

An Update on Effective Management of the Postdural Puncture Headache

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KEY POINTS

- Postdural puncture headaches (PDPHs) usually present as a positional headache within 3 days of dural puncture.
- Postpartum headaches require a thorough history and physical exam, as the differential is broad and PDPHs make up a minority of cases.
- Needle type and size directly impact the rate of PDPH. Small, noncutting needles are recommended when possible.
- Fluids and bedrest are not effective treatments for PDPH, and multimodal analgesia is indicated.
- Sphenopalatine ganglion block is a less invasive alternative to an epidural blood patch, but evidence is limited.
- Epidural blood patch remains the most effective treatment for PDPH.

INTRODUCTION

Toward the evening I was forced to take to bed and remained there for nine days, because all the manifestations recurred as soon as I got up. At midnight a violent headache set in that quickly became insupportable.

August Bier, 1898: a personal experience of postdural puncture headache

Postdural puncture headache (PDPH) was first described by August Bier in 1898 and classically presents as a postural headache following therapeutic or diagnostic interventions of the epidural or spinal space.

The incidence of PDPH varies, but is estimated to be 36% or more following lumbar puncture, 0%-10% following spinal anaesthesia, and 81% following accidental dural puncture during epidural insertion. Rates of accidental dural puncture during epidural insertion in pregnancy are estimated to be 0.04%-6%.^{1,2}

Although PDPH usually resolves spontaneously, it may interfere with a mother's ability to care for her newborn and may extend the length of hospital stay. More rarely, PDPH may be associated with serious complications such as subdural haematoma, seizures, sagittal sinus thrombosis, and cranial nerve palsies.

PATHOGENESIS AND ANATOMY

The anatomy of the epidural space is shown in Figure 1. The pathogenesis of PDPH remains unclear but is thought to be caused by cerebrospinal fluid (CSF) leakage into the epidural space via a tear in the meninges. The CSF loss leads to a

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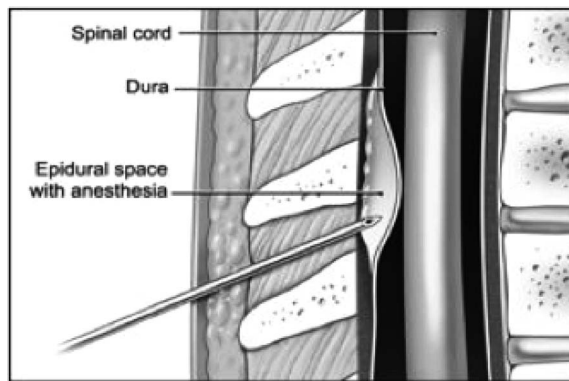


Figure 1. Anatomy of the dura mater. Illustration ©Chris Gralapp, reproduced with permission. Not for use without permission of copyright holder.

reduction in intracranial pressure and downward traction on pain-sensitive intracranial structures, resulting in a headache that is classically worse in the upright position. The fall in intracranial pressure may also cause compensatory cerebrovascular venodilation contributing to the headache.¹

DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS

The fundamental principle in the assessment of a postpartum headache is to carefully consider the differential diagnosis. While postpartum headaches occur in up to 40% of postpartum women, 50%-75% of postpartum headaches are tension or migraine headaches, and only 5%-15% are PDPHs.³ Importantly, one study found that 24% of postpartum headaches were due to preeclampsia, affirming the importance of ruling out serious causes.⁴ Other often-overlooked causes such as medication headaches (eg ondansetron) should also be excluded (Table 1).

A history and examination should be performed, taking into account the timing of the headache in relation to the neuraxial procedure and the nature of the headache, as well as other symptoms and signs. Since PDPH can present following an unrecognized dural puncture during an epidural, details of the epidural insertion should be reviewed including the difficulty of the procedure and number of attempts. Following a spinal procedure, PDPH is more likely with a larger-gauge 'cutting'-tipped needle (see below) or after multiple attempts at spinal block which might result in a number of dural tears, increasing the chance of a CSF leak.

<ul style="list-style-type: none"> Infective <ul style="list-style-type: none"> Meningitis Encephalitis Vascular <ul style="list-style-type: none"> Migraine Cerebral vein thrombosis Cerebral infarction Subdural hematoma Subarachnoid hemorrhage Neoplastic <ul style="list-style-type: none"> Space occupying lesion Pharmacological/Metabolic <ul style="list-style-type: none"> Dehydration Caffeine withdrawal Medication side effect (eg ondansetron) Other <ul style="list-style-type: none"> Postdural puncture headache Preeclampsia Tension headache Benign intracranial hypertension Pneumocephalus Lactation headache
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Table 1. Causes of Postpartum Headache

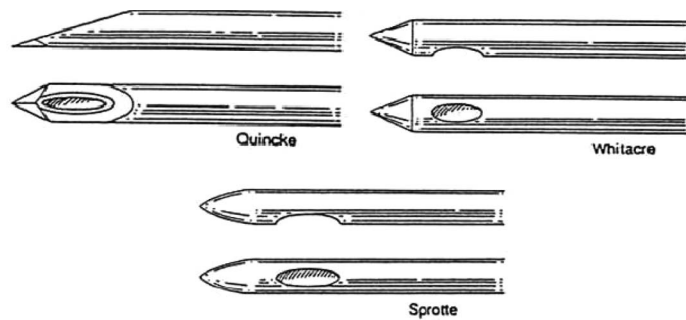


Figure 2. A comparison of different spinal needle tips. Figure reprinted from Moghtaderi et al. 2012. *Emergency Medicine—An International Perspective: InTech* 2012:43-48.⁶ Image licensed under a Creative Commons Attribution 3.0 License.⁶

The cardinal features of PDPH as defined by the International Headache Society are a headache occurring within 5 days of lumbar puncture caused by CSF leakage through the dural puncture. It is usually accompanied by neck stiffness and/or subjective hearing symptoms. It remits spontaneously within 2 weeks, or after sealing the leak with autologous epidural lumbar patch. However, PDPH can occur later and continue for longer than these times, with case reports of PDPH lasting for years. Presentation is often variable but classic features include the following:

- Headache is often frontal-occipital.
- Usually develops 24 to 48 hours after the procedure with 90% of headaches presenting within 3 days.¹
- Headache is worse in the upright position and eases when supine.
- Pressure over the abdomen with the patient in the upright position may give transient relief to the headache by raising intracranial pressure secondary to a rise in intra-abdominal pressure (Gutsche sign).
- Associated symptoms include neck stiffness, photophobia, tinnitus, visual disturbance, and cranial nerve palsies.

Skin over the epidural or spinal puncture site should be inspected for inflammation and tenderness and vital signs should be recorded. PDPH is a clinical diagnosis; however, diagnostic imaging should be considered early if there is concern for more serious intracranial pathology. In cases of PDPH, magnetic resonance imaging may demonstrate diffuse meningeal enhancement and brain descent.¹

PREVENTION

Spinal Needle Selection

Smaller spinal needles and pencil-point tips such as the Whitacre and Sprotte needles are associated with lower rates of PDPH than larger or cutting-tip needles.¹ A common belief is that pencil-point needles part, rather than cut, the dural fibers, resulting in less trauma and decreased incidence of PDPH. However, scanning electron microscopy demonstrates that cutting-tip needles produced a U-shaped flap while pencil-point needles created a traumatic tearing of meningeal fibers. It is believed that an inflammatory response to the tearing results in closure of the lesion and decreased incidence of PDPH.⁵ Ideally, pencil-point spinal needles no larger than 25 gauge should be used (Figure 2).

Neuraxial Block Technique

Epidurals can be inserted using a loss of resistance to saline (LORS) or to air (LORA). Inadvertent dural puncture while using loss of resistance to air may result in pneumocephalus, which itself can cause headache. Despite suggestions that loss of resistance to saline is preferable to loss of resistance to air, a meta-analysis of prospective, randomized trials found no difference in rates of accidental dural puncture or PDPH between air or saline.⁷

Bevel orientation of spinal and epidural needles during insertion has been shown to influence the rate of PDPH with lower incidence of headache if bevel orientation is 'parallel' to dural fibers.¹ However, given evidence that dural fibers do not run longitudinally and are not arranged in a parallel structure, the mechanism of this is still unclear.⁵

Other precautions include optimal patient positioning, slow controlled advancement of the needle, and limiting patient movement during the procedure by using adequate local anaesthetic infiltration to overlying soft tissue and maintaining verbal contact throughout. Operator experience is inversely related to inadvertent dural puncture and PDPH rates. Fatigue, sleep deprivation, and shift work are other important factors that may contribute to PDPH rate.¹

After accidental dural puncture with a Tuohy needle, placement of the epidural catheter through the dural perforation may reduce the likelihood and severity of PDPH. This is thought to be due to an inflammatory response to the catheter, which promotes healing and reduces CSF leakage. Randomized trials are limited, evidence is conflicting, and how long the catheter

should be left in place is unclear. One meta-analysis found a nonsignificant decrease in PDPH but a significant reduction in need for an epidural blood patch (EBP).⁸ The risks of leaving an intrathecal catheter include infection and drug overdose and hence the catheter should be clearly labelled.

