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## Perioperative Management of post dural puncture headache

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### Abstract

Post dural puncture headache (PDPH) is a common complication of interventional neuraxial procedures. It carries a considerable morbidity with symptoms lasting for several days, sometimes severe enough to immobilise the patient. If left untreated it can result in serious complication which may be fatal. It is therefore important that the doctors should aware of the methods available for reducing the incidence of PDPH. This article reviews the scientific literature involved in the management of PDPH including the epidural blood patch.

**Keywords:** PDPH, CSF, dural puncture, headache, caffeine, epidural blood patch

### 1. Introduction

Headache is a complication of lumbar puncture that has been known for well over a century. The syndrome of post dural puncture headache was described by Dr August Beir[1]. Lumbar puncture is also known as spinal puncture, involving passing a needle through the wall of the dural sac into the subarachnoid space which contains cerebrospinal fluid in the lumbar region[2].

Post dural puncture headache can occur as a result of diagnostic lumbar puncture, spinal anaesthesia and unintentional dural puncture while performing epidural anaesthesia<sup>3</sup>. Headache is a common sequale of this procedure irrespective of the indication. PDPH is an important cause of iatrogenic morbidity following a lumbar puncture.

### 2. History

Spinal anaesthesia was developed in the late 1800s. In 1891 Wynter Quincke[4], aspirated CSF from the subarachnoid space for the treatment of raised intracranial hypertension associated with tuberculous meningitis.

In august 1898, Wulf HF[5], a German surgeon injected cocaine 10-15mg into the subarachnoid space of seven patients, himself and his

assistant Hildebrandt Bier. Hildebrandt & four of the subjects all described the symptoms associated with post dural puncture headache. Bier attributed this headache to loss of CSF.

In early 1900s there were numerous reports in the medical literature of the application of spinal anaesthesia using large spinal needles[6], headache was reported to be a complication in 50% of subjects.

In 1951 Whitacre and Hart[7] developed the pencil point needle. Developments of needle design since that time have led to a significant reduction in the incidence of post dural puncture headache. However PDPH remains a disabling complication of needle insertion into the subarachnoid space.

### 3. Definition

According to the headache classification committee of the international headache society, headache after lumbar puncture is defined as bilateral headache that develops within 7 days after a lumbar puncture and disappears within 14 days. The headache worsens within 15 min of resuming the upright position, disappears or improves within 30 min of resuming the recumbent position.[8]

#### 4. Incidence

Risk of developing PDPH depends on a number of factors and the incidence varies with the population studies needles & techniques have been used[9][10]. The gauge of the lumbar puncture needle[11], size of the needle used & shape of the tip of the needle appear to be the most important individual factors which determines on the incidence[12]-[16].

#### 5. Factors

Factors which contribute to the development of headache after lumbar puncture are:

##### 5.1 Age

The incidence of spinal headache is inversely proportional to the age of the patient after the age of 20.[17]-[19] It is interesting that patients less than 20 years of age have been found to have a lower relative risk of PDPH[17][18].

##### 5.2 Sex

Studies have shown that incidence is more among females than males and in young women there is a disproportionately high risk of PDPH which decreases gradually until menopause. Obstetric patient contributes to the large majority of PDPH patients.[18][20]

##### 5.3 Needle Size

Incidence of PDPH depends on volume of CSF lost through the dural tear created by lumbar puncture which in turn depends on needle size. Incidence of headache is 70% if the needle size is between 16 & 19G. 40% if the needle size is between 20 & 22G and 12% if the needle size is between 24 & 27 G[21]. Smaller needles are satisfactory for spinal & epidural anaesthesia. But for diagnostic lumbar puncture 22G needle is the smallest size that should be used[22].

##### 5.4 Direction of Bevel

As the collagen fibres in the human dura run in a longitudinal direction parallel to the long 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[23]. This separates the fibres rather than cutting them. This facilitates the closure of the hole on needle withdrawal.

If the needle is at right angle to the collagen fibers, the cut in the dural fibres previously under tension would then tend to retract resulting in a bigger dural tear, thus increasing the likeliness of CSF leakage & incidence of headache after lumbar puncture.

##### 5.5 Needle Design

There are three basic needle points available. The Quincke point is a simple cutting

needle & most commonly used lumbar puncture needle. The theoretical advantage of the whitacre is the tapered pencil point tip with lateral displacement of the distal orifice. This causes an atraumatic splitting of the dural fibres rather than the cutting action of the quincke. Sprotte needle has blunted tip causes atraumatic splitting of dural fibres[24][25].

