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PREVENTION OF POST-DURAL PUNCTURE HEADACHE IN OBSTETRIC PATIENTS: A SYSTEMATIC REVIEW

PREVENÇÃO DA CEFALEIA PÓS-PUNÇÃO DURAL EM PACIENTES OBSTÉTRICAS: UMA REVISÃO SISTEMÁTICA

PREVENCIÓN DE LA CEFALEA POSTPUNCIÓN DURAL EN PACIENTES OBSTÉTRICAS: UNA REVISIÓN SISTEMÁTICA

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ABSTRACT

Introduction: Post-dural puncture headache remains one of the most relevant causes of maternal morbidity after neuraxial anesthesia in obstetric practice. Its clinical impact extends beyond pain alone and may impair mobility, breastfeeding, maternal-infant interaction, and overall postpartum recovery. Preventive strategies have therefore gained increasing importance in both cesarean delivery under spinal anesthesia and in cases of accidental dural puncture during labor epidural analgesia.

Objective: The primary objective of this systematic review was to evaluate the efficacy and safety of available preventive strategies for post-dural puncture headache in obstetric patients undergoing neuraxial anesthesia. Secondary objectives were to compare prophylactic approaches used after planned spinal anesthesia with those used after accidental dural puncture, to assess the effect of pharmacological prophylaxis on headache incidence and severity, to examine the preventive role of intrathecal catheter-based strategies, to appraise methodological quality and risk of bias, and to identify the main evidence gaps for future research.

Methods: A systematic review was conducted according to PRISMA principles using PubMed, Scopus, Web of Science, Cochrane Library, LILACS, ClinicalTrials.gov, and ICTRP. Clinical studies involving obstetric patients and preventive interventions for post-dural puncture headache were eligible, with a primary search window of the last five years and prespecified expansion if needed. Study selection and data extraction were performed independently, and risk of bias and certainty of evidence were assessed with established tools including RoB 2, ROBINS-I, QUADAS-2, and GRADE as applicable.

Results and Discussion: Nine studies met the inclusion criteria and were included in the final qualitative synthesis. The available evidence suggests that pharmacological strategies

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such as aminophylline, ondansetron, pregabalin, and acetaminophen plus caffeine may reduce the incidence or severity of post-dural puncture headache after cesarean delivery under spinal anesthesia, whereas evidence for dexamethasone and intrathecal morphine remains inconsistent. In patients with accidental dural puncture during labor epidural analgesia, intrathecal catheter placement showed the most consistent favorable trend, with possible reduction in headache occurrence and epidural blood patch requirement, although most supporting data were observational. Overall, the literature was heterogeneous, with variation in interventions, comparators, diagnostic criteria, and follow-up periods, which limited certainty of evidence and the strength of universal recommendations.

Conclusion: Current evidence supports the view that prevention of post-dural puncture headache in obstetric patients is possible, but no single strategy has yet demonstrated sufficiently consistent superiority for universal routine use. Pharmacological prophylaxis may be beneficial in selected cesarean populations, and intrathecal catheter placement appears promising after accidental dural puncture in experienced settings. Preventive decision-making should therefore remain individualized, evidence-based, and adapted to procedural context, patient risk, and local expertise.

Keywords: Post-Dural Puncture Headache. Obstetric Anesthesia. Cesarean Section. Spinal Puncture.

RESUMO

Introdução: A cefaleia pós-punção dural permanece como uma das causas mais relevantes de morbidade materna após anestesia neuroaxial na prática obstétrica. Seu impacto clínico vai além da dor, podendo comprometer a mobilidade, a amamentação, a interação mãe-bebê e a recuperação pós-parto como um todo. Dessa forma, estratégias preventivas têm ganhado crescente importância tanto em cesarianas sob anestesia raquidiana quanto em casos de punção dural acidental durante analgesia epidural no trabalho de parto.

Objetivo: O objetivo principal desta revisão sistemática foi avaliar a eficácia e a segurança das estratégias preventivas disponíveis para cefaleia pós-punção dural em pacientes obstétricas submetidas à anestesia neuroaxial. Os objetivos secundários incluíram comparar abordagens profiláticas após anestesia raquidiana planejada com aquelas utilizadas após punção dural acidental, avaliar o efeito da profilaxia farmacológica na incidência e gravidade da cefaleia, examinar o papel preventivo de estratégias baseadas em cateter intratecal, avaliar a qualidade metodológica e o risco de viés, e identificar lacunas de evidência para pesquisas futuras.

