

Post Dural Puncture Headache in Obstetric Patients: A Review Article

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Abstract

PDPH is the most common complication occurring after the neuraxial blocks.

The known risk factors are young age, female, obstetrics patients, multiple attempts during the procedure, inexperienced operators, needle size, type and bevel orientation of the cutting needle expose the patient to high incidence of PDPH.

Diagnosis of PDPH can be confirmed with history of Postural component of the headache as aggravated in the sitting and standing position and relieved in the supine lying posture. Refractory to routine analgesia and a witness of the Dural puncture from the available record of the procedure notes.

The possible mechanism is CSF leakage through the puncture site.

Conservative management such as bed rest, adequate hydration, carbonated drinks, caffeine, dexamethasone, paracetamol, NSAIDs and narcotics are used by different anaesthetist with their own preferences and the Epidural blood patch is the definitive treatment for PDPH.

This article reviews the current literature on the clinical diagnosis, risk factors, pathophysiology and definitive treatment of PDPH.

Key Words

Post Dural puncture headache, diagnosis of PDPH, Epidural blood patch,

Introduction:

Neuraxial anesthesia is one of the most common ways of pain relief in labor and caesarean sections. Post-dural Puncture Headache (PDPH) is a known complication of neuraxial anaesthesia. It is the most frequent complication occurring after a neuraxial anesthetic in obstetric patients with an incidence of around 5% in all obstetric anesthesia cases and 50% after accidental Dural puncture¹. PDPH is one of the common causes of prolonged hospital stay after neuraxial anesthesia for childbirth. A very limited information is available to understand the pathophysiology of the PDPH and many of the available treatment options are not evidence based. This review aims to provide the reader with a comprehensive overview of the clinical picture, differential diagnosis and treatment of PDPH in obstetric patients.

Definition:

PDPH is defined as:

‘Headache that worsens within 15 min after sitting or standing and improves within 15 min after lying down after dural puncture has occurred or is suspected and is usually within 72 hours after the dural puncture.

The headache may or may not be accompanied by neck stiffness, vestibular, visual, or auditory symptoms.

Pathophysiology:

As it is clear that dural puncture leads to loss of CSF from the subarachnoid space and thus it is involved in the pathophysiology of PDPH. The evidence of CSF leakage can be seen in the MRI. A study by Vakharia et al demonstrates MRI evidence of CSF leakage in patients of PDPH with extrathecal CSF and hemosiderosis indicating the site of dural puncture.² As the CSF leakage decreases CSF volume, the gravity causes CSF to move into the spinal dural sac in an upright position. As a consequence, the brain loses buoyancy. As it says, this creates tension on the meninges and other pain-sensitive intracranial structures, like vessels and nerves. MRI in PDPH patients also demonstrates low CSF volume, sagging of intracranial structures, and meningeal enhancement. This is the picture of intracranial hypotension syndrome characterized by low CSF pressure and symptomizes as postural headache. Although it is unclear that why a headache occurs in this situation but it is postulated that it may be due to traction on pain-sensitive areas of the brain. Severe cases of CSF hypotension are associated with downward displacement of pons towards the clivus which can lead to cranial nerve palsies, confusion, obtundation, and coma.³

Another possibility may be that the decrease of CSF pressure leads to an increase in blood flow and vascular dilatation and thus pathophysiology similar to vascular headaches. This is dictated by Monroe Kellie's doctrine which states that the sum of volumes of the brain, CSF, and intracranial blood is constant.⁴ Thus, as CSF volume decreases, Blood flow and thus

blood volume increases. The resulting vasodilatation is observed to be mediated by adenosine.⁵ This supports the usage of caffeine in the treatment of such headaches.

Another possible mechanism of PDPH is upregulation of neurokinin 1 receptors and thus increased sensitivity to substance P. It is hypothesized that a low substance P concentration, or a history of chronic headache, or both are associated with a higher risk of PDPH and the risk is seen to increase by three-fold.⁶

During pregnancy, as the abdominal pressure increases, there is stretching of subarachnoid space and increased pressure in the space in the lumbar region. This causes more CSF leakage to occur as a result of dural puncture.⁷ Thus, pregnant patients are more prone to PDPH as compared to non-pregnant patients.

