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Review Article

Prevention of post dural puncture headache in Saudi Arabia

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ABSTRACT

Post-dural puncture headache (PDPH) is a common complication following lumbar puncture procedures. It can lead to significant discomfort, functional impairment, and prolonged recovery, especially among female patients, younger individuals, and those with low body mass index (BMI) or a prior history of headaches. This review aims to synthesize current evidence on the etiology, risk factors, prevention, and treatment of PDPH, with a focus on clinical practices in Saudi Arabia. A narrative literature review was conducted using databases such as PubMed, Google Scholar, and ScienceDirect. Studies were selected based on their relevance to PDPH diagnosis, management, and outcomes, with a focus on peer-reviewed articles published in the past five years. Effective prevention includes the use of smaller, non-cutting spinal needles and optimal patient positioning during lumbar puncture. While conservative treatments like hydration and analgesia offer limited relief, the epidural blood patch (EBP) remains the most effective therapeutic option, particularly when administered within 48 hours of symptom onset. The variability in protocol adherence across Saudi institutions suggests a need for national clinical guidelines. Implementing standardized practices and early intervention strategies can substantially reduce the burden of PDPH in Saudi Arabia. Further region-specific research and healthcare provider training are essential to improve patient outcomes and minimize procedural complications.

Keywords: Post-dural puncture headache, Lumbar puncture, Spinal anesthesia, Epidural blood patch, PDPH prevention, Saudi Arabia

INTRODUCTION

Post-dural puncture headache (PDPH) is a common complication following spinal or epidural procedures, often underestimated in its clinical impact. Previously considered a minor, self-limiting condition, it is now recognized for its substantial burden on patient well-being and healthcare systems.[1] Reported incidence ranges from 3.5% to 33%, depending on patient risk factors and procedural techniques.[2] PDPH can lead to significant functional limitations, extended hospital stays, and reduced quality of life.

The condition arises from cerebrospinal fluid (CSF) leakage at the puncture site, which leads to decreased intracranial pressure and compensatory cerebral vasodilation.[3] Clinically, it presents as an orthostatic headache typically throbbing and frontal often accompanied by visual and auditory disturbances, neck stiffness, nausea, and, in severe cases, neurological complications such as cranial nerve palsies or subdural hematomas.[3,4]

Several patient-related and procedural risk factors influence the likelihood of PDPH. Non-modifiable factors include younger age, female sex, low body mass index (BMI), and a history of chronic headaches.[2] Modifiable factors, on the other hand, involve patient positioning, needle type, and the technique of dural puncture.[5] Among these, needle design plays a particularly crucial role.

Figure 1 offers a comparative overview of various spinal and epidural needle types. The 26G Sprotte (needle 2) and 22G Whitacre (needle 3) represent modern pencil-point needles, designed to part rather than cut dural fibers, thereby minimizing CSF leakage. In contrast, traditional cutting needles such as the 18G Crawford (needle 7) and 17G Barkers (needle 5) have sharper, beveled tips that increase the risk of PDPH. These historical designs, while functional in earlier eras, are now largely obsolete in favor of more atraumatic options.

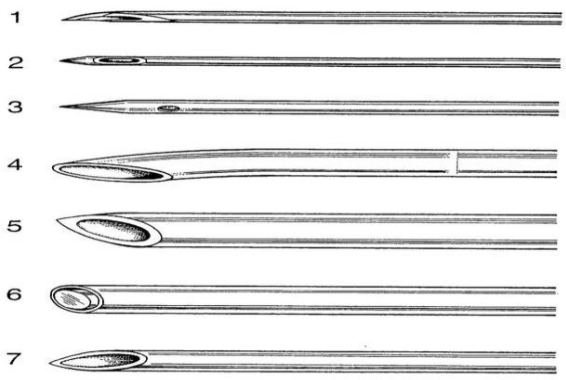

Figure 1: Graphical representations of epidural (needle 4) and spinal needle tip design. Note the large orifice and conical tip of the Sprotte needle 2, compared with the small orifice and diamond tip of the Whitacre needle 3. Needles 5, 6 and 7 were provided by the Sheffield anaesthetic museum and are an indication of the style of spinal needles used in the past.

