Scientific Research Publishing

Open Journal of Anesthesiology, 2025, 15(3), 65-81
https://www.scirp.org/journal/ojanes
ISSN Online: 2164-5558
ISSN Print: 2164-5531

Analysis of the Effectiveness of Using the Blood Patch in Patients with Post-Dural Puncture Headache: A Systematic Review and Meta-Analysis

Lysandra Maria Sampaio de Abreu[1], Elis de Souza Brandão Almeida[1], Marina Meirelles Paes[1], Thais Gotfryd Ben Ezri[1], Silvia Aparecida Oesterreich[2], Laís Chancare Garcia[2], Ubiratan Ribeiro Martins Neto[2], Francisco Rodrigues Martins[2], Raquel Borges de Barros Primo[2], Dioelen Virginia Borges Souza de Aquino Coelho[2], Antonia Gomes de Olinda[2], Pablinny Moreira Galdino de Carvalho[3], Adryano Augustto Valladao de Carvalho[3], Bruno Henrique da Silva Ramos[3], Maria Luísa Lima Pires Ferreira Correa[4], Aliny Grippe Mota[5], Igor Muriel da Silva Fernandes[5], Gustavo Roberto Villas-Boas[1]*

[1]Research Group on Development of Pharmaceutical Products (P&DProFar), Center for Biological and Health Sciences, Federal University of Western Bahia, Barreiras, Brazil
[2]Faculty of Health Sciences, Federal University of Grande Dourados, Dourados, Brazil
[3]Center for Biological and Health Sciences, Federal University of Western Bahia, Barreiras, Brazil
[4]Faculty of Medicine, Uninovafapi University Center, Teresina, Brazil
[5]Anesthetic Experience Space (EVA), Luís Eduardo Magalhães, Brazil
Email: *gustavo.villasboas@gmail.com, lysandra.a7494@ufob.edu.br, elis.a7171@ufob.edu.br, marinameirelles@ymail.com, thaisdoc@hotmail.com, silviaoesterreich@gmail.com, laisgarcianutri@gmail.com, ubiratan41@gmail.com, fco.martins31@gmail.com, raquelbbp@ymail.com, dioelen.coelho@uems.br, antoniagomesdeolinda@gmail.com, pablinny.galdino@ufob.edu.br, adryano.carvalho@ufob.edu.br, bruno.r0543@ufob.edu.br, malulimapf@hotmail.com, inhagrippe@hotmail.com, igormuriel11@hotmail.com

How to cite this paper: Abreu, L.M.S.d., Almeida, E.d.S.B., Paes, M.M., Ezri, T.G.B., Oesterreich, S.A., Garcia, L.C., Neto, U.R.M., Martins, F.R., Primo, R.B.d.B., Coelho, D.V.-B.S.d.A., Olinda, A.G.d., Carvalho, P.M.G.d., Carvalho, A.A.V.d., Ramos, B.H.d.S., Correa, M.L.L.P.F., Mota, A.G., Fernandes, I.M.d.S. and Villas-Boas, G.R. (2025) Analysis of the Effectiveness of Using the Blood Patch in Patients with Post-Dural Puncture Headache: A Systematic Review and Meta-Analysis. *Open Journal of Anesthesiology*, **15**, 65-81.
https://doi.org/10.4236/ojanes.2025.153006

Abstract

Post-dural puncture headache (PDPH) is one of the most relevant complications that can occur after a dural puncture. The gold standard technique for treating PDPH is known as the blood patch. A systematic review of the scientific literature with a meta-analytic study was conducted and previously registered in the PROSPERO. It aimed to study the effectiveness of the blood patch as a first-choice treatment in patients with PDPH. The review followed the recommendations of the PRISMA. A guiding question was formulated following the acronym PICO. The research and preliminary screening strategy were conducted in three databases: Medline, Cochrane, and the Regional Portal of the VHL. The selection criteria were randomized clinical trials that evaluated the blood patch's effectiveness in treating PDPH. For data collection and anal-

Received: February 9, 2025
Accepted: March 16, 2025
Published: March 19, 2025

ysis, two authors independently selected studies, assessed the risk of bias, and extracted data. The primary outcome was the effectiveness rate of using the blood patch. Following the meta-analysis, an analysis of the certainty of the evidence was conducted. Our electronic search data resulted in 1118 studies; three were included in the meta-analysis. The blood patch has a favorable effect compared to placebo or other drug interventions in reducing headaches associated with PDPH.

Keywords

Epidural Blood Patch, Post-Dural Puncture Headache, Spinal Anesthesia, Spinal Punctures, Subarachnoid Spaces

1. Introduction

Dural or lumbar puncture involves passing a needle through the dura mater into the subarachnoid space, where cerebrospinal fluid (CSF) can be found. It is a standard procedure performed for therapeutic diagnostic purposes or spinal anesthesia. However, this procedure is not without risks, and its main complication is post-dural puncture headache (PDPH) [1] [2].

Sometimes, PDPH is a complication that cannot be avoided. Under a pathophysiological aspect, this condition develops from the constant loss of CSF volume through the puncture hole in the dura mater, which results in a reduction in intracranial pressure, retraction of membranes and structures sensitive to pain, and cerebral vasodilation. The headache usually appears or worsens when the patient assumes an upright position, attributing the orthostatic nature to PDPH [3].

When refractory, the diagnosis must be reconsidered, and differential diagnoses must be excluded, including meningitis, pre-eclampsia, cerebral venous thrombosis, subdural hematoma, subarachnoid hematoma, brain tumor, and stroke, among others [4]. Among patients diagnosed with this condition, around 39% have persistent symptoms for at least a week, which are refractory to conservative treatment [5].

PDPH is generally a self-limiting condition, and about 53% of headaches disappear with conservative treatment (rest, hydration, and symptomatic treatment) within four days. However, in other cases, symptoms may persist for weeks, months, or even years. Headache can become chronic, with the longest PDPH reported lasting five years [6] [7].