Risk factors:

The risk of PDPH after spinal anesthesia mostly depends on the type and gauge of needle used. A systematic Cochrane review published in 2017 concluded that the risk of developing a PDPH is much higher if a cutting tip needle is used instead of a pencil point needle, but did not find any significant difference when comparing different sizes of the same type of needle.⁸ Cutting needles such as Quincke is associated with at least a five-fold increase in CSF loss and PDPH when compared with blunt/ pencil points such as Sprotte, Whitacre of the same gauge. When comparing the diameter of different needles though it is found to be less significant than type of needle, it is evident that the more the diameter, the more the CSF leakage, and thus more the chances of PDPH. The incidence of PDPH with 24-26 gauge is 3.5% as compared to 0.8% with 27-30 gauge.⁹ As it is clear from the literature that accidental dural puncture is associated with PDPH more often than spinal anesthesia, all the risk factors for accidental dural puncture are associated with the risk of PDPH. Accidental dural puncture complicates from 0.5% to 2.5% of epidurals.¹⁰ It is obvious that, accidental dural puncture is less commonly seen with an experienced anesthesiologist.¹¹ Another factor that is associated with an accidental dural

puncture is the stage of cervical dilatation. With more progress of labor, it is difficult for a woman to assume a favorable position or stay still for the insertion of the needle.¹²

Pushing during labor increases the leakage of CSF from the subarachnoid space, thus, increases the chances of PDPH.¹³ When comparing the BMI and incidence of PDPH although some studies show a protective effect of obesity on PDPH, newer studies have shown that there is no significant association between BMI and PDPH.¹⁴ The study done by J Song et al on 164 patients with accidental dural puncture showed that 51.2% of these developed post-

dural puncture headache out of which 35.7% required epidural patch. But their data failed to find any association between the incidence of PDPH and BMI of patients.¹⁵

Although it is easier to perform a neuraxial block in a sitting position because the intervertebral spaces are more prominent and wider but the dura takes more time to heal after sitting position puncture. Also, the CSF pressure in the sitting position is 40 cm H₂O and in the lateral position is 5-20 cm of H₂O. Therefore, the dural puncture done in a sitting position leads to more CSF leakage and for a prolonged period as well.¹⁶

When comparing the age of parturient it is seen that younger females between ages 18-30 years have a higher incidence of PDPH as compared to the elder women. The reason which is hypothesized behind this is that with age the meninges become less distensible and thus lesser leakage.¹⁷

Clinical Presentation:

Postpartum headache is common and is seen in 39% of parturient females¹⁸ and the causes vary from non-specific to subarachnoid hemorrhage. With this wide range of possibilities, it is important to differentiate PDPH from other causes for adequate treatment. History of the procedure is vital to diagnosis and certain procedure complications such as accidental dural puncture during epidural increases its chances as compared to spinal anesthesia.

The typical feature of PDPH which distinguishes it from other causes is postural variation, it worsening or manifesting within 20 seconds of change of position from lying down to sitting, reaching its peaking in 1 minute, and subsiding or decreasing within 20 seconds of lying down is characteristic.¹⁹

The intensity of pain varies from mild to severe but usually is severe. The quality of pain also varies from dull to throbbing. In the same way, the location of the pain is not consistent, it is mostly frontal but can be occipital, temporal, vertex, or holocephalic with radiation to the neck and shoulders.²⁰ The pain typically starts within 72 hours of procedure in 90% of patients and usually is self-limiting resolving within 14 days.²¹ The pain is aggravated with head movements, Valsalva maneuver, coughing, sneezing, straining, or ocular compression. The associated symptoms of PDPH can be vertigo, tinnitus, photophobia, hearing changes, cranial nerve palsies, diplopia, and even cortical blindness.²² Some patients have prolonged symptoms requiring treatment as long as years later after the procedure.

Complicated cases may extend up to chronic subdural hematoma and cortical vein and venous sinus thrombosis. This is because of decreased CSF pressure and cortical vein dilatation. Other complications associated with PDPH are persistent headache, persistent back pain, and postpartum depression. These complications can lead to increased hospital stay and risk of re-admission with complications. The median time for re-admission with major complications is 5 days with a wide range of 2-22 days. The time to readmission for

depression, headache, and low back pain was much longer and up to 4 months for low back pain.²³

Diagnosis:

Although the diagnosis of PDPH is primarily clinical there are certain screening maneuvers that aid in suggesting orthostatic hypotension. These maneuvers focus on relieving the headache by correcting the CSF pressure. There is a relief of headache by applying firm abdominal pressure which when released can again lead to a headache.²⁴ Another mechanism is to place the patient in Trendelenburg's position, thus decreasing the intensity of headache.²⁵ Although these tests have questionable sensitivity, specificity, and clinical value, they may aid in suggesting the diagnosis.