Métodos: Foi realizada uma revisão sistemática de acordo com os princípios PRISMA, utilizando PubMed, Scopus, Web of Science, Cochrane Library, LILACS, ClinicalTrials.gov e ICTRP. Estudos clínicos envolvendo pacientes obstétricas e intervenções preventivas para cefaleia pós-punção dural foram elegíveis, com janela de busca principal dos últimos cinco anos e expansão pré-especificada, se necessário. A seleção dos estudos e a extração de dados foram realizadas de forma independente, e o risco de viés e a certeza da evidência foram avaliados com ferramentas estabelecidas, incluindo RoB 2, ROBINS-I, QUADAS-2 e GRADE, conforme aplicável.

Resultados e Discussão: Nove estudos atenderam aos critérios de inclusão e foram incluídos na síntese qualitativa final. As evidências disponíveis sugerem que estratégias farmacológicas, como aminofilina, ondansetrona, pregabalina e paracetamol associado à cafeína, podem reduzir a incidência ou a gravidade da cefaleia pós-punção dural após cesariana sob anestesia raquidiana, enquanto as evidências para dexametasona e morfina intratecal permanecem inconsistentes. Em pacientes com punção dural acidental durante

analgesia epidural no trabalho de parto, o posicionamento de cateter intratecal demonstrou a tendência favorável mais consistente, com possível redução na ocorrência de cefaleia e na necessidade de tampão sanguíneo epidural, embora a maioria dos dados de suporte seja observacional. De modo geral, a literatura apresentou heterogeneidade, com variação nas intervenções, comparadores, critérios diagnósticos e períodos de seguimento, o que limitou a certeza da evidência e a força de recomendações universais.

Conclusão: As evidências atuais sustentam que a prevenção da cefaleia pós-punção dural em pacientes obstétricas é possível, porém nenhuma estratégia isolada demonstrou superioridade consistente suficiente para uso rotineiro universal. A profilaxia farmacológica pode ser benéfica em populações selecionadas de cesariana, e o uso de cateter intratecal parece promissor após punção dural acidental em ambientes com experiência. Assim, a tomada de decisão preventiva deve permanecer individualizada, baseada em evidências e adaptada ao contexto do procedimento, ao risco do paciente e à expertise local.

Palavras-chave: Cefaleia Pós-Punção Dural. Anestesia Obstétrica. Cesariana. Punção Raquidiana.

RESUMEN

Introducción: La cefalea postpunción dural sigue siendo una de las causas más relevantes de morbimortalidad materna tras la anestesia neuroaxial en la práctica obstétrica. Su impacto clínico va más allá del dolor, pudiendo afectar la movilidad, la lactancia, la interacción madre-hijo y la recuperación posparto en general. Por ello, las estrategias preventivas han adquirido una importancia creciente tanto en cesáreas bajo anestesia espinal como en casos de punción dural accidental durante la analgesia epidural en el trabajo de parto.

Objetivo: El objetivo principal de esta revisión sistemática fue evaluar la eficacia y seguridad de las estrategias preventivas disponibles para la cefalea postpunción dural en pacientes obstétricas sometidas a anestesia neuroaxial. Los objetivos secundarios incluyeron comparar los enfoques profilácticos tras anestesia espinal planificada con aquellos utilizados tras punción dural accidental, evaluar el efecto de la profilaxis farmacológica en la incidencia y gravedad de la cefalea, examinar el papel preventivo de las estrategias basadas en catéter intratecal, evaluar la calidad metodológica y el riesgo de sesgo, e identificar las principales lagunas de evidencia para futuras investigaciones.

Métodos: Se realizó una revisión sistemática de acuerdo con los principios PRISMA, utilizando PubMed, Scopus, Web of Science, Cochrane Library, LILACS, ClinicalTrials.gov e ICTRP. Se incluyeron estudios clínicos que involucraban pacientes obstétricas y estrategias preventivas para la cefalea postpunción dural, con una ventana de búsqueda principal de los últimos cinco años y expansión predefinida si era necesario. La selección de estudios y la extracción de datos se realizaron de forma independiente, y el riesgo de sesgo y la certeza de la evidencia se evaluaron mediante herramientas establecidas como RoB 2, ROBINS-I, QUADAS-2 y GRADE, según correspondiera.

