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Unaccustomed Complications of Epidurals for Labor Analgesia Insight from Five Years of Clinical Experiences- A Narrative Review

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ABSTRACT

Epidural labor analgesia (ELA) has become the standard of care for pain management during childbirth. However, implementing an ELA program in settings without established policies presents challenges, including the management of unfamiliar complications. This narrative review summarizes five years of clinical experience with ELA, focusing on unaccustomed (e.g., unilateral epidural effects, CSF-cutaneous fistulas, knotting of epidural catheters, blurring of vision, and pneumocephalus). Strategies for diagnosing, managing, and preventing these complications are discussed. This review suggests the need for national level protocols and continuous medical education to address unaccustomed events associated with ELA. We have attempted to generate recommendations for the same.

Background

Epidural for labor analgesia is standard of care in the current clinical practice for pain less delivery. Implementing an epidural labor analgesia program in a country like ours lacking established policies and structured guidelines presents significant challenges. It requires thorough preparation for known complications (Table 1) and increased vigilance for unexpected ones.

Table 1: Common complications related to epidural analgesia

	Physiological changes like hypotension and bradycardia		
2	Postoperative nausea vomiting	8	Epidural hematoma
3	Pruritus	9	Infection; meningitis
4	Urinary retention	10	Subdural injection
5	Maternal fever	11	Inadvertently dural puncture
6	Total spinal	12	Postdural puncture headache (PDPH)
7	Permanent neurological deficits	13	Transient neurological deficits

While we can develop protocols to troubleshoot anticipated issues, managing uncommon complications remains complex and requires adaptive strategies. Adaptive strategies involve having a team that is trained to think on their feet, make quick decisions, and modify their responses based on the specific knowledge of each situation. This might include problem-solving techniques, access to additional resources, and a plan for effective communication under pressure. The review attempts to suggest formulating protocols of prevention as well as management of unaccustomed complications of epidural labor analgesia. (Table 2) (Table3)

Complications of epidural labor analgesia

A concise summary of complications related to labor epidural service is provided to help the reader grasp the known (Table 1) or unaccustomed events experienced and not experienced during care of epidural for labor analgesia (Table 2&3). This list is not comprehensive, as unknown complications may arise. The unaccustomed complications we encountered were unilateral epidural effects, CSF-cutaneous fistula, blurring of vision, knotting of epidural catheter, Failure of epidural blood patch, Misconnection wrong site injection, Wrong dose, Cardiac arrest/Altered sensorium during catheter insertion, We have administered epidural labor analgesia (ELA) to 1,018 patients over the past five years. A total of 6.8%, i.e. seventy events, were identified as unaccustomed complications during the care of epidural labor analgesia. We did not come across other possible events as Uteroplacental insufficiency, Effects on labor as prolongation, Pneumocephalus, and Subcutaneous extracranial emphysema. (Table 3)

Table 2: Unaccustomed complications related to epidural analgesia encountered

S.N.		Number of cases encountered
1	Unilateral epidural effects	50
2	Blurring of vision	6
3	CSF-cutaneous fistulas	1
4	Knotting of epidural catheter	2
5	Failure of epidural blood patch	2
6	Misconnection wrong site injection and Wrong dose detected	4
7	Cardiac arrest/Altered sensorium during catheter insertion prior to administration of local anesthetics	5

Table 3: Unaccustomed complications related to epidural analgesia not encountered

S.N.	Uteroplacental insufficency
1	Effects on labor as prolongation
2	Pneumocephalus
3	Subcutaneous extracranial emphysema

Approach to unaccustomed events related to epidural labor analgesia (ELA)

Unilateral epidural motor blockade

The evidence suggests that unilateral epidural block may result from asymmetric distribution of local anesthetic due to catheter misplacement in the anterior epidural space or within an intervertebral foramen with the incidence of 29.2%. Our data showed its incidence of 4.9%. The disparity may stem from underreporting and the absence of well-standardized protocols. Our lower follow-up rates are primarily due to workforce limitations. As a newly established program, our protocols may still have gaps. We recognize the need to enhance and refine our processes. Besides asymmetric distribution of local anesthetics, other causes of unilateral blockade could be injection of air during identification of the space, spread of local anesthetics due to engorged veins, migration of catheter to paravertebral space or subarachnoid space, neurological injury. The risk of epidural hematoma/abscess following unilateral blockade remains, although presentation of motor blockade of epidural hematoma is usually bilateral.

