

## Differential diagnosis of postpartum headaches

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Postpartum headache is the occurrence of cephalic, neck or shoulder pain during the period of time from placental delivery to six weeks postpartum. The incidence of postpartum headache during the six week postpartum period has yet to be evaluated in a prospective study, however, recent literature is available from a prospective evaluation of women during the first week postpartum<sup>(1)</sup> and from a prospectively collected database evaluating symptoms during pregnancy until one week postdelivery<sup>(2)</sup>. Goldszmidt et al reported an 38.7% (381 of 985 women studied) incidence of postpartum headache during the first week<sup>(1)</sup>. The median time to onset of symptoms was two days and median duration of headache was four hours. Benhamou et al examined information collected on 2,924 women, excluding women with recognized dural punctures, premature deliveries, multiple gestation, or scheduled for elective cesarean delivery<sup>(2)</sup>. Headache was reported by 12% of 1,058 patients who had epidural anesthesia without dural puncture and by 15% of 140 patients who delivered without epidural anesthesia.

Postdural puncture headache (PDPH) during the postpartum period is usually one of the most common complications in obstetric anesthesia. A patient with PDPH experiences an exacerbation of symptoms when she moves from the horizontal to the upright position. Physicians and nurses should be aware that dural puncture is only one of many causes of postpartum headache (Table I). Difficult diagnostic problems require the opinion of a neurologist. The purpose of this talk is to discuss the differential diagnosis of postpartum headache and PDPH in detail.

### DIFFERENTIAL DIAGNOSIS OF POSTPARTUM HEADACHE

The classification of headaches has universally followed the International Classification of Headache Disorders, created in 1988 by the Headache Classification Committee of

the International Headache Society. This classification system has been updated in its second edition and identifies two broad categories of headaches, as primary and secondary<sup>(3)</sup>. Primary headaches include migraine, tension-type headache, cluster headache and trigeminal autonomic cephalalgia. Secondary headaches are attributable to specific underlying pathology. It appears that primary headaches are 20 times more common than secondary headaches amongst women in the first week postpartum<sup>(1)</sup>.

After delivery, women frequently suffer from headache. A retrospective study reviewed five years of hospital records to identify women with postpartum headaches which lasted more than 24 hours after delivery and occurred within 6 weeks of delivery<sup>(4)</sup>. Ninety five women met this criteria, and while incidence rates could not be calculated, the study did identify some important features of postpartum headache. Most women (82%) were still in hospital at the onset of their headache. The demographics of the study population largely reflect the general population in that the mean maternal age was 25.2 years, 87% of the women had received some type of regional anesthesia and 29% of the women had cesarean deliveries.

### PRIMARY HEADACHES

Patients with histories of headache disorders typically are diagnosed with one of four major types of primary headaches. The most common in the postpartum period are tension-type and migrainous headaches, which account for almost two-thirds of headaches during this period<sup>(1,2)</sup>. Tension-type headaches are often circumferential and constricting, can be associated with scalp tenderness and are usually of mild to moderate severity. The postpartum patient can present with a recurrence of her known primary disorder or present with the first presentation of the primary condition.

