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Review Article

POST DURAL PUNCTURE HEADACHE: A REVIEW

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ABSTRACT

Though developed in the late 1800s by Wynter, Quincke and Corning, Karl August Bier was the first to report the debilitating headache from dural puncture in 1989. Post dural puncture Headache(PDPH) is the most common complication of lumbar puncture. It is assumed to be caused by leakage of Cerebrospinal fluid(CSF) through the hole in the dura. Although the development of fine-gauge spinal needles and needle tip modification have decreased the incidence of the headache by reducing the size of the dural perforation and hence the loss of CSF, there are several other measures that are to be discussed. While prolonged bed rest has been used to treat Post dural puncture headache once it has started, epidural blood patch can also be considered within 24 hours in high risk patients. This article deals with pathogenesis, treatment and prevention of Post dural puncture headache.

Keywords: Post dural Puncture Headache, Quincke's, Cerebrospinal Fluid, Spinal needles, Gauge, Epidural anesthesia, Caffeine, Sumatriptan, Epidural Blood Patch

INTRODUCTION

Anatomy of spinal dura:

The spinal dura mater is a tube extending from the foramen magnum to the second segment of the sacrum. It contains the spinal cord and nerve roots that pierce it. The dura mater is a dense, connective tissue layer made up of collagen and elastic fibres. The classical description of the spinal dura mater is of collagen fibres running in a longitudinal direction.[1] A cutting spinal needle is orientated parallel rather than at right angles to these longitudinal dural fibres. Orientating the needle at right angles to the parallel fibres, it was said would cut more fibres. The cut dural fibres, previously under tension, would then tend to retract and increase the longitudinal dimensions of the dural perforation, increasing the likelihood of a post-spinal headache. Clinical studies had confirmed that post-dural puncture headache was more likely when the cutting spinal needle was orientated perpendicular to the direction of the dural fibres. However, recent light and electron microscopic studies of human dura mater have contested this classical description of the anatomy of the dura mater.[2] Hence it is assumed that CSF leak is minimal in dural perforation of thick area of dura than the thin area where CSF leak is more likely thereby giving variable outcomes.

Cerebrospinal Fluid (CSF):

The average adult produces about 500 mL of CSF per day, or 21 mL per hour (0.3 mL/kg/hr), with 90% coming from the choroid plexus, and 10% from the brain substance itself. A total of about 150 mL of CSF circulates at any one time and is absorbed by the arachnoid villi. The cause of PDPH is not entirely certain. The CSF pressure in the lumbar region in the horizontal position is between 5 and 15 cm H_2O. On assuming the erect posture, this increases to over 40 cm H_2O. The pressure of the CSF in children rises with age, and may be little more than a few cm H_2O in early life.[3] The best explanation is that low CSF pressure results from CSF leakage through a dural or arachnoid tear; a leakage that exceeds the rate of CSF production.[4]

There are two basic theoretical mechanisms to explain PDPH. One is reflex vasodilatation of the meningeal vessels due to the lowered CSF pressure. The other is traction on the pain-sensitive intracranial structures in the upright position. Traction on the upper cervical nerves including C1, C2, and C3, causes pain in the neck and shoulders. Traction on the fifth cranial nerve causes a frontal headache. Traction on the sixth cranial nerve causes visual symptoms. Pain in the occipital region is due to the traction of the ninth and tenth cranial nerves.[5]

FACTORS PRECIPITATIONG PDPH:

Needle Size:

The incidence of PDPH is directly related to the needle diameter that pierces the dura mater.[6] An addendum to the American Academy of Neurology (AAN) practice guidelines advocated the use of 22-gauge needles, but reported a case series where 25-gauge needles were used successfully.[7] With needles smaller

than size 22-gauge, collection of 2 mL of CSF may take 6 minutes or longer and measurement of CSF pressure may be less accurate.[8]

The incidence of PDPH with the 25-gauge Whitacre (non-cutting) needle is less than with the 27-gauge Quincke (cutting) needle.[6]

Needle deformation:

It has been proposed that contact with bone during insertion may lead to spinal needle tip deformation.[9, 10] Damaged needle tips could lead to an increase in the size of the subsequent dural perforation. Recent *in vivo* studies have demonstrated that the cutting type spinal needle is more likely to be deformed after bony contact than comparable sized pencil-point needles.[10]

Direction of Bevel:

Orienting the bevel of a cutting needle probably needs further consideration before making absolute, blanket statements regarding the etiology of dural puncture leaks. The use of a paramedian approach to the subarachnoid space has been suggested as a means of reducing PDPH particularly when using cutting needles.[11]

Incidence in Women:

Women, particularly during pregnancy and especially after vaginal delivery, are considered at increased risk for PDPH. The incidence of PDPH is highest between 18 and 30 years of age and declines in children younger than 13 years and adults older than 60 years. The incidence is greater in patients with lower body mass index.[12] Women who are obese or morbidly obese may actually have a decreased incidence of PDPH. The decreased incidence is due to the increase in intra-abdominal pressure which may act as an abdominal binder helping to seal the defect in the dura and decreasing the loss of CSF. Younger women may be at a greater risk because of increased dural fiber elasticity that maintains a patent dural defect compared to a less elastic dura in older patients.[4] Patients with a headache before lumbar puncture and a prior history of PDPH are also at increased risk. There is no known relationship between the diagnosis of migraine headaches and increased incidence of PDPH after regional anesthesia.[13] There may be some correlation between a history of motion sickness and PDPH.

Operator Skills and fatigue:

It has been suggested that the incidence of inadvertent dural puncture during epidural anaesthesia is inversely related to operator experience.[14] However, sleep deprivation, operator fatigue and the effect of night work may be a confounding variable producing the higher incidence of inadvertent dural puncture in junior personnel performing epidural analgesia.

PRESENTATION OF POST-DURAL PUNCTURE HEADACHE:

PDPH typically manifests as a postural, frontal, frontotemporal, or occipital headache, worsened by ambulation and improved by assuming the decubitus position, occurring within 48 hours after dural puncture. The accompanying symptoms are usually nausea, vomiting and neck stiffness.[14, 15] Ninety per cent of headaches will occur within 3 days of the procedure,[14] and 66% start within the first 48 h.[16] Rarely, the headache develops between 5 and 14 days after the procedure. Headache may present immediately after dural puncture.[17] However, this is rare, and its occurrence should alert the physician to alternative causes.

Cranial nerve palsies are not uncommon.[18] Neurological symptoms may precede the onset of grand mal seizures. Intracranial subdural haematomas, cerebral herniation and death,[19] have been described as a consequence of dural puncture. Unless a headache with postural features is present, the diagnosis of post-dural puncture headache should be questioned, as other serious intracranial causes for headache must be excluded.[20]

Differential Diagnosis:

Spinal abscess, spinal hematoma, septic or aseptic meningitis, intracranial mass lesion, cerebral aneurysm, cerebral edema, myofascial syndrome, arachnoiditis caused by intrathecal steroids, transient neurologic syndrome or related symptoms, unspecific post-dural puncture lumbalgia, neural toxicity of the drugs, and anterior spinal artery syndrome, post-partum cerebral angiopathy and cerebral thrombophlebitis should all be ruled out.[21-23] Additional tests such as a cerebral CT scan, or magnetic resonance imaging could be performed in cases with atypical post-dural puncture symptoms, to exclude the possibility of developing serious complications.[24]

TREATMENT:

Psychological treatment:

Patients who develop post-dural puncture headache may reveal a wide range of emotional responses from misery and tears to anger and panic. It is important both from a clinical and medico-legal point of view, to discuss the possibility of headache before a procedure is undertaken that has a risk of this complication.

Conservative treatment:

Although bed rest is believed to be ineffective in PDPH,[25] a recent meta-analysis failed to show that bed rest after dural puncture was better than immediate mobilization in reducing the incidence of PDPH.[26] Supportive therapy such as rehydration, acetaminophen, non-steroidal anti-inflammatory drugs, opioids, and antiemetics may control the symptoms and so reduce the need for more aggressive therapy,[27] but do not provide complete relief.[28]

Positioning of the Patient:

While there is no clinical evidence to support the maintenance of the supine position before or after the onset of the headache as a means of treatment,[29] the prone position raises the intra-abdominal pressure, which is transmitted to the epidural space and may alleviate the headache. A clinical trial of the prone position following dural puncture failed to demonstrate a reduction in post-dural puncture headache.[30]

Caffeine:

Intravenous caffeine is an effective therapy for post-dural puncture headache. Caffeine is a central nervous system stimulant that amongst other properties produces cerebral vasoconstriction. The most frequently quoted work on the treatment of post-dural puncture headache with caffeine is that of Sechzer.[3] He evaluated the effects of one or two 0.5 g doses of intravenous caffeine on subjects with established post-dural puncture headache.

The dose now recommended for the treatment of post-dural puncture headache is 300–500 mg of oral or intravenous caffeine once or twice daily.[31] One cup of coffee contains about 50–100 mg of caffeine and soft drinks contain 35–50 mg.

Sumatriptan:

Sumatriptan is a 5-HT_{1D} receptor agonist that promotes cerebral vasoconstriction, in a similar way to caffeine.[32] Sumatriptan is advocated for the management of migraine and recently, for post-dural puncture headache. There have been only a few case reports where sumatriptan was used successfully to manage post-dural puncture headache.[33]

Epidural Blood Patch (EBP):

The injection of autologous blood in the lumbar epidural space was initially suggested in 1960 by Gormley[34] and later introduced by DiGiovanni and Dunbar.[35] Two theories have been proposed to explain EBP efficiency in PDPH.[36-38] The first one suggests that the injected blood creates a clot particularly adherent to the dura mater, directly patching the hole in the dura and thus preventing CSF leak.[38, 39] The second theory suggests that the volume of blood injected in the epidural space increases CSF pressure, thus reducing traction on brain and meningeal structures, leading to the relief of symptoms.[36, 37, 40, 41] These two theories are probably both correct. The first one probably explains the long-lasting effectiveness of the EBP, whereas the second one probably explains the rapid onset of symptom relief after EBP.

CONCLUSION

Although PDPH is not a life threatening condition, post-dural puncture headache is a complication that should be treated with due consideration as there is the likelihood of substantial morbidity. While in majority of cases, the headache resolves spontaneously, some patients may suffer from PDPH for months and even years. The noninvasive treatment modalities might be helpful temporarily for mitigating the symptoms. For severe PDPH, however, epidural blood patch remains the invasive treatment of choice.

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