As these needles cause temporary separation rather than cutting the elastic fibres which then recoil after removal of the needle. This considerably reduces the incidence of headache & need for medical intervention. Three randomised double blind controlled studies concluded that atraumatic needles considerably reduce the incidence of headache after diagnostic lumbar puncture[26]-[28].

To conclude needle size is more important in preventing PDPH, but given two needles of identical size a Whitacre point will produce fewer cases of PDPH than quincke needle. A sprotte needle may result in a significantly lower risk of PDPH than a whitacre or quincke needle but more clinical trials are needed[29].

Number of lumbar puncture attempts- as the number of dural puncture 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.

#### 6. Pathophysiology

The exact pathophysiology of headache after lumbar puncture is unclear. However proposed mechanism is hole which is left in the dura after the lumbar puncture[30], resulting in persistent leakage of CSF from the subarachnoid space, this leakage results in a fall in intracranial CSF volume & CSF pressure[31]. These causes gravitational traction on the pain sensitive structures (meningeal membrane, blood vessels and nerves) & deplete the cushion of fluid supporting the brain causing classical headache which worsen when the patient is upright and is relieved on lying down[32].

According to the Monro-Kellie-Burrows doctrine (the sum of the volumes of the CSF, the blood & the brain tissue in the skull remains constant) loss of CSF may result in compensatory intracranial vasodilatation. Relative cerebrospinal fluid hypovolaemia[33] which results in painful possibly adenosine receptor mediated[34] cerebral vasodilatation. It is then responsible for the headache.

Studies have shown that a low level of substance p, a neuropeptide associated with neurogenic inflammation resulted in a three times higher risk of developing headache after lumbar puncture[35].

## 6.1 Clinical Symptoms

### 6.1.1 Headache

Headache is the predominant symptoms after accidental dural puncture[36]. 90% of headache will occur within 3 days of the procedure[40] & 66% start within the first 48 hour[41]. It can be delayed for upto 12days. Headache may present immediately after dural puncture[42]. However it is rare and looks for alternative causes such as rise in intracranial pressure with associated displacement of intracranial structure.

Symptoms of PDPH are very characteristic and usually self limiting. Headache is described as severe dull aching or throbbing in nature, distributed over the frontal & occipital areas[37] radiating to the neck & shoulders which can later become generalised, could be associated with neck stiffness. The headache exacerbated when the patient is upright and decreases when the patient is lying down. Head movements exacerbate the pain. Any manoeuvres that increase intracranial pressure such as coughing, sneezing, straining or ocular compression may worsen the symptoms.

### 6.1.2 Other associated symptoms

Other associated symptoms include Lower backache, Nausea, vomiting, Vertigo, tinnitus, Parasthesia of the scalp, upper& lower limb pain[38], Visual disturbances[39] such as diplopia or cortical blindness also has been reported, Photophobia. Headache disappears spontaneously within a week or within 48hours after the CSF leak has been effectively treated.

### 6.2 Diagnosis

This is mainly a clinical diagnosis, history of accidental or deliberate lumbar puncture, followed by characteristic headache with neck stiffness and other associated symptoms usually confirms the diagnosis[43].

If a diagnostic lumbar puncture is performed. It may demonstrate a low CSF opening pressure, a slightly raised CSF protein, and a rise in CSF lymphocyte count[42].

Magnetic resonance imaging of the brain may show diffuse dural enhancement due to contrast medium with evidence of a sagging of brain. Descent of brain and brainstem, optic chiasma through foramen magnum, obliteration of basal cisterns and enhancement of the pituitary gland[43].

When there is doubt, CT myelography, cisternography or spinal MRI with thin sections can be used to locate the spinal source of the CSF leak.

### 6.3 Differential Diagnosis

The diagnosis of PDPH is frequently confirmed from the history of lumbar puncture and

presence of a characteristic severe postdural puncture headache. However it is important to exclude or consider other alternative conditions such as, intracranial tumours[45][46], intracranial haematoma[47][48], pituitary apoplexy[50], migraine, viral or bacterial or chemical meningitis[51], cerebral venous thrombosis[50], other nonspecific headache, intracerebral haemorrhage and preeclampsia[52] in obstetric patient. It has been estimated that 39% of parturients report symptoms of a headache unrelated to dural puncture following delivery.

### 6.4 Treatment

As headache after lumbar puncture is relatively common and is a significant cause of morbidity and has a self limiting course, it should always be discussed when a patient gives consent to undergo lumbar puncture, especially those who are in a high risk category, such as young women with low body mass index, and during pregnancy[53]. As the headache usually occurs after 24hours and it can be delayed for few days, in case if the patient is discharged earlier then patient should be warned about it.