Currently, the treatment approach is based on limited clinical trials, observational studies, and experience in clinical practice. PDPH treatment can be divided into four stages: conservative treatment, aggressive medical treatment, conventional invasive therapy, and aggressive invasive treatment. There are no hard and fast rules for choosing treatment; however, they involve the severity of symptoms, patient preference, and urgency for relief. The technique of choice is considered the gold standard for PDPH therapy, and it is known as a blood patch. This procedure involves the injection of autologous blood into the epidural space to compress the dural sac and occlude the CSF passage orifice, avoiding volume loss and intracranial hypotension [8] [9].

There is a lack of evidence to prove the effectiveness of conservative treatments, such as rest, hydration, methylxanthine derivatives, acetaminophen, non-steroidal anti-inflammatory drugs, and adrenocorticotropic hormone. Furthermore, conservative management is only symptomatic and allows the maintenance of CSF volume loss through the orifice of the dura mater [10] [11].

The high success rate and low incidence of complications make the blood patch the gold-standard treatment for PDPH. Autologous blood in the epidural space acts as a clot that compresses the epidural sac, raising intracranial pressure and, in addition, preventing CSF leakage [12] [13]. The blood patch success rate ranges from 77% to 96% [14]. Conducted a blind randomized clinical trial in a non-obstetric population with 40 patients diagnosed with PDPH for seven days, comparing blood patches and conservative treatments. At the end of the 7th day, headache was present in 3 (16%) patients treated with blood patch and 18 (86%) treated with conservative therapy [1] [6].

Despite this, clinical studies evaluating the effectiveness of using blood patches in PDPH were conducted using insufficient participants, requiring in-depth investigation into the certainty of such evidence. For this, a systematic review with meta-analysis, which is at the top of the pyramid of evidence in medical research, is necessary.

Through systematic review, it is possible to compile, in an organized way, many qualitative and quantitative results. This helps the interpretation of consistencies and inconsistencies found between primary studies investigating the same question [15] [16]. One of the main advantages of meta-analysis is that it applies when there are several studies on a specific intervention. Still, there are doubts about whether the small number of individuals involved could mask their results. In these cases, meta-analysis increases the "n" of research, allowing greater security in decision-making. Furthermore, when the number of studies on a given subject is scarce, as in the present study, meta-analysis will enable us to gather the evidence available at the time of the study and point out areas where there is a need for further research [17] [18].

Finally, given the factors mentioned above, it is of fundamental importance to investigate the effectiveness of using the blood patch as a first-choice treatment in patients diagnosed with PDPH and, therefore, justifying the carrying out of a systematic review with meta-analysis, given its ability to aggregate information, analyze data and critically synthesize it, to provide updated material on the best scientific evidence for health professionals. Therefore, the objective of this systematic review was to analyze the effectiveness of the blood patch as a first-choice treatment for PDPH.

2. Materials and Methods

The review was previously registered in the International Prospective Register of Systematic Reviews (PROSPERO) under protocol CRD42023405805. The study was carried out following the recommendations of the Systematic Reviews and Meta-Analyses (PRISMA), which allows the optimization of the systematic review report and is useful for critically evaluating reviews that have already been published.

The elaboration of the guiding research question was determined following the acronym PICO (Population, Intervention, Comparator, and Outcome). Thus, the question is: "Given the population of patients diagnosed with high-intensity post-dural puncture headache (P), the first-choice treatment with blood patch (I), when compared to conventional analgesic treatment and placebo (C) in patients with the same diagnosis, is it effective in reducing pain (O)?"

2.1. Eligibility Criteria and Characterization of the Intervention (I)

This review included randomized clinical trials that applied the blood patch as an intervention in individuals diagnosed with PDPH. The blood patch may have been compared with conventional drug treatment, placebo, or other drug therapy alternatives. Studies were eligible regardless of publication status and language.

The following steps/criteria were followed:

1. Studies were collected that quantified the effectiveness of first-choice blood patch treatment in patients with high-intensity PDPH;
2. Studies published in any language were included;
3. The individuals researched are people diagnosed with PDPH;
4. Individuals of any age were included;
5. Individuals using public or private healthcare systems were included.;
6. The intervention factor "use of blood patch" should be present.

Studies should evaluate the pain reduction outcome after the intervention using an appropriate scale, such as the visual analog pain scale.

As established in the PROSPERO protocol, the cutoff point for the parameters that demonstrate the effectiveness of using the blood patch to treat PDPH was defined according to the criteria adopted in each article included in this review. Subsequently, this assessment was considered to limit the categories adopted in the data extraction stage.

2.2. Preliminary Search and Screening Strategy

The central search strategy was conducted online in 3 databases: Medline/PubMed, Cochrane Library, and VHL.

An advanced search was carried out for published scientific articles and technical materials (published or not) whose central theme was the effectiveness of using the blood patch in patients with PDPH.

For all studies, the strategy adopted was based on the PICO structure, with related keywords and more common synonyms adopted (**Table S1**).

In all cases, the descriptors were chosen based on preliminary research results within the scope of critical evaluation by researchers in the area members of the review team. The team also read systematic reviews related to the theme proposed in the present study, and the final criterion for selecting keywords was sensitivity; that is, more comprehensive strategies were preferred for precise searches.

The search strategies were adapted to the standards of each database regarding the use of filters and Boolean operators. Selection filters were used for the comparator. In addition, eligible studies from the bibliographic references of the included studies were also included. To ensure the efficiency and precision of the entire study inclusion process, the screening was carried out in three sequential and cumulative stages, each with its verification criteria:

A. Title analysis (for criteria 1 and 2, described in item 2.3);

B. Analysis of the summary (for criteria 3, 4, and 5, described in item 2.3);

C. Analysis of the full text (for criterion 7, described in item 2.3) using the Rayyan application (available at: https://rayyan.qcri.org/welcome), which provides agility and selection of articles for inclusion (or exclusion) in the study.

This initial screening was carried out by two reviewers (LMSA and EASB) independently due to the possibility of a high degree of methodological variability and type of data that demonstrate the effectiveness of using the blood patch as a first-choice treatment in patients with PDPH; it was established in the PROSPERO protocol the possibility of adding new inclusion and exclusion criteria to analyze which measurement methods and types of data were most prevalent and most homogeneously used in the assessment of such consequences.

2.3. Description of Data Extraction and Final Screening

Two reviewers (LMSA and ESBA) independently performed data extraction and final screening. A third reviewer (GRVB) resolved the differences between the two reviewers through meetings and dialogues.

Excel® software from the Microsoft 365 Office package tabulated the collected data. The database comprised the main fields provided for parametric and non-parametric data from the included studies. The extraction only started when the two reviewers responsible for this stage presented convergent results.

Data were collected according to the following criteria:

1. Type of study;
2. The research used time and methodology to obtain data that demonstrate the effectiveness of the blood patch as a first-choice treatment in patients with PDPH;
3. Detail of the intervention (use of the blood patch as first-choice treatment in PDPH);
4. Process of recruiting research participants;
5. Risk factors of the study population, when available;
6. Possible withdrawals of research participants;
7. Results obtained;
8. Participant inclusion and exclusion criteria.

In addition, information was collected to analyze the risk of bias and effect measurements, as well as the methods used to measure them.

Aiming to increase the power of comparison, homogeneity of experimental designs, and natural scientific advancement to the data described in the literature, only studies that contained at least one group of individuals who used the blood patch for the treatment of PDPH and this group was compared with a group with a group of individuals who used conventional analgesic medication or placebo (9) who had their treatment in public or private health institutions (10). Therefore, studies that aimed to analyze parallel issues (11) were excluded.

At this stage, aiming for greater methodological rigor, criteria 1 to 7 were rechecked based on the full text of the selected studies, and then, the definitive screening (8 - 11) was carried out.

2.4. Main Outcome and Secondary Outcomes

The main outcome to be analyzed was the effectiveness rate, that is, the effectiveness of using the blood patch as a first-choice treatment in patients with PDPH.

The effect measures analyzed in the outcomes are mean, standard deviation, median, and confidence intervals, in addition to the sample size of the Treated (blood patch) and Control (conventional pharmacological therapy/placebo) groups. These measures were extracted, considering the initial assessment and follow-up after the intervention.

2.5. Analysis of Risk of Bias and Certainty of Evidence

Two reviewers (LMSA and EASB) independently assessed the risk of bias in the included studies following the criteria proposed by the Cochrane Collaboration, which is based on the following domains:

1. Randomization process;
2. Deviation from intended interventions;
3. Lack of outcome data;
4. Measurement of results;
5. Selection of the reported result

The risk of bias for each domain analyzed was judged as low, high, or uncertain. Disagreements between reviewers regarding assessing the risk of bias were resolved through discussion mediated by the third reviewer (GRVB). After analyzing the risk of bias and conducting the meta-analysis, the GRADE tool (Grades of Recommendations, Assessment, Development, and Evaluation Working Group) was used to analyze the certainty of the evidence.

2.6. Data Synthesis and Statistical Analysis Strategy

The meta package (version 6.5-0) implemented in R language was used to perform the meta-analyses. The random effects model was used for meta-analysis to provide a summary effect size, which represents the means of a distribution of effects from the included studies. The homogeneity of studies was measured through the heterogeneity test using T2 and I2 statistics. As the analyzed outcomes were measured using categorical (dichotomous) data, the odds ratio (Odds Ratio, OR), with 95% CI, was used for dichotomous outcomes.

Heterogeneity was considered significant if the p-value determined by the chi-square test was less than 0.1, the I-square test (I2) was greater than or equal to 50%, or visual inspection of the Forest Plot graph revealed studies with discrepant effect sizes and confidence intervals compared with other studies.

3. Results

3.1. Study Search Results

Searches in PubMed, VHL, and Cochrane Library databases initially resulted in 1,118 studies. Two hundred ninety-five duplicate works were excluded, leaving 823 for screening. After the first stage of reading titles and abstracts, 40 studies were selected for reading the full text. Subsequently, 37 studies were excluded because they needed to meet the inclusion criteria. Therefore, three studies were chosen for inclusion in this review, and their data were subjected to meta-analysis (Figure 1).

