the insertion of epidural catheters, and this is generally not associated with permanent neurological injury.[18]

After the effects of the central neuraxial block have worn off, patients may experience pain, paresthesia, and muscular weakness in the distribution of the affected nerve.[19] In obstetric patients, the risk of permanent neurological impairment following central neuraxial blocks is extremely low, and the majority of patients who experience traumatic nerve injuries tend to fully recover.[20]

Vertebral canal hematoma (VCH) is another potential complication associated with central neuraxial blocks.[21] Both technically challenging CNBs and those that breach a vessel wall with the needle or catheter are recognized risk factors for VCH development.[22] The risk increases when patients are on anticoagulant or antiplatelet medications. The clinical presentation of acute VCH includes a sudden onset of back pain, often radiating, with motor and sensory deficits below the level of spinal cord compression.[23]

Epidural abscess formation is another rare complication, resulting from bacterial infection seeding the epidural space. Symptoms of epidural abscess tend to develop more insidiously and may include fever, malaise, headache, back pain (possibly radiating), and neurological deficits. Physical examination findings may reveal tenderness over the abscess site, pain with movement (especially lumbar flexion), motor weakness, and bladder and bowel dysfunction.[24]

Cauda equina syndrome can result from lesions compressing the cauda equina nerve roots. This syndrome is characterized by motor and sensory deficits in the lower limbs, urethral and anal sphincter dysfunction, and sensory loss in the perineal and lower limb dermatomes.

Bacterial meningitis is an uncommon but serious complication of central neuraxial blocks. [25]It can occur if the dura is breached during the procedure, allowing infectious agents to enter the cerebrospinal fluid. Symptoms of bacterial meningitis typically develop 24-48 hours after the procedure and include nuchal rigidity (neck stiffness), photophobia, headache, fever, and sometimes back pain, altered mental status, vomiting, and seizures. Kernig's and Brudzinski's signs may be positive in severe cases. Aseptic meningitis, which presents with similar symptoms but no identifiable organism in cerebrospinal fluid cultures, may occur within 24 hours of central neuraxial blocks and tends to be self-limiting.

Chronic adhesive arachnoiditis (CAA) is an extremely rare but debilitating condition. It involves inflammation of the arachnoid and intrathecal elements, resulting in collagen formation between nerve roots and pia arachnoid. This encapsulation of nerve roots compromises their vascular supply and can lead to a range of neurological abnormalities, including back pain, leg pain, and various sensory and motor deficits.

Transient neurological syndrome (TNS) or transient radicular irritation is characterized by pain and dysesthesia in the buttocks, thighs, or calves following spinal anesthesia. It typically resolves within 72 hours in most cases.[26]

In conclusion, anesthesia-related traumatic nerve injuries and associated complications can present with a wide range of clinical features, from immediate paresthesia to more delayed and insidious symptoms. [27]

Evaluation and Management of Neurological Complications Following Obstetric Regional Anesthesia

Before conducting any Caudal Nerve Block (CNB), it is essential to obtain a comprehensive anesthetic history.[28] This history should encompass any preexisting neurological deficits and potential risk factors for neurological complications that may arise following the procedure. Particular emphasis should be placed on preexisting coagulation disorders, localized skin infections over the site of needle insertion, and signs of systemic sepsis. [29]

History: The patient's pre-anesthetic and obstetric histories can provide valuable insights into the underlying causes of postpartum neuropathies.

Examination: Conducting a thorough neurological examination, including an assessment of cranial nerves and any signs of systemic sepsis, is crucial. Mapping the patient's symptoms may reveal a pattern consistent with a peripheral nerve injury.[30]

Diagnostic Investigations: Routine laboratory tests, including a complete blood count, blood cultures, and coagulation screening, should be conducted if there is suspicion of an epidural abscess, meningitis, or vertebral canal hematoma.[31] In cases of suspected meningitis, more invasive investigations such as lumbar puncture and cerebrospinal fluid analysis are helpful.[32]

Magnetic resonance imaging (MRI), with or without gadolinium contrast, can reveal spinal cord swelling and areas of inflammation, making it the gold standard for investigating space-occupying lesions.[33] Electrophysiological studies can differentiate between central and peripheral nerve injuries, identify affected muscles, estimate the likelihood of neural recovery, and provide a temporal estimate of the injury's timing.

