remainder lies within the spinal subarachnoid space, and represents the volume through which the injected solution can distribute. While many factors influence CSF volume, and it may have a crucial effect on intrathecal drug spread, detailed study is, unfortunately, inhibited by the difficulties of measuring CSF volume, even with radiological imaging.

Pregnancy

Many physiological changes that occur during pregnancy increase the effect of intrathecal anaesthetic injection. Physical spread of the solution can be increased by changes in the lumbar lordosis, and in the volume and density of the CSF. Cephalad spread may be greater due to a progesterone mediated increase in neuronal sensitivity, The mechanisms which may be involved include direct effects on membrane excitability, indirect actions on neurotransmitters, increased permeability of the neural sheath, potentiation of endogenous opioids, and potentiation of GABA-mediated increases in chloride conductance. These physical and pharmacological factors add up to a considerable increase in the consequences of an intrathecal injection in the full term pregnant patient.

Summary

Many factors affect the intrathecal spread of injected local anaesthetics, however, the influence of most of these is small, unpredictable and outside the clinician's control. The major factors are the baricity of the solution injected and the subsequent posture of the patient. The most predictable effects are produced by the slow injection (into a patient placed supine immediately thereafter) of a small volume of local anaesthetic solution containing glucose. Use of glucose concentrations somewhat lower (about 1%) than are traditional (5-8%), will reduce the risk of excessive spread, but still ensure good quality and extent of block for most surgical procedures for which spinal anaesthesia is appropriate. Manipulation of the factors which affect spread may be used to produce different types of block, as long as the clinician has a clear understanding of what is involved.

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POST DURAL PUNCTURE HEADACHE

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Introduction

Post dural puncture headache (PDPH) was first reported just over one hundred years ago. PDPH has the potential to cause considerable morbidity and is a complication that should not to be treated lightly. PDPH is usually a self-limiting process. If left untreated, 75% resolve within the first week and 88% resolve by 6 weeks. Most treatments are geared towards lessening the pain and symptoms until the hole in the dura can heal, or at least until it can close to the point where the symptoms are tolerable. PDPH continues to be a common morbidity despite several innovations in equipment and techniques used for spinal (subarachnoid) and epidural (extradural) anaesthesia.

Pathophysiology of PDPH

CSF leaking from a dural puncture leads to a loss of cerebrospinal fluid (CSF) pressure around the spinal cord and a loss of buoyancy supporting the brain. When the patient assumes an upright posture, the brain sags and tension on the meninges and other intracranial structures creates the pain seen with PDPH. This explanation is probably overly simplified. Much of the pain in a PDPH may be related to vascular distension - as the body assumes a vertical posture, the hydrostatic gradient across the brain increases forcing more CSF to exit the dural puncture. The body then attempts to compensate for the loss of intracranial volume by vasodilatation. This process is reversed when the patient returns to the supine position.

Prevention of PDPH

Anaesthetists have been active in attempting to reduce the incidence of post-spinal headache by reducing the size of the spinal needle. The quoted incidences are about 40% with a 22G needle, 25% with a 25G needle, 2%–12% with a 26G Quincke needle, and <2% with a 29G needle.[1-4] In 1951, Whitacre and Hart introduced the 'atraumatic' spinal needle . This design offered the handling characteristics of larger needles with a low incidence of post-spinal headache. Needle modifications since that time, such as the Sprotte and Atraucan needles, promise further reductions in post-spinal headache.

In parturients receiving epidural anaesthesia, the incidence of dural puncture is between 0 and 2.6%.[5] The incidence is inversely related to the experience of the anaesthetist and is said to be reduced by orientation of the needle bevel parallel to the dural fibres.[6] Loss of resistance to air confers a higher risk of dural puncture than loss of resistance to fluid.[7] After a dural puncture with a 16G Tuohy needle, up to 70% of subjects will report symptoms related to low CSF pressure.[8]

Onset

Headache and backache are the dominant symptoms that develop after a deliberate or accidental dural puncture. 66% of headaches start within the first 48 hrs and 99% occur within 3 days of the procedure. Headache may present immediately after dural puncture or may rarely develop between 5 and 14 days after the procedure.

Symptoms

Headache is the predominant presenting complaint. The so-called *spinal headache* is usually described as a severe, dull, non-throbbing pain, usually fronto-occipital, which is aggravated in the upright position and diminished in the supine position. It may be accompanied by nausea, vomiting, visual disturbances or auditory disturbances and is exacerbated by head movement. The postural headache is so characteristic that in its absence the diagnosis of post-dural puncture headache should be questioned and other serious intracranial causes for headache must be excluded.