If the patient develops headache, they should be encouraged to lie in a comfortable position, which is mostly in the supine position but not necessarily and advised to avoid upright position. As it has got self limiting course initially conservative approach should be considered, which includes bed rest, good rehydration and treatment of symptoms with simple analgesics, opioids, and antiemetics. Abdominal binders are no longer recommended. Generally >85% of headaches after lumbar puncture resolve within 6 weeks without any specific treatment[54].

However if conservative measures fail to resolve headache then specific treatment should be considered 72hour after onset of pain, it would avoid the catastrophic complications of subdural haematoma and seizure that could be fatal[55].

The aim of specific treatment of post dural puncture headache is to replace the lost CSF, seal the puncture site and to control the cerebral vasodilatation.

#### 6.4.1 Caffeine

It is the first treatment and studies have shown that symptom relief and decrease in duration of headache when caffeine is used. As PDPH is partly result of dilatation of the intracranial veins and caffeine is a methylxanthine produces vasoconstriction which is specific to the cerebral vasculature by blocking adenosine receptors, which has a role in the pathogenesis of headache after lumbar puncture. As a therapeutic option Caffeine

available in oral and intravenous form. Randomised controlled studies have been conducted to prove the effectiveness of caffeine. Published information on this treatment comes mainly from reviews that one study in 1979[56]. This study was carried out in 41 patients in whom IV administration of 500mg of caffeine sodium benzoate relieved headache in 75% of the patients with further improvement observed with a second dose. IV caffeine sodium benzoate is less expensive and easily administered than an epidural blood patch.

There are some studies concluded that IV caffeine is an effective therapy for post dural puncture headache but still a well designed clinical study is needed to demonstrate the efficacy of oral route. Recommended dose is 300-500mg of oral or caffeine once or twice a daily[57]. However therapeutic doses of caffeine have been associated with CNS toxicity & atrial fibrillation and need to be used cautiously in high risk patients.

#### 6.4.2 Epidural blood patch

This therapy is justified for patients with moderate to severe PDPH, which is not responding to conservative measure & caffeine. Concept of epidural blood patch was made after observing patient who had bloody tap in whom incidence of PDPH is low. Blood proves to coagulate on contact with CSF and the reason for applying an epidural blood patch is that the blood will seal the dural hole created by the puncture needle & prevent further CSF leakage and space which eliminates relative CSF deficiency. The high success rate and low incidence of complications have established the epidural blood patch as the standard against which to evaluate alternative methods to treat PDPH.

Patient is put in lateral position with head flexed and hips and knees are flexed. Under aseptic precaution epidural tuohy needle is introduced slowly into the epidural space. It is not necessary to introduce it into the exact site at which the dural puncture was performed. 20-30 ml of blood is drawn from the cubital vein by other person and immediately introduced slowly into the epidural space through epidural needle. The blood will distribute into the epidural space through few spinal segments superiorly and inferiorly. After the procedure, patient should remain lying down for 1-2 hour. This procedure has a success rate of 70-98%[54] and can be repeated if it fails to resolve the symptoms at the first attempt. However presence of persistent severe headache, an alternative cause should be considered. It has been found that success rate is low if it is administered prophylactically and within 24hours of lumbar puncture[58].

Complications rarely occur with epidural blood patch, arachnoiditis, subdural haematoma, meningitis have been reported.

#### 6.4.3 Epidural saline

This concept was brought with possible compression of the epidural space with presumed increase in subarachnoid pressure owing to the volume of blood injected. The same effect was expected on using saline which is relatively inert and sterile and epidural saline bolus and infusion regimen with variable results[54].

#### 6.4.4 Fibrin Glue

Alternative agents to blood such as fibrinous glue have been used to seal dural perforation[59]. The fibrin glue may be injected blindly or CT guided percutaneous injection into the epidural space if an epidural blood patch fails[60].

#### 6.4.5 Surgery

PDPH; which is unresponsive to other therapies, being treated successfully by surgical closure of the dural perforation[61].

## 7. Conclusion

Lumbar puncture is an important cause of iatrogenic morbidity in the form of post dural puncture headache. In majority of cases, the problem will resolve spontaneously. The incidence of headache can be reduced by using higher gauge needle. Epidural blood patch is reasonably efficient in treating headache when it is not responding to conservative measure. Surgical closure of dural tear is an option of last resort.

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