Radiological tools are important in confirming the diagnosis and differentiating it from other possible causes and complications. PDPH confirmation from magnetic resonance imaging consists of the enhancement of the pachymeninges, decreased size of subarachnoid cisterns and cerebral ventricles, downward displacement of the brain, and subdural collections.²⁶ There is crowding of the posterior fossa and obliteration of basal cisterns due to shifting of brain structures. However, since MRI is not very sensitive to CSF leak it may also present as a normal picture.²⁶

Another alternative study can be a diagnostic lumbar puncture, but unfortunately, it can further lead to loss of CSF and thus accentuating the situation of low CSF pressure. It shows low CSF pressure also known as dry tap, increased protein, and a rise in CSF lymphocyte count.²¹ However this test can also delay the diagnosis if false negative. Therefore, this is not recommended until radiological studies are done.

Prevention:

There are many interventions that are studied for the prevention of PDPH in intentional dural puncture, that is subarachnoid block as well as in unintentional dural puncture.

Conservative strategies – These interventions aim at maintaining the CSF volume by decreasing the loss through the dural puncture or restore the volume via fluid administration. Bed rest is one of the top interventions suggested as it may lead to a decrease in CSF loss due to gravity. However, its role is controversial and a Cochrane review done in 2016 did not find any benefit in preventive bed rest after dural puncture.²⁷ They also analyzed the effect of fluid supplementation and found low-quality evidence for an absence of benefits on the incidence of severe PDPH and moderate quality of evidence on the incidence of any headache after lumbar puncture. Moreover, early ambulation is advisable in women after childbirth to prevent complications of bed rest such as deep vein thrombosis and pulmonary embolism. As

pregnancy and puerperium are periods of hypercoagulability, usage of bed rest can be harmful in that duration.

For subarachnoid block, lateral positioning of the needle bevel upon insertion and removal has also been found to decrease the incidence of PDPH. A meta-analysis performed by Richman

et al showed that PDPH is less common if the bevel of a traumatic needle of any design is oriented parallel to the long axis of the spine rather than perpendicular to it.²⁸ The reason behind this intervention is to decrease the damage to dural fibers in a parallel position. Bevel orientation is likely less important with atraumatic needles as they do not cause dural tears, which results in closure of the hole after the needle is withdrawn.

Prophylactic drugs – Neuraxial opioids have shown some role in the prevention of PDPH. A study by Al-metwalli shows decreased incidence of PDPH after an accidental dural puncture in parturient if they receive two epidural doses of morphine 24 hours apart.²⁹ However, it is not very commonly used because of significant side effect profiles such as nausea and vomiting and limited evidence.³⁰

Cosyntropin which is an analog of ACTH when given intravenous after an accidental dural puncture in parturient was associated with a significant reduction in the incidence of PDPH and need for epidural blood patch and significant prolongation of the time from a dural puncture to the occurrence of PDPH.³¹

Intravenous dexamethasone has also been implicated to decrease the incidence of PDPH but its role in parturient is questionable and in fact, a study done in 2016 found an increased incidence of PDPH with dexamethasone.³²

Prophylactic administration of oral caffeine is not affected, by the risk of increasing insomnia as a side effect.³³

Prophylactic epidural blood patch – After an accidental dural puncture, the Tuohy needle can be withdrawn and reinserted at a different site. Once an epidural catheter is inserted in this site, a prophylactic blood patch through the catheter can be performed to decrease the chances of PDPH. However, recent systemic reviews with a meta-analysis of four randomized controlled studies have not conclusively supported the use of a prophylactic epidural blood patch for preventing PDPH.³⁴ Three trials did find the prophylactic usage of epidural blood patches but they have been reported to be having flawed methodology or limited quality.

A study posted by Stein et al showed a significant reduction in PDPH with an accidental dural puncture with results showing 18.3% developed a PDPH in epidural blood patch and, in the group with conservative treatment 79.6% developed a PDPH. But their results are questionable because of the lack of a control group with a sham epidural patch to eliminate

the placebo effect.³⁵ Therefore, there is currently insufficient evidence to recommend the use of prophylactic epidural blood patches.

Intrathecal catheter insertion - Another way to proceed after an accidental dural puncture is to thread an intrathecal catheter into the subarachnoid space. There are many advantages of this method. Firstly, this catheter will serve as a method of providing analgesia for labor and if required for cesarean section.³⁶ Secondly, as it is evident from few studies there is a 4-9% chance of a second dural puncture in a repeat attempt of epidural catheter insertion,³⁷ using the intrathecal insertion instead will negate these risks. Thirdly this method followed by keeping the catheter in situ for 24 hours seals the dural hole and thereafter incites an inflammatory reaction and thus healing the puncture site.³⁸ Three of the four studies in the meta-analysis done by Bradbury et al showed a prophylactic value of epidural blood patches. Although the incidence of PDPH is not statistically significantly reduced the severity of the headache and the need for a repeat blood patch is reduced significantly.