Differential diagnosis

Diagnoses that may masquerade as post dural puncture headache include intracranial tumours, intracranial haematoma, pituitary apoplexy, cerebral venous thrombosis, migraine, chemical or infective meningitis, cerebral malaria and non-specific headache. It has been estimated that 39% of parturients report symptoms of a headache, unrelated to dural puncture, following delivery.

CLINICAL SCENARIO

A 30-year-old primigravida woman had spinal anaesthesia for an elective caesarean section. She had uneventful surgery and had a healthy baby boy. Unfortunately on day 2 post delivery she developed a fronto-occipital headache with postural characteristics. She was bed-bound and had associated nausea, vomiting and photophobia.

How would you manage this patient?

Conservative non-invasive methods

- *Bed rest*

Recent literature provides evidence against this.[9] Bed rest after dural puncture does not reduce the risk of PDPH occurring. Early ambulation after dural puncture is advisable and patients who have already developed PDPH should also be encouraged to ambulate as much as they can tolerate.

- *Position*

If a patient develops a headache, they should be encouraged to lie in a comfortable position. 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. The prone position has been advocated, but it is not a comfortable position for the post-partum patient. 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.[10]

- *Hydration status*

There is no evidence to show that over hydration reduces incidence and severity of PDPH, but it is important to maintain hydration in balance.

- *Abdominal binder*

A tight abdominal binder raises the intra-abdominal pressure which is transmitted to the epidural space and may relieve the headache. Unfortunately, tight binders are uncomfortable and are seldom used in current practice.

- *Analgesics*

Paracetamol, non-steroidal anti-inflammatory drugs, opioids, and antiemetics may control the symptoms and so reduce the need for more interventional therapy, but do not provide complete relief.

- *Caffeine*

Caffeine is a central nervous system stimulant that, amongst other properties, produces cerebral vasoconstriction and it has been demonstrated to cause an transient reduction in cerebral blood flow. Sechzer et al evaluated the effects of one or two 0.5g doses of IV caffeine on subjects with established post-dural puncture headache.[11,12] There are some statistical and methodological flaws in his study, but it was concluded that IV caffeine is an effective therapy for PDPH. The dose now recommended for the treatment of PDPH is 300–500mg of oral or intravenous caffeine once or twice daily. One cup of coffee contains about 50–100mg of caffeine, a cup of black tea 60-90mg and soft drinks contain 35–50mg.

Invasive methods

- *Epidural blood patch*

The concept of the epidural blood patch was developed after the observation that 'bloody taps' were associated with a reduced headache rate. The theory is that the blood, introduced into the epidural space, will clot and occlude the perforation, preventing further CSF leak. The high success rate and the low incidence of complications have established the epidural blood patch as the best available treatment of this condition.

Technique

The presence of fever, infection on the back, coagulopathy, or patient refusal are contraindications to the performance of an epidural blood patch. Limited experience with HIV-positive patients suggest that it is acceptable providing no other bacterial or viral illnesses are active.[13]

Under strict sterile conditions, with the patient in the lateral position, the epidural space is located with a Tuohy needle at the level of the dural puncture or an intervertebral space lower. Up to 30ml blood is then taken from the patient's arm and injected slowly through the Tuohy needle. This process may be easiest using two clinicians. There is no consensus as to the most effective volume of blood required. Around 20 ml blood appears most likely to guarantee success, but the injection should be ceased if lower back pain or difficulty to inject occurs. At the conclusion of the procedure, the patient is asked to lie still for 1 or 2hrs, and is then allowed to mobilise.

Risks

Epidural blood patch carries risks of transient paraesthesia, radicular pain, repeated inadvertent dural puncture and epidural infection.

Outcome

The technique has a success rate of 70–98% if carried out more than 24h after the dural puncture.[14] If an epidural blood patch fails to resolve the headache, repeating the blood patch has a similar success rate. However in the presence of persistent severe headache, an alternative cause should be considered. The beneficial effects of earlier studies into this technique may have been overstated.

Conclusion

The evidence base for some therapies used for treatment of PDPH is weak. The benefit of prophylactic blood patching is not so clear but deserves consideration in the parturient with a headache after accidental dural perforation with a Tuohy needle. Epidural blood patch will be ineffective in treating the headache of a certain proportion of patients and it is wise to consider other causes of the headache and use simple conservative measures to alleviate the symptoms, before applying alternative therapeutic options.

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