Review Article

The epidural blood patch. Resolving the controversies

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Purpose: To review the literature regarding epidural blood patch (EBP) to generate conclusions relating to the controversial issues surrounding its application.

Source: A Medline search was made for relevant publications using keywords *epidural blood patch, prophylactic epidural blood patch, dural puncture,* and *postdural puncture headache.* Bibliographies of retrieved articles were hand-searched for relevant articles. Case series and comparative trials were emphasized in the analyses. These were culled and those deemed relevant were reviewed.

Principal Findings: The majority of the literature consists of observational reports: there are few comparative studies. Headache most likely results from cerebrospinal fluid (CSF) loss leading to intracranial content shift and traction on pain sensitive structures; cerebrovascular alterations may be implicated. An EBP with 10-15 ml blood is indicated and effective therapy for severe headache after dural puncture. There is conflicting evidence regarding larger volume blood injections or delaying EBP for 24 hr or more after the diagnosis of postdural puncture headache (PDPH). Efficacy of EBP is related to a "patch effect" as well as transmission of increased epidural space pressure to the CSF space. Previous estimates of EBP efficacy were overgenerous; persistent symptomatic relief can be expected in 61-75% of patients with initial EBP. Patching with non-blood solutions, although initially effective, is associated with a high incidence of headache recurrence. Prophylactic injection of saline or blood decreases the incidence of severe headache after dural puncture.

Conclusion: Blood-patching is an effective treatment of PDPH but further research is required regarding its mechanisms and prophylaxis.

Objectif : Revoir la littérature concernant le colmatage sanguin épidural (CSE) et en tirer les conclusions relatives à la controverse qui entoure son utilisation.

Source : Des articles pertinents dans Medline selon les mots-clés : *colmatage sanguin épidural, colmatage prophylactique de sang épidural, ponction durale,* et *céphalée postponction durale.* Les bibliographies des articles retenus pour y découvrir d'autres articles pertinents. Surtout les séries et les essais comparatifs dans les analyses. La revue des articles choisis et jugés utiles.

Constatations principales : La documentation présente surtout des comptes rendus d'observations; il y a peu d'études comparatives. Les céphalées résultent principalement d'une perte de liquide céphalo-rachidien (LCR) qui provoque un déplacement de son contenu intracrânien et une traction sur les structures sensibles à la douleur; les changements vasculaires cérébraux peuvent aussi contribuer. Un CSE de 10-15 ml de sang est indiqué et efficace contre les céphalées sévères suivant une ponction durale. Des arguments contradictoires concernent les injections de grand volume de sang ou le délai de 24 h ou plus dans l'application d'un CSE après le diagnostic de CPPD. L'efficacité du CSE dépend de l'«effet colmatage» autant que de la transmission de la pression accrue de l'espace épidural au LCR. Les estimations antérieures de l'efficacité du CSE ont été trop généreuses; un soulagement symptomatique persistant peut être attendu chez 61-75 % des patients avec un CSE initial. L'utilisation de solutions non sanguines, bien qu'efficace au départ, est associée à une plus grande incidence de céphalées récurrentes. L'injection prophylactique d'une solution salée ou de sang diminue l'incidence de céphalée sévère suivant une ponction durale.

Conclusion : Le colmatage sanguin est un traitement efficace des CPPD, mais des recherches supplémentaires sont nécessaires pour préciser son mécanisme et sa prophylaxie.

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OSTDURAL puncture headache (PDPH) has been a clinical problem since the intrathecal space was first instrumented over 100 yr ago. Many modalities of treatment have been proffered for dural puncture headache but few have been demonstrated to have therapeutic value.[1] Epidural blood patch (EBP) has been employed over the last four decades in the treatment of PDPH and has proven benefit. However, despite its long history, there are a number of unresolved issues regarding application of EBP. For example, recommendations vary regarding the indication, timing and optimum technique, the expected outcome and complications as well as the advisability of performing a prophylactic patch. To resolve these and other issues, we conducted a Medline Search of the English language literature using the following keywords: *dural puncture*; *postdural puncture headache*; *epidural blood patch;* and *prophylactic epidural blood patch.* The bibliographies of the retrieved articles were then searched to supplement the computer search. Emphasis was placed on articles containing original information, especially that derived from studies and observations of populations of patients and those assessed or managed in a comparative fashion. The selected articles were culled, then reviewed and conclusions reached regarding the unresolved issues.

What are the indications for epidural blood patch?

The primary application of epidural blood patch (EBP) is for the treatment of moderate to severe PDPH. Although there is little debate regarding this indication, it has been suggested that EBP be reserved for patients who have failed conservative (medical) treatment.[2] Because there are no controlled trials that demonstrate a non-EBP therapy that produces a consistent and sustained resolution of PDPH symptoms, this recommendation cannot be supported. Epidural blood patches are also used to provide prophylaxis against PDPH; this is a controversial indication and will be discussed.

Durocutaneous (subarachnoid cutaneous) fistulae can arise from anesthesia-related dural puncture, myelography, lumbar subarachnoid catheters used to drain CSF from the operative site (e.g. pituitary surgery), intentional or unintentional surgical breaches during surgery in proximity to the dura, or trauma.[3,4] These fistulae can produce a typical PDPH which may be relieved with EBP.[5,6] Spontaneous low cerebrospinal fluid pressure headache (Schaltenbrand's syndrome) has also been successfully treated with EBP.[7] The pathophysiology of these headaches is not well understood but they are postulated to arise from low cerebrospinal fluid production, increased cerebrospinal fluid absorption, or CSF loss through small spontaneous meningeal tears. Most cases resolve spontaneously over weeks to months However, epidural blood and saline patching have been used successfully to provide earlier relief. The epidural blood patch has also been used to treat *chronic headaches* resembling PDPH but of uncertain etiology.[8] The literature does not support strong conclusions on the relative merits of EBP for these latter indications.

When is an epidural blood patch contraindicated?

Contraindications to EBP are related either to epidural *needle placement* or to the *injection of autologous blood.* Contraindications to needle placement include patient refusal, inexperience with the technique, coagulopathy, systemic sepsis, local infection at the puncture site, and anatomical abnormality that makes epidural space localization impossible. A concern expressed regarding the performance of a blood patch has been the potential for injecting infected blood into the epidural space with the subsequent development of an abscess. Related issues have also generated controversy, including whether or not an epidural blood patch should be performed in a febrile patient. Pyrexia may reflect concurrent bacteremia and bacteremia has been associated with the development of meningitis after simple dural puncture in rats.[9] Injecting blood would be expected to increase the risk further because of the potential for direct seeding of the epidural space with blood borne pathogens. Despite the limited data, in most cases, it would be prudent to delay EBP until the patient becomes afebrile.

There has been controversy regarding the performance of EBP in patients with HIV infection.[10] Adverse sequelae in HIV-infected patients receiving EBP have not been reported and there appears to be no justification to deny these patients EBP.

How should epidural blood patch be performed?

DiGiovanni and Dunbar, in 1970, described the technique that was the progenitor of the technique commonly used today.[11] They performed EBP by first locating the epidural space with a needle and then collecting and injecting autologous blood aseptically. Although three decades have passed since their description, several aspects of block performance remain controversial including the timing of patch, the optimum volume of blood to inject, and the optimum duration of bedrest following EBP.

Timing of the epidural blood patch

Timing of EBP may influence therapeutic effectiveness in some patients. It is widely believed that EBP is less effec-

tive if performed within 24 hr after dural puncture. This clinical impression is supported only by one report from Loeser, who described the results of immediate (within 24 hr of dural puncture) and late (beyond 24 hr) EBP in 48 patients with PDPH.[12] All patients received 10 ml autologous blood, the duration of followup was not stated. Loeser noted a 71% failure rate when the patch was done in the first 24 hr compared with 4% for procedures performed after 24 hr. Interpretation of this uncontrolled, retrospective observation is complicated: dural punctures had taken place with different sized needles; patients who had dural puncture with smaller needles were exclusively in the late treatment group; a number of patients in the late group had punctures that were ≥ 72 hr remote; and the nature and duration of follow-up was not stated. This study has not been substantiated. However, Tobias reported that lidocaine concentrations potentially achievable with epidural block inhibit blood coagulation and suggested that lidocaine remaining after epidural block may contribute to failure of immediate EBP.[13]

There is no strong evidence to support delaying EBP if PDPH symptoms are present and incapacitating. In many cases, however, conservative therapy may be provided in the 24 hr after dural puncture, before EBP is performed. This provides time to confirm the diagnosis and allows for potential resolution or improvement in symptoms. It may increase the efficacy of the patch but this is not clearly demonstrated. If the patient has had a major neuraxial block, the procedure should be delayed until the block has resolved completely. Injecting blood while residual block remains may result in an extensive neuraxial block and the local anesthetic still resident may interfere with coagulation.

Volume of injectate

The optimal volume of blood that must be injected is controversial but recommended volumes have increased over time. Crawford's initial experience using 6-15 ml produced a 30% failure rate while later experience with 20 ml produced a 96% success rate;[14] 20 ml became the recommended volume and has since become commonly cited as a "target volume" to enhance patch efficacy. Taivainen compared the effectiveness of EBP in 53 patients with PDPH an average of 3.7 ± 2.9 days after dural puncture, who received either 10 ml (27 patients) or a height-adjusted 10-15 ml (26 patients) and could not detect any advantage with larger volumes.[15] Despite an initial 91% effectiveness of EBP in relieving headache symptoms, only 61% had persistent relief. It is possible that an advantage to even larger injected volumes (≥ 20 ml) would have been missed because the injected volumes were so similar.

Although the trend over time has been to advocate larger volumes of blood, there is no evidence that more than 10 ml will provide a better outcome after therapeutic blood patch.

Duration of bedrest following epidural blood patch

Martin studied three groups of ten patients who received 12 ml EBP for PDPH.[16] Patients remaining supine for 30 min and one hour had residual headache in 40 and 20%, respectively. No patient who remained supine for two hours had residual headache. Thus, two hours of recumbent positioning after patching may improve the efficacy of the EBP compared with shorter periods of bedrest.

Does epidural blood patch prevent or reverse the complications of dural puncture?

Dural puncture is associated with a number of sequelae in addition to headache. Because these complications are not reported in patients who have had successful EBP, it is presumed that EBP provides effective prophylaxis against their development. The effectiveness of EBP in reversing these complications, once established, is less uniform.

Cranial nerve palsies

Ocular effects reported following dural puncture include blurred vision, diplopia, and blindness.[17,18] The majority of the symptoms are related to the shift in anatomical structures resulting from intracranial hypotension. With descent of the intracranial structures following CSF loss, the abducens nerve (CN VI) is stretched over the edge of the petrous portion of the temporal bone. Diplopia then results from abducens nerve dysfunction and palsy of the lateral rectus muscle; usually transient, it may persist for months after dural puncture.[19]

The abducens nerve is the cranial nerve most frequently involved following dural puncture, but transient palsies of the third, fourth, seventh, and eighth cranial nerves have also been attributed to dural puncture.[17]

In a number of reports, EBP has not restored cranial nerve function to normal concurrent with resolution of headache symptoms. This suggests that a neuropraxia has occurred and that symptoms will persist until resolution of the injury.