A prospective study by F Russel in 97 women shows that inserting the catheter into subarachnoid space did not reduce the incidence of post-dural puncture headache (spinal 72% vs. epidural 62%, P=0.2) or blood patch (spinal 50% vs. epidural 55%, P=0.6). However, it had the advantage of the easier establishment of neuraxial analgesia for labor.³⁹ Another systematic review published by Apfel et al. in 2010 came to the same conclusion of not having a significant reduction in the incidence of PDPH with intrathecal catheter insertion.⁴⁰

There is a most feared complication of accidentally giving epidural dose and volume of a drug into the intrathecal catheter which should be vigilantly monitored.

Management:

Although PDPH is a self-limited condition, the severity of symptoms along with some of the serious complications warrants its early effective management. A case-control study done in 40 parturient with unintentional dural puncture shows that the incidence of chronic headache in the study group was 28% as compared to matched controls in whom incidence was 5% and the difference was significant.⁴¹ Thus, it can be concluded that PDPH can have long-term sequelae such as chronic headaches and back pain. So management of PDPH is important even for mild to moderate cases. Many modalities have been tried for the treatment of PDPH and they should be selected from case to case basis depending upon the severity and complications.

Conservative Management – Because the PDPH course is mostly benign and self-limiting it is most advisable to use conservative measures such as bed rest in a supine position and adequate hydration. Again, these measures have questionable efficacy⁴² but they have been used for ages to decrease the severity of PDPH. Other methods tend to increase

intraabdominal pressure and thus decrease CSF loss. These are supine positioning and usage of abdominal binders. These maneuvers generally lead to patient discomfort and are limited by a lack of significant efficacy.⁴³

Pharmacological treatment – Methylxanthine derivatives such as caffeine and aminophylline are the most commonly used drugs for the treatment of PDPH. Caffeine use was introduced in 1949 and it acts by causing cerebral vasoconstriction via acting on adenosine receptors. It also increases CSF production via acting on a sodium-potassium pump.⁴⁴ Caffeine ingestion is found to be associated with significant reductions in cerebral perfusion thirty and ninety minutes later in a study done after ingestion of 250 mg of oral caffeine.⁴⁵ In the study by Sechzer et al, 41 patients were given 500 mg of caffeine sodium benzoate or saline intravenously out of which headache was relieved in 75% of patients after the first dose of caffeine compared with 14% in the saline group. Twenty-four hours after treatment, there were no significant differences between the caffeine-treated and saline-treated groups. Therefore, caffeine is

considered a temporary measure.⁴⁵ While proof of benefit from high-grade studies is lacking, the current clinical literature shows some continued support for caffeine use, particularly in mild to moderate cases. Aminophylline is also a cerebral vasoconstrictor and has been found to have a significant effect on the reduction of pain in PDPH patients as compared to placebo.⁴⁶ An average of 59.1% relief of pain was obtained in the group treated with theophylline infusion as compared to 5.8% in the placebo group. Unfortunately, methylxanthine derivatives have some serious side effects such as seizures and cardiac dysrhythmias which limit their usage in patients susceptible to these.

Gabapentinoids have a structure similar to GABA and act on voltage-sensitive calcium channels to decrease the release of excitatory neurotransmitters. Gabapentin has been shown to decrease the pain score associated with PDPH compared to placebo or ergotamine plus caffeine.⁴⁷ Mahoori et al in a randomized study compared 300 mg oral gabapentin, 100 mg oral pregabalin, and 500 mg oral acetaminophen administered three times daily for three days in patients of PDPH, and both gabapentin and pregabalin significantly reduced the severity of headache.⁴⁸

Triptans are used for migraine for ages and they act on 5HT 1B/1D to cause cerebral vasoconstriction, and they have been tested for migraine. A few case reports have described the relief of PDPH with sumatriptan⁴⁹ but the controlled trials have found sumatriptan to be ineffective for PDPH.⁵⁰

Adrenocorticotrophic hormone (ACTH) is another drug, which is being investigated for treating PDPH. IT acts by two mechanisms – first, it increases pain threshold by increasing beta-endorphin levels, secondly, it increases CSF production via sodium transporters. Ghai et

al reported 80% pain relief in a patient who had previously failed conservative therapy after 4 doses of intramuscular ACTH given for 2 days.⁵¹ A recent study using cosyntropin which is an ACTH analog reported remarkable efficacy and need for EBP and significant prolongation of the time from ADP to the occurrence of PDPH but has yet to be independently confirmed.⁵²

Other drugs which have been studied for the treatment of PDPH are – methergine with metoclopramide, mirtazapine, hydrocortisone, and acetaminophen. All of these drugs have varied effects mostly because they rely on cerebral vasoconstriction as a mechanism to solve the pathophysiology which is only partially true.