**Table I.** Differential diagnosis of postpartum headache.

Headache etiology	% of Postpartum headaches	Primary symptoms/signs	Diagnostic modality
Tension headache	38.3–39%	Mild to moderate headache, lasting 30 min – 7 days, often bilateral, non-pulsating, not aggravated by physical activity	History&Physical
Migraine	11–34.1%	Recurrent moderate to severe headaches, lasting 4 – 72 hours, often unilateral, pulsating, aggravated by physical activity, associated with nausea, photophobia, phonophobia	History&Physical
Musculoskeletal	11.3-14.7 %	Mild to moderate headache accompanied by neck and/ or shoulder pain	History&Physical
Pre-eclampsia/ Eclampsia	8.1-24%	Hypertension ± symptoms of HELLP; headache often bilateral, pulsating and aggravated by physical activity	History&Physical, Laboratory (ALT, AST, uric acid, platelet count, proteinuria)
Postdural puncture headache (PDPH)	4.7–16%	Headache within 5 days of dural puncture, worsens w/i 15 minutes of sitting or standing, associated with neck stiffness, tinnitus, photophobia, nausea	History&Physical, ± MRI
Cortical vein thrombosis	3%	Nonspecific headache always present, often accompanied by focal neurological signs (seizures, deficits)	History&Physical, CT or MRI ± angiography
Subarachnoid hemorrhage	1 %	Abrupt onset, intense and incapacitating headache, often unilateral, accompanied by nausea, nuchal rigidity, altered consciousness	History&Physical, CT scan without contrast or MRI (flair sequencing)
Posterior Reversible Leukoencephalopathy (PRES) syndrome	Unknown	Often diffuse, severe headache which can be abrupt onset or more slowly ± focal neurological deficits, seizures	History&Physical, MRI imaging, angiographic «strings and beads» appearance
Brain tumor	Unknown	Progressive headache; often worse in the morning, localized, aggravated by coughing/straining	History&Physical, Neuro-imaging (CT or MRI)
Subdural hematoma	Unknown	Headache usually without typical features, often overshadowed by focal neurological signs/altered consciousness	History&Physical, Neuro-imaging (CT or MRI)
Cerebral infarction/ ischemia	Unknown	Moderate headache accompanied by focal neurological signs/alteration in consciousness	History&Physical, Neuro-imaging (CT, MRI)
Pseudotumor cerebri/ Benign intracranial hypertension	Unknown	Progressive headache, non-pulsating, aggravated by coughing, straining; associated with increased CSF pressure, normal CSF chemistry	History&Physical, Lumbar puncture
Spontaneous Intra-cranial Hypotension	Unknown	No history of dural trauma; diffuse, dull headache worsening w/i 15 minutes of sitting, standing; associated with neck stiffness, nausea, tinnitus, photophobia; CSF opening pressure < 60 mmH2O in sitting position	History&Physical, Lumbar Puncture, Radio-isotope cisternography and CT myelography
Sinusitis	Unknown	Frontal headache accompanying pain in region of face; development of headache coincides with nasal symptoms of nasal obstruction, purulent nasal discharge, anosmia; fever	History&Physical, nasal endoscopic, CT or MRI imaging

Meningitis	Unknown	Headache is most frequent symptom, often diffuse and increasing intensity with time; associated with nausea, photophobia, phonophobia, general feeling of illness; fever	History&Physical, Lumbar Puncture
Pneumocephalus	Unknown	Often abrupt onset, frontal headache immediately following dural puncture; symptoms can worsen with upright posture	History&Physical, CT imaging
Caffeine withdrawal	Unknown	Caffeine consumption of $\geq 200$ mg/ day for $> 2$ weeks; headache developing within 24 hours of last caffeine intake, relieved by caffeine intake; often bilateral $\pm$ pulsating	History&Physical
Lactation headache	Unknown	Mild to moderate headaches associated temporally with onset of breastfeeding or when breasts overfull	History&Physical

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Headache Classification Committee of the International Headache Society. The International Classification of Headache Disorders 2nd Edition. *Cephalalgia* 2004;24:8–160.

## MIGRAINE

Migraine headaches are defined as recurring cranial pain lasting 4–72 hours, often with typical features such as pulsating pain in a unilateral location, nausea and photophobia<sup>(3)</sup>. The presence of focal neurological symptoms, usually preceding the headache, characterizes the subset type of migrainous headache with aura. Migraine headache prevalence is approximately 17% in the female population (three times more common than in men) and has a particular age association between 30–50 years or age<sup>(5)</sup>. Pregnancy can have an ameliorating effect on migraine frequency in the majority of sufferers but symptoms may recur soon after delivery, with reports of 34% within the first week postpartum and 55% within the first month<sup>(6)</sup>. Generally the symptoms are similar to their typical pattern, although often milder and less often unilateral. It is rare for a migraine presentation to occur for the first time during the postpartum period. Recently there has been interest in the potential association between migraines and pregnancy induced hypertension. At this point in time there appears to be a positive association which may reflect an underlying predisposition to cerebral ischemic injury<sup>(7)</sup>.

## SECONDARY HEADACHES

One of the most common secondary headache types in the postpartum period is the musculoskeletal headache, exacerbated by the maternal physical exertion of labor and associated sleep deprivation. This headache has accompanying neck and shoulder pain without a history of dural puncture.

Approximately 11% of postpartum headaches are diagnosed in this category<sup>(1)</sup>, and the remaining 25% include systemic, vascular, neoplastic, and infectious causes.

## HYPERTENSION

Pregnancy-induced hypertension (PIH) is commonly associated with headache symptoms, although often the symptoms develop in the antepartum interval. With early identification of PIH and intervention in the antepartum period, the incidence of postpartum eclampsia has increased to almost 50% of all cases<sup>(8)</sup>. Eclampsia is a form of hypertensive encephalopathy that includes headache, visual disturbances, nausea, vomiting, seizures, stupor and sometimes coma. Seizures can occur even when hypertension is not severe. Headache is a serious premonitory sign. Other hypertensive disorders, with or without superimposed preeclampsia, also may cause postpartum headache and lead to encephalopathy. The diagnosis can be difficult if the parturient's labor and delivery course is complicated by a dural puncture<sup>(9)</sup>.

## POSTERIOR REVERSIBLE LEUKOENCEPHALOPATHY SYNDROME

In 1996, a neuroradiological entity, posterior reversible leukoencephalopathy syndrome (PRES) was identified following recognition of consistent symptom presentation in a diverse group of patients. The population included patients with hemolytic-uremic syndrome, patients exposed to anti-rejection medication, uremic patient, and pregnant women with pregnancy-induced hypertensive disorders<sup>(10)</sup>. Approx-

imately 25% of cases occur in pregnant patients. PRES symptoms include headache, seizures, altered mental status, visual changes and occasionally, focal neurologic deficits<sup>(11)</sup>. The neuroradiologic features of PRES include symmetric areas of cerebral edema, predominantly involving the white matter regions of the posterior circulation (occipital lobes, posterior parietal and temporal lobes). The pathophysiology of this disorder is similar to hypertensive encephalopathy, in that the cerebrovascular regulation is altered and with it loss of blood-brain integrity. The accompanying vasogenic edema can be reversed by prompt recognition and supportive therapy (cessation of provocative medications, aggressive treatment of hypertension and seizure prevention). However, irreversible cytotoxic edema with permanent neurological damage can occur if the initial disorder is not diagnosed early. This syndrome often presents in the postpartum period, usually following identification of pregnancy-induced hypertension<sup>(12-16)</sup>. There are five case reports of obstetric anesthesia considerations in pregnant patients with PRES, with the first case report occurring before the syndrome was well detailed<sup>(12)</sup>. Typical features distinguishing it from other causes of postpartum headache include associated accompanying seizures, and focal neurological deficits, such as temporary loss of vision.

### BRAIN TUMOR

Postpartum headaches as a presenting feature of intracranial tumors has been reported<sup>(17-19)</sup>. The features of the headache may be dull rather than throbbing, and often do not have the noticeable improvement with supine positioning. The headache may occasionally be associated with nausea, vomiting, seizures, or focal signs. Neurologic examination may reveal evidence of increased intracranial pressure. In reviewing these case reports the atypical presentation of the headache, either with persisting headache symptoms in the supine position, or exacerbation following epidural blood patch should prompt further neuroradiological investigations.

### SUBARACHNOID HEMORRHAGE

Subarachnoid hemorrhage is increased during pregnancy, with the incidence estimated at 20 per 100,000 deliveries, and is usually secondary to a cerebral aneurysm, arteriovenous malformation or hypertensive encephalopathy<sup>(20)</sup>. The presenting headache is classically with sudden, severe pain, unlike any previous headache symptoms. The period of risk for bleeding appears to be related to increasing changes of pregnancy affecting circulating volume and specific hormonal changes affecting arterial integrity. Other risk factors that increase the likelihood during pregnancy is a history of cigarette smoking, genetic associations such as polycystic kid-

ney disease, and nulliparity. Any index of suspicion necessitates urgent investigation by computed tomographic scanning, as non-operable therapies, such as endovascular ablation, are available and long term sequelae can be minimized.

### CORTICAL VEIN THROMBOSIS

Cerebral cortical vein thrombosis risk is increased in the pregnancy and has been estimated at an incidence between 10–20 per 100,000 deliveries in developed countries. The incidence appears higher in developing countries with an incidence of 450 per 100,000 deliveries in India<sup>(21)</sup>. Its presentation can often be difficult to distinguish from postdural puncture headache, as it often has a postural component. Preceding dural punctures have been reported in several cases, and it is difficult to ascertain whether the decreased CSF pressure and cerebral vasodilation predispose to thrombosis development. Associated features may include focal neurological signs, seizures, and coma. Cerebral infarction may ensue if diagnosis is delayed. Diagnosis is best confirmed by magnetic resonance imaging (MRI), as computed tomography appears to identify only one-third of cases<sup>(22)</sup>. Treatment of cortical vein thrombosis largely is symptomatic, with the aim of preventing seizures. Currently anticoagulation therapy is being evaluated, with observational and randomized trial studies indicating better outcomes<sup>(23,24)</sup>.

