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Post Dural Puncture Headache: How to Keep It the Patient's Headache

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The Problem

Headache remains a major problem to both the obstetrician and the obstetric anesthesiologist. Headache is one of the most common symptoms encountered in the postpartum period. In a study of 95 postpartum parturients with a headache lasting greater than 24 hours, 47% were due to tension/migraines, 24% to preclampsia, and 16% were PDPHA.(1) When examining obstetric anesthesia claims from the Closed Claims Study, the proportion of claims has not changed from the period before 1990 to the period 1990-2003(2) The third most common reason for a claim was headache (14% of obstetric claims). Headache was more common than maternal death, back pain, and maternal brain damage. Headache remains a problem even after the patient is discharged. Hayes, et al, reviewed the records of those parturients who contacted the department after discharge. Of the 98 parturients who contacted after discharge, 43 complained of headache (44%). Of these, only 4 were felt to be due to PDPHA (all received CSE). Seven of the 43 patients received radiologic investigations; all were normal.(3) Academic anesthesiologists disclose to patients that headache is the greatest risk of neuraxial anesthesia with an incidence of 1:100.(4)

Symptoms

The International Headache Society has defined a PDPHA as a bilateral headache that develops within 7 days after lumbar puncture and disappears within 14 days after the lumbar puncture. The headache worsens within 15 minutes of assuming the upright position and disappears or improves within 30 minutes of resuming the recumbent position.(5). These symptoms are helpful in distinguishing from migraine headaches. PDPHA usually occurs in the frontal, occipital, or both areas, but also may involve the neck and upper shoulders. Although it generally occurs within 48 hours of the dural puncture, it can occur later than 3 days in 25% of the cases.(6) In regard to duration, the largest study is by Vandam and Dripps.(7) They followed 8,460 patients who received 10,098 spinal anesthetics. The needles used were Quincke gauges 16 to 24. They reported that 72% of the headaches resolved within 7 days and 87% by six months. The persistence of headache beyond 6 months has been documented and has been successfully treated by epidural blood patch.(8) Duration of the headache is directly related to the gauge of the needle causing the dural puncture.

Other symptoms include nausea, vomiting, neck stiffness, visual disturbances, and hearing alteration. Visual disturbances (blurred vision or double vision) are due to dysfunction of the extraoccular muscles from transient paralysis of the cranial nerves (CN) of the eyes (CN III, IV, and VI) due to traction from downward displacement of the cranial contents.(19) CN VI is the most frequently affected because of its long intracranial course. Hearing (CN VIII) is also affected. Fog performed audiograms preoperatively and 2 days postoperatively in 28 patients given spinal anesthesia.(10) In 14 patients, a 22-gauge Quincke needle was used and a 26-gauge Quincke needle was used in the other 14 patients. Hearing alteration of 10 decibels or more was observed in 13/14 patients in the 22-g group and 4/14 patients in the 26-g group. The alteration tended to occur in the low-frequency range. Alterations in hearing are variable and depend upon the patency of the adult cochlear aqueduct. If the aqueduct is open, loss of CSF leads to an endolymphatic hydrops which affects the hair cells of the inner ear.(11)

Incidence

The incidence of accidental dural puncture (ADP) with an epidural needle is 1.5% but the incidence of headache in the parturient depends upon the type of delivery.(12) The incidence of ADP in patients with prior history of spine surgery is 2.7%.(13) The incidence of headache with a 16-gauge epidural needle is 88% and is 64% with an 18-gauge Tuohy needle.(14) See Table

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Etiology

In the central nervous system, there is approximately 150 cc CSF. Of this CSF, 75 cc is located supraspinally and 75 cc spinally. The production rate of CSF is approximately 0.35 ml/min.(15) It is believed that PDPHA is due to leakage of CSF though the dural tear. Kunkle showed that in volunteers, removal of 10% of CSF through a lumbar needle reliably produced a headache that was relieved by replacement with an equal volume saline.(16) An extradural collection of CSF has been seen on MRI in a patient with a PDPHA.(17)

If the rate of leakage exceeds production, low CSF pressure results in a loss of the cushion effect provided within the cranium. The decrease in CSF volume results in sagging of the brain in the cranial vault, pulling on the falx cerebri, cerebral blood vessels and tentorium. In seven patients with positional headache, downward descent of the brain was seen in five patients.(18) Another hypothesis is cerebral venous dilation. Loss of CSF causes a decrease in CSF pressure without a decrease in intravenous pressure. The pressure difference causes these veins to dilate. Paradoxical postural headache is felt to be due to this response, only exaggerated, resulting in the headache being worse with standing and relieved by the supine position.(19) There is another component to PDPHA. A total of 3730 epidural blocks were performed in 2955 patients.(20) The identification of the epidural space was by loss-of-resistance to either saline or air using a total of 1-5 ml of either substance. In all patients with evident or suspected ADP, a CT scan was immediately obtained. Although ADP occurred to a similar extent in both groups (2.6% for air and 2.7% for saline), the incidence of headache was different, 66.7% for air and 9.8% for saline. In the air group, supraspinal intrathecal air bubbles were found on CT examination in 78% of those with a PDPHA. Air can enter the subarachnoid space with “nicking” the dura. The headache from intrathecal air was more rapid in onset and has a shorter duration than a PDPHA. The entry of air into the intrathecal space when using LORA after a previous dural puncture has been reported.(21) A meta-analysis comparing loss-of-resistance with air to saline demonstrated no difference in adverse outcome when used for the obstetric patient.(22) If the provider chooses the preferred medium (air vs saline), there is less attempts, fewer paresthesias, and fewer ADPs.(23) Furthermore, being awake for 24 hours does not increase the number of attempts or success rate of epidural catheter placement in parturients.(24)

Risk Factors

Not all patients who have dural puncture develop a PDPHA. The frequency of PDPHA is inversely associated with age.(25) A meta-analysis comparing men vs women (excluding obstetric patients) demonstrated that the odds of developing a PDPHA were significantly lower for men than women (odds ratio 0.55).(26) Men have a larger cerebellar hemisphere resulting in a gender difference in the craniospinal junction.(27)

The greatest influence on the incidence of PDPHA is technique and choice of needle. Technique is important for the Quincke needle, ensuring the direction of the bevel is parallel to the longitudinal axis of the dural cylinder. The dura mater is a laminated structure built up from well-defined layers oriented concentrically with no predominant direction to the fibers.(28) The cells of the arachnoid mater are oriented parallel to the long axis of the spinal cord and parallel insertion my result in less disruption.(29) For epidural needles, bevel orientation is not as important. Leakage from puncture with a 18-gauge Tuohy needle is similar whether the puncture is parallel or transverse.(30) The thickness of the lumbar dura mater varies. The hole created when the needle penetrated a thinner part of the dura mater resulted in a larger hole and greater leakage than when punctured in a thicker part.

For needle type, size of needle and needle design are important. Smaller needles have a lower incidence of PDPHA, especially with the Quincke needle. Kang showed the incidence of PDPHA was 9.6% with the 26-gauge needle and 1.5% with the 27-gauge.(31) Gauge is not as important for the pencil point needle. I feel that some of the headaches from the pencil point needle are due to advancing the local infiltration needle too far. Absalom described a case of cord injury when the local infiltration needle was inserted to the hub.(32) Another example would be the occurrence of a PDPHA following acupuncture for the treatment of back pain.(33) For needle design, the pencil point needles have a low incidence of PDPHA. Comparing 676 PS I or II patients undergoing spinal anesthesia with either a 27-gauge Quincke or 27-gauge Whitacre needle, the incidences of PDPH in the Quincke and

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Whitacre groups were 2.7% and 0.37%, respectively.(34) The Practice Guidelines for Obstetric Anesthesia recommend the use of the pencil-point needles to reduce the frequency of PDPHA.(35)

Another factor affecting the incidence of PDPHA after accidental dural puncture is management of the second stage. In 33 patients with accidental dural puncture, 23 engaged in active pushing and 10 went to cesarean section before pushing. 17/23 patients developed a headache in the pushing group and 1/10 in the nonpushing group.(36) Active bearing down causes a marked increase in cerebrospinal fluid pressure and possibly leads to greater CSF loss, accounting for the higher incidence in parturients.