Recommendations to Prevent and Manage Unilateral Motor Blockade

A. Prevention Measures:

1. Optimal Catheter Placement:
   Ensure the catheter is not inserted more than 5 cm into the epidural space to prevent misalignment.

2. Secure Catheter Positioning:
   Use tunneling techniques to minimize displacement and maintain proper placement.

3. Standardized Medication Protocols:
   Follow established guidelines for induction and maintenance doses of local anesthetics and opioids.

4. Continuous Monitoring:
   Maintain ongoing assessment by the pain management team to ensure consistent and safe labor analgesia.

B. Management Strategies for Unilateral Motor Weakness:

1. Patient Reassurance:
   Clearly communicate that the condition is reversible to alleviate concerns.

2. Adjust Infusion Parameters:
   Reduce the infusion volume or concentration to control anesthetic spread while preserving analgesia.

3. Temporary Infusion Cessation:
   If weakness persists, stop the infusion temporarily and monitor for motor power recovery.

4. Patient Repositioning:
   Place the weaker side upright to help redistribute the anesthetic effect.

5. Catheter Adjustment:
   If needed, withdraw the catheter by 1–2 cm to optimize placement.

6. Catheter Removal Consideration:
   If motor weakness persists, consider removing the epidural catheter.

7. Further Investigation:

If symptoms are not resolved, perform an MRI to rule out an epidural hematoma.

Blurring of vision

Causes of blurring of vision after epidural catheter placement could be intravascular placement, especially in Batson's vertebral venous plexus, predisposing factors like glaucoma, transient glaucoma (in patients sustained with eye/head injury), hypermetropia, persistent pupillary membranes. We experienced blurring of vision in 0.0059% of our patients. The epidural steroids injections used for treatment of lower back pain are also associated with blurring of vision. The sudden increase in epidural pressure, due to drug injection potentially increasing intracranial pressure (ICP), may lead to occlusion of retinal veins, venous stasis, and various retinal hemorrhages. Postpartum sublingual Misoprostol can cause blurring of vision. Misoprostol induced blurring of vision is sometimes associated with fever and (or) shivering. Parturient having preexisted Idiopathic intracranial hypertension associated with pseudotumor cerebri syndrome may develop visual symptoms in addition to headache and vomiting. Details history of headache or ophthalmological disorders and documentation of the same are essential prior to any epidural related procedures. The blurring of vision if occurred, after initiation of epidural analgesia, will resolve within a few days. Permanent eye damages are rare however blurring of vision accompanied with flashes and floaters are suggestive of retinal detachment; that need immediate ophthalmologic consultation.

CSF-cutaneous fistula

A leakage of cerebrospinal fluid (CSF) occurs when fluid escapes from the subarachnoid space to the skin through the epidural insertion site, with an estimated incidence rate of 0.16%. There are less than 100 reported cases. We encountered a case of CSF-cutaneous fistula where there weren't any known risk factors. CSF-cutaneous fistula we diagnosed on clinical background. There was continuous flow of clear fluid from the puncture site that was sent for laboratory for analysis. Although no conclusive results was given to identify fluid was CSF, it was evident that the fluid was not transudate or exudate. The neurosurgical consultation was done; in the multiple department meeting it was diagnosed as the fistula that was cured after application of purse string suture.

The diagnosis is almost always based on clinical background; positive glucose and protein, tested by Combur-testR in escaped fluid can suggest the CSF. The detection of beta-2 transferrin or tau proteins in the fluid is sensitive and specific but the test is expensive and time consuming. CT, MRI are used to diagnose location of fistula and intrathecal fluorescein is reserved for intraoperative identification of complex CSF-fistula. Patients are usually asymptomatic; but may complain of features of intracranial hypotension or subdural hematoma. Risk factors include usage of steroids, history of laminectomy, multiple punctures, wet tap, larger size needle and catheter used and prolonged duration of catheter placement.