Following diagnostic lumbar puncture, replacing the stylet prior to removing the needle may reduce the risk of headache. Stylet insertion may prevent a strand of arachnoid that was trapped in the needle following CSF aspiration from being avulsed on needle withdrawal, reducing damage to the dura.⁹

MANAGEMENT

Conservative Management

Most PDPHs resolve spontaneously. Conservative management has traditionally involved bed rest and fluids, though there is little evidence to support either. A Cochrane review on fluids and bedrest for treating PDPH was updated in 2016 and concluded that routine bed rest and fluids after dural puncture is not beneficial,² yet despite this it continues to be recommended by physicians.

Pharmacological Management

Many treatment modalities have been recommended to treat PDPH; however, evidence of effectiveness for most is limited. Multimodal analgesia should be instituted in all patients with PDPH; regular acetaminophen and nonsteroidal anti-inflammatory medications may control symptoms adequately.

Caffeine

Caffeine is thought to treat PDPH by inducing cerebral vasoconstriction. Doses from 75 to 500 mg, orally and intravenously, both one-time and repeated, have been studied. A Cochrane review in 2015 concluded there is evidence that caffeine confers a temporary benefit in PDPH compared to placebo; however, the evidence quality was poor.¹⁰ Caffeine is associated with adverse events including cardiac arrhythmias and seizures, and high doses may enter breast milk and lead to neonatal irritability.

Corticotropin Analogues

Synthetic corticotropin was reported for treating PDPH in the 1990s. Postulated mechanisms include CSF retention through mineralocorticoid-mediated sodium reabsorption, and a direct analgesic effect via its glucocorticoid activity. Most reports of its effectiveness stem from case reports and case series; however, a randomized controlled trial in 2004 found no effect of a single intramuscular injection of Synacthen compared with placebo.¹¹

Other Medications

Numerous other reports exist in the literature with for a variety of other pharmacological agents, most with a mechanism involving vasoconstriction. Some of these include serotonin agonists (eg sumatriptan), methylergonovine, gabapentin, theophylline, and hydrocortisone.¹¹ While some evidence suggests gabapentin, theophylline, and hydrocortisone decreased pain scores, no intervention reduced need for an EBP. In addition, the evidence is of low quality as all studies were small with short follow-up, and further research is required.¹⁰

One recent randomized, double-blind, controlled trial of obstetrics patients with PDPH found that neostigmine and atropine significantly decreased pain scores, and no patient in the study group required an EBP. The proposed mechanism is cerebral vasoconstriction and increased CSF production.¹² However, no other studies have investigated this, and further research is required.

Invasive Management

Sphenopalatine Ganglion Block

A sphenopalatine ganglion block (SPGB) is a recent treatment option for PDPH that has been used in the past for treating migraines. The sphenopalatine ganglion is a collection of parasympathetic cells located in bilateral nares posterior to the middle nasal concha in the nasopharynx. The proposed mechanism of action is a block of the sphenopalatine ganglion parasympathetic-induced cerebral vasodilation.¹³

Technique

- Have the patient lie supine in a sniffing position.
- Soak a long cotton-tipped applicator in local anaesthetic (2%-4% lidocaine, 0.5% ropivacaine, or 0.5% bupivacaine).

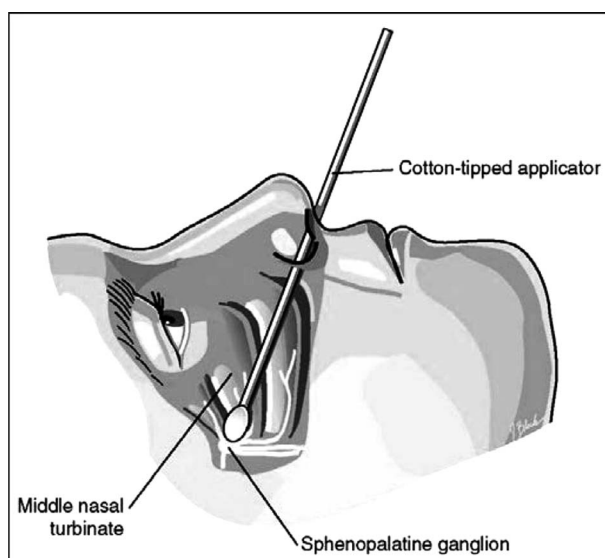


Figure 3. Sphenopalatine ganglion block location. Figure reprinted from Machado et al. 2009.¹⁴ *BrJP* 2(4), 392-394. Image licensed under a Creative Commons Attribution License.

- Insert cotton-tipped applicator into patient's nare aiming straight back.
- Advance until the posterior nasopharynx wall is reached and resistance is felt.
- Leave applicator in place and in contact with sphenopalatine ganglion for 10 minutes, then remove.

Adverse events include nausea, bitter taste, discomfort during insertion of applicator, and nasal or throat pain.