### CEREBRAL INFARCTION/ISCHEMIA

Cerebral arterial insufficiency is one of the causes of stroke in pregnancy and has an estimated incidence of 19 per 100,000 deliveries<sup>(25)</sup>. Approximately half of the events occur in the delivery and postpartum period, and the clinical presentation is often a woman with sudden onset of headache, vomiting, seizures and focal neurologic deficits. Postpartum cerebral angiopathy has been recently identified with the use of cerebral angiography, and has characteristic «arterial beading» indicative of arterial spasm. Reports in the literature describe the common presentation of patients reviewed by anesthesia because of central axial anesthesia for delivery, with the key feature being a nonpostural headache<sup>(26,27)</sup>. CT and MRI evaluations are often normal and require cranial doppler or angiographic investigations to diagnose the arterial ischemia or infarct.

### SUBDURAL HEMATOMA

In rare instances, dural puncture is associated with the subsequent development of a subdural hematoma. In the reports, the identification of the subdural hematoma is preceded by symptoms of a PDPH<sup>(28-30)</sup>. A dural puncture results in leakage of cerebrospinal fluid (CSF) and decreased in-

tracranial pressure (ICP). Presumably, the reduction in ICP causes places stress on bridging cerebral vessels, which may precipitate bleeding. Neurologic signs of subdural hematoma are variable but include evidence of increased ICP (e.g., headache, somnolence, vomiting, confusion) and focal abnormalities. This topic is further discussed in the complications of postdural puncture headache section.

### **PSEUDOTUMOR CEREBRI/BENIGN INTRACRANIAL HYPERTENSION**

Parturients with pseudotumor cerebri (i.e., increased ICP in the absence of a mass lesion) present with headache and visual disturbances, usually in the antepartum period. As a postpartum presentation, patients usually report the same features of chronic headache symptoms. The diagnosis largely is one of exclusion (see Chapter 48). Treatment involves reduction of CSF pressure, either with glucocorticoids, carbonic-anhydrase inhibitors, diuretics or serial lumbar punctures. Case reports of these patients describe the use of intrathecal catheters for labor analgesia and delivery, and the development of PDPH and absence of PDPH<sup>(31,32)</sup>.

### **SPONTANEOUS INTRACRANIAL HYPOTENSION**

Spontaneous intracranial hypotension develops because of CSF leakage secondary to dural tears, occurring usually at the thoracic spinal level and not associated with prior spinal intervention<sup>(33)</sup>. Diagnosis requires radioisotope cisternography and computed tomography myelography which may also identify the level of the leak. Presentation of this disorder is identical to postdural puncture headache occurrences, as the pathophysiology is the same. The only difference is the lack of central axial intervention. A case report of an obstetric patient describes the development of a postural headache four days after a spontaneous vaginal delivery without epidural or spinal anesthesia. The patient was found to have a cervical-thoracic region dural leak<sup>(34)</sup>.

### **PNEUMOCEPHALUS**

The subdural or subarachnoid injection of air used for identification of the epidural space may be associated with the sudden onset of severe headache, sometimes accompanied by neck pain, back pain, or changes in mental status<sup>(35)</sup>. Headache symptoms can mimic postdural puncture headaches in that they are worse in the sitting position and may be relieved by lying down. Radiologic studies confirm the presence of intracranial air and the headache typically resolves over the first week.

### **MENINGITIS**

The severe headache of meningitis typically presents several days after delivery. It is accompanied by fever, nuchal rigidity, and positive Kernig and Brudzinski signs. Lethargy, confusion, vomiting, seizures and a skin rash also may occur. Usual pathogens include group B streptococcus, staphylococcus epidermidis, group A  $\beta$ -hemolytic streptococcus, and recent parasitic agent, taenia solium, causing neurocysticercosis<sup>(36-38)</sup>. The diagnosis is confirmed by examination and culture of the CSF.