Management of CSF-cutaneous fistula

Range from conservative management to invasive procedures. Neurosurgical consultation is recommended.

1. Conservative Measures:
   Strict bed rest in a slight Trendelenburg position.
   Pillow placed on the abdomen.
   Hips kept in a flexed position to reduce cerebrospinal fluid (CSF) leakage.

2. Fistula Closure:
   Purse-string skin sutures have been effective in reported cases.
   Risk of post-dural puncture headache (PDPH) remains after closure.

3. Epidural Blood Patch:
   May be required if fistula closure fails after suturing.
   Necessary if PDPH develops following suture closure.

4. Neurosurgical Intervention:
   Needed in rare, refractory cases.

5. Follow-ups:
   Essential to assess proper healing of the fistula.
   Required for suture removal.

Knotting of epidural catheter

Epidural catheter knotting and entrapment is a rare complication with a reported occurrence rate of 0.0015%. We experienced 0.0019% of knotting of epidural catheter that is persistence to established incidence. In both of our cases the length of the catheter was inserted deeper than 12 cm. This issue is more common in middle-aged females, especially during labor, likely due to the widespread use of epidurals for obstetric procedures. The primary cause of a stuck epidural catheter is the formation of a knot and knot typically forms close to the catheter tip. The risk of entrapment increases when the catheter is inserted deeper than 11 cm, as longer insertion lengths can cause curling or kinking. The lumbar region is the most common site for catheter entrapment, particularly in obstetric cases. Complications like hematoma or infection can arise from entrapment of epidural catheter. CT scans are recommended to locate the catheter when imaging is necessary, as radiography is often ineffective. The primary approach for removing a knotted or stuck epidural catheter is gentle traction, with surgical removal reserved for symptomatic cases or when entrapment persists despite multiple traction attempts. Techniques to aid catheter removal include positioning the patient as they were during catheter insertion, applying gentle traction while changing the patient's position, or performing traction under general anesthesia. Prevention strategies involve limiting the epidural catheter insertion length to less than 5 cm after achieving loss of resistance and using

catheters with higher tensile strength.

1. Primary Removal Approach:
   Gentle traction is the first-line method.
   Surgical removal is reserved for symptomatic cases and cases of persistent entrapment despite multiple traction attempts.

2. Techniques to Aid Removal:
   Position the patient as they were during catheter insertion.
   Apply gentle traction while changing the patient's position.
   Perform traction under general anesthesia if needed.

3. Prevention Strategies:
   Limit epidural catheter insertion length to less than 5 cm after loss of resistance.
   Use catheters with higher tensile strength.

Failure of epidural blood patch

Epidural blood patch (EBP) is the gold standard treatment of post dural puncture headache (PDPH); though prophylactic epidural blood patch is not recommended. EBP is said to be "failure", if symptoms persist beyond two days after administering autologous blood patches. We experienced 2 out of 13 (15%) failure of epidural blood patch. The headache was relieved after repeating the blood patch in the two cases. We repeat epidural blood patch when headache was not resolved after the initial patch within 48 hours. The initial EBP has been reported to achieve a success rate of approximately 93% if blood volume injected is more than 20 ml. We have to counsel for a second epidural blood patch beforehand in case of failure of the first procedure. The risk factors for failure of the first patch could be history of migraine, initial ADP occurring at a higher lumbar level (L1/L3) compared with lower levels (L3/L5), early insertion of epidural blood patch (it is recommended to perform the patches after 24-48 hours of CSF leak), blood volume if used less than 20 ml. The second patch is performed twenty-four hours after the first patch. The complications of epidural blood patches are backache, radicular irritation by blood products, arachnoiditis, mild fever and failure of patches to relieve headache. The literature is scarce about the management of failed second epidural blood patches. In 1989 Fry et al reported successful treatment of PDPH after fourth attempts of epidural blood patches but the first attempt was before 24 hours of onset of headache. Less than 20 ml of blood volume was used. Most recent literature suggests the second epidural blood patches are usually successful provided repeat patch performed at least twenty-four hours after the first with injection of 20 ml autologous blood. Ho et al reported a third epidural blood patch and they explained that the failure of first blood was due to early (within 24 hours) of onset of headache and use of blood volume less than 24 hours and the failure of second blood patch could injecting blood from epidural catheter in situ. In both instances it was unable to seal the dural leak by the clot formation. If repeat patches are unable to relieve the headache, we can proceed with a third patch; however, it is better to seek radiological guidance to confirm the level of dural leak. We should perform the blood patch one or two levels up with adequate blood volume. It is not advisable to perform epidural blood patches via epidural catheter in situ. The complications pertaining to repeated epidural blood patches permanent paralysis and cauda equina syndrome, pneumocephalus, back pain, radicular pain, epidural abscess, facial nerve paralysis, fibrosis and obliteration of the epidural space, mass effect resulting in spinal cord and nerve root compression. It is better to consider the first attempt as the best attempt following the recommendation.