Management: Prompt recognition and treatment of limb- or life-threatening conditions remain central to managing neurological complications resulting from obstetric regional anesthesia. If space-occupying lesions and meningitis can be confidently ruled out, alternative diagnoses, their prognoses, and appropriate treatments must be explored. This may involve reassuring patients with self-limiting symptoms, referring them to physiotherapists for common intrinsic obstetric palsies, or consulting with neurologists for complex neurological complications.[34]

Prognosis of Nerve Injuries Unrelated to Anesthetic Intervention

Nerve injuries unrelated to anesthetic intervention encompass various causes, each with its own prognosis. Here, we outline the prognosis for different types of nerve injuries:

1. Compressive Neuropathies: Intrinsic obstetric neuropathies typically resolve spontaneously within two months. Managing these injuries conservatively by minimizing periods of standing, avoiding positions that worsen nerve injury, and using simple oral analgesics can facilitate recovery.

2. Ischemic Neuropathies: Prognosis for ischemic neuropathies is challenging to categorize and varies from paraplegia to mild motor weakness. The outcome depends on the initial neurological deficit's severity and any signs of improvement within the first 24 hours.

Prognosis of Nerve Injuries Related to Anesthetic Intervention

1. Traumatic Neuropathies: Neurological injuries caused by direct trauma from a regional anesthetic needle or catheter are typically transient, resolving within a year. Rarely, symptoms may persist indefinitely.[35]

2. Compressive Neuropathies (VCH or Epidural Abscess): Recovery following conditions like VCH or epidural abscess depends on the time interval from lesion onset to surgical decompression. An interval exceeding eight hours is associated with a high risk of permanent neurological injury.[36]

3. Meningitis: For bacterial meningitis, early administration of appropriate antibiotics generally leads to a positive prognosis.[37] However, any delay in diagnosis or antibiotic administration increases the risk of morbidity and mortality. Aseptic meningitis tends to resolve spontaneously without specific treatment.[38]

4. Chronic Adhesive Arachnoiditis (CAA): CAA following obstetric regional anesthesia is poorly documented, with cases reported after chlorhexidine injection into epidural and intrathecal spaces. Guidelines recommend using a safe concentration of chlorhexidine in alcohol for CNB asepsis. Diagnosis and prognosis are challenging due to varied symptoms and delayed onset.[39] Some patients plateau, while others experience progressive deterioration, potentially leading to limb function loss.[40]

5. Transient Neurological Syndrome (TNS): TNS symptoms usually resolve within 72 hours, and reassurance and simple oral analgesics suffice for symptom control.[4142]

6. Peripheral Nerve Lesions: Maternal nerve palsies, often associated with prolonged labor and forceps use, typically recover within three months for neuropraxia. Axonotmesis cases might require up to three years for full recovery. Various nerves can be affected, including the lateral cutaneous nerve of the thigh, causing numbness in the thigh, which resolves within three months.[43] Postpartum foot drop, due to lumbosacral or common peroneal nerve damage, requires nerve conduction studies for accurate diagnosis. The recovery

period varies depending on the nerve and the extent of damage. Femoral neuropathy, resulting from fetal head pressure in the pelvis or retractors during Caesarean delivery, causes problems with climbing stairs and sensory loss.[44] Obturator nerve palsy may occur alongside femoral nerve damage.

7. Nerve Root Damage: Nerve root damage can result from needle/catheter trauma or intraneural injection of local anesthetic[45]. Recovery time varies but is usually quicker for nerve root damage, with major symptoms often resolving in weeks, although complete recovery may take months or longer. Chronic pain syndromes may develop.[46]

CONCLUSION

In conclusion, most postpartum neurological issues stem from inherent obstetric palsies, yet obstetric regional anesthesia can lead to neurological injuries. Anesthesiologists should promptly identify and manage complications linked to CNB to avert lasting neurological harm.[47]

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