Resultados y Discusión: Nueve estudios cumplieron con los criterios de inclusión y fueron incluidos en la síntesis cualitativa final. La evidencia disponible sugiere que estrategias farmacológicas como la aminofilina, ondansetrón, pregabalina y paracetamol combinado con cafeína pueden reducir la incidencia o gravedad de la cefalea postpunción dural tras cesárea bajo anestesia espinal, mientras que la evidencia para la dexametasona y la morfina intratecal sigue siendo inconsistente. En pacientes con punción dural accidental durante la analgesia epidural del trabajo de parto, la colocación de un catéter intratecal mostró la tendencia favorable más consistente, con posible reducción en la aparición de cefalea y en la necesidad de parche hemático epidural, aunque la mayoría de los datos disponibles son

de naturaleza observacional. En general, la literatura mostró heterogeneidad en intervenciones, comparadores, criterios diagnósticos y períodos de seguimiento, lo que limitó la certeza de la evidencia y la fuerza de las recomendaciones universales.

Conclusión: La evidencia actual respalda que la prevención de la cefalea postpunción dural en pacientes obstétricas es posible; sin embargo, ninguna estrategia única ha demostrado una superioridad suficientemente consistente para su uso rutinario universal. La profilaxis farmacológica puede ser beneficiosa en poblaciones seleccionadas de cesárea, y la colocación de catéter intratecal parece prometedora tras punción dural accidental en entornos con experiencia. Por lo tanto, la toma de decisiones preventivas debe ser individualizada, basada en la evidencia y adaptada al contexto del procedimiento, al riesgo del paciente y a la experiencia local.

Palabras clave: Cefalea Postpunción Dural. Anestesia Obstétrica. Cesárea. Punción Espinal.

1 INTRODUCTION

Post-dural puncture headache remains one of the most clinically relevant complications of neuraxial anesthesia in obstetric care because it combines frequent exposure to spinal and epidural techniques with potentially significant maternal morbidity.[1] The condition is especially important in parturients because neuraxial analgesia and anesthesia are central components of labor and cesarean care in modern obstetric practice.[1] Current evidence-based guidance continues to recognize post-dural puncture headache as a major complication requiring structured prevention, prompt recognition, and standardized management.[1] In obstetric settings, the burden of this complication extends beyond pain alone and directly affects maternal mobility, breastfeeding, infant care, and early postpartum recovery.[2] This broader clinical effect has reinforced the principle that prevention should be prioritized whenever feasible rather than relying exclusively on rescue treatment after symptom onset.[2] Accordingly, the contemporary obstetric anesthesia literature increasingly frames post-dural puncture headache as a preventable cause of postpartum morbidity rather than an unavoidable adverse event.[2]

The pathophysiological basis of post-dural puncture headache is generally attributed to cerebrospinal fluid loss through the dural defect, followed by intracranial hypotension and compensatory vascular and meningeal changes.[3] This mechanism helps explain the classic postural nature of symptoms and clarifies why preventive strategies have focused either on reducing dural leakage or on attenuating downstream neurovascular responses.[3] In obstetric patients, this process becomes especially relevant because the affected population is predominantly young, female, and highly exposed to neuraxial procedures during labor and cesarean delivery.[3] Recent obstetric-focused reviews have emphasized that these features make parturients a clinically enriched risk group for post-dural puncture headache and its sequelae.[4] The importance of prevention is therefore not merely theoretical, but grounded in the specific vulnerability of the peripartum period.[4] Even a transient but disabling headache may produce disproportionate consequences when it arises during the first days of maternal adaptation and newborn care.[4]

Interest in prevention has intensified because post-dural puncture headache is no longer regarded solely as a short-lived procedural inconvenience.[5] Recent studies and reviews have highlighted associations between obstetric post-dural puncture headache and persistent symptoms such as chronic headache, neck pain, back pain, and adverse psychosocial outcomes.[5] This change in perspective has widened the clinical rationale for prevention from immediate symptom reduction to broader protection of maternal well-being.[5] In parallel, contemporary obstetric literature has stressed that postpartum recovery is

uniquely sensitive to interruptions in sleep, mobility, breastfeeding, and maternal-infant interaction.[6] Within this context, effective prevention may improve not only acute comfort but also overall functional recovery after delivery.[6] These considerations are particularly important in specialist obstetric anesthesia practice, where procedural decisions often have consequences extending well beyond the operating room or labor suite.[6]

Preventive approaches described in the current literature can be broadly divided into technical strategies and pharmacological strategies.[7] Technical strategies are especially relevant after accidental dural puncture during labor epidural analgesia, when clinicians must decide whether subsequent catheter-based management may reduce the later risk of headache.[7] Pharmacological strategies are more often studied after spinal anesthesia for cesarean delivery, where prophylactic agents are administered with the intention of reducing headache incidence or severity.[7] However, the available evidence remains heterogeneous because studies differ markedly in intervention type, comparator, follow-up duration, diagnostic criteria, and rescue protocols.[8] This heterogeneity has limited the strength and consistency of recommendations regarding routine prophylactic drug use in obstetric patients.[8] It also justifies a focused systematic review that isolates contemporary obstetric evidence rather than extrapolating from mixed or non-obstetric populations.[8]

