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REVIEW ARTICLE

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Peripheral venous catheter-related phlebitis: A meta-analysis of topical treatment

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Abstract

Aim: To systematically evaluate the efficacy of different topical treatments for PVC-related phlebitis in hospital in-patients.

Design: A systematic review and meta-analysis.

Methods: A selection was made of experimental and quasi-experimental studies published in English or Spanish. These should provide data on the degree of phlebitis, pain and infiltration (means and standard deviations, mainly) of hospitalized patients with phlebitis secondary to peripheral venous catheter. All those studies that reflected systemic or exclusive prevention treatments were excluded. Searches were from inception to April 2020. The date of data collection was from December 2020 to May 2021. The selection criteria were based on the PICOS model. Risk of bias was assessed using the Cochrane Collaboration tool.

Results: Twelve studies (726 patients) met the inclusion criteria. With respect to the decrease in the degree of phlebitis, was found ichthammol glycerine, followed by heparinoids. As for degree of pain, sesame oil obtained the most marked reduction. In terms of degree of infiltration, heparinoids and ichthammol glycerine were the only products to achieve a statistically significant reduction. The most important limitations are the low quantity and quality of the trials included. Insufficient data are available to draw valid conclusions about the efficacy of any treatment.

KEYWORDS
intravenous infusions, peripheral catheter, phlebitis, therapeutic, topical administration

1 | INTRODUCTION

The peripheral venous catheter (PVC) is an extremely useful clinical device, which allows rapid and safe access to the bloodstream. It is one of the most commonly used resources for hospital in-patients (Parreira et al., 2020; Varghese & Kt, 2018). However, the use of PVCs has been associated with complications (Vendramim et al., 2020), the most notable being phlebitis (Di Nisio et al., 2015; Simin et al., 2019), followed by extravasation and, with a lower incidence, occlusion and catheter dislodgement (Simin et al., 2019). PVC-related phlebitis or thrombophlebitis is caused by the inflammation of tunica intima of a superficial vein by mechanical, chemical or bacterial sources (Ravindra & Patel, 2015). These aetiological factors are often simultaneously combined (Hidayah et al., 2017; Varghese &

Kt, 2018), and the origin of the phlebitis can, therefore, be difficult to determine.

There is no standard diagnosis or group of distinctive clinical criteria for PVC-related phlebitis. The most common signs and symptoms are pain, swelling, reddening, induration and a palpable cord in the affected area (Di Nisio et al., 2015; Hidayah et al., 2017; Zheng et al., 2014). The appearance of these symptoms makes it difficult to continue with the venous therapy and potentially causing discomfort for the patient (Takahashi et al., 2020). There is considerable disagreement as to its clinical incidence in the scientific literature (Packialakshmi & Vidhya, 2017; Varghese & Kt, 2018). One recent study (Lv & Zhang, 2020) reported an incidence rate of 31%. The considerable variations in the reported incidence rate are due to a number of factors, including a lack of consensus as to its assessment, and differences in study designs, participant selection and follow-up time (Mihala et al., 2018).

The prevention, early diagnosis and treatment of phlebitis constitute a fundamental part of the healthcare work of the nursing profession (Jourabloo et al., 2017; Varghese & Kt, 2018). It should be noted that in clinical practice various forms of treatment are available for PVC-related phlebitis: pharmacological interventions (anticoagulants, anti-inflammatories, vasodilators), phytotherapeutic products (chamomilla recutita, notoginseny, aloe vera) and/or physical measures (cold, heat) (Hidayah et al., 2017; Jourabloo et al., 2017; Martín et al., 2017; Varghese & Kt, 2018). Most of the therapies that are applied are topical, while systemic administration is only occasionally used (Di Nisio et al., 2015).

An analysis of the treatments and their possible effects on the symptoms associated to PVC-related phlebitis is of fundamental importance given the high incidence of phlebitis in the clinical context, the need to improve nursing knowledge with respect to this practice, and the risk that is entailed for the safety and well-being of the affected patient (Salgueiro-Oliveira et al., 2019). There are different systematic review studies (Dos Reis et al., 2009; Goulart et al., 2020; Martín et al., 2017; Zheng et al., 2014), which address this issue, but this is the first meta-analysis that exclusively analyses the effectiveness of different topical products. The study by Di Nisio et al. (2015) included topical, oral and parenteral treatments. The studies included in these systematic reviews, surprisingly, come mostly from the Eastern culture and are associated with research on phytotherapeutic products. On the other hand, all agree that the current available evidence is limited by poor methodological quality and variation in effect size between studies (Zheng et al., 2014). In addition, these coincide with the need to generate primary research, with more consistent clinical trials, which include larger samples and which allow for an adequate assessment of side effects after the application of treatment (Martín et al., 2017). There is no consensus about the optimal products despite the variety of treatments that are available. While it continues to be an important problem at a clinical level, the scarcity of studies on this topic is noteworthy.

The aim of the study is to systematically evaluate the efficacy of different topical treatments against PVC-related phlebitis in hospital in-patients.

2 | METHODS

2.1 | Design

This systematic review and meta-analysis were produced by using the guidelines of Cochrane Handbook for Systematic Reviews of Interventions (Higgins et al., 2019) and reported following the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement.

2.2 | Search methods

A literature search was carried out in CINAHL Plus, PubMed, Cochrane Plus, Cuiden, Scopus, Web of Science, WorldWideScience, ProQuest Dissertations & Theses and Joanna Briggs. With the aim of recovering unpublished documents, searches were also performed, with less structured procedures, of different books, protocols and monographs. Researchers in the field were also contacted. The bibliographic references of the systematic reviews which were found that considered the topical treatment of PVC-related phlebitis were also consulted (see Appendix S1: Detailed search formula).

In the electronic searches, MeSh terms, DeCs terms or free terms were used: "Phlebiti*", "Periphlebiti*", "Thrombophlebiti*", "Catheterization, Peripheral", "Infusions, Intravenous", "Drip infusion*", "Intravenous Infusion*", "Administration, Topical", "Therap*", "Treatment*". To create the search equations, appropriate keywords were selected for each database, and the Boolean operators for maximum sensitivity and specificity.

In accordance with the PICOS model (Sánchez-Meca & Botella, 2010) the following study selection and inclusion criteria were applied: (a) Participants: hospital in-patients with PVC-related phlebitis; (b) Interventions: topical treatments applied to treat the PVC-related phlebitis; (c) Comparison groups: in studies, which included comparison groups, untreated control groups were accepted; (d) Outcomes: the trials had to provide useful data in relation to any of the measures of the resulting degree of phlebitis, pain and infiltration (in general, means and standard deviations); and (e) Study designs: randomized clinical trials were accepted with or without a control group and quasi-experimental trials. Studies that considered systemic treatments or exclusively preventive measures were excluded. The search was limited to studies conducted in English and Spanish from inception to April 2020. The date of data collection was from December 2020 to May 2021.

2.3 | Search outcome

The search results were imported into the Mendeley programme version 1.19.4 (https://www.mendeley.com), using Excel version 16.16.27 as information manager. The initial selection phase and the subsequent review phase were performed by two members of the research team (JG and AA). Any disagreements were resolved with

the help of two other members of the team (JR and AT). All research team members were in continuous contact during the search process and the selection and inclusion of the articles. Cohen's Kappa index was calculated to verify interrater agreement.

2.4 | Quality appraisal

Risk of bias of the selected full-text articles was independently assessed by two reviewers (JA and JG) using the Cochrane Collaboration tool described in the Cochrane Handbook for Systematic Reviews of Interventions (Higgins et al., 2019). Differences between reviewers were resolved by LL and AT.

2.5 | Data extraction

The included studies were subjected to a characteristics extraction process through the application of a coding questionnaire, generating a registry protocol of moderator variables (Sánchez-Meca & Botella, 2010). These variables were classified in different categories: (a) extrinsic variables, which record year of publication and author/s; (b) methodological variables, such as sample size, study methodology, type of control group and the scale used to evaluate the symptoms associated to the phlebitis; and (c) substantive variables, containing information about the treatment, the subjects (age, gender) and the context (hospital unit) (Sánchez-Meca & Botella, 2010). To check the reliability of the coding process, 25% of all the meta-analysed studies were randomly selected and, subsequently, two members of the research team (JG and JR) independently coded this subset of trials. Any disagreements were resolved through consensus.

2.6 | Calculation of effect size and statistical analysis

All the studies were randomized and quasi-experimental clinical trials, but only two included a control group. Given the diversity of topical interventions that were included in the different studies, it was decided in this meta-analysis to use intervention group as the unit of analysis rather than the study. For each intervention group, the index of the effect size was defined as the difference between the means (DM) of the pre-test and post-test: $DM = M_{Pre} - M_{Post}$, where M_{Pre} and M_{Post} are the pre-test and post-test means, respectively. Positive *DM* values indicate an improvement of symptoms. The difference between the means was obtained from the various tools used (VIP Score, VAS, Infiltration Scale), according to the studied variable. The standard error (*SE*) was calculated for each DM through the formula: $SE_{DM} = SD / \sqrt{N}$, where *SD* and *N* are the standard deviation of the change scores and the sample size, respectively, of each intervention group. This index was also calculated for the two untreated control groups. For each intervention group, a 95% confidence interval was constructed around DM. To calculate DM and its SE, the means and SDs were extracted and the sample sizes of the trials.

A wide range of measurement tools were employed in the selected studies for each dependent variable. To measure the degree of phlebitis, the studies used the Visual Infusion Phlebitis (VIP) Score. Five stages of phlebitis are rated with the VIP Score, with the highest score (5) indicating the highest degree. Six symptoms are taken into account: pain, erythema, inflammation, induration, palpable venous cord and pyrexia (Ray-Barruel et al., 2014). Pain was measured using the Visual Analogue Scale (VAS), which ranges from a score of 0 (absence of pain) to 10 (maximum pain). Finally, infiltration was measured using the Infiltration Scale, which comprises values between 0 (no symptoms) and 4 (maximum degree).

Separate analyses were performed for each dependent variable (degree of phlebitis, infiltration and pain control). Given that heterogeneity between studies was expected, random effect models were applied, weighting each effect size by the inverse of its variance, with this being defined as the sum of the intra-study and inter-study variances. The statistical analysis process comprised calculation of the mean effect size with its 95% confidence interval, calculation of the *Q* statistic and the I^2 index to evaluate the degree of heterogeneity of the effect sizes around the mean effect. Forest plots were constructed to represent the results. Although initially the objective was to analyse the influence of the moderator variables on the effect sizes, the low number of studies made this unfeasible. All statistical analyses were performed with Review Manager 5.3.

3 | RESULTS

3.1 | Selection process

Through the aforementioned database search strategies, a total of 570 records were identified. The manual search that was also performed resulted in the selection of a further 336 records, making a total of 906.

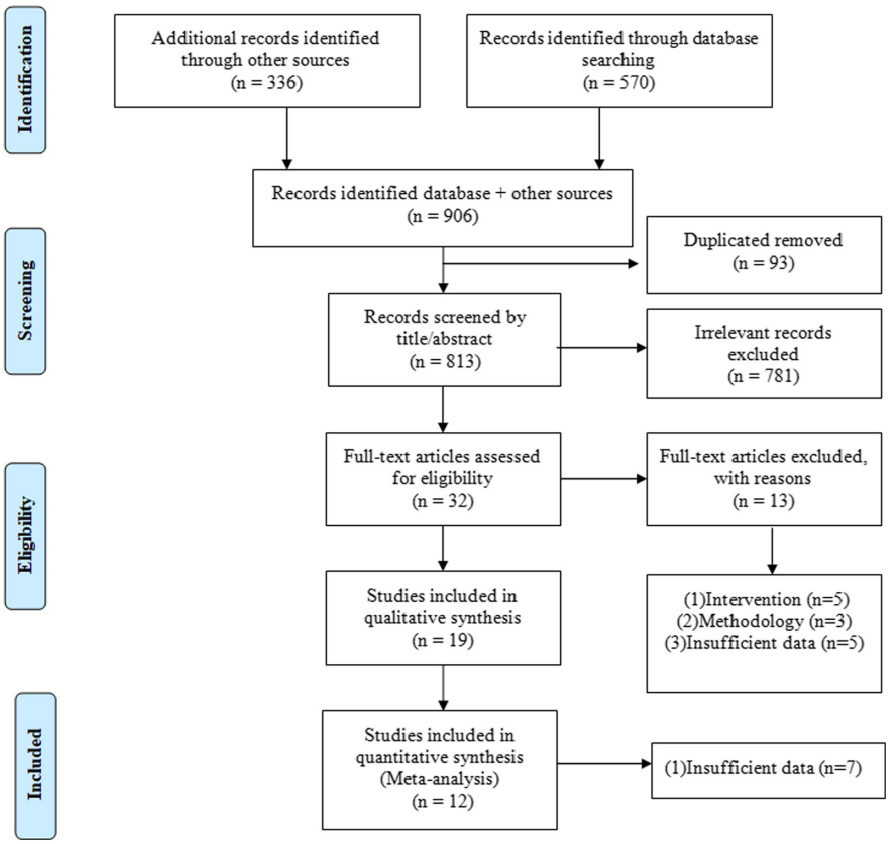
After eliminating duplicates, 813 articles were examined on the basis of their titles and Abstracts, with only 32 meeting the selection criteria. An analysis of the full text of the remaining articles was then performed and, after carrying out a qualitative synthesis, a total of 12 articles were included in the final selection. In the attempt to locate unpublished works, a total of 3 doctoral theses were also included (Blessly, 2012; Lalithambigai, 2018; Parthipan, 2012). The search process is summarized in the PRISM flow chart (Figure 1).

The reliability of the study selection process scored a mean value of 0.812 on Cohen's Kappa index, a highly satisfactory value.

3.2 | Characteristics of included studies

The intervention groups of the 12 studies included a total of 726 patients (minimum sample size = 15, maximum = 45, mean = 30). The studies were carried out in the following countries: India (*N* = 9), Iran

FIGURE 1 PRISMA flow chart



(*N* = 2) and Indonesia (*N* = 1). Mean age was 54.26, but only three studies reported it (Basu et al., 2017; Damanik, 2017; Jourabloo et al., 2017). On average, 43.36% of the study participants were women (minimum = 17, maximum = 60).

Of the 12 studies, 10 measured the degree of phlebitis (18 intervention groups and 2 control groups), 2 measured the degree of pain (4 intervention groups) and 2 of infiltration (3 intervention groups). Table 1 shows the database with the principal characteristics of the studies. Table 1.

3.3 | Risk of bias

Figure 2 represents details on the assessment of the risk of bias of the included articles. 50% of the studies had a low risk of bias for the generation of the randomization sequence. Of the studies, only one (Bigdeli Shamloo et al., 2019) adequately concealed the randomization process, while this risk was unclear in the other 11. As for the blinding of personnel and participants, 50% of the studies displayed a high risk of bias, while the risk was unclear in 33.3%.

One study (Basu et al., 2017) explicitly stated that data collection was performed by a blinded assessor with respect to the patient group. A total of 6 studies (50%) applied missing data imputation techniques, while 41.6% of the studies had inadequate information about one or more of the results of interest. None of the studies reported on the biases that their data were exposed to.

3.4 | Degree of phlebitis

The 18 intervention groups in which the degree of phlebitis was measured with the VIP Score applied ichthammol glycerine (Basu et al., 2017; Parthipan, 2012; Thomas et al., 2016), heparinoids (Basu et al., 2017; Parthipan, 2012; Thomas et al., 2016; Yambem et al., 2015), magnesium sulphate glycerine (Basu et al., 2017; Lalithambigai, 2018; Packialakshmi & Vidhya, 2017; Rukhsana et al., 2016; Yambem et al., 2015), aloe vera (Lalithambigai, 2018), cold (Rukhsana et al., 2016), heat (Blessly, 2012; Jourabloo et al., 2017; Shilpa et al., 2015) and calendula (Jourabloo et al., 2017).

Seven studies (13 intervention groups) (Basu et al., 2017; Jourabloo et al., 2017; Packialakshmi & Vidhya, 2017; Parthipan, 2012; Rukhsana et al., 2016; Shilpa et al., 2015; Thomas et al., 2016) included in the analysis of the degree of phlebitis reported on the days of application of the products, observation and assessment of the VIP scale. They all agreed on a period of 3 days, minus the studies carried out by Thomas et al. (2016) and Lalithambigai (2018) that have a 48 h follow-up and the Damanik (2017) only 1 day. The other two remaining studies (3 groups of intervention) (Blessly, 2012; Yambem et al., 2015) included in the analysis did not report on the days of follow-up or product application.

Figure 3 shows a forest plot with the results. Ichthammol glycerine had the highest statistically significant mean pre-test to post-test improvement ($DM_+ = 2.63$; $p = .001$), although high heterogeneity was observed between the three studies ($I^2 = 87\%$). The second highest statistically significant pre-test to post-test improvement

TABLE 1 Record of moderator variables

Extrinsic	Methodological						Substantive		
								Subject	
Author(s) and year	N[a]	Design type*	Phlebitis evaluation	Time	Control group type	Setting	Treatment**	% Female	Mean Age
Basu et al. (2017)	120	1	VIP Score	3 days	Active	Surgery unit	GI[1]: IG GI[2]: HP GI[3]: MSG	33.33	52.88
Jourabloo et al. (2017)	96	2	VIP Score	3 days	Inactive	Surgery unit	GI[1]: C GI[2]: WC	37.5	61
Parthipan (2012)	60	1	VIP score Infiltration Scale	3 days	–	Hospital units	GI[1]: IG GI[2]: HP	46.66	–
Packialakshmi and Vidhya (2017)	30	2	VIP score Infiltration Scale VAS score	3 days	–	Hospital units	GI: MSG	–	20–60 years
Thomas et al. (2016)	90	2	VIP score VAS score	3 days	–	General, surgical and orthopaedic units	GI[1]: IG GI[2]: HP	35.6	–
Yambem et al. (2015)	30	2	VIP score	–	–	Intensive care units	GI[1]: MSG GI[2]: HP	–	–
Lalithambigai (2018)	60	1	VIP score	2 days	–	Paediatric ward	GI[1]: AV GI[2]: MSG	36.65	1–12
Rukhsana et al. (2016)	30	2	VIP score	3 days	Active	Hospital units	GI: CA GC: MSG	53.35	GI: 53.5% 20–29Y GC: 40% 30–39Y
Blessly (2012)	30	2	VIP score	–	–	Paediatric unit	GI: HA	17	–
Shilpa et al. (2015)	80	2	VIP score	3 days	–	Hospital unit	GI: HA GC: NI	–	–
Bigdeli Shamloo et al. (2019)	60	1	VAS	7 days	Active	Oncology ward	GI: SO GC: MS	55	25–70
Damanik (2017)	40	1	VAS	1 day	Active	Oncology Ward	GI: SO GC: OH	60	48.92

*In the variable "Design type", 1 indicates experimental design (random assignment) and 2 indicates quasi-experimental design (non-random assignment).

**In the variable "Treatment", GI, intervention group; GC, control group; IG, indicates that this group in the study applied ichthammol glycerine; HP, heparinoid preparation; MSG, magnesium sulphate glycerine; C, calendula; WC, water compress; NT, notoginseny; AV, aloe vera; SO, sesame oil; MS, massