

REVIEW

Post lumbar puncture headache: diagnosis and management

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Lumbar puncture is a frequently performed procedure in medical emergencies and anaesthesia. Headache after lumbar puncture is a common occurrence (32%) and carries a considerable morbidity, with symptoms lasting for several days, at times severe enough to immobilise the patient. If untreated, it can result in serious complications such as subdural haematoma and seizures, which could be fatal. Certain factors contribute to the development of headache after lumbar puncture. If these factors are taken into consideration, the incidence of headache could be markedly reduced. It is therefore important that the doctors are aware of the methods available for reducing the incidence of headaches after lumbar puncture. On the other hand, there are several misconceptions that are thought to decrease the incidence of headaches with no scientific basis. This article reviews the scientific literature and highlights the practical issues involved in the diagnosis and management of headaches after lumbar puncture, including the epidural blood patch treatment.

of resuming the recumbent position". This definition helps to avoid confusion with migraine or simple headache after lumbar puncture.

CHARACTERISTICS OF HEADACHE AFTER LUMBAR PUNCTURE

The onset of headache after lumbar puncture is usually within 24–48 h after dural puncture,^{1–5} but contrary to the above definition, it could be delayed by up to 12 days,⁶ indicating that the time points in the definition are random. Although the headache may rarely present immediately after dural puncture,⁷ its occurrence should alert the doctor to an alternate cause such as rise in intracranial pressure, with associated displacement of intracranial structures. The postural nature of the headache is very characteristic and the symptoms are usually self-limited,⁶ but sometimes it may be severe enough to immobilise the patient. Headache after lumbar puncture is usually dull or throbbing in nature, and can start in the frontal or occipital region,⁸ which can later become generalised. It is possible for the pain to radiate to the neck and shoulder area, and could be associated with neck stiffness. Head movements exacerbate the pain and any manoeuvres that increase intracerebral pressure, such as coughing, sneezing, straining or ocular compression, may also worsen the symptoms. Other associated symptoms include lower back pain, nausea, vomiting, vertigo and tinnitus and, rarely, diplopia due to cranial nerve palsy and even cortical blindness.⁹

Headache usually resolves within a few days, but the longest reported headache after lumbar puncture lasted for 19 months.¹⁰

DIAGNOSIS

This is essentially a clinical diagnosis and the history of a dural puncture and the postural nature of the headache with associated symptoms usually confirms the diagnosis. If a diagnostic lumbar puncture is performed, it may show a low cerebrospinal fluid (CSF) opening pressure, a slightly raised CSF protein and a rise in CSF lymphocyte count.⁷ Magnetic resonance imaging of the brain may show diffuse dural enhancement with evidence of sagging, descent of the brain and brain stem, obliteration of the basilar cisterns and enlargement of the pituitary gland.¹¹

Lumbar puncture is a common procedure for diagnosis and anaesthesia. Headache is a common sequela of this procedure irrespective of the indication, although the frequency is less with spinal and epidural anaesthesia where fluid is injected and not removed. About one third of patients develop headaches after lumbar puncture,¹ although the incidence may be higher, as minor symptoms may not be reported.

Headache after lumbar puncture occurs more often in young adults, especially in the 18–30-year age group.² Young women with a lower body mass index and those who are pregnant have the highest risk of developing headaches after lumbar puncture.³ A less stretchable duramater due to either atherosclerosis or age-related mechanical changes in the epidural space might explain why the incidence is low in elderly patients.⁴

DEFINITION

According to the Headache Classification Committee of the International Headache Society,⁵ headache after lumbar puncture is defined as "bilateral headaches that develop within 7 days after an lumbar puncture and disappears within 14 days. The headache worsens within 15 min of resuming the upright position, disappears or improves within 30 min

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Abbreviation: CSF, cerebrospinal fluid

PATHOPHYSIOLOGY

The exact pathophysiology of headache after lumbar puncture is unclear. However, it is most probably related to the "hole" in the left dura after the needle has been withdrawn,¹² resulting in persistent leak of CSF from the subarachnoid space. This leakage results in a fall in intracranial CSF volume and CSF pressure.¹³

Although the loss of CSF and lowering of CSF pressure is not disputed, the actual mechanism producing the headache after lumbar puncture is not clear. There are two possible explanations. Firstly, the low CSF volume depletes the cushion of fluid supporting the brain and its sensitive meningeal vascular coverings, resulting in gravitational traction on the pain-sensitive intracranial structures causing classical headache, which worsens when the patient is upright and is relieved on lying down.¹⁴ Secondly, the decrease in CSF volume may activate adenosine receptors directly, causing cerebral vasodilatation and stretching of pain-sensitive cerebral structures, resulting in headache after lumbar puncture.⁶

FACTORS CONTRIBUTING TO THE DEVELOPMENT OF HEADACHE AFTER LUMBAR PUNCTURE

The following factors contribute to the development of headache after lumbar puncture:

1. *Needle size:* The size of the dural tear is directly proportionate to the amount of CSF leakage. As a smaller needle diameter produces a smaller tear in the dura, there is less potential for leakage and incidence of headache after lumbar puncture. The incidence of headache is 70% if the needle size is between 16 and 19G, 40% if the needle size is between 20 and 22G and 12% if the needle size is between 24 and 27G.¹⁵ Although smaller needles are satisfactory for spinal and epidural anaesthesia and for myelography, for diagnostic lumbar puncture, the use of a needle with a diameter <22G may not be practical (unless only a small volume of fluid is needed), as the time for transduction of the opening pressure using the manometer may be too long and the flow rate may be too slow.¹³ Needles <22G take >6 min to collect 2 ml of fluid and a similar period is required for measuring pressure and even then the measurement may be inaccurate. In practice, therefore, a 22G needle is the smallest size that should be used for diagnostic lumbar puncture.¹⁶
2. *Direction of bevel:* As the collagen fibres in the dura matter run in a longitudinal direction, parallel to the long or vertical axis of the spine, the incidence of headache after lumbar puncture is less if the needle is inserted with the bevel parallel to the dural fibres, rather than perpendicular.¹⁷ This "separates" the fibres rather than cutting them, thus facilitating closure of the hole on needle withdrawal. If the needle is at right angles to the collagen fibres, the cut in the dural fibres, previously under tension, would then tend to retract, resulting in a bigger dural tear, thus increasing the likelihood of CSF leakage and the incidence of headache after lumbar puncture.
3. *Needle design:* There is convincing evidence in the anaesthesia literature that headache after lumbar puncture is reduced using non-cutting (atraumatic) needles.¹⁸ These atraumatic needles have a diamond-shaped tip and the orifice is situated up to 0.5 mm from the needle tip. As these needles cause temporary separation rather than cutting the elastic fibres, which then recoil after removal of the needle, the damage to the dura is less with atraumatic needles.¹⁷ This considerably reduces the incidence of headache and

the need for medical intervention. The literature on diagnostic lumbar puncture has been conflicting until recently. Three randomised, double-blind controlled studies¹⁹⁻²¹ concluded that atraumatic needles considerably reduced the incidence of headache after diagnostic lumbar puncture, although they were associated with a higher failure rate than the standard needles. As the tip has to be passed at least 0.5 mm into the subarachnoid space before the orifice enters into it, some patients may develop paraesthesia owing to the possible impingement on the stretched cauda equina by the tip of the needle.

4. *Replacement of the stylet:* The standard procedure is to replace the stylet before withdrawing the needle when a non-cutting needle is used. In a study of 600 patients,²² the incidence of headache was 5% in patients whose stylet was replaced as compared with 16% in the patients whose stylet was not reinserted. It is thought that the higher incidence in the second group is due to a strand of arachnoid that may enter the needle with the CSF and when the needle is removed the strand could be threaded back through the dural defect and produce prolonged CSF leakage. Theoretically, reintroducing a stylet that may have been contaminated with respiratory droplets could result in a rare complication such as bacterial meningitis after a diagnostic lumbar puncture.
5. *Number of lumbar puncture attempts:* As the number of dural punctures directly relates to the size of the dural damage, making fewer attempts at dural puncture could be associated with lesser incidence of headache after lumbar puncture. However, no studies have been conducted.

FACTORS NOT INFLUENCING THE INCIDENCE OF HEADACHE AFTER LUMBAR PUNCTURE

The following factors do not influence the incidence of headache after lumbar puncture:

1. The volume of the spinal fluid removed is not a risk factor for headache after lumbar puncture.^{1 4}
2. There is no evidence that any duration of bed rest after lumbar puncture has a role in preventing headache.²³
3. Improving hydration by increased fluids (either oral or intravenous) has not been shown to prevent headache after lumbar puncture.¹
4. Mostly, lumbar punctures are performed with patients lying on their side,²⁴ although it is considered to be quicker and technically easier with the patient sitting upright. So far, there is no convincing evidence to suggest any particular position to reduce the incidence of headache after lumbar puncture, and it depends mainly on the choice of the doctor unless it is to measure the CSF pressure, where the patient should be in the supine position.
5. The incidence of headache after lumbar puncture does not depend on the CSF opening pressure, CSF analysis or the volume of CSF removed.³

MANAGEMENT

As headache after lumbar puncture is relatively common and is a significant cause of morbidity, it should always be explicitly discussed when a patient consents for lumbar puncture, especially those who are in a high-risk category, such as young women with a low body mass index, and during pregnancy.²⁵ As the onset of headache is usually after 24 h and may be delayed for a few days, the patients should be warned about it before discharge, particularly if they are discharged soon after the procedure.

If a patient develops headache after lumbar puncture with characteristic features, they should be encouraged to lie in a comfortable position, which is mostly in the supine position owing to the postural nature of the symptoms. Supporting treatment such as rehydration, simple analgesics, opioids and anti-emetics may control the symptoms in milder cases. Generally, >85% of headaches after lumbar puncture will resolve without any specific treatment.⁸

However, if conservative measures fail to resolve headaches after lumbar puncture, then specific treatment is indicated 72 h after the onset of pain, as it would avert the catastrophic complications of subdural haematoma and seizures that could be fatal. In one survey, 4 of 14 patients with subdural haematoma after dural puncture died.²⁶

The aim of specific management of headache after lumbar puncture is to replace the lost CSF, seal the puncture site and control the cerebral vasodilatation. Several therapeutic measures have been suggested to treat headache after lumbar puncture based on these strategies.

1. *Blood patch*: The concept of the epidural blood patch was developed after the observation made on patients who had "bloody tap", in whom the incidence of headache was low. Once blood is introduced into the epidural space, it will form a clot and seal the perforation, thus preventing further leak of CSF. The presence of fever, local infection in the back and bleeding disorders are the main contraindications for this procedure. Lumbar puncture is usually carried out by a trained anaesthetist. The patient is asked to lie down in a curled-up lateral position and using a proper aseptic technique, an epidural needle is introduced into the epidural space of the lumbar region. About 20–30 ml of blood is then taken from a large vein, usually from the patient's arm, and injected immediately but slowly into the epidural space through the epidural needle. As blood will distribute into the epidural space through few spinal segments superiorly and inferiorly, it is not essential to introduce it into the exact place at which the dural puncture was performed. After the procedure, the patient is asked to lie still for 1–2 h in a supine position and is then mobilised. This procedure has a success rate of about 70–98%⁸ and can be repeated if it fails to resolve the symptoms at the first attempt. Although it is rare, arachnoiditis may complicate the epidural blood patch.⁸ It has been found that the success rate is lower if it is performed within the first 24 h of lumbar puncture.²⁷ This could be because a large amount of CSF leaks out during the first 24 h, which could interfere with blood clotting.⁶
2. *Epidural saline*: It was noted that after a blood patch treatment, there was a rapid resolution of symptoms, which could not be explained purely by the sealing effect on the puncture site. This brought the concept of possible compression of the thecal sac with presumed increase in subarachnoid pressure owing to the volume of blood introduced. The same effect was expected on using saline, which is relatively inert and sterile, and epidural saline bolus or infusions were advocated in some regimens based on this hypothesis, with variable results.⁸
3. *Epidural dextran 40*: It has not been extensively studied for the treatment of headache after lumbar puncture and is not in current use. However, in a series of 56 patients with headache, who failed to respond to treatment including epidural blood patch, relief of headache was accomplished in all patients within 24 h after injection with 20 ml of dextran 40 epidural.²⁸ Apparently, it raises the epidural pressure, thus reducing

Five key references

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the leak of CSF. Due to high molecular weight and viscosity, it remains in the epidural space for a longer period before it is absorbed, which enhances the healing of the dura.

4. *Caffeine*: A few studies^{29–30} and some case reports have recommended oral and intravenous caffeine as a therapeutic option, although the recurrence of headache after caffeine treatment is frequent. However, no well-designed, adequately powered, randomised controlled trials have been conducted to prove the effectiveness of caffeine. Published information on this treatment comes mainly from reviews that cite only one study in 1979.²⁹ This study was carried out in 41 patients in whom intravenous administration of 500 mg of caffeine sodium benzoate relieved 75% of headaches after lumbar puncture, with further improvement observed with a second dose. Apparently, caffeine acts as a cerebral vasoconstrictor by blocking adenosine receptors, which has a role in the pathogenesis of headache after lumbar puncture. Caffeine is also available as an oral form, which is well absorbed, with blood peak levels reached in 30 min. However, therapeutic doses of caffeine are associated with atrial fibrillation and central nervous system toxicity, and need to be used cautiously in high-risk patients. Further studies will be required before caffeine can be recommended as a routine treatment for headache after lumbar puncture.
5. *Hydration*: Initially, increased hydration was recommended as a way of replacing fluids to produce more CSF. However, several studies have shown that increased fluid intake has no effect on CSF production and this hypothesis has been discarded.⁶
6. *Surgical closure of the dural gap*: This is the last resort treatment where other treatments have failed.^{6–7}

SELF ASSESSMENT QUESTIONS (TRUE (T) / FALSE (F)); ANSWERS AT END OF REFERENCES

1. Headache after lumbar puncture is an uncommon complication.
2. Headache after lumbar puncture is defined as "Bilateral headaches that develop within 7 days after the procedure and disappear within 14 days, and has a definite relationship to the patient's position".

3. Needle size has no relation to the incidence of headaches after lumbar puncture.
4. Bed rest after lumbar puncture has a role in preventing headaches after lumbar puncture.
5. Epidural blood patch is more likely to be successful if carried out after 24 h of headache after lumbar puncture.

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ANSWERS

(1) F; (2) T; (3) F; (4) F; (5) T

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