a. 20 ml of autologous blood volume

b. 24-48 hours of onset of headache

c. 1-2 levels up of dural leak

Misconnection of catheter, Wrong site injection and Wrong dose of local anesthetic agents

Adverse drug events are defined as 'the failure of a planned action to be completed as intended or the use of a wrong plan to achieve an aim'. We detected 4 cases (0.38%) of misconnection or wrong local anesthetic injection without any fatal outcomes. The incidence of misconnection of epidural catheter or wrong drug administration are not low but medication error in anesthesia practice is alarming. The incidence of medication errors is 6.5%, with 1% resulting in fatalities, 12% being life-threatening, and 28% are preventable. Close loop communication and the clear instructions are essential to prevent misconnection of catheters and wrong dose injection; for example in the instructions we have to write "please dilute 10 ml of 0.5% of bupivacaine with 50 ml of normal saline" and for bolus dose "please inject 11 ml of 0.125 % of plain bupivacaine via epidural catheter" rather than "please inject 0.125 % of bupivacaine." It is advised to prepare and check the drug dilution and connection by two staff and we should have checklists to ensure all the steps are followed accurately. This requires coordination and communication between various departments. In cases of misconnection or incorrect drug dosage being infused or injected, the following steps should be taken:

1. Immediately discontinue the medication.

2. Monitor and manage any signs and symptoms of adverse drug reactions.

3. If local anesthetic agents are accidentally infused intravenously, activate the protocol for Local Anesthetic Systemic Toxicity (LAST), ensuring that 20% lipid emulsion is readily available.

4. Document and report every incident thoroughly.

5. Conduct a root cause analysis for each incident and implement a systematic approach to prevent future occurrences.

Cardiac arrest/altered sensorium during epidural catheter insertion prior to administration of local anesthetic agents

Cardiac arrest during the placement of an epidural catheter, prior to the administration of any local anesthetic agents via epidurals, is a rarely documented occurrence. The incidence rate was 0.49%. The known causes of cardiac arrest are vasovagal syncope, transient episodes of insignificant cerebral blood flow or Bezold-Jarisch reflex in patients without history of heart disease. The patients with history of vasovagal symptoms in previous procedures performed are susceptible to neurocardiogenic arrests; hence history taking of previous procedures is always crucial. In all of our cases we simply considered the cause as vasovagal syncope as no root cause analysis was performed. We have to consider preventative steps in the patients with positive history of vasovagal syncope; These measures include effective communication to reduce the patient's anxiety levels before and during the procedure, close monitoring of their vital signs throughout the procedure, gentle techniques to minimize pain, and the possible use of sedatives, such as benzodiazepines, or anticholinergic agents, such as glycopyrrolate. It is essential to manage a patient's hydration status to prevent Bezold-Jarisch reflexes, especially in patients who are kept nil per oral for surgery, though this may not apply to obstetric cases. It is important to recognize the higher incidence of vasovagal syncope in young adults, as their increased susceptibility to high vagal tone can lead to severe bradycardia and, in some cases, cardiac arrest. We recommend reporting and performing root cause analysis of these types of unaccustomed cases to better understand pathophysiology and incidence of the event.