Epidural blood patch – Since epidural blood patch is highly effective with a success rate of 61-98% and has low complication rate, it is the treatment of choice for moderate and severe PDPH. In severe PDPH there is no reason to delay the EBP more than 24 hours after the diagnosis.⁵³ It is usually given to patients within 48 hours of PDPH if conventional therapy fails.

The procedure of epidural blood patch involves injecting patients' blood taken from a big vein such as an antecubital vein into the epidural space via an epidural needle. Because blood in the epidural space tends to move upward, the epidural needle is inserted at or below the site of the previous insertion and around 20 ml of the blood is injected. Thereafter the patient is told to stay in a supine position for at least 2 hours.⁵⁴ The adequate volume of blood to be injected is controversial and investigators have found volumes as low as 7.5 ml effective in some cases.⁵⁵ However, volumes such as 20–30 ml of blood result in lower pain scores and a higher probability of permanent relief when compared to smaller amounts.⁵⁶ The variation in the volume required must be due to anatomical variation in the volume of intrathecal and epidural spaces.

The postulated mechanism of action of this technique is increasing pressure in the epidural space and thus restoring the intrathecal pressure. This leads to immediate relief of headache which is felt after epidural blood injection. This is why there is a relief of headache in cases with epidural saline injection. Another mechanism is to form a clot of the puncture site this leading to the closure of it. Magnetic resonance imaging studies have found that epidural blood adheres to the thecal sac, resulting in clot formation for up to 18–24 h.⁵⁷ However, the CSF formation is slow and thus replenishment of CSF volume takes time, thus this mechanism is involved in the relief after some time. An epidural blood patch may also produce venous and arterial cerebral vasoconstriction and therefore, relieving the vascular component of the headache.⁵⁸

If a single epidural blood patch injection fails, a second injection can be given and almost one-third of patients will need a second injection.⁵⁹ However, if that is ineffective a brain MRI and this exclusion of intracranial pathologies should be done before considering a third blood patch. Complications of epidural blood patch injection are severe but rare. There have been reports of severe lumbar back pain and radicular symptoms which were in most cases self-limiting.⁶⁰ Other reported complications are bradycardia, aseptic arachnoiditis, chemical or infectious meningitis, subdural and subarachnoid hematoma.²¹

Epidural colloids - The epidural injection of colloids is a useful alternative to blood if an epidural blood patch is contraindicated. Dextran-40⁶¹ or hydroxyethyl starch⁶² has been described with various success rates. The increased viscosity of colloid solutions results in slower migration from the epidural space and thus helps in the buildup of intrathecal pressure.

Fibrin glue - For patients in whom PDPH recurs despite several epidural blood patches, fibrin glue can be injected in epidural space.⁶³ This glue has a combination of fibrin and thrombin which lead to the formation of a clot. Another desperate measure in refractory cases is surgical closure of the dural defect.⁶⁴

Acupuncture - Acupuncture has been found effective in migraine⁶⁵ and other headaches and it is also found success in some case series⁶⁶ for PDPH but large studies which have conclusive evidence cannot be found.

Greater occipital nerve block - The greater occipital nerve is a sensory nerve originating from C2-C3 which carries sensory fibers from the skin, muscles, and vasculature over the posterior aspect of the head. Greater occipital nerve blocks have been used successfully in the treatment

of migraine and cluster headaches.⁶⁷ Similar studies have shown its role in the treatment of PDPH.⁶⁸

Sphenopalatine ganglion block - Sphenopalatine ganglion is located in the pterygopalatine fossa in the posterior nasal pharynx and contains sympathetic, parasympathetic, and sensory nerve fibers. Ganglion prohibits a non-invasive intervention with fewer side effects and high efficacy had been tried as a treatment modality of PDPH. Several case reports and case series are reporting the success of sphenopalatine ganglion block for the management of spinal headache in obstetric patients.⁶⁹

Conclusion:

PDPH is although a common and well-known complication of neuraxial anesthesia it is often disregarded and not appropriately treated. Since the onset of this headache occurs after a certain lag period from a dural puncture, puerperium is often misdiagnosed or under-reported. This can lead to significant morbidity and steals some precious happy experiences from new mothers even if mild. This obscures the mother-child bonding and more stress to the already exhausting postpartum period. Therefore, adequate follow-up visits by anesthesiologists in this period, early diagnosis, and treatment are essential for quality patient care.

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