Auditory disturbances

Transient hearing loss (hypoacusis) and tinnitus have long been recognized as sequelae of dural puncture.[20] The most commonly accepted mechanism for auditory disturbance relates to CSF leak through the dural defect. As there is a direct connection between CSF

and perilymph across the cochlear aqueduct, changes in CSF pressure result in changes in perilymph pressure in the cochlea. An imbalance is created between perilymph and endolymph, the relationship between the hair cells and the basement membrane is disturbed and the response to auditory input is dampened. Although auditory disturbances are usually transient, symptoms may persist for prolonged periods.[21]

Lybecker determined the effect of EBP in 16 patients with severe PDPH after either myelography or spinal anesthesia.[22] Audiometry was performed before and one hour after successful EBP. Hearing was considerably improved in 12 of 16 patients. This implies that EBP rapidly restores a more normal balance of pressures in the cochlear aqueduct in the majority of patients and is usually effective in relieving auditory dysfunction concurrent with resolution of headache symptoms.

Seizures

Seizures are reported in association with dural puncture.[23,24] Shearer estimated that seizures occur in one percent of patients with PDPH. Most patients with seizures had PDPH that were severe and often associated with either auditory or visual disturbances. Seizure onset was typically been between one and seven days after dural puncture although Rosenow reported onset of seizures 22 dy after dural puncture.[24] The etiology of the seizures is likely multifactorial. Shearer evaluated three patients with seizure and PDPH and demonstrated disturbances of the cerebral vascular circulation in all three.[23] The concurrent use of caffeine has also been implicated in the genesis of seizures after dural puncture.[25–27]

Few PDPH patients experience seizure. Seizures do not tend to be recurrent and so the role of EBP to prevent further seizures is unclear.

Subdural hematoma and intracranial hemorrhage

Severe neurological morbidity has been reported after dural puncture.[28–32] Subdural hematomas have been reported by a number of authors, more typically in patients who had prolonged and persistent symptoms after dural puncture. Additionally, spontaneous intracerebral bleeding and rupture of an intracranial aneurysm have been reported.

Any intervention undertaken in patients who have suffered severe central nervous system complications as a result of dural puncture should be directed towards the complication. There are no data to support a therapeutic role for EBP in these situations. In fact, by increasing CNS pressure, further deterioration may be precipitated.

How effective is epidural blood patch in treating postdural puncture headache?

Early reports claimed that resolution of PDPH symptoms following EBP occurred in virtually all patients (≥ 90 percent).[33,34] Unfortunately, these observations often combined patients with both small (spinal) needle and large (epidural) needle punctures and patient follow-up and reassessment was limited and usually not reported. If reports of patients who had exclusively large needle punctures are considered, the efficacy of EBP in providing persistent relief varies from 61-75% even though over 90% of patients often experience initial symptom relief following EBP.[1,15,35]

How does epidural blood patch work?

The mechanism by which an EBP relieves PDPH is not known. The most commonly accepted etiology for headache postulates that it is a direct result of loss of CSF from the CNS, through the dural hole. If sufficient CSF is lost, the brain will descend in the cranial vault when the patient assumes the upright position. Traction on pain fibres localized to venous sinuses and tributaries, dural and cerebral arteries, and parts of dura mater, result in pain.[36] Cerebrospinal fluid loss and intracranial hypotension lead to compensatory vasodilatation of the cerebral vasculature.[37] Arterial and arteriolar dilatation occurs in response to reduced CSF pressure. The thin-walled veins adjust to the reduced external pressure by passively dilating. Since the cerebral vasculature and its supporting structures are richly innervated, pain results. It is likely that both of these mechanisms have a role in the genesis of PDPH.

The "*Plug*" theory for symptom resolution proposes that the blood injected during EBP forms a gelatinous plug, sealing the dural hole and preventing further CSF leak into the epidural space. In the absence of continued loss, regeneration of CSF restores CSF pressure and alleviates the headache. Normal reparative responses then seal the dural hole.[38] Most headaches are relieved in a time frame consistent with this CSF regeneration theory. However, despite its simplicity and supporting evidence, this theory cannot account for patients who obtain immediate relief after blood patching. This theory also does not explain the efficacy of epidural injections of crystalloid and colloid or the action of drugs such as caffeine.

The "*Pressure Patch*" hypothesis emphasizes the impact of injected blood or other fluid (crystalloid or colloid) on the pressure dynamics of the CNS. The injected fluid increases epidural pressure which, in turn, elevates subarachnoid CSF pressure by compressing the dura. Spinal CSF is displaced into the cranium immediately restoring intracranial CSF volume and pressure.

This alleviates the headache by reducing traction on pain sensitive structures and decreasing vascular dilatation. The headache relief is independent of any direct effect on the dural hole; however, persistent relief requires maintenance of the pressure elevation.

Support for the "*Pressure Patch*" theory comes from observations of the effect that blood or fluid injected into the epidural space has on the pressure dynamics of the spinal canal. When blood or fluid is injected into the epidural space, epidural pressure becomes positive and compresses the dura elevating adjacent subarachnoid pressure and, through continuity, the intracranial pressure. The magnitude of the increase in pressure is dependent on several factors including the rate and volume of injection, the site (i.e. level) injected, and the nature of the injectate.[39] The pressure response to *fluid* (e.g. saline) injection is nonlinear and peak injection pressures dissipate to a plateau in less than one minute.[40] As larger volumes are injected more rapidly, the peak pressure increases (e.g., 85 cmH_2O CSF pressure with injection of 20 ml epidural saline). However, for all volumes, the pressure elevation has a finite duration lasting only minutes.

In contrast to fluid injection, the elevation of epidural and CSF pressures after the epidural injection of *blood* is maintained for longer. Fifteen millilitres blood produce a threefold increase in CSF pressure that was sustained at 70% of peak injection pressure 15 min later.[41] Seven to ten ml of blood can restore normal CSF pressure of greater than five cmH_20. Beards *et al.* using MRI demonstrated that an EBP produces a "mass effect" compressing the thecal sac.[42] This compression was present at 30 min and three hours but had resolved by seven hours.

The most likely explanation is that multiple mechanisms are active in providing headache relief after EBP. If a sufficient volume of blood is used to produce the required pressure change an immediate response may be seen as intracranial CSF volumes and pressures are restored. This relief is mediated primarily through a reduction in traction on pain sensitive structures and partly by a reduction in vasodilatation. Crystalloid and colloid exert their effect via the same mechanism. Once the blood patch seals the hole, CSF regeneration contributes to sustained relief and normal tissue reparative processes then seal the defect permanently.

Does epidural blood patch have an impact on future epidural block?

A concern expressed early in the history of blood patching was that the EBP would result in changes in the epidural space that would impair the effectiveness of future epidural anesthesia. Ong reviewed the experience of 46 parturients, who had remote dural puncture with previous attempts at epidural anesthesia.[43] Twenty-nine (63%) also had an EBP at that time. Previous dural puncture was associated with a higher incidence of subsequent complicated epidural anesthesia, with either poor analgesia due to restricted spread or missed segments (11 of 46 patients, 24%), or requirements for larger doses of local anesthetics to achieve satisfactory blockade (3 of 46 patients, 6.5%). In eight patients (17%), the epidural anesthetic was inadequate for Cesarean section and general anesthesia was used. Patients, who had previous dural puncture, had only a 59% incidence of a subsequent, uncomplicated epidural anesthetic compared with a 90% incidence in a comparative group of parturients who had a previous, uncomplicated epidural anesthetic. However, EBP performed after remote dural puncture did not further increase the rate of complications with subsequent epidural anesthesia. Ong concluded that dural puncture may impair subsequent epidural anesthesia, whether or not EBP is performed for PDPH.

Blanche offered a contrary opinion on the impact of remote dural puncture on the effectiveness of subsequent epidural anesthesia after reviewing the experience of 47 women.[44] Nineteen (40%) of these women had developed PDPH and nine (19%) had been provided EBP following the remote dural puncture. Their experience was compared to that of 500 consecutive women receiving epidural analgesia and to 44 matched controls. Epidural analgesia was considered successful in 93% of patients with previous dural tap, an incidence that was similar to that of the matched controls (89%). However, the incidence of subsequent dural puncture was higher in those patients with previous puncture (4%) than it was in the 500 consecutive cases (0%). Again, the use of remote EBP had no effect on subsequent epidural anesthesia.

In both reviews, there was a higher incidence of complications during subsequent attempts at providing epidural anesthesia in patients who had remote dural puncture during previous attempts at epidural anesthesia. However, there was a difference in the nature of the complications with catheter siting complications being increased in the review of Blanche and block-related problems in that of Ong. There was also a difference in the background characteristics of the two study groups. The patients in Ong's study had a higher incidence of both headache ($P < 0.05$) and EBP ($P < 0.001$) following previous dural puncture than did those in Blanche's review. It is not clear how the consequences of the previous dural puncture would effect subsequent epidural anesthesia, but it is possible that they could.

A higher incidence of complications during epidural anesthesia should be anticipated in patients who have had dural puncture during previous, remote attempts at epidural anesthesia. Administration of EBP after a remote dural puncture does not appear to increase the incidence or magnitude of complications during subsequent epidural anesthesia over that from the dural puncture alone.

Are there viable alternatives to blood in the epidural blood patch?

Epidural crystalloid administration

Epidural crystalloid administration is commonly used both to provide prophylaxis against PDPH after EBP and for treatment of PDPH.[45,46] Compared with epidural blood patching, more interventions are usually required, there is no evidence to suggest fewer complications, and the likelihood of headache recurrence is higher.[14,35] Saline injections and infusions do not reduce the requirement for subsequent EBP. The main advantage of epidural saline is the avoidance of blood injection when this is inadvisable or contraindicated. Complications of saline infusion include back pain and headache related to infusion rates that produce high epidural pressures. Intraocular hemorrhage was reported with a bolus of 120 ml epidural saline and flaccid paraparesis occurred after injection of 40 ml saline 0.9% containing benzyl alcohol 1.5% as preservative.[47,48]

Epidural colloid administration

Epidural colloid administration has been described as effective for established PDPH.[49] Barrios-Alarcon gave Dextran 40 to 56 patients with PDPH who had failed various other forms of therapy (including blood patch). Patients received 20-30 ml epidural Dextran 40 over approximately two minutes. Headache was relieved permanently in all cases. Sixty-eight percent developed immediate relief while 98% were relieved within two hours of injection. Six patients complained of dysesthesia or burning on injection, otherwise there were no complications. Subsequent work by the same authors demonstrated the efficacy of 20 ml bolus of Dextran 40 followed by three $ml \cdot hr^{-1}$ infusion in ten patients.[50] Onset of relief required an average of 9.5 hr (range 1 to 14 hr). Again, there were no complications or symptom recurrence. Although there was no group for comparison, the lack of therapeutic failures in the 66 patients treated is impressive.

Although there are alternatives to blood for epidural injection, crystalloid substituted for blood provides only a limited duration of symptom relief and EBP is usually necessary subsequently to provide sustained relief. There are no data confirming that large volume injections of colloid into the neuraxis are safe in humans although they have been used with apparent efficacy. Further study is warranted.

Are prophylactic epidural patches effective?

Current practice with small-gauge, non-cutting needles for subarachnoid anesthesia produces a low incidence of PDPH.[51] Consequently, prophylactic therapy is not warranted in these patients, even in those at high risk for PDPH. However, large gauge, unintentional dural puncture, especially in obstetric and other high-risk patients, produces a high incidence of incapacitating headache. Safe and effective prophylactic measures are warranted in these patients to prevent postdural puncture complications including PDPH.

Epidural saline prophylaxis

Craft assessed the effect of administration of epidural saline, provided as two 60 ml boluses, once immediately postpartum and again 24 hr later, on the development of PDPH.[52] The incidence of PDPH was 12.5% in 16 study participants and 76.5% in control patients. Crawford reported similar results with a reduction of PDPH from 73% to 21% in patients treated with a continuous epidural infusion of crystalloid for 24-36 hr after delivery.[14] Stride, in a subsequent report from the same centre, noted a less striking reduction in the incidence of headache; 70% of 241 patients who received epidural infusion developed headache compared with 86% of 219 treated without infusion ($P < 0.001$).[35] Among those who developed headache, there was a decrease in the incidence of symptoms classified as severe, in patients treated with epidural crystalloid infusion (79 of 169, 47%) compared with those who were not (120 of 188, 64%) with $P < 0.01$. Brownridge reported a similar reduction in headache in patients treated with epidural saline (15% reduction) but with fewer patients studied (37 treated, 19 controls) the difference was not statistically significant ($P = 0.44$).[1] Similarly, Trivedi in a prospective randomized trial of a single bolus of 40-60 ml epidural saline, noted a reduction in the incidence of headache from 87.5% (21/24) to 66.7% (20/30).[53] Again, despite proportionately similar results to those reported by Stride, the difference was not statistically significant.

Summarizing the evidence available, there is consistent evidence that prophylactic epidural saline administration results in a decrease in the incidence of both headache and severe headache after accidental dural puncture.

Epidural blood prophylaxis

Following a retrospective chart review, Palahniuk

reported no effect on the incidence of PDPH in 11 patients who received 5-10 ml autologous blood through an epidural catheter after delivery (6/11, 54%) compared with 75 patients who did not (44/75, 59%).[54] In two prospective, randomized trials comparing 15 ml autologous blood through an *in situ* catheter post-delivery, both Trivedi and Colonna-Romano demonstrated reductions in the incidence of PDPH when compared with patients managed conservatively or with epidural saline injections.[53,55] In Colonna-Romano's report, there was no difference between the two groups in the number of patients for whom a therapeutic EBP was indicated or administered after PEBP; EBP was indicated in 21% of the patients who received PEBP and 50% of those who did not. However, the lack of significance may have been was due to the small numbers studied. There was a difference in the indication and application of EBP in the study by Trivedi, with EBP being indicated in 18 (75%) and administered in 13 (54%) control patients and only one study patient (5%).

There is sufficient evidence to support the use of PEBP following large needle dural puncture. The efficacy of a PEBP may be affected by the volume of blood injected; studies demonstrating efficacy of prophylactic epidural blood patching have used volumes of 15 ml autologous blood.

In patients at high risk for the development of an incapacitating headache, specifically young patients and parturients who have experienced large needle dural puncture, prophylactic epidural administration of both saline and blood deserves consideration as both will reduce the subsequent incidence of PDPH. It is more difficult to determine the impact of prophylactic saline or blood administration on the need for subsequent EBP, because, very often, patients who would benefit from recommended EBP, refused them, despite having moderate to severe headache.[53]

Conclusions

Current evidence clarifies some but not all of the controversies surrounding EBP. Delaying EBP for 24 hr or more after the dural puncture is not strongly supported. However, headache symptoms are not usually established within the first 24 hr. Most recent series reporting on the efficacy of EBP have used 10-15 ml autologous blood. There is no evidence regarding the efficacy for smaller or larger volumes than this. Two hours of bedrest after application of EBP is optimal. Prophylactic administration of saline or blood via an *in situ* epidural reduces the incidence of both postdural puncture headache and severe headache symptoms. The requirement for therapeutic patch after prophylactic EBP is also likely to be reduced. Finally, 61-75% of patients obtain persistent relief from PDPH symptoms after EBP, although more than 90% may experience immediate relief of symptoms.

There is a need for further prospective assessments of PDPH prophylaxis after large needle dural puncture as well as clarification of the optimal performance of EBP.

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