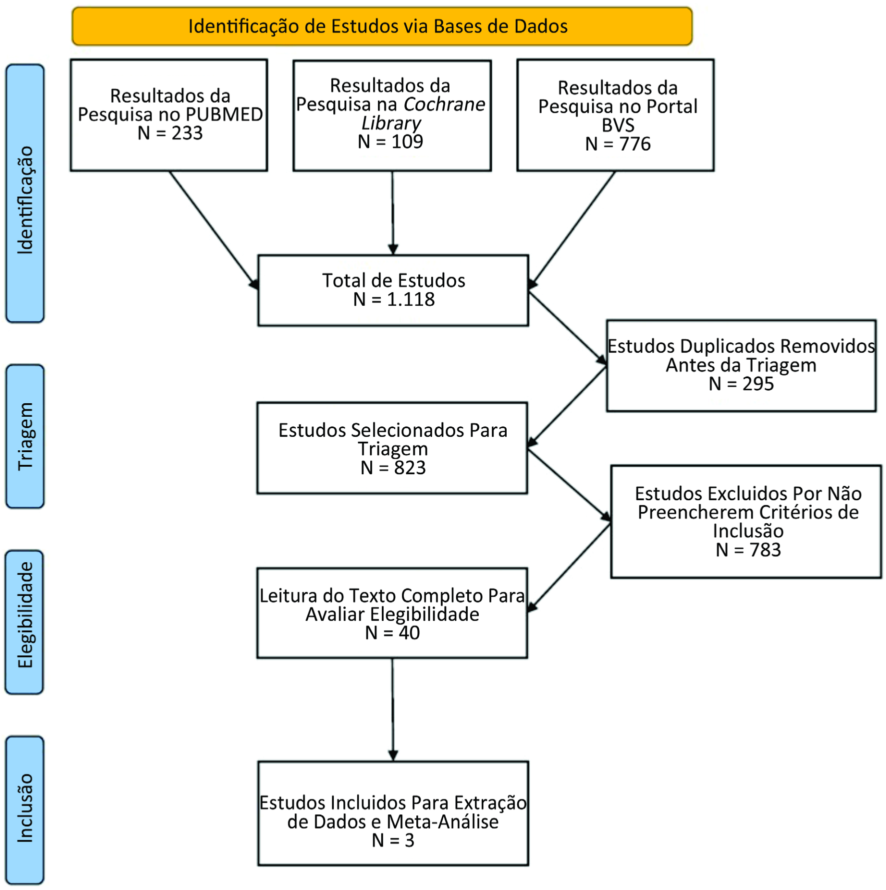

Figure 1. Diagram of the study selection steps for systematic reviews.

3.2. Included Studies

The three studies only included patients over 18 years of age who were diagnosed with PDPH by a neurologist in two of them and by an anesthetist in the remaining study. Regarding intervention, each study compared the blood patch with a different therapeutic approach, namely conservative treatment, intravenous cosyntropin, and placebo. In all of them, the primary outcome was the same – a reduction in headache after the intervention. Scales suitable for this purpose were used to assess pain intensity. In the first study, of 6 patients, 1 required a second application of the blood patch for complete pain relief [19], which was compared with placebo. Another study, after evaluating the intervention compared with placebo, demonstrated the presence of headache classified as mild in 3 of 19 patients who received the blood patch, compared to 18 of 21 patients who received the placebo [20]. Finally, the study that evaluated the effectiveness of the blood patch compared to cosyntropin showed an improvement in PDPH in 11 of 13 patients who received the intervention with the blood patch versus 8 of 15 patients who received cosyntropin [21].

All studies met the inclusion criteria for a population diagnosed with PDPH, pain assessment using an appropriate scale, and use of the blood patch as an intervention compared to conservative treatment or placebo (**Table 1**).

3.3. Risk of Bias in Included Studies and Analysis of Certainty of Evidence

The risk of bias analysis, carried out using the ROB2 tool, classified the three studies with bias as "some concerns." OF 5 domains analyzed (randomization process, deviation from intended interventions, missing outcome data, outcome measurement, and selection of reported outcome), four were classified as "low risk" of bias, and only one was classified as "high risk" of bias (in domain 5, selection of the reported outcome). Thus, due to the analysis of domain 5 (selection of the reported result), the general risk of bias was classified as "some concerns." In domain 1, the randomization process, all studies were classified as "low risk," as there was a randomly generated randomization sequence and, in two studies, the allocation sequence was hidden until participants were enrolled and assigned to the interventions – only in one study it was not reported whether the allocation sequence was hidden. In domain 2, deviation from intended interventions, all studies were classified as "low risk" of bias; therefore, participants received the intervention previously designated by the randomization process. Only in the study by F van Kooten [20] did two patients who were allocated to conservative treatment insist on being treated with the blood patch; however, when this request was not met, these individuals refused participation and withdrew their consent. Consequently, this fact did not generate any deviation in the intervention. Regarding domain 3, lack of results data, the classification was "low risk" of bias, as, for all participants, outcome data were available at the end of the study. In domain 4, outcome measurement, the three studies were classified as "low risk" of bias; therefore, they all used appropriate scales to measure headaches. Finally, in domain 5, selection of the reported result, the works were classified as "high risk" of bias. Only F van Kooten's study [20] produced results analyzed according to a pre-analysis plan finalized before unblinded outcome data were available for analysis [20]. The other two studies, [21] [22], did not report whether there was such a plan.

Furthermore, domain five also analyzed whether there were multiple eligible outcome measurements, such as, for example, assessment of the outcome at different time points, and all studies assessed headache at more than one point after the intervention, fulfilling this criterion (Figure 2 and Figure 3).

The certainty of evidence was analyzed using the GRADEpro tool, a platform that facilitates the management of a systematic and transparent decision-making process based on evidence. This tool allows for a collaborative approach to assessing the quality of evidence and developing recommendations, promoting more efficient action. The quality of the evidence was high from the insertion of data obtained by the study and the meta-analytic calculation (Table 2).

Table 1. Results of studies included in the review.

Authors /Year	Methodological Design	Participants	Control Group	Intervention Protocol	Main Outcome	Results
[14]	Double-Blind Randomized Clinical Trial	40 (over 18 years old)	Guidance on absolute rest for 24 hours and intake of at least 2 liters of liquid daily. The use of analgesics was not prohibited.	Blood patch: the patient was placed in lateral decubitus, and the back was flexed, sterilized, and covered. Sterile gloves were used. A needle was placed in the epidural space using the loss of resistance technique. Subsequently, 20mL of blood was withdrawn from the antecubital vein, 15-20mL was slowly injected into the epidural area, and the needle was removed. The subject was kept supine for a few minutes, after which there were no further restrictions.	Presence or absence of headache after treatment.	Nineteen patients received a blood patch, and 21 received conservative treatment. The primary outcome, headache 24 hours after randomization, occurred in 11 (58%) compared with 19 (90%) patients allocated to active and conservative treatment, respectively. Seven days after randomization, headaches remained present in 3 (16%) versus 18 (86%) patients in the active and conservative groups, respectively.
[19]	Double-Blind Randomized Clinical Trial	12 (18 - 70 years old)	Placebo	Blood patch (slow epidural injection of 10 to 20 ml of autologous blood into the space below which the dura mater had been penetrated during the original procedure).	Presence or absence of headache after treatment.	In the placebo group, no patient reported complete pain relief. Two described a reduction in headache intensity as shown on the analog scale at the 2-hour assessment, but with resurgence 24 hours later. Five of six patients achieved relief in the group randomized to active treatment at baseline, which was maintained at subsequent evaluation. The patient who did not get relief in the active treatment group received a second blood patch.
[21]	Double-Blind Randomized Clinical Trial	28 (18 - 65 years old)	Cosyntropin 500 mcg in 1000 cc of saline.	Blood patch epidural and normal saline 1000 cc.	Presence or absence of headache after treatment, using a headache score on a numerical scale (0 no pain, 10 worst pain) on days 1, 3, and 7 after the procedure.	Fifteen individuals received intravenous cosyntropin (group A), and 13 received the blood patch (group B). Seven days after treatment, seven patients had headaches in group A and only two in B.

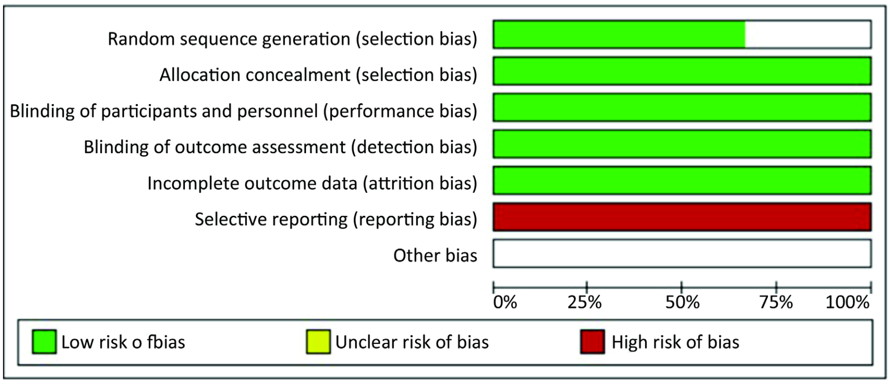

Figure 2. Result of the risk of bias analysis.

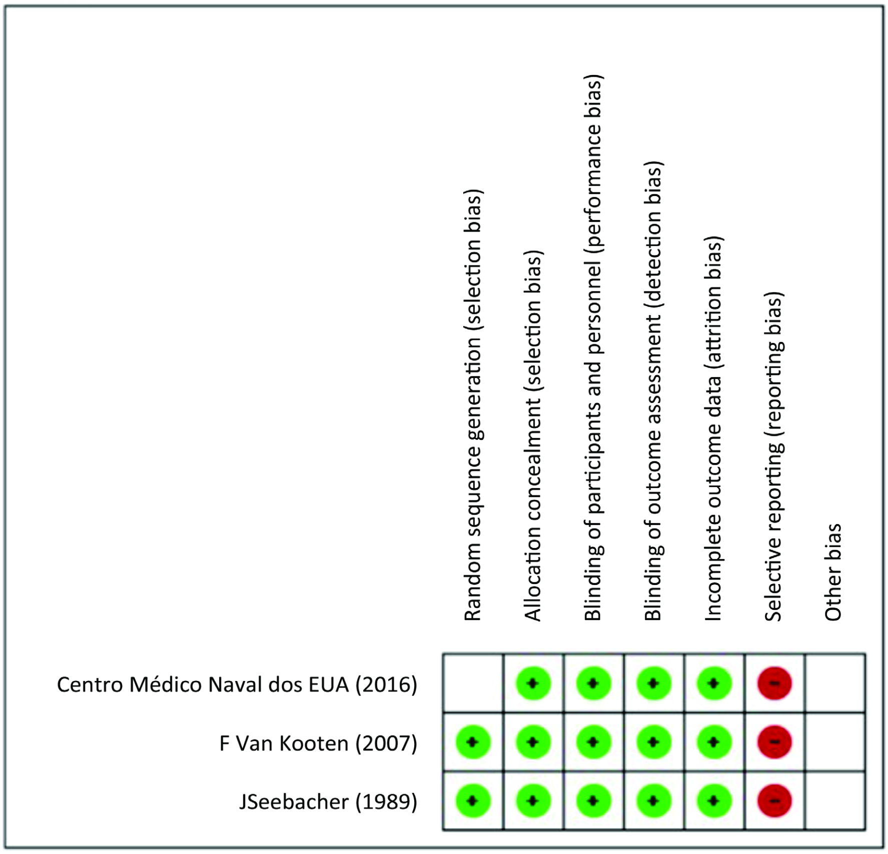

Figure 3. Risk of bias summary: reviewers' judgments on each risk of bias item for each included study.

3.4 Meta-Analysis

In the present research, the meta-analysis included data from the blood patch intervention in the 7-day follow-up since this information was standard in the three studies that compared the intervention with a control group. Figure 4 shows that the blood patch intervention favors reducing headaches compared to the control group, conservative treatment, or cosyntropin (according to the study methodology) (diamond positioned on the left). All three studies included in the analysis demonstrated that the effect of the blood patch is favorable for reducing PDPH. Furthermore, the data from this research showed heterogeneity between studies without statistical significance (I2 = 44%).

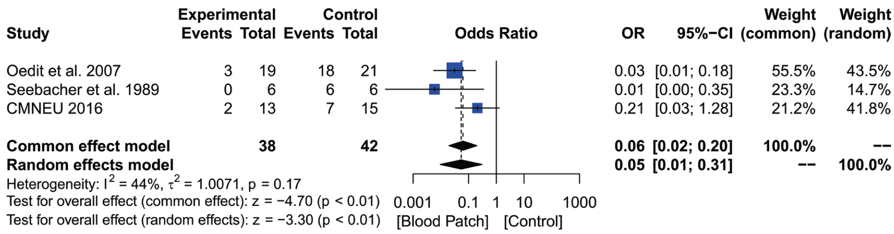

Figure 4. Meta-analysis of the comparison between the intervention with the blood patch and the control for the outcome of reducing PDPH.

Data from this research demonstrated an Odds Ratio of 0.05 (95% CI, 0.01 to 0.31). When the odds ratio is less than one, exposure to the intervention reduces the chance of the patient continuing with PDPH. In short, this means that exposure to the intervention reduces the likelihood of the patient continuing to have a headache after the puncture by 95%.

4. Discussion

Systematic review with meta-analysis plays a fundamental role in the clinical context, providing a rigorous and comprehensive approach to synthesizing scientific evidence. By compiling results from multiple primary studies, meta-analysis allows for a more accurate assessment of the effect of an intervention or exposure in a given population. In this context, a more precise estimate of the average effect emerges, increasing statistical power and reducing the uncertainty associated with isolated results from individual studies [23]. Additionally, meta-analysis can reveal trends and patterns that may not be evident in a single study, identifying significant differences and generalizing results to a broader range of patients. This systematic and quantitative approach is essential for making evidence-based clinical decisions, as it provides more reliable information to guide medical practice [15] [24]. Meta-analysis is crucial in clinical research, providing a comprehensive view of results and strengthening the evidence base for improving healthcare quality [25] [26].

Because PDPH can cause debilitating symptoms, significantly affecting patients' quality of life, this study sought to systematically evaluate the available data to determine whether the blood patch is effective for treating this frequent and often disabling condition. The results of this review provide valuable information for clinical decision-making and could significantly impact current practice [27] [28].

Based on the available information, the data from the present research provides solid evidence that the blood patch is an effective treatment for reducing PDPH. The results of the meta-analysis, risk of bias analysis, and analysis of certainty of evidence corroborate this data. Currently, the blood patch is recommended for patients with persistent PDPH, even after conservative treatment has been attempted,

Table 2. Analysis of the certainty of evidence.

Blood patch for PDPH treatment compared with placebo.						
Patient or Population: Patients diagnosed with PDPH.						
Setting: Patients who underwent lumbar puncture and developed PDPH.						
Intervention: Blood patch.						
Comparison: Placebo and/or conservative treatment.						
	Anticipated absolute effects* (95% CI)					
Outcomes	Risk with conservative treatment or placebo	Risk with Blood Patch	Relative Effect	N° of Participants (Studies)	Certainty of the Evidence (GRADE)	Comments
Presence of headache after the intervention	74 per 100	0 per 100 (0 to 0)	Not estimable	4 (3 RCTs)	⊕⊕⊕⊕ High	Headache reduction with blood patch intervention

*The risk in the intervention group (and its 95% confidence interval) is based on the assumed risk in the comparison group and the relative effect of the intervention (and its 95% CI). **CI**: confidence interval. Grade Working Group grades of evidence. **High certainty**: we are very confident that the true effect lies close to that of the estimate of the effect. **Moderate certainty**: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different. **Low certainty**: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of effect. **Very low certainty**: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

which involves rest, intravenous hydration, analgesics, and caffeine [29]. Previous studies demonstrated that headaches persisted in 86% of cases in which conservative treatment was used for patients with moderate to high-intensity PDPH [20]. Furthermore, a systematic review with meta-analysis showed that the blood patch was more effective than conservative treatment in reducing severe PDPH. These findings highlight the importance of the blood patch as a preferred therapeutic option for more intense cases of PDPH.

In the management of PDPH, it is expected to use bed rest and intravenous hydration as therapeutic measures. However, it is essential to highlight that no evidence indicates the benefits of bed rest in preventing or treating headaches. On the contrary, it has been found that bed rest may increase the risk of developing PDPH when compared to early ambulation [4]. Furthermore, intravenous hydration does not control groups. Two studies, in particular [14] [22], did not provide these essential data. One of the studies [22] mentioned that the inclusion of participants required the presence of severe headache, classified by the patient himself on a visual analog scale, but no specific mean values were provided. Another 14 study [14] only mentioned that patients had persistent PDPH without classifying pain intensity. Furthermore, another limitation was the need to clearly define the criteria used by neurologists [14] [22] and anesthetists [21] to diagnose PDPH. These limitations highlight the importance of providing complete and consistent data for a more accurate assessment and adequate interpretation of the results obtained in the studies analyzed. Future research must be more rigorous in this aspect, ensuring the inclusion of relevant information, such as average pain before randomization, to strengthen the validity and reliability of the results.

Recently, studies have emerged investigating the potential of blood patches as a prophylactic measure to prevent the development of PDPH [30] [31]. From future perspectives, it is essential that research follows this line of investigation and expands understanding of the effectiveness and safety of the blood patch in this context. Inertia in the appropriate treatment of PDPH can lead to significant limitations in the quality of life of affected patients. Therefore, investing in studies to improve clinical approaches and provide better results for patients with PDPH is essential to minimizing the impacts of this debilitating condition.

5. Conclusion

The present systematic review with meta-analysis demonstrated the effectiveness of the blood patch as a treatment in patients with PDPH. By compiling results from multiple primary studies, meta-analysis allowed for an accurate assessment of the effect of this intervention in a specific population. The data analyzed consistently indicated significant headache relief in patients undergoing the blood patch, strengthening the evidence favoring its use as the preferred therapy for this condition. Furthermore, the risk of bias analysis demonstrated the robustness of the included studies, minimizing the possibility of distorted or biased results. The analysis of the certainty of evidence, in turn, reinforced the reliability and consistency of the results, providing a solid basis to support clinical recommendations related to the use of the blood patch in the treatment of PDPH. These findings have important implications for medical practice, offering professionals an effective, evidence-backed therapeutic option to improve patients' quality of life affected by this debilitating condition. However, as the number of primary studies that evaluate the blood patch in the clinical management of PDPH is too low, further research is needed to increase the "n" of the studied population to optimize dose administration, among other pertinent assessments. Systematic and evidence-based approaches are essential to improve healthcare quality and provide reliable information to guide medical practice. They should be encouraged in the context of translational research.

Acknowledgements

The authors thank the Federal University of Western Bahia for providing all the necessary infrastructure to develop this research.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Rodríguez-Camacho, M., Guirado-Ruiz, P.A. and Barrero-Hernández, F.J. (2023) Risk Factors in Post-Dural Puncture Headache. *Revista Clínica Española*, **223**, 331-339. https://doi.org/10.1016/j.rce.2023.03.006

[2] Amorim, J.A. (2012) Cefaleia pós-punção dural: Características clínicas e critérios

para o diagnóstico. Ph.D. Thesis, Universidade Federal de Pernambuco.

[3] Feitoza, L.R.B., de Souza, A.T.B. and da Silva Fernandes, D.R. (2021) Cefaleia pós-punção dural em cesariana: Fatores de risco associados e novas perspectivas sobre condutas medicamentosas. *Revista Eletrônica Acervo Saúde*, **13**, e9127. https://doi.org/10.25248/reas.e9127.2021

[4] Buddeberg, B.S., Bandschapp, O. and Girard, T. (2019) Post-Dural Puncture Headache. *Minerva Anestesiologica*, **85**, 543-553. https://doi.org/10.23736/S0375-9393.18.13331-1

[5] Paschoal, A.P., Vilaça, M.P., da Silva Rodrigues Machado, A.R., da Silva K.R.T., S.R., Gazarini, L. and da Silva, A.V. (2020) Cefaleia pós-punção dural-uma revisão de literatura. *Brazilian Journal of Health Review*, **3**, 12153-12168. https://doi.org/10.34119/bjhrv3n5-062

[6] Bezov, D., Ashina, S. and Lipton, R. (2010) Post-Dural Puncture Headache: Part II—Prevention, Management, and Prognosis. *Headache*, **50**, 1482-1498. https://doi.org/10.1111/j.1526-4610.2010.01758.x

[7] Fan, Y.T., Zhao, T.Y., Chen, J.H., Tang, Y.L. and Song, X.R. (2023) Prophylactic Epidural Blood Patch or Prophylactic Epidural Infusion of Hydroxyethyl Starch in Preventing Post-Dural Puncture Headache—A Retrospective Study. *Pain Physician Journal*, **26**, 485-493. https://doi.org/10.36076/ppj.2023.26.485

[8] Waschke, J. (2019) Sobotta Anatomia Clínica. Elsevier.

[9] Uppal, V., Russell, R., Sondekoppam, R.V., *et al.* (2023) Evidence-Based Clinical Practice Guidelines on Postdural Puncture Headache: A Consensus Report from a Multisociety International Working Group. *Regional Anesthesia & Pain Medicine*, **49**, 471-501.

[10] Turnbull, D.K. and Shepherd, D.B. (2003) Post-Dural Puncture Headache: Pathogenesis, Prevention and Treatment. *British Journal of Anaesthesia*, **91**, 718-729. https://doi.org/10.1093/bja/aeg231

[11] Bicket, M.C., Peahl, A. and Gaiser, R.R. (2023) Improving the Management of Postdural Puncture Headache—An International Clinical Guideline and Call for Better Evidence. *JAMA Network Open*, **6**, e2325348. https://doi.org/10.1001/jamanetworkopen.2023.25348

[12] Shear, T. (2008) Epidural Blood Patch for Chronic Daily Headache with Postural Component: A Case Report and the Review of Published Cases. *Pain Physician Journal*, **11**, 77-80. https://doi.org/10.36076/ppj.2008/11/77

[13] Kwak, K.H. (2017) Postdural Puncture Headache. *Korean Journal of Anesthesiology*, **70**, 136-143. https://doi.org/10.4097/kjae.2017.70.2.136

[14] Van Kooten, F., Oedit, R., Bakker, S.L.M. and Dippel, D.W.J. (2008) Epidural Blood Patch in Post Dural Puncture Headache: A Randomised, Observer-Blind, Controlled Clinical Trial. *Journal of Neurology, Neurosurgery and Psychiatry*, **79**, 553-558. https://doi.org/10.1136/jnnp.2007.122879

[15] Cook, D.J., Mulrow, C.D. and Haynes, R.B. (1997) Systematic Reviews: Synthesis of Best Evidence for Clinical Decisions. *Annals of Internal Medicine*, **126**, 376-380. https://doi.org/10.7326/0003-4819-126-5-199703010-00006

[16] Honorio, H.M. and Santiago-Jr., J.F. (2021) Fundamentos das Revisões Sistemáticas em Saúde. SP: Santos Publicações.

[17] Pissini, C.F. (2006) Aplicações em Meta-análise sob um enfoque Bayesiano usando dados médicos. Master's Thesis, Universidade Federal de São Carlos.

[18] Petrie, A.S.C. (2001) Compêndio de estatística médica. Instituto Piaget.

[19] Seebacher, J., Ribeiro, V., LeGuillou, J.L., *et al.* (1989) Epidural Blood Patch in the

Treatment of Post Dural Puncture Headache: A Double Blind Study. *Headache*: *The Journal of Head and Face Pain*, **29**, 630-632. https://doi.org/10.1111/j.1526-4610.1989.hed2910630.x

[20] Oedit, R., van Kooten, F., Bakker, S.L.M. and Dippel, D.W.J. (2005) Efficacy of the Epidural Blood Patch for the Treatment of Post Lumbar Puncture Headache BLOPP: A Randomised, Observer-Blind, Controlled Clinical Trial [ISRCTN 71598245]. *BMC Neurology*, **5**, Article No. 12. https://doi.org/10.1186/1471-2377-5-12

[21] CMNEU (2016) Cosyntropin Versus Epidural Blood Patch (EBP) for Treatment of Treatment of Post Dural Puncture Headache (PDPH). https://clinicaltrials.gov/ct2/show/NCT02394457

[22] Seebacher, J., Ribeiro, V., Leguillou, J.L., Lacomblez, L., Henry, M., Thorman, F., *et al*. (1989) Epidural Blood Patch in the Treatment of Post Dural Puncture Headache: A Double Blind Study. *Headache*: *The Journal of Head and Face Pain*, **29**, 630-632. https://doi.org/10.1111/j.1526-4610.1989.hed2910630.x

[23] El Dib, R. (2022) Como interpretar uma metanálise? *Jornal Vascular Brasileiro*, **21**, 1-5. https://doi.org/10.1590/1677-5449.202200432

[24] Pereira, R.S., Santos, I.C., Oliveira, K.D.S. and Leão, N.C.A. (2019) Meta-Analysis as a Research Tool: A Systematic Review of Bibliometric Studies in Administration. *Human and Social Management*, **20**, eRAMG190186. https://doi.org/10.1590/1678-6971/eramg190186

[25] Monteiro, R.N.M. (2010) Metodologias de meta-análise aplicadas nas ciências da saúde. Master's Thesis, Universidade da Beira Interior.