Among technical preventive measures, intrathecal catheter placement after accidental dural puncture has received renewed attention in recent years.[9] This strategy is attractive because it may simultaneously preserve neuraxial analgesia and reduce cerebrospinal fluid leakage through mechanical or inflammatory sealing effects at the puncture site.[9] Updated systematic reviews and pooled analyses have suggested that intrathecal catheterization may reduce the incidence of post-dural puncture headache and lower the need for epidural blood patch in obstetric populations.[9] Nevertheless, much of this evidence is derived from retrospective or nonrandomized studies, which introduces important risks of confounding related to local expertise, catheter dwell time, and associated management protocols.[10] Recent obstetric anesthesia guidance therefore recognizes intrathecal catheter placement as a potentially beneficial strategy while still acknowledging uncertainty regarding the magnitude and consistency of its preventive effect.[10] The current literature thus supports cautious optimism, but not unqualified certainty, regarding the routine preventive value of this approach.[10]

Pharmacological prophylaxis has also attracted sustained interest, particularly in women undergoing cesarean delivery under spinal anesthesia.[11] Recent evidence syntheses have identified potentially favorable signals for agents such as aminophylline, ondansetron, and propofol, but the certainty of these comparative findings remains limited by indirectness,

imprecision, and the small size of individual trials.[11] More recent randomized studies have continued to evaluate specific regimens, including acetaminophen combined with caffeine, with some reports of reduced headache incidence and lower pain intensity.[11] At the same time, not all candidate interventions have demonstrated consistent benefit across studies.[12] For example, corticosteroid-based prophylaxis has produced mixed findings in more recent obstetric investigations, underscoring the need for critical appraisal rather than simple extrapolation from older or non-obstetric evidence.[12] The pharmacological prevention literature therefore remains promising but methodologically uneven, making it particularly suitable for structured synthesis and formal evaluation of certainty.[12]

The preventive question is further complicated by the fact that the literature often merges prevention and treatment, although these are clinically distinct domains.[13] Treatment-oriented publications understandably focus on epidural blood patch and other rescue interventions after symptom onset, but they do not adequately address how clinicians should act before headache develops.[13] Obstetric care requires this distinction because preventive decisions are made either immediately after dural puncture or at the time of neuraxial planning, whereas treatment decisions occur later under different clinical conditions and priorities.[13] Moreover, broad practice guidelines necessarily address multiple patient groups and procedures, which may dilute obstetric-specific concerns related to maternal recovery, breastfeeding, and postpartum surveillance.[14] A dedicated obstetric systematic review is therefore necessary to separate primary prevention after intended spinal puncture from secondary prevention after accidental dural puncture during epidural procedures.[14] Such differentiation is essential for bedside decision-making and for the development of practical preventive pathways tailored specifically to labor and cesarean care.[14]

A contemporary systematic review is therefore justified not merely to summarize existing interventions, but to clarify which strategies are supported by current evidence, which remain investigational, and which should not yet be incorporated into routine obstetric practice.[15] Such a review must integrate the strongest available randomized evidence on prophylactic drugs with the growing observational and pooled evidence regarding intrathecal catheter-based management after accidental dural puncture.[15] It must also evaluate risk of bias, clinical heterogeneity, and certainty of evidence to avoid overinterpretation of small or methodologically limited studies.[15] By addressing these issues in a structured manner, the present review aims to provide an obstetric-centered synthesis directly relevant to anesthesiologists, obstetricians, and multidisciplinary peripartum teams.[16] The review also seeks to identify major evidence gaps requiring future randomized trials, standardized definitions, and harmonized outcome reporting.[16] Ultimately, improved prevention of post-

dural puncture headache has the potential to enhance maternal recovery, reduce the need for rescue procedures, and strengthen evidence-based peripartum care.[16]

2 OBJECTIVES

The primary objective of this systematic review is to evaluate the efficacy and safety of available preventive strategies for post-dural puncture headache in obstetric patients undergoing neuraxial anesthesia. The secondary objectives are to compare preventive strategies used after planned spinal anesthesia with those used after accidental dural puncture during labor epidural analgesia; to assess whether pharmacological prophylaxis reduces the incidence, severity, or duration of post-dural puncture headache in obstetric populations; to determine whether intrathecal catheter-based management after accidental dural puncture decreases subsequent headache occurrence or the need for epidural blood patch; to critically appraise the methodological quality and risk of bias of the current obstetric literature; and to identify the principal evidence gaps that should guide future trials, guideline development, and individualized clinical decision-making.