The SPGB has been described in case reports and series, and in one retrospective cohort as an effective treatment for PDPH. However, just recently a randomized, blinded, controlled trial compared SPGB using local anaesthetic-soaked cotton swabs to placebo swabs. This study found a large decrease in pain scores for both placebo and local anaesthetic groups, and no difference in rates of EBPs, suggesting a placebo as the cause of SPGB's reported effectiveness (Figure 3).¹³

Epidural Blood Patch

After the observation that patients with bloody spinal taps at lumbar puncture were less likely to develop PDPH, the first EBP was performed in 1960. Just 2 mL of the patient's blood was injected during the first EBP and the headache was relieved.

Epidural blood patching involves injection of autologous blood into the epidural space. It remains one of the few proven treatments of PDPH; however, the mechanism of action remains unclear. The resulting blood clot may have a 'patch effect' on the dural tear while the volume of blood transfused into the epidural space raises intracranial pressure.

Effectiveness

Early studies of the efficacy of EBPs (up to 90%) were overestimates due to inadequate patient follow-up, as evidence suggests pain can reoccur after an initial period of relief.¹⁵ Data suggest that complete, permanent relief of PDPH by a single blood patch occurs in 31%-50% of patients after puncture with an epidural needle, and up to 75% after a spinal needle. Complete or partial relief occurs in approximately 90% of patients.¹⁵⁻¹⁷ About 30% of patients require a second blood patch.^{15,16} Needle diameter smaller than 20 gauge is also a predictor of partial or failed response to EBP.¹⁷ Despite recent data, EBP remains the most effective treatment for PDPH and is more effective than conservative management in treating established PDPH.¹⁸

Optimal Technique

- An EBP should be performed by two personnel: one an experienced anaesthetist, the other competent in taking a volume of blood from the arm. Both should employ full aseptic precautions.
- Contraindications include sepsis, coagulopathy, and patient refusal.
- Timing of EBP performance is somewhat controversial, with limited evidence pointing to less failure (ie return of headache and need for subsequent EBP) when performed more than 48 hours after PDPH onset. However, failure of earlier EBPs may be due to larger, more difficult to treat dural punctures presenting earlier, and waiting to offer EBP until after 48 hours has passed may unnecessarily prolong patient discomfort and distress.¹⁶

- Volumes of between 2 and 60 mL of blood have been described in literature. A randomized, controlled trial in 2011 compared 15, 20, and 30 mL of blood for an EBP. The study suggests that a volume of 20 mL is a reasonable volume to use as it resulted in lower headache pain scores and less back pain during injection. Injection should be stopped if the patient experiences pain during the procedure.¹⁶
- Most anaesthesiologists recommend the patient lie flat for 1 to 2 hours after the procedure and avoid heavy lifting for 48 hours; however, evidence supporting this is lacking.¹⁹

Safety

- Strict asepsis must be maintained during an EBP.
- Do not perform in the presence of leucocytosis or fever due to the risk of meningitis.
- Minor complications include backache, neck ache, and transient bradycardia.
- Major complications are rare and include meningitis, subdural haematoma, seizures, arachnoiditis, and dural puncture.^{15,16}
- An EBP may be unacceptable to Jehovah's Witness patients, so thorough informed consent detailing the procedure, alternatives, risks, and benefits should be performed in these and all patients.
- If an EBP fails to relieve a PDPH, it may be prudent to consider head imaging to exclude other pathology prior to a repeat EBP.

Prophylactic EBP

An attractive option after accidental dural puncture is a prophylactic EBP (PEBP) in the hope of preventing a subsequent PDPH. Unfortunately, PEBP did not decrease the risk of PDPH compared to a sham procedure, and a Cochrane review concluded that PEBP could not be recommended over other treatments.¹⁸ In addition, not all dural punctures cause PDPH and many PDPHs do not require an EBP. Therefore, PEBP following dural puncture may expose patients to an unnecessary procedure with associated risks.

Other Techniques

Epidural Fluids

Both infusions and boluses of saline into the epidural space have been studied. While both may transiently increase the CSF pressure and provide temporary relief of the headache, longer-term relief is not seen.¹

Neuraxial Morphine

A small randomized trial found that 3 mg epidural morphine reduced the development of PDPH and need for EBP following accidental dural puncture. A more recent randomized trial in 2020 found that intrathecal morphine did not decrease development of PDPH or rates of EBP.²⁰ Further research is required.

SUMMARY

In summary, PDPH is usually a self-limited, positional headache that can occur following dural puncture but may be very painful and have a significant impact on a patient's functional ability. A broad differential diagnosis is critical when evaluating a suspected PDPH as there are many alternative causes, including serious and life-threatening conditions. While there are multiple potential pharmacological treatments, many lack strong evidence to support their efficacy. The SPGB is a newer treatment modality that offers an alternative to an EBP. However, further evidence is required to determine its true efficacy. An EBP remains the most effective treatment for PDPH.

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