### **SINUSITIS**

Headache caused by inflamed paranasal sinuses is associated with purulent nasal discharge and occasionally fever. Pain may be unilateral or bilateral depending on the extent of the disease, and the skin over the affected sinus may be tender. Frontal sinus infection causes headache in the frontal region. Ethmoidal and sphenoidal sinus infections cause periorbital pain, and maxillary sinus infection may cause diffuse facial discomfort. The sinuses fill overnight, and pain typically is worse on awakening. Pain improves in the upright position, which assists drainage<sup>(39)</sup>.

### **CAFFEINE WITHDRAWAL**

The withdrawal of caffeine may lead to headache, increased fatigue, and anxiety, and have been reported to occur after as little 3 days exposure to 300 mg per day or 7 days exposure to 100 mg per day (50-100 mg of caffeine per coffee drink)<sup>(40)</sup>. Caffeine withdrawal may be the cause of postoperative headache<sup>(41)</sup>. Although it has not been confirmed as a cause of postpartum headache, the diagnosis should be considered.

### **LACTATION HEADACHE**

Askmark and Lundberg reported episodes of intense headache during periods of breast-feeding in a woman known to suffer from migraine<sup>(42)</sup>. Headache was associated with an increased plasma vasopressin concentration, were transiently present within the first few minutes breastfeeding and disappeared by ten minutes. As well, headaches have been described in women with breast overfullness, who have elected not to breastfeed, or have reduced feeding episodes<sup>(43)</sup>.

### **POSTDURAL PUNCTURE HEADACHE (PDPH)**

#### **Incidence**

A recent meta-analysis of obstetric patients and PDPH calculated a pooled risk of inadvertent dural puncture with any



epidural needle as 1.5% (95% CI: 1.5, 5%)<sup>(44)</sup>. Once a dural puncture had occurred the risk of a PDPH was 52.1% (95% CI: 51.4, 52.8%). Dural punctures with spinal needles had PDPH rates between 1.5 to 11.2%. The seemingly minor complication of a PDPH has appeared as a cause of 18% of closed-claims cases in the American Society of Anesthesiologists Closed Claims Project<sup>(45)</sup>.

### SYMPTOMS

Patients typically experience headache pain in the frontal and occipital regions. Pain often radiates to the neck, which may be stiff. Some women have a mild headache that permits full ambulation. In others, pain is severe and incapacitating. Symptoms are worse in the upright position and are relieved to some extent in the horizontal position. Abdominal compression may relieve pain in some patients. The International Classification of Headache Disorders - II define a PDPH as occurring within 15 minutes of moving to an upright position (sitting or standing) and relief of headache within 15 minutes of moving to supine position<sup>(3)</sup>.

The ICHD - II PDPH diagnostic criteria also require one of the following symptoms to be present: neck stiffness, tinnitus, hypacusia, photophobia, or nausea. In a prospective study of 75 nonobstetric patients with PDPH, Lybecker et al noted the following incidence of symptoms: nausea 60%, vomiting 24%, neck stiffness 43%, ocular (photophobia, diplopia, difficulty in accommodation) 13%, and auditory (hearing loss, hyperacusis, tinnitus) 12%<sup>(46)</sup>. Cranial nerve palsy occurs occasionally. The sixth cranial nerve is most susceptible to traction during its long intracranial course. This results in failure of the involved eye to abduct, and parturients may have diplopia. Hearing loss is usually in the low-frequency range and is related to CSF pressure reduction and alteration of hair cell position in the inner ear<sup>(47)</sup>. The risk of hearing loss appears to be increased by larger gauge needles causing dural punctures and advancing age (> 40 years).

Other rarer symptoms that have been reported after development of postdural puncture headache symptoms include seizures, and abdominal pain, diarrhea. Shearer et al reported postpartum seizures in eight women with severe PDPH without convincing evidence of preexisting hypertension<sup>(48)</sup>. Cerebral vasospasm was thought to be the etiologic factor. Vercauteren et al described a woman who had received epidural analgesia and developed postpartum seizures with a severe headache<sup>(49)</sup>. The CSF was blood-stained,

but a CT scan showed no source of hemorrhage. This patient improved dramatically after the performance of a blood patch. A 20 year old male developed a PDPH following a spinal anesthetic with 25 gauge Quincke needle<sup>(50)</sup>. Twelve days following the anesthetic, abdominal pain and diarrhea began which persisted despite negative infectious and inflammatory investigations. One month following spinal anesthesia an epidural blood patch was performed with prompt resolution of headache and gastrointestinal symptoms. The etiology was felt to be visceral hyperalgesia of the lumbosacral nerve roots secondary to noninfectious arachnoiditis.