[26] Brasil (2021) Diretrizes metodológicas: Elaboração de revisão sistemática e meta-análise de ensaios clínico randomizados. Brasília-DF: Ministério da Saúde.

[27] Stannard, D. (2011) Epidural Blood Patching for Preventing and Treating Postdural Puncture Headache. *Journal of PeriAnesthesia Nursing*, **26**, 411-412. https://doi.org/10.1016/j.jopan.2011.09.002

[28] Orbach-Zinger, S., Azem, K., Heesen, P. and Frenkel, Y.B.A. (2023) Cosyntropin Prophylaxis with Intrathecal Saline: Impact on Post-Dural Puncture Headache and Epidural Blood Patch. *Anesthesia*, **79**, 91-92. https://doi.org/10.1111/anae.16139

[29] Tubben, R.E., Jain, S. and Murphy, P.B. (2022) Epidural Blood Patch. StatPearls Publ.

[30] Bradbury, C.L., Singh, S.I., Badder, S.R., Wakely, L.J. and Jones, P.M. (2013) Prevention of Post-Dural Puncture Headache in Parturients: A Systematic Review and Meta-analysis. *Acta Anaesthesiologica Scandinavica*, **57**, 417-430.

[31] Boonmak, P. and Boonmak, S. (2001) Epidural Blood Patching for Preventing and Treating Post-Dural Puncture Headache. *Cochrane Database of Systematic Reviews*, **20**, 1-32.

Appendix

Table S1. PICO strategy (population, intervention, comparator, and outcome) and central search engines for regular studies.

Target	Description	Uniterms
Strategy used in the regional portal of the virtual health library		
Population /Condition	1. Post Dural Puncture Headache	#1. MR: (Cefaleia Pós-Punção Dural) OR (Post-Dural Puncture Headache) OR (Cefalea Pospunción de la Duramadre) OR (Cefalalgia Pós-Punção Dural) OR (Cefalalgia Pós-Punção Lombar) OR (Cefaleia Pós-Punção Lombar) OR (Cefalgia Pós-Punção Dural) OR (Cefalgia Pós-Punção Lombar) OR (Headache, Post-Dural Puncture) OR (Headache, Postdural Puncture) OR (Headaches, Post-Dural Puncture) OR (Headaches, Postdural Puncture) OR (Post-Dural Puncture Headache) OR (Post-Dural Puncture Headaches) OR (Post-Lumbar Puncture Headache) OR (Postdural Puncture Headache) OR (Postdural Puncture Headaches) OR MH: C10.228.140.546.699.124$
Intervention	1. Epidural Blood Plate	#2. MR: (Placa de Sangue Epidural) OR (Placa de Sangue Epidural) OR (Blood Patch, Epidural) OR (Parche de Sangre Epidural) OR (Blood Patchs, Epidural) OR (Epidural Blood Patch) OR (Epidural Blood Patchs) OR (Patch, Epidural Blood) OR (Patchs, Epidural Blood) OR MH: E02.095.125$ OR MH: E02.319.267.530.580.300.145$
Boolean Operator	OR e AND	#3. #1 AND #2
Strategy used in the MEDLINE database (PUBMED)		
Population /Condition	1. Post-Dural Puncture Headache	#1. "Post-Dural Puncture Headache" [Mesh] OR (Headache, Post-Dural Puncture) OR (Headache, Postdural Puncture) OR (Headaches, Post-Dural Puncture) OR (Headaches, Postdural Puncture) OR (Post Dural Puncture Headache) OR (Post-Dural Puncture Headaches) OR (Post-Lumbar Puncture Headache) OR(Postdural Puncture Headache) OR (Postdural Puncture Headaches)
Intervention	1. Blood Patch, Epidural	#2. "Blood Patch, Epidural" [Mesh] OR (Blood Patch, Epidural) OR (Parche de Sangre Epidural) OR (Blood Patchs, Epidural) OR (Epidural Blood Patch) OR (Epidural Blood Patchs) OR (Patch, Epidural Blood) OR (Patchs, Epidural Blood)
Boolean Operator	OR e AND	#3. #1 AND #2
Strategy used in the central database (Cochrane Library)		
Population /Condition	1. Post-Dural Puncture Headache	#1. MeSH descriptor: [Post-Dural Puncture Headache] explode all trees
		#2. (Post-Dural Puncture Headache) OR (Headache, Post-Dural Puncture) OR (Headache, Postdural Puncture) OR (Headaches, Post-Dural Puncture) OR (Headaches, Postdural Puncture) OR (Post Dural Puncture Headache) OR (Post-Dural Puncture Headaches) OR (Post-Lumbar Puncture Headache) OR (Postdural Puncture Headache) OR (Postdural Puncture Headaches)

Continued

Boolean Operator	OR e AND	#3. #1 AND #2
Intervention	1. Blood Patch, Epidural	#4. MeSH descriptor: [Blood Patch, Epidural] explode all trees
		#5. (Blood Patchs, Epidural) OR (Epidural Blood Patch) OR (Epidural Blood Patchs) OR (Patch, Epidural Blood) OR (Patchs, Epidural Blood)
Boolean Operator	OR e AND	#6. #4 OR #5
		#7. #3 AND #6