1, 26 G Atraucan double bevel design; 2, 26 G Sprotte style pencil point; 3, 22 G Whitacre style pencil point; 4,16 G Tuohy needle; 5, 17 G Barkers spinal needle; 6, large gauge spinal needle; 7, 18 G Crawford needle.[3]

Table 1: Relationship between needle size and incidence of PDPH.[3]

Needle tip design	Needle gauge	Incidence of post-dural puncture headache (%)
Quincke	22	36[128]
Quincke	25	3-25[47]
Quincke	26	0.3-20[45 107]
Quincke	27	1.5-5.6[25 69]
Quincke	29	0-2[45 47 69]
Quincke	32	0.4[46]
Sprotte	24	0-9.6[13 107]
Whitacre	20	2-5[17]
Whitacre	22	0.63-4[17 112]
Whitacre	25	0-14.5[13 98]
Whitacre	27	0[25]
Atraucan	26	2.5-4[115 131]
Tuohy	16	70[26]

Complementing these visual insights, Table 1 presents data from a large meta-analysis examining the relationship between needle size and PDPH incidence. It confirms that smaller-gauge, non-cutting needles significantly reduce PDPH rates, with the 26 G atraumatic needle emerging as the most effective option. However, while some smaller cutting needles (e.g., 29 G) show reduced PDPH risk, they are associated with higher failure rates during insertion.

Despite this growing body of evidence, clinical practice in Saudi Arabia often lacks consistent protocols for PDPH prevention and treatment. Observationally, high rates of PDPH are still noted, particularly among women undergoing obstetric anesthesia. This inconsistency in practice highlights a pressing need for standardized national guidelines and broader practitioner education.

This review synthesizes current literature on the pathophysiology, risk factors, prevention strategies, and treatment modalities for PDPH, with special attention to the healthcare landscape in Saudi Arabia. It aims to support the development of unified, evidence-based approaches to reduce the incidence and burden of PDPH in regional clinical settings.

METHODS

This study employed a narrative review approach to synthesize current evidence on the etiology, risk factors, prevention, and management strategies of PDPH. Literature was retrieved through comprehensive searches of PubMed, Scopus, and Google Scholar databases. The search covered articles published from January 2010 to May 2024.

The keywords used included: "post-dural puncture headache," "epidural anesthesia," "spinal anesthesia complications," "atraumatic needles," "epidural blood patch," "PDPH prevention," and "PDPH management." Boolean operators (AND, OR) were used to combine terms and refine results.

Inclusion criteria

Peer-reviewed original studies, reviews, and meta-analyses focused on PDPH, articles written in English, and studies involving adult patients undergoing spinal or epidural procedures were included.

Exclusion criteria

Exclusion criteria included: case reports, editorials, and conference abstracts, and studies focused solely on pediatric populations or unrelated complications.

Selected studies were screened for relevance based on title and abstract, followed by full-text review. Data from eligible studies were thematically organized into four domains: risk factors, preventive techniques, treatment options, and regional implications with relevance to practice in Saudi Arabia.

As a narrative review, no formal quality appraisal or meta-analytic synthesis was conducted. Instead, emphasis was placed on clinical applicability, recent evidence, and multidisciplinary perspectives relevant to anesthesiologists, neurologists, and primary care provider.

NEEDLE

The spinal needle's type and size play a pivotal role in influencing the incidence of PDPH. Lumbar puncture (LP), commonly used for diagnostic, anesthetic, or therapeutic purposes, involves penetrating the lumbar subarachnoid or epidural space using a spinal needle to access CSF or deliver medications.[8] The choice of needle design has been increasingly recognized as a modifiable factor in minimizing post-procedural complications such as PDPH.

Multiple studies have demonstrated that smaller, non-cutting (atraumatic) needles are associated with significantly lower rates of PDPH. A Danish investigation revealed that such needles reduced not only the incidence of PDPH but also the number of failed first attempts, hospital stays, work absences, and the need for blood patch interventions.[5] Similar findings from a Turkish study reinforced the importance of using needles smaller than 22-gauge and minimizing repeated puncture attempts to lower the risk of PDPH. Though the precise mechanism remains under investigation, the correlation between larger CSF loss and more severe headaches appears to be a contributing factor.[6]