### ONSET AND DURATION

Headache typically occurs on the first or second day after dural puncture, and must appear, by ICHD-II criteria, by five days post dural puncture<sup>(3)</sup>. 95% of PDPH headaches last less than a week. Prospective follow-up of patients with PDPH in the National Obstetric Anaesthesia Database project of the Obstetric Anaesthetists' Association demonstrated that 75% of 975 cases had interference of daily activities secondary to the headache<sup>(51)</sup>. There are rare reports of symptoms lasting for months or even years<sup>(52)</sup>.

### IMAGING

Imaging investigations are not recommended for the postpartum patient with a PDPH unless the symptoms are suggestive of other potential diagnoses. However, information is available from parturients with PDPH who underwent imaging studies<sup>(53,54)</sup>. The contrast-enhanced magnetic resonance image (MRI) is the method of choice to study the meninges and has revealed characteristic findings of PDPH. These included marked, diffuse contrast enhancement with thickening of the dura mater, occasionally extradural local fluid collections, and enhancement and expansion of the superior sagittal sinus. The enlarged venous sinus may represent compensatory venous expansion in response to low CSF pressure<sup>(54)</sup>. If MRI facilities are not available, Somri et al have suggested the use of computerized tomography scan when dealing with postural headaches following epidural techniques used with the loss-of-resistance to air technique<sup>(55)</sup>. Their recommendation is to image with CT when conservative therapy has failed over 24-48 hours or symptoms do not improve following epidural blood patch therapy.