3 METHODOLOGY

This systematic review was designed in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses framework and was justified by the persistent clinical importance of post-dural puncture headache in obstetric anesthesia, the diversity of preventive interventions, and the absence of a single contemporary synthesis focused specifically on prevention in parturients. The review question was structured around obstetric patients exposed to neuraxial techniques, any intervention intended to prevent post-dural puncture headache, eligible comparators including placebo, standard care, or alternative preventive strategies, and clinically relevant maternal outcomes.

The search strategy included PubMed, Scopus, Web of Science, Cochrane Library, LILACS, ClinicalTrials.gov, and the International Clinical Trials Registry Platform. Controlled vocabulary and free-text terms were combined around the concepts of post-dural puncture headache, obstetric anesthesia, pregnancy, cesarean delivery, labor analgesia, prevention, prophylaxis, intrathecal catheter, epidural catheter, spinal anesthesia, and candidate pharmacologic agents. The primary time window was the last five years, with predefined expansion to the last ten years if fewer than 10 eligible studies were identified after full-text review.

Inclusion criteria comprised clinical studies involving obstetric patients that evaluated any preventive intervention for post-dural puncture headache after neuraxial anesthesia, with

no language restriction. Human studies were prioritized for the main synthesis, whereas animal or in vitro studies, if found and considered mechanistically relevant, were to be presented separately in distinct tables and not pooled with clinical data. Small samples were accepted because of the narrow and procedure-specific nature of the field, but sample size limitations were explicitly recorded during data appraisal. Exclusion criteria comprised non-obstetric populations, treatment-only studies without a preventive component, narrative reviews, editorials, duplicate datasets, conference abstracts without extractable data, and studies lacking sufficient obstetric outcome reporting.

Study selection was planned in duplicate by two independent reviewers through title screening, abstract screening, and full-text eligibility assessment, with disagreements resolved by consensus or third-reviewer adjudication. Data extraction was also planned independently and included study design, setting, sample size, patient characteristics, neuraxial technique, type of preventive intervention, comparator, diagnostic criteria for post-dural puncture headache, follow-up duration, efficacy outcomes, adverse events, and authors' main conclusions. A Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow diagram was prespecified to document records identified, screened, excluded, and included.

Risk of bias was planned to be assessed with RoB 2 for randomized controlled trials, ROBINS-I for nonrandomized comparative studies, and QUADAS-2 only if any diagnostic accuracy studies were identified. Certainty of evidence for the main outcomes was planned according to the Grading of Recommendations Assessment, Development and Evaluation approach, considering risk of bias, inconsistency, indirectness, imprecision, and publication bias. This methodological framework was chosen to ensure transparent evidence synthesis and to support clinically meaningful interpretation of preventive strategies in obstetric anesthesia.

4 RESULTS

The search identified 428 records across PubMed, Scopus, Web of Science, Cochrane Library, LILACS, ClinicalTrials.gov, and ICTRP. After duplicate removal, 301 records underwent title and abstract screening. Of these, 41 articles were assessed in full text, 32 were excluded for non-obstetric populations, treatment-only designs, duplicate datasets, inadequate outcome reporting, or absence of a true preventive intervention, and 9 studies were finally included in the qualitative synthesis.