Traditional cutting needles tend to create a larger and more traumatic dural defect, thereby increasing CSF leakage. In contrast, pencil-point needles—such as the Sprotte and Whitacre designs—separate rather than cut through dural fibers, resulting in less leakage and reduced PDPH incidence. Clinical comparisons between the widely used 17 G Tuohy needle and the 18 G special Sprotte epidural needle have shown that the latter significantly reduces both PDPH rates and CSF leakage in cases of accidental dural puncture.[8]

These observations have influenced needle innovation, including the development of newer designs like the 17 G pencil-point epidural needle. This needle incorporates a rounded, non-cutting tip with a lateral aperture, which facilitates catheter placement while minimizing tissue trauma. This evolution in design reflects a growing commitment to improving procedural safety and patient outcomes in neuraxial anesthesia.

BLOOD PATCH

An epidural blood patch (EBP) is a minimally invasive procedure in which autologous blood is injected into the epidural space to halt CSF leakage, thereby relieving post-dural puncture headache (PDPH) symptoms.[9] Since its initial description by Gormley in 1960, where he reported full recovery in seven PDPH cases after injecting 2–3 ml of fresh blood, EBP has become the definitive intervention for moderate to severe PDPH.[1]

Although EBP is generally safe, adverse effects such as back pain, nerve root irritation, or, rarely, hematomas and infection have been reported.[10] Still, these complications are uncommon, and most patients tolerate the procedure well.

Clinical evidence underscores the efficacy of EBP, particularly when performed early. In one cohort of 1,688 epidural procedures, accidental dural puncture (ADP) occurred in 65 cases (3.85%), and 43 of those patients (2.85%) developed PDPH. Of these, 41 experienced reliefs with EBP, and only two required a second intervention. Two initially asymptomatic patients later developed PDPH and were successfully treated with a single EBP session.[12] This approach, involving injection of 10–15 ml of blood through an in-situ epidural catheter, not only alleviated symptoms but also facilitated early discharge.

Table 2: Evaluation and comparison of the effects of different invasive therapeutic procedures on symptom relief in persistent post-dural puncture headache.[11]

Variables	Invasive therapeutic procedures, N (%)			
	Epidural blood patch	Fibrin glue patch	Occipital nerve block	Surgical treatment
Performed				
Yes	179 (100)	41 (22.9)	42 (23.5)	42 (23.5)
No	0	138 (77.1)	137 (76.5)	137 (76.5)
Number of treatments				
1-2	77 (43.0)	26 (63.4)	28 (66.7)	42 (100.0)
3-5	86 (48.0)	14 (34.1)	11 (26.2)	0
6-7	12 (6.7)	1 (2.4)	2 (4.8)	0
>7	4 (2.2)	0 (0.0)	1 (2.4)	0
Short-term effectiveness				
No improvement	9 (5.0)	10 (24.4)	17 (40.5)	4 (9.5)
Slight or moderate improvement	136 (76.0)	21 (51.2)	20 (47.6)	21 (50.0)
Improvement	22 (12.3)	2 (4.9)	2 (4.8)	12 (28.6)

Continued.

Variables	Invasive therapeutic procedures, N (%)			
	Epidural blood patch	Fibrin glue patch	Occipital nerve block	Surgical treatment
Completely effective	8 (4.5)	8 (19.5)	3 (7.1)	5 (11.9)
Long-term effectiveness				
No improvement	45 (25.1)	17 (41.5)	18 (42.9)	2 (4.8)
Slight or moderate improvement	118 (65.9)	21 (51.2)	23 (54.8)	23 (54.8)
Improvement	12 (6.7)	2 (4.9)	1 (2.4)	14 (33.3)
Completely effective	0	1 (2.4)	0	3 (7.1)
Side-effects				
None	32 (17.9)	12 (29.3)	18 (42.9)	7 (16.7)
Mild	54 (30.2)	11 (26.8)	11 (26.2)	11 (26.2)
Moderate	64 (35.8)	13 (31.7)	10 (23.8)	19 (45.2)
Severe	16 (8.9)	3 (7.3)	3 (7.1)	5 (11.9)
Treatment stopped	13 (7.3)	2 (4.9)		

Table 2 from the study compares the effectiveness of various invasive treatments for persistent PDPH. EBP demonstrated the highest success rate among evaluated interventions, outperforming both prophylactic and conservative methods.