## REFERENCES

1. Goldszmidt E, Kern R, Chaput A, Macarthur A. The incidence and etiology of postpartum headaches: A prospective cohort study. *Can J Anesth* 2005;52:971-7.
2. Benhamou D, Hamza J, Ducot B. Postpartum headache after epidural analgesia without dural puncture. *Internat J Obstet Anesth* 1995;4:17-20.
3. Headache Classification Committee of the International Headache Society. The International Classification of Headache Disorders 2nd Edition. *Cephalgia* 2004;24:8-160.
4. Stella CL, Jodicke CC, How HY, Harness UF, Sibai BM. Postpartum headache: Is your work-up complete? *Am J Obst Gynecol* 2007;196:318.e1-318.e7.
5. Lipton RB, Scher AI, Kolodner K, Liberman J, Steiner TJ, Stewart WF. Migraine in the United States. Epidemiology and patterns of health care use. *Neurology* 2002;58:885-94.
6. Sances G, Granella F, Nappi RE, Fignon A, Ghiotto N, Polatti F, Nappi G. Course of migraine during pregnancy and postpartum: A prospective study. *Cephalalgia* 2003;23:197-205.
7. Adeney KL, Williams MA. Migraine headaches and preeclampsia: An epidemiologic review. *Headache* 2006;46:794-803.
8. Zeeman GG, Fleckenstein JL, Twickler DM, Cunningham FG. Cerebral infarction in eclampsia. *Am J Obst Gynecol* 2004;190:714-720.
9. Katzin LW, Levine M, Singhal AB. Dural puncture headache, postpartum angiopathy, pre-eclampsia and cortical vein thrombosis after an uncomplicated pregnancy. *Cephalgia* 2007;27:461-4.
10. Hinchey J, Chaves C, Appignani B, Breen J, Pao L, Wang A, Pessin MS, Lamy C, Mas JL, Caplan LR. A reversible posterior leukoencephalopathy syndrome. *NEJM* 1996;334:494-500.
11. Pande AR, Ando K, Ishikura R, Nagami Y, Takada Y, Wada A, Watanabe Y, Miki Y, Uchino A, Nakao. Clinicoradiological features influencing the reversibility of posterior reversible encephalopathy syndrome: A multicenter study. *Radiat Med* 2006;24:659-668.
12. Crosby ET, Preston R. Obstetrical anaesthesia for a parturient with preeclampsia, HELLP syndrome and acute cortical blindness. *Can J Anaesth* 1998;45:452-9.
13. Prout RE, Tuckey JP, Giffen NJ. Reversible posterior leukoencephalopathy syndrome in a peripartum patient. *IJOA* 2007;16:74-6.
14. Torrillo TM, Bronster CJ, Beilin Y. Delayed diagnosis of posterior reversible encephalopathy syndrome (PRES) in a parturient with preeclampsia after inadvertent dural puncture. *IJOA* 2007;16:171-4.
15. Ho CM, Chan KH. Posterior reversible encephalopathy syndrome with vasospasm in a postpartum woman after postdural puncture headache following spinal anesthesia. *Anesth Analg* 2007;105:770-2.
16. Long TR, Brown MJ, Rydberg CH, Wass CT. Posterior reversible encephalopathy syndrome during pregnancy: Seizures in a previously healthy parturient. *J Clin Anesth* 2007;19:145-8.
17. Eede HV, Hoffmann SLH, Vercauteren MP. Post-delivery postural headache: Not always a classical post-dural puncture headache. *Acta Anaesthesiol Scand* 2007;51:763-5.
18. Dutton DA. A 'postspinal headache' associated with incidental intracranial pathology. *Anaesthesia* 1991;46:1044-6.
19. Alfery DD, March ML, Shapiro HM. Post-spinal headache or intracranial tumor after obstetric anesthesia. *Anesthesiology* 1979;51:92-4.
20. Selo-Ojeme DO, Marshman LAG, Ikomi A, Ojutiku D, Aspoas RA, Chawda SJ, Bawa GPS, Rai MS. Aneurysmal subarachnoid haemorrhage in pregnancy. *Eur J Obst Gynecol* 2004;116:131-143.
21. Lockhart EM, Baysinger CL. Intracranial venous thrombosis in the parturient. *Anesthesiology* 2007;107:652-8.
22. Boussier MG. Cerebral venous thrombosis. Diagnosis and management. *J Neurol* 2000;247:252-8.
23. de Bruijn SFTM, Stam J. Randomized, placebo-controlled trial of anticoagulant treatment with low-molecular weight heparin for cerebral sinus thrombosis. *Stroke* 1999;30:484-8.
24. Canhao P, Ferro JM, Lindren AG, Boussier MG, Stam J, Barinagarrementeria F. Causes and predictors of death in cerebral venous thrombosis. *Stroke* 2005;36:1720-5.
25. Jaigobin C, Silver FL. Stroke and pregnancy. *Stroke* 2000;31:2948-51.
26. Konstantinopoulos PA, Mousa S, Khairallah R, Mtanos G. Postpartum cerebral angiopathy: An important diagnostic consideration in the postpartum period. 2004;191:375-7.
27. Nicol GLJ, Millns JP. Cerebellar infarction as a cause of postpartum headache. *Int J Obstet Anesth* 2002;11:306-9.
28. Kardash K, Morrow F, Béique F. Seizures after epidural blood patch with undiagnosed subdural hematoma. *Reg Anesth Pain Med* 2002;27:433-6.
29. Vaughan DJA, Stirrup CA, Robinson PN. Cranial subdural haematoma associated with dural puncture in labour. *Br J Anaesth* 2000;84:518-20.
30. Davies JM, Murphy A, Smith M, et al. Subdural haematoma after dural puncture headache treated by epidural blood patch. *Br J Anaesth* 2001;86:720-3.
31. Aly EE, Lawther BK. Anaesthetic management of uncontrolled idiopathic intracranial hypertension during labour and delivery using an intrathecal catheter. *Anaesthesia* 2007;62:178-81.
32. Lussos SA, Loeffler C. Epidural blood patch improves postdural puncture headache in patient with benign intracranial hypertension. *Reg Anesth* 1993;18:315-7.
33. Mokri B. Headaches caused by decreased intracranial pressure: Diagnosis and management. *Curr Opin Neurol* 2003;16:319-26.
34. Albaryram Tuzgen S, Gunduz A, Kihc F, Bas A. Spontaneous intracranial hypotension after labor without spinal intervention. *Eur J Neurol* 2008;15:91-3.
35. Smarkusky L, DeCarvalho H, Bermudez A, Gonzalez-Quintero VH. Acute onset headache complicating labor epidural caused by intrapartum pneumocephalus. *Obstet Gynecol* 2006;108:795-8.
36. Ghani NAA, Jaafar R, Ishak S, Zainuddin AA, Mukari SAM, Madhy ZA. Mother with post-partum group B Streptococcus meningitis and cerebellar abscess. *J Obstet Gynaecol* 2007;33:195-98.
37. Cohen S, Hunter CW, Sakr A, Jijazi RH. Meningitis following intrathecal catheter placement after accidental dural puncture. *IJOA* 2005;15:172.
38. Browne IM, Birnback DM. Neurocysticercosis: A new differential in the diagnosis of postdural puncture headache. 2003;97:580-582.
39. Sobol SE, Frenkie S, Nachtigal D, Wiener D, Teblum C. Clinical manifestations of sinonasal pathology during pregnancy. *J Otolaryngol* 2001;30:24-8.
40. Shapiro RE. Caffeine and headaches. *Neurol Sci* 2007;28:S179-83.
41. Weber JG, Klindworth JT, Arnold, JJ, Danielson DR, Ereth MH. Prophylactic intravenous administration of caffeine and recovery after ambulatory surgical procedures. 1997;72:621-6.
42. Askmark H, Lundberg PO. Lactation headache: A new form of headache? *Cephalalgia* 1989;9:119-22.
43. Thorley V. Lactational headache: A lactation consultant's diary. *J Hum Lact* 1997;13:51-3.
44. Choi PT, Galinski SE, Takeuchi L, Lucas S, Tamayo C, Jadad AR. PDPH is a common complication of neuraxial blockage in