Table 1

Reference	Population / Intervention / Comparison	Outcomes	Main conclusions
Karami et al., 2021	Obstetric patients undergoing elective cesarean section received pregabalin prophylaxis and were compared with a control group after spinal anesthesia.	The investigators assessed the incidence and severity of post-dural puncture headache after cesarean delivery.	Pregabalin was associated with lower headache incidence and severity, although the study was limited by sample size and single-center design.
Okpala et al., 2022	Parturients undergoing cesarean section under spinal anesthesia received intravenous dexamethasone or placebo in a randomized design.	The study evaluated post-dural puncture headache incidence and severity during postoperative follow-up.	Prophylactic dexamethasone appeared to reduce headache incidence and severity in this trial, but these findings remained inconsistent with other contemporary evidence.
Razavizadeh et al., 2022	Women undergoing cesarean section under spinal anesthesia were randomized to aminophylline, dexamethasone, or placebo prophylaxis.	Headache frequency and postoperative pain outcomes were assessed over the early postoperative period.	Aminophylline and dexamethasone both showed signals of benefit compared with placebo, with aminophylline appearing more favorable overall.
Onay et al., 2023	Obstetric patients receiving cesarean delivery under spinal anesthesia received low-dose intrathecal morphine or a comparator analgesic regimen.	The authors evaluated post-dural puncture headache incidence, analgesic requirements, and adverse effects.	Low-dose intrathecal morphine improved postoperative analgesia but did not significantly reduce post-dural puncture headache incidence.
Liu et al., 2023	Parturients with accidental dural puncture were analyzed in a propensity-matched retrospective cohort examining prophylactic cosyntropin versus no cosyntropin.	The study evaluated subsequent post-dural puncture headache and epidural blood patch use.	Cosyntropin showed a possible preventive signal, but the retrospective design and residual confounding limited certainty.
Creazzola et al., 2023	Parturients with accidental dural puncture during labor analgesia were managed with intrathecal catheter placement and compared with alternative management strategies in a retrospective analysis accompanied by pooled synthesis.	The main outcomes were post-dural puncture headache occurrence and need for epidural blood patch.	Intrathecal catheter placement appeared to reduce headache and blood patch requirements, although the underlying evidence remained largely observational.
Baharvand et al., 2024	Pregnant patients undergoing elective cesarean section under spinal anesthesia were randomized to postoperative ondansetron or placebo.	The study assessed post-dural puncture headache incidence, neck pain, and postoperative nausea and vomiting.	Ondansetron reduced headache occurrence and neck pain, but the effect on headache severity was less clear.
Hadavi et al., 2024	Obstetric women undergoing elective cesarean section under spinal anesthesia received prophylactic acetaminophen plus caffeine or placebo in a randomized double-blind trial.	The primary outcomes were headache incidence and pain intensity after spinal anesthesia.	Acetaminophen plus caffeine reduced the risk of post-dural puncture headache and attenuated pain intensity in this population.
Moreno Giménez et al., 2025	Obstetric patients with documented accidental dural puncture during labor epidural analgesia were retrospectively compared according to intrathecal catheter placement or epidural re-siting.	The outcomes included post-dural puncture headache incidence, epidural blood patch requirement, and catheter-related complications.	Intrathecal catheter use was safe and showed a favorable trend, but statistically significant reduction in headache was not demonstrated in this cohort.

5 RESULTS AND DISCUSSION

The earliest eligible contemporary study in the final dataset was the randomized trial by Karami et al., which evaluated pregabalin prophylaxis in women undergoing elective cesarean section under spinal anesthesia.[17] The trial reported a reduction in both headache incidence and headache severity, suggesting that modulation of central sensitization may have preventive relevance in selected obstetric patients.[17] However, the study was relatively small, single-center, and pharmacologically narrow, which limits the external validity of its findings despite the favorable signal.[17] The 2022 randomized trial by Okpala et al. examined prophylactic intravenous dexamethasone after cesarean delivery and found lower post-dural puncture headache incidence and severity in the intervention arm.[18] Although this result appears clinically attractive, it stands in tension with other contemporary analyses that failed to reproduce a clear dexamethasone benefit in obstetric spinal anesthesia.[18] This inconsistency immediately underscores that positive individual trials in this field must be interpreted in the context of broader methodological heterogeneity rather than in isolation.[18]

The subsequent randomized trial by Razavizadeh et al. broadened the pharmacological comparison by directly evaluating aminophylline, dexamethasone, and placebo in women undergoing cesarean section under spinal anesthesia.[19] This design was especially useful because it allowed relative comparison between two active strategies within the same obstetric and procedural context.[19] The results suggested a more favorable preventive profile for aminophylline than for dexamethasone, while both active regimens appeared to outperform placebo to some extent.[19] From a mechanistic perspective, these findings align with the hypothesis that methylxanthine-mediated cerebral vasoconstriction and adenosine antagonism may be more relevant to post-dural puncture headache prophylaxis than steroid-mediated anti-inflammatory effects alone.[20] Nevertheless, the modest sample size, short follow-up structure, and early postoperative emphasis still limit confidence in the durability and reproducibility of the observed effects.[20] These limitations are important because transient early differences may not necessarily translate into clinically robust prevention across the full postpartum window.[20]

Onay et al. explored a conceptually different strategy by testing low-dose intrathecal morphine in obstetric anesthesia, thereby linking preventive inquiry to postoperative analgesic optimization.[21] Their study showed that intrathecal morphine improved analgesia but did not significantly reduce post-dural puncture headache incidence, which is an important negative finding in a literature that often privileges positive signals.[21] This result suggests that better postoperative pain control alone does not necessarily translate into true prophylaxis against cerebrospinal fluid leak-related headache.[21] In contrast, Liu et al.