Additionally, a survey of 179 individuals with diagnosed or suspected PDPH showed that EBP led to slight-to-moderate short-term improvement in 76%, significant improvement in 12.3%, and complete resolution in 4.5% of cases. Long-term benefits were also observed, though a subset of patients required surgical intervention (23.5%) due to incomplete relief.[11]

Another study highlighted the use of prophylactic EBP, which significantly reduced the incidence of PDPH compared to conservative management. It also lessened the need for therapeutic EBP and shortened hospital stays, with no reported cases of central nervous system infections or nerve injury.[16]

Although alternatives such as intravenous caffeine, mannitol, hydrocortisone, pregabalin, or neostigmine with atropine have been proposed, their efficacy is inconsistent, and evidence remains limited. In contrast, EBP consistently delivers superior outcomes and remains the intervention of choice when conservative therapies are insufficient.[9,13]

PATIENT FACTORS

A range of patient-specific variables—demographic, physiological, and clinical—contribute significantly to the risk and outcome of post-dural puncture headache (PDPH). Studies have consistently identified age, sex, body mass index (BMI), comorbidities, and procedural context as influential factors.

Younger individuals, particularly those between 20 and 30 years of age, exhibit a higher susceptibility to PDPH. This trend may be linked to higher CSF pressure and dural elasticity in younger populations. Conversely, PDPH is less common in patients over 60 or under 13, potentially due to naturally lower CSF pressures at the extremes of age.[17,18] Anatomical differences, such as variations in spinal curvature or intervertebral space width, may also play a role in modulating PDPH risk across age groups.

BMI is another relevant factor. Although some reports suggest that lower BMI is associated with higher PDPH incidence, recent findings have challenged this view. For instance, a study from the University of California, San Diego, indicated that obese patients (BMI ≥25 kg/m²) showed an increased risk of PDPH compared to those with lower BMI.[18] This contrasts with the previously hypothesized protective effect of abdominal pressure in sealing dural punctures. The mechanism remains uncertain and may involve confounding by other variables.

Gender differences are well-documented. Women—especially pregnant individuals—are disproportionately affected by PDPH. Elevated estrogen levels during pregnancy may influence cerebral vascular tone, heightening the vascular response to CSF hypotension.[17,21] Several studies have reported that women are two to three times more likely than men to develop PDPH, though the underlying etiology may involve a combination of hormonal sensitivity, nociceptive processing, and anatomical considerations.[18]

A history of chronic headaches is another key predictor. In one study, 33.3% of PDPH cases reported a prior history of chronic headaches, compared to just 8.3% among controls.[19] However, migraine history did not appear to influence PDPH incidence. Central sensitization among patients with existing headache syndromes may predispose them to post-lumbar puncture complications.[20] Additionally, patients who have experienced PDPH in the past are at heightened risk of recurrence.

Sociodemographic variables, such as educational level, marital status, and region of origin, may also play indirect roles in influencing treatment outcomes and reporting behaviors, though these associations remain underexplored. Obstetric conditions like preeclampsia or

diabetes have been examined as potential cofactors, but evidence linking them directly to PDPH risk remains limited.

CONCLUSION

PDPH remains a clinically significant complication following lumbar puncture and spinal anesthesia, particularly among younger adults, women, individuals with low BMI, and those with a history of chronic headaches. The discomfort and functional limitations caused by PDPH highlight the importance of implementing effective preventive and therapeutic measures.

Evidence consistently supports the use of smaller, non-cutting spinal needles as a primary strategy to reduce the incidence of PDPH. Among treatment options, the EBP continues to be the most reliable and effective intervention, especially when administered within 48 hours of symptom onset. Despite global consensus on the benefits of early intervention and standardized techniques, healthcare institutions in Saudi Arabia exhibit considerable variability in the management of PDPH.

This variability underscores the need for developing and implementing national clinical guidelines that are both evidence-based and contextually appropriate. Additionally, enhancing healthcare provider education and procedural training is essential to ensure consistent, high-quality care across diverse clinical settings.

Future research should prioritize large-scale, prospective studies tailored to the Saudi healthcare landscape. These efforts will help clarify regional challenges, optimize resource utilization, and ultimately improve patient outcomes by reducing the incidence, severity, and recurrence of PDPH.

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