- parturients: A meta-analysis of obstetrical studies. *Can J Anesth* 2003;50:460-9.
45. Chadwick HS. An analysis of obstetric anesthesia cases from the American Society of Anesthesiologists closed claims project database. *IJOA* 1996;5:258-63.
46. Lybecker H, Djernes M, Schmidt JF. Postdural puncture headache (PDPH): Onset, duration, severity, and associated symptoms. An analysis of 75 consecutive patients with PDPH. *Acta Anaesthesiol Scand* 1995;39:605-12.
47. Ok G, Tok D, Erboyun K, Aslan A, Tekin I. Hearing loss does not occur in young patients undergoing spinal anesthesia. *Reg Anesth Pain Med* 2004;29:430-3.
48. Shearer VE, Jhaveri HS, Cunningham FG. Puerperal seizures after post-dural puncture headache. *Obstet Gynecol* 1995;85:255-60.
49. Vercauteren MP, Vundelinckx GJ, Hanegreefs GH. Postpartum headache, seizures and bloodstained CSF: A possible complication of dural puncture? *Intensive Care Med* 1988;14:176-7.
50. Yang CP, Lee CH, Borel CO, Yeh CC, Lu CH, Wong CS, Wu CT. Postdural puncture headache with abdominal pain and diarrhea. *Anesth Analg* 2005;100:879-81.
51. Chan TML, Ahmed E, Yentis SM, Holdcroft A. Postpartum headaches: Summary report of the National Obstetric Anaesthetic Database (NOAD) 1999. *IJOA* 2003;12:107-12.
52. Kepstad P. Relief of postural postdural puncture headache by an epidural blood patch 12 months after dural puncture. *Acta Anaesthesiol Scand* 1999;43:964-6.
53. Vakharia SB, Thomas PS, Rosenbaum AE, Wasenko JJ, Fellows DG. Magnetic resonance imaging of cerebrospinal fluid leak and tamponade effect of blood patch in postdural puncture headache. *Anesth Analg* 1997;84:585-90.
54. Bakshi R, Mechtler LL, Kamran S, Gosy E, Bates VE, Kinkel PR, Kinkel WR. MRI findings in lumbar puncture headache syndrome: Abnormal dural-meningeal and dural venous sinus enhancement. *Clin Imag* 1999;23:73-6.
55. Somri M, Teszler CB, Vaida SJ, Yanovski B, Gaitini D, Tome R, Fradis M, Gaitini LA. Postdural puncture headache: An imaging-guided management protocol. *Anesth Anal* 2003;96:1809-12.
56. Schummer W, Schummer C. Two cases of delayed diagnosis of postpartal streptococcal toxic shock syndrome. *Infect Dis Obstet Gynecol* 2002;10:217-22.