addressed accidental dural puncture directly through a propensity-matched retrospective analysis of prophylactic cosyntropin in parturients.[22] That study suggested a possible reduction in post-dural puncture headache and epidural blood patch use, but the retrospective nature of the analysis left substantial room for residual confounding and practice-pattern bias.[22] Accordingly, cosyntropin remains an intriguing but not yet practice-establishing strategy in obstetric prevention.[22]

Creazzola et al. shifted the focus from drug prophylaxis to procedural secondary prevention after accidental dural puncture, analyzing intrathecal catheter placement in parturients and complementing the cohort analysis with pooled evidence.[23] Their results favored intrathecal catheter use, particularly with respect to lowering post-dural puncture headache occurrence and reducing the need for epidural blood patch.[23] This is clinically important because accidental dural puncture represents the highest-risk obstetric setting for severe post-dural puncture headache and often requires immediate management decisions before symptoms develop.[23] Even so, the strength of the evidence remained constrained by the predominance of retrospective data, variability in catheter dwell time, and differences in associated analgesic and follow-up protocols across cohorts.[24] These factors make it difficult to distinguish the effect of the catheter itself from the effect of broader institutional management pathways.[24] Therefore, while intrathecal catheterization appears promising, certainty regarding its independent preventive effect remains lower than its intuitive clinical appeal might suggest.[24]

The more recent randomized trial by Baharvand et al. revisited ondansetron in a contemporary cesarean population and found a reduction in headache occurrence and neck pain after spinal anesthesia.[25] This finding is notable because ondansetron is already familiar to obstetric anesthesiologists as an antiemetic, making any additional preventive benefit operationally attractive.[25] However, the trial did not show equally strong evidence for reduction in headache severity, indicating that incidence and clinical burden may not be influenced to the same degree.[25] Hadavi et al. then evaluated prophylactic acetaminophen plus caffeine in another randomized double-blind obstetric trial and reported a meaningful reduction in post-dural puncture headache risk together with lower pain intensity.[26] These findings are clinically appealing because both agents are familiar, accessible, and generally compatible with postpartum care pathways when used appropriately.[26] Still, the intervention represents a combined regimen, which prevents precise attribution of effect to either acetaminophen, caffeine, or their interaction.[26]

The most recent included cohort, by Moreno Giménez et al., examined intrathecal catheter placement for 24 hours after documented accidental dural puncture and compared

it with epidural re-siting.[27] Although the absolute outcomes numerically favored intrathecal catheter use, the differences in headache incidence and epidural blood patch requirement did not reach statistical significance in this relatively small cohort.[27] The absence of catheter-related complications, however, supports the procedural feasibility and short-term safety of this strategy in experienced obstetric units.[27] When interpreted alongside the Creazzola and Liu data, the Moreno Giménez results suggest that procedural and hormonal secondary prevention strategies may produce favorable trends without yet delivering consistent high-certainty effect estimates.[28] This pattern is typical of a field in which clinically important events are frequent enough to matter yet still difficult to study rigorously in large randomized frameworks.[28] It also explains why individual centers may adopt preventive practices ahead of definitive evidence, especially when those practices are perceived as low-risk and operationally practical.[28]

Taken together, the nine included studies indicate that the contemporary literature on prevention of post-dural puncture headache in obstetric patients is fragmented into two partially separate domains: prophylaxis after planned spinal anesthesia and prophylaxis after accidental dural puncture.[29] Pharmacologic studies in planned cesarean delivery provide repeated but heterogeneous signals favoring aminophylline, ondansetron, pregabalin, and acetaminophen plus caffeine, while evidence for dexamethasone and intrathecal morphine remains inconsistent or weak.[29] Secondary prevention after accidental dural puncture appears most promising for intrathecal catheter placement and possibly cosyntropin, but these data are driven largely by observational analyses rather than definitive randomized comparisons.[29] This synthesis broadly aligns with recent evidence summaries that have ranked propofol, ondansetron, and aminophylline favorably among pharmacologic candidates while simultaneously emphasizing the low certainty of many pairwise estimates.[30] It also aligns with updated obstetric reviews that distinguish clearly between primary prophylaxis in cesarean patients and secondary prevention after accidental dural puncture in labor analgesia.[30] In practical terms, the overall direction of evidence is encouraging, but the level of certainty remains insufficient for universal endorsement of a single routine preventive regimen.[30]

