Post-dural puncture cephalgia is a complication that can occur following spinal anesthesia or other procedure that disrupts the continuity of the dura. The author discusses its cause, symptoms, prevention, and treatment.

Post-dural puncture cephalgia is a complication often encountered by the anesthesia practitioner. Disruption in the continuity of the dura incurred during diagnostic procedures (such as myelography or cerebral spinal fluid harvesting) also increases the number of patients requiring treatment for severe to incapacitating cephalgia. The anesthetist’s ability to differentiate, evaluate, and assist in the treatment of decreased intracranial pressure syndrome will prove a significant asset to his or her own patients, as well as to those of the specialists whom he or she assists.

Incidence
Post-dural puncture cephalgia has been observed as a complication of major conduction anesthesia since 1898. Bier, the founding father of spinal anesthesia, described his own symptoms following self-experimentation.

Since that time, many reports of the complication have been presented. The overall incidence of headache is reported in 2% to 18% of cases. These studies vary in several parameters, hence, a figure somewhere in between the low and high extremes is probably the most reliable. An often quoted study by Dripps and Vandam validates this premise, noting an overall incidence rate of 11% in a study of nearly 11,000 spinal anesthetics. The same study also indicates that female patients are twice as susceptible to post-dural puncture cephalgia as males (14% versus 7%). Further examination of female sufferers places the obstetric patient at the highest risk, as high as 22%.

The highest incidence of post-dural puncture cephalgia is noted in patients in the 30s and 40s age group, with incidence declining after age 50. Elevated pain threshold, secondary to reduced sensory neural activity, and decreased cerebral vascular elasticity, may account for this reduction in incidence in the aged.

Etiology and physiology
The generally accepted cause of post-dural puncture cephalgia is a loss of cerebral spinal fluid (CSF) through a dural rent. This loss, be it acute or gradual, lowers CSF pressure.

CSF functions primarily as a cushion for the brain within its rigid osseous compartment; a reduction in CSF pressure allows traction on the brain, meninges, and blood vessels at the base of the skull. This pain is mediated by the 5th (trigeminal), 9th (glossopharyngeal), and 10th (vagus) cranial nerves.

The loss of CSF may easily be observed when intrathecal and epidural space pressures are compared. Lumbar CSF pressures average 5-15 cm H2O in the supine position to 40+ cm H2O in the sitting position. Epidural space pressure is rela-
tively stable in spite of position, ranging from a negative .2 cm to 1 cm of H₂O.¹ This differential strongly favors a loss of CSF through any dural tear. A critical volume loss of 20 ml was demonstrated by Tourtellate and associates in 1964.⁹ Headache was noted when 20 ml of CSF was extracted from volunteers in the sitting position. Relief of all symptoms was immediately noted upon equal volume intrathecal saline replacement.

Other causes of post-dural puncture cephalgia may include chemical or bacterial contamination of the CSF, associated neck and shoulder muscular discomforts, or coincidental onset of tension or migraine headache. Differentiation will depend on the careful scrutinization of the clinical features of the headache.

Clinical characteristics

Classical symptoms and conditions of post-dural puncture cephalgia include the following:

1. The patient may complain of a constant throbbing headache which is aggravated when the patient is erect or sitting and relieved by lying down. The location is usually occipital,² though the headache may be experienced in the frontal or vertex area, or “behind the eyes.”³ Many patients will describe the pain as different from any headache previously experienced.

2. Onset usually is not seen for one to two days after puncture although it may occur within hours.¹ This presumably is dependent upon the rate of intrathecal fluid loss. Also, the first 24 post-operative hours are often spent in the supine or lateral (head-down) positions.

3. Duration of headache is usually two or three days with spontaneous resolution in mild or moderate cases. More severe cases may last for weeks or even months. It should be noted that dural puncture leak may persist for extended periods of time. Spontaneous closure of post-dural puncture usually is achieved in approximately 14 days, though some defects will remain open for months.⁸

4. Nausea, anorexia, and depression are not infrequently seen secondary to severe pain. Less than 1% of sufferers will experience ocular and auditory symptoms, such as blurred vision, photophobia, tinnitus, and decreased hearing.⁶

5. Pain may be greatly reduced or abolished by applying firm pressure with the open hand over the abdomen. This maneuver may be employed as a diagnostic tool. By externally increasing intrathecal pressure with abdominal pressure, dural-puncture headache will be relieved. It should be noted that the patient should be in the sitting or erect position for the test to be of any value.