A patient with a previous PDPHA is at risk for subsequent PDPHA. In 258 patients who received a repeat spinal anesthetic, 42 had a previous PDPHA. Of these, 19% developed PDPHA again as compared to an incidence of 6.9% in those who did not have a previous PDPHA.(37)

Prevention

Various maneuvers are used to prevent PDPHA and the majority are poorly supported by the literature. A survey of practicing anesthesiologists in the United States revealed that the majority of hospitals do NOT have written protocols for the management of unintended dural puncture.(38) Many recommend bed rest to prevent a PDPHA. A systematic examination of recumbence showed no benefit.(39)

Following dural puncture during attempted epidural analgesia, a subarachnoid (SA) catheter may be passed. Norris and Leighton failed to note any difference in the incidence or severity of PDPHA with a SA catheter.(40) In this study, the catheter was pulled at the end of delivery. Ayad studied 115 parturients who had accidental dural puncture.(41) The patients were randomized into one of three groups: resite the epidural catheter, SA catheter with removal after delivery, and SA catheter with removal 24 hours after delivery. The incidence of PDPHA was 91.1% in the resite group, 51.4% in the immediate group, and 6.2% in the delayed group. This data suggest the placement of a SA catheter after the occurrence of a wet tap and leaving it in for 24 hours may be helpful. Extreme care should be used when a SA catheter is left in place for 24 hours. A case report discussed a patient who had the catheter adapter dislodge, resulting in a CSF leak while another presented a patient who developed meningitis.(42,43) The use of SA catheters is increasing. No randomized study has demonstrated the effectiveness of intrathecal catheters. An audit of a ten year experience failed to demonstrate a benefit to the intrathecal catheter.(44) In the US survey, 50% of practicing anesthesiologists would remove the intrathecal catheter after delivery.(37)

A randomized study compared 3 mg of preservative free morphine injected epidurally at delivery and 24 hours later in 50 parturients who had dural puncture. As compared to saline, there was a lower incidence of headache (12% vs 48%) and a lower need for EBP (0 vs 6). There was also a higher incidence of pruritus in the epidural morphine group.(45) Consyntropin 1.0 mg has been shown to decrease the incidence of PDPHA following accidental dural puncture and to decrease the need for EBP.(46) The concerns with the study were the lack of postulated reason for effectiveness as well as the lack of definition for PDPHA and for need for EBP.

Treatment

The treatment of PDPHA ranges from conservative to invasive. Conservative measures include bed rest, analgesics, intravenous hydration, and other medications. Caffeine is commonly recommended for PDPHA because of its ability to increase cerebral vascular resistance, decrease cerebral blood flow, and decrease cerebral blood volume. The original study examining intravenous caffeine was published in 1978. The authors studied 1932 patients undergoing spinal anesthesia with a 22-gauge Quincke needle.(47) 41 patients developed PDPHA and were randomized to either intravenous saline or intravenous caffeine benzoate 500 mg. Caffeine had an overall effectiveness of 85%. To achieve this effectiveness, 2 patients required a repeat dose. There has been no study examining its effectiveness for accidental dural puncture with an epidural needle. A review concluded that there is no valid pharmacological rationale for caffeine as a treatment for PDPHA.(48)

It is thought that epidural saline increases pressure in the area and decreases the outflow of CSF. In 15 patients who had a PDPHA following dural puncture with a 25-gauge needle, 30 ml of saline administered epidurally provided relief in 9/15 patients. No patient who had a PDPHA following dural puncture with a 17-gauge

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needle had relief.(49) Epidural saline provides temporary relief that disappears once the saline is absorbed.

In 1960, Gormley reasoned that blood could serve as the sealing material. In his report of 7 cases (one of which was himself), 2-3 ml of blood injected into the lumbar epidural space at the same level as the dural puncture was effective.(50) Crawford recommended up to 20 ml of blood, stopping if the patient complains of back or leg pain. Using this method, he reported 97/98 had complete success.(51) Some practitioners recommend injecting blood until the patient develops symptoms but a case report of hematoma in one patient and arachnoiditis in another patient raises a concern with this practice.(52) A recent study upheld Crawford's recommendation of 20 cc for an EBP.(53) The postulated mechanism for its effectiveness is compression of the thecal space and elevating the subarachnoid pressure. Maintenance of the therapeutic effect is attributed to clot preventing further CSF leak.(54) Blood in the epidural space will spread between 7 and 14 spinal segments. The mean spread of blood is six segments upward and three segments downward.(55) MRIs performed in two patients after 20 ml of blood being injected into the lumbar epidural space revealed blood in the upper cervical region.(56) MRI shows the blood patch as a large extradural collection mainly in the posterior space, with spread to the anterior epidural space as well as out the intervertebral foramina and into the paravertebral space.(57) Complications of the EBP include back pain (occurs during the first 48 hours in 35% of patients and persists in 16% of patients with a mean duration of 27 days)(58) and bradycardia(59). A previous EBP is not a contraindication to epidural anesthesia although EBP may cause scarring in the space and ineffective anesthesia.(60,61) An EBP is contraindicated if the patient is febrile. During an epidural blood patch, it is possible to inject the blood subarachnoid.(62) The literature concerning this complication is scant. Subarachnoid injection may result in meningitis, arachnoiditis, or paresthesias. To give an idea of the effectiveness of EBP, the number needed to treat to result in success is 1.(63) In the first randomized trial of EBP, 42 patients with PDPHA following lumbar puncture with a 22-gauge Quincke needle were randomized to conservative treatment or EBP. (64) EBP reduced the severity of PDPHA and resulted in quicker resolution. In the literature, there are 5 patients who developed cerebral venous thrombosis after EBP. Pregnancy is associated with a hypercoagulable state and it is unclear if this association of cerebral venous thrombosis with EBP is valid.(65)

The timing of the EBP is debated. Loeser noted a 71% failure rate if the epidural blood patch was done within 24 hours of dural puncture as compared to a 4% failure rate if done greater than 24 hours. Subsequent studies have also noted this finding.(66) The largest series consists of 504 patients. 75% achieved complete relief, 18% incomplete relief, and 7% no relief.(67) Performing the EBP within 3 days was a risk factor for failure (odds ratio 2.63). Vilming et al questioned when should an EBP be done.(68) According to these authors, an EBP should be performed after an initial observation period of 24 hours if the patient is symptomatic. This delay increases the success rate while reducing the suffering of the patients. The optimal time to place an epidural blood patch is $\geq$24 hours after development of the PDPHA. This 24 hour delay is supported by a survey of Nordic countries.(69) Given the improved outcome if the EBP is delayed, one would have to question the prophylactic EBP. A prophylactic blood patch involves the injection of blood through the epidural catheter before the development of a headache. 64 parturients with accidental dural puncture with a 17-gauge epidural needle were randomized either to blood patch through a catheter or to sham blood patch (blood drawn but not injected).(70) There was no difference between groups in the incidence of PDPHA or in the need for therapeutic blood patch. A Cochrane review did not recommend prophylactic epidural blood patch and determined that therapeutic EBP to be beneficial.(71)

Conclusion

PDPHA continues to be a problem following neuraxial anesthesia. It is due to a decrease in CSF volume and is not easily prevented. It is easily treated with an EBP. An EBP performed within the first 24 hours of PDPHA may decrease its effectiveness.

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Incidence of PDPHA

Needle Type	Gauge	Incidence of PDPHA
Quincke	16	18%
Quincke	19	10%
Quincke	20	16%
Quincke	22	10%
Quincke	24	6%
Quincke	25	6%
Quincke	26	6%
Quincke	27	1.5%
Pencil Point	22	1.6%
Pencil Point	24	2%
Pencil Point	25	1.1%
Tuohy	16	88%
Tuohy	18	64%

Data is extrapolated from several various studies

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