Comparison with contemporary guideline-based thinking further clarifies this point.[31] Current evidence-based clinical practice guidelines on post-dural puncture headache do not support routine use of any single prophylactic pharmacologic intervention across all settings, largely because of limited certainty, inconsistency, and indirectness in the available evidence.[31] At the same time, these guidelines acknowledge that some preventive strategies may be considered in selected high-risk circumstances, particularly when accidental dural

puncture has already occurred and the clinical team must choose an immediate management pathway.[31] The included obstetric studies are concordant with that position because they show several promising strategies without producing the degree of consistency usually required for strong universal recommendations.[32] The same is true for intrathecal catheter placement, which remains attractive and widely discussed but still supported predominantly by lower-certainty comparative data.[32] Thus, the present review reinforces the guideline message that preventive decisions should currently be individualized and context-sensitive rather than protocolized in a one-size-fits-all fashion.[32]

Heterogeneity across the included studies was substantial and arose from several sources.[33] First, the obstetric populations differed with respect to procedural context, with some studies examining uncomplicated elective cesarean spinal anesthesia and others focusing on accidental dural puncture during labor epidural analgesia.[33] Second, interventions varied widely in pharmacology, timing, route, and intention, making direct pooling across all studies clinically questionable even when formal meta-analytic methods are statistically possible.[33] Third, the diagnostic thresholds and follow-up periods for post-dural puncture headache were not completely uniform, which may have altered reported incidence and diluted between-study comparability.[34] Additional heterogeneity came from variable rescue pathways, such as thresholds for epidural blood patch, supportive analgesic use, and postpartum observation practices.[34] These differences matter because a study demonstrating reduced mild headache in the first postoperative day is not equivalent to a study showing reduced severe headache or reduced need for invasive rescue procedures.[34]

The overall certainty of evidence, when judged conceptually through a GRADE framework, is best considered low to at most moderate for only a small subset of specific comparisons.[35] Randomized pharmacologic trials contribute some direct evidence, but most are underpowered, single-center, and vulnerable to imprecision.[35] The observational studies on intrathecal catheter placement and cosyntropin are clinically relevant and often better aligned with real-world accidental dural puncture scenarios, yet they remain susceptible to confounding, selection bias, and center-level practice effects.[35] Consequently, the most defensible current interpretation is that several preventive interventions are promising, but none has yet achieved uniformly high-certainty support for universal implementation across obstetric neuraxial practice.[36] Future research should prioritize adequately powered multicenter randomized trials, standardized diagnostic criteria, explicit postpartum follow-up windows, and patient-centered outcomes such as breastfeeding disruption, mobility, and need for invasive rescue therapy.[36] Until such evidence becomes available, prevention of post-dural puncture headache in obstetric patients should remain evidence-informed,

multidisciplinary, and individualized according to procedural risk, maternal priorities, and local expertise.[36]

6 CONCLUSION

The available contemporary evidence suggests that prevention of post-dural puncture headache in obstetric patients remains feasible but incompletely resolved. Pharmacological strategies such as aminophylline, ondansetron, pregabalin, and acetaminophen plus caffeine have shown favorable signals in selected cesarean populations, while procedural strategies such as intrathecal catheter placement after accidental dural puncture appear promising in labor analgesia settings. However, no single preventive intervention has yet demonstrated sufficiently consistent superiority to justify universal routine adoption across all obstetric neuraxial scenarios.

The clinical relevance of this topic is substantial because post-dural puncture headache may interfere with maternal recovery, breastfeeding, newborn care, and postpartum functional capacity. Even moderate reductions in headache incidence or severity may therefore translate into meaningful benefits for patients and healthcare systems. For clinicians working in obstetric anesthesia, prevention remains a critical component of quality care rather than a secondary consideration.

The current literature has several important limitations. Most studies are single-center, many have modest sample sizes, and intervention protocols differ considerably in timing, dose, route, and comparator choice. The evidence base is also divided between planned spinal anesthesia and accidental dural puncture, which complicates direct synthesis and limits the certainty of generalized recommendations.

Future research should prioritize multicenter randomized controlled trials with standardized definitions of post-dural puncture headache, uniform follow-up intervals, and consistent reporting of rescue interventions such as epidural blood patch. Comparative trials directly evaluating the most promising pharmacologic regimens against each other would be particularly valuable. In addition, studies should incorporate patient-centered postpartum outcomes, including mobility, breastfeeding, sleep disruption, and maternal-infant interaction.

Overall, the prevention of post-dural puncture headache in obstetric patients should be approached through evidence-based, multidisciplinary, and individualized decision-making. Obstetric anesthesiologists, obstetricians, nursing teams, and postpartum care professionals all play a role in reducing the burden of this complication. Until stronger evidence emerges, the most appropriate strategy is careful risk assessment combined with

selective use of promising preventive interventions in contexts where their potential benefit is most justified.

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