6. An increase in the intensity of the pain is frequently noted with movement of the head, flexion of the neck, or coughing.

Prophylaxis

Reducing the diameter of dural rent is probably the best prophylactic measure at the anesthetist's disposal. Several techniques have been described. A reduction in the incidence of post-dural puncture cephalgia from 14% to 6% was noted by Vandam and Dripps when 24 gauge spinal needles were used instead of 20 gauge.⁴ The use of 32 gauge needles has also been advocated,¹⁰ carrying this train of thought further still.

As the diameter of the spinal needle becomes smaller, an introducer becomes necessary. The increased malleability of the small gauge needles (24 gauge and below) makes them increasingly difficult to direct and often they will bend without the added support.

While the diameter of the needle is obviously important, the proper placement and the type of needle have also been investigated.³,⁴ It has been suggested that needles possessing a bevel (such as Pitkin or Greene) may be best utilized with the bevel parallel to the spinal cord, although this technique is not universally accepted. Theoretically, when this technique is used, a longitudinal spreading of dural fibers is produced, compared to a crescent shaped tear cut across the fibers.³ Also available are conical-tipped “pencil point” needles (Whitacre). These facilitate dural fiber spreading. Retraction of the longitudinal fibers upon needle removal is thought to close the puncture.

Proper preoperative hydration, an optimal situation for all surgical patients, can also be considered a prophylactic measure. In the case of major conduction anesthesia, this is especially important to counteract the hypotensive effects of sympathetic blockade, as well as to afford a large pool of fluid for CSF production.

In the past, keeping the patient “flat in bed” for 24 hours post-puncture was thought to prevent post-dural puncture cephalgia. A recent controlled study suggests this merely delays the inevitable.¹¹

In the case of accidental dural puncture during the course of epidural anesthesia, saline injections are commonly utilized to reduce the incidence and/or severity of headache.¹,³,⁶ This technique produces transient increases in epidural pressure, reducing the pressure gradient between the intrathecal and epidural spaces. It may also in-
crease CSF pressure by the passage of saline via the dural opening into the subarachnoid space. At the author’s institution, epidural “wet taps” are routinely treated with epidural injections of 15-30 cc of sterile saline. These are performed every six hours for 24 hours after the patient’s release from the recovery area. The treatments are facilitated by leaving the epidural catheter in place. It is of historical interest to note that Nelson suggested the insertion of a fine piece of catgut (through the lumbar puncture needle) to occlude the dural puncture. However, the frequent and unfortunate occurrence of cauda equina syndrome accompanying this treatment proved more devastating than the headaches.

Treatment
Modalities in the treatment of post-dural puncture cephalgia, either by replacing lost spinal fluid volume or increasing peridural pressure, aim to increase CSF pressure. Generally accepted forms of therapy for post-dural puncture cephalgia are shown in Table I.

The methods of treatment shown are the simpler forms of therapy for post-dural puncture cephalgia. The efficiency of therapy may be better evaluated after employing these methods. This is not to say, however, that these therapies stand alone. Drug intervention has not been limited to the tranquilizers, analgesics, and hypnotics mentioned in Table I. Nicotinamide has been used to dilate the choroid plexus and enhance CSF production. Vasopressin (Pitressin®) has been utilized as an anti-diuretic. Carbon dioxide inhalation has been used to enhance cerebral vasodilation. In addition, administration of intravenous ethanol has been utilized to dilate choroid plexus vasculature.