Uteroplacental insufficiency

The role of labor epidural analgesia in the context of uteroplacental circulation is controversial. Traditionally, the use of epidural analgesia during non-reassuring fetal heart rate patterns raises concerns. In cases of uteroplacental insufficiency, epidural analgesia may further reduce blood flow, worsening fetal acid-base status and potentially causing or exacerbating hypoxic brain injury in vulnerable fetuses. In other hand, the antenatal use of epidural local anesthetics improved placental blood flow reducing villous vascular resistance, leading to improved fetoplacental circulation and higher birth weights in infants born to mothers with severe preeclampsia. The decision to use epidural analgesia for labor pain management in cases of suspected compromised uteroplacental function should be determined by institutional protocols. Developing standardized national policies on this matter could provide greater consistency and guidance. We are not offering epidural labor analgesia for parturients with suspected uteroplacental insufficiency so far.

Extracranial epidural emphysema

Extracranial epidural emphysema is defined as air in the spinal canal; outside of the cranial cavity, either epidural space or cutaneous. Other terms used for similar conditions are pneumorrhachis, pneumosaccus, intraspinal pneumocele, aerorachia pneumomyelogram, and epidural pneumatosis. These conditions can be either intradural, extradural or subcutaneous. Intradural air is malignant (see below) while extradural air is benign. The cranial dura mater has two layers, while the spinal dura mater continues as only the meningeal layer, extending to the sacral vertebra and forming the filum terminale. The arachnoid closely adheres to the dura, while the pia mater forms the filum terminale. The intracranial and spinal epidural spaces are distinct, as the intracranial space ends at the foramen magnum. This means epidural emphysema in one region does not necessarily extend to the other. The causes of extracranial epidural emphysema were iatrogenic observed alongside a symptomatic epidural hematoma, a rare complication of epidural anesthesia with an incidence of less than 1 in 150,000 cases. We have not encountered this complication. It is an asymptomatic condition; some patients may present with sensorimotor deficits, incidentally diagnosed with CT and MRI. Oxygen therapy can reduce emphysema; For patients with epidural emphysema requiring general anesthesia, nitrous oxide should be avoided to prevent intraspinal air expansion and increased cerebrospinal fluid pressure.

Pneumocephalus

Pneumocephalus is a rare event during epidural catheter insertion. It is caused by accidental injection of air into subarachnoid space due to dural puncture while performing epidural catheter insertion by loss of resistance technique using air. Pneumocephalus refers to the presence of air within the cranial cavity, which can occur in various intracranial compartments, including the intraventricular, intraparenchymal, subarachnoid, subdural, and epidural spaces; usually seen after neurological procedures or trauma. Pneumocephalus typically presents with clinical findings such as headache worsening by movement that, unlike post-dural puncture headache (PDPH), is not relieved by lying down. Other symptoms may include dizziness, nausea, vomiting, seizures, and encephalopathy. Two theories explain its mechanism: the "ball-valve" theory, where air enters forcefully due to positive pressure events like coughing, sneezing through dural defects and the "inverted bottle" theory, where enters into intracranial space due to compensate decrease intracranial pressure because of excessive CSF drainage. Diagnosis is confirmed with a CT scan. Management includes preventative and treatment strategies as listed[33]

1. Prevention Strategies:
   Use saline instead of air during procedures.
   Position the patient laterally to reduce risk.
   These measures are not definitive but may help.

2. Treatment:
   Administer 100% oxygen in a recumbent position.
   In severe cases, hyperbaric oxygen therapy may be required.

Conclusion

Epidural labor analgesia is a cornerstone of obstetric care, offering effective pain relief during childbirth. While the benefits

are well-established, this review emphasizes the management of unaccustomed complications. Insights from five years of clinical experience reveal that vigilance, adaptability, and structured protocols are essential to addressing unfamiliar complications such as unilateral motor blockade, CSF-cutaneous fistulas, and catheter-related issues. Stakeholders must establish comprehensive policies, provide effective training programs, enhance communication skills, and implement well-structured response systems at national level. Future research should focus on refining prevention and management strategies for these types of events, while policy development should aim to standardize care across diverse healthcare settings. It deems necessary to form a government label task force to formulate a national policy to support epidural labor analgesia. By adopting a proactive and patient-centered approach, clinicians can continue to enhance the safety and efficacy of epidural labor analgesia programs.

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