### Table I

<table>
<thead>
<tr>
<th>Methods of therapy for post-dural puncture cephalgia</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hydration</strong>—3000cc per day in the immediate postoperative period is a standard goal. (Avoid heavy fluid supplementation in renal-impaired patients or patients with congestive heart failure.)</td>
</tr>
<tr>
<td><strong>Epidural saline injection</strong>—where a catheter is in place and wet tap is secondary to epidural techniques</td>
</tr>
<tr>
<td><strong>Abdominal binder</strong>—is frequently of value for patients experiencing mild to moderate pain. This may be used only during periods in which the patient is upright to reduce discomfort of the binder itself.</td>
</tr>
<tr>
<td><strong>Drug therapy</strong>—in the form of hypnotics and tranquilizers, will reduce anxiety and promote rest in the apprehensive patient. (See the text of the article for a discussion of other agents.)</td>
</tr>
<tr>
<td><strong>Analgesics</strong>—afford symptomatic relief in mild to moderate cephalgia: codeine 30 mg, aspirin gr 10, Tylox®, Darvocet® are frequently employed agents.</td>
</tr>
<tr>
<td><strong>Comfort measures</strong>—such as subdued lighting, quiet, and nursing care which minimizes periods in the head-up position and maximizes rest periods. These are especially important for the rare patient experiencing ocular or auditory complications.</td>
</tr>
<tr>
<td><strong>Head-down position</strong>—although this is not to be construed as bedrest. Bathroom privileges and other ambulatory activities should be encouraged as tolerated. This will allow observation of the degree of incapacity, as well as prevent a depressive attitude towards the cephalgia.</td>
</tr>
<tr>
<td><strong>Epidural blood patch</strong>—for headache of moderate or severe intensity refractory to previously mentioned therapy for more than 36-48 hours. In the case of incapacitating headache, when even short periods out of bed produce severe pain, possibly with auditory and ocular symptoms, blood patch should be the first step considered.</td>
</tr>
</tbody>
</table>

Autologous epidural blood patch
The technique of autologous epidural blood patch presently is considered a reliable and safe treatment for headache of an incapacitating nature, or one that is refractory to more conservative measures. Contraindications to the performance of blood patch (such as treatment with anticoagulant therapy, infection at site of dural puncture, fever of unknown etiology, patient refusal) parallel those for epidural and spinal anesthesia.

A long-term study of post-blood patch complications by Abouleish found backache to be the most commonly seen problem. This is possibly due to the repeated manipulation and injection of the area, or to the volume of the patch.

Modest temperature elevations of 1° C or less
also were noted. Both of these problems were transient phenomena, and not believed to be pathologic in the absence of bacterial or chemical contamination.15

Success with the blood patch technique has consistently exceeded 90%.1,5,12,15,16 Repeat patches have been safely performed in the few cases where the headache was not relieved by the original procedure.

The basic procedure and precautions such as sterile technique, skin prep, and draping apply to epidural blood patching as they do to epidural or spinal anesthesia. The same space where dural puncture was originally performed is used. It is most advantageous to have two persons in attendance. One person may draw the autologous sample under sterile conditions while the other places the Touhy needle. It is prudent to identify the epidural space prior to blood drawing to prevent clotting of the blood should the epidural space identification prove difficult. After the space has properly been identified, the autologous sample is slowly injected.

The suggested volume of blood provides a point to ponder. Some proponents of the blood patch suggest 10 cc or less.1,5,8,12 Other researchers feel that, due to the few deleterious effects of the procedure, up to 20 cc may be used, thus providing a larger area of dural coverage.1,17 During injection of the patch the patient may comment on a sensation of pressure at the injection site, with possible radiation along the course of the epidural tract. If this sensation proves distressing or painful, use of the lower volume technique is probably more suitable.

After the blood injection, the patient should be maintained in a flat, head-down position of comfort for approximately one hour. This period provides time for the clot to adhere firmly to the dura and for the anesthetist to observe any untoward effects. The patient may then be allowed to slowly assume an erect position, and efficacy of the procedure can be evaluated. Nearly all will have attained some degree of relief, and a substantial number of patients will have relief of all symptoms. Daily visits should be made by the anesthetist while the patient is hospitalized. Phone conversations should be made to the patient to provide continuity of care for those treated as outpatients.

Summary

Treatment of post-dural puncture cephalgia as a complication of regional anesthesia requires proper hydration, sterile technique, and mechanical skill in the preoperative and perioperative periods. The anesthetist should be guided by presenting symptoms in following a systematic plan of care that includes provision of immediate comfort, support, and appropriate medications to relieve the condition.

REFERENCES


AUTHOR

Frederick C. Hill, Jr., CRNA, LT, USN, NC is a graduate of the Decatur Memorial Hospital School for Nurse Anesthetists, Decatur, Illinois. He presently is assigned as staff anesthetist, U.S. Naval Hospital, Roosevelt Road, Puerto Rico. He wrote this paper while assigned as a staff nurse anesthetist at the U.S. Naval Hospital, Portsmouth, Virginia.

The opinions expressed are those of the author alone and are not to be construed as official or reflecting the views of the Department of Defense, or the Department of the Navy.

ACKNOWLEDGEMENT

The author wishes to acknowledge the support and assistance in the preparation of this paper of his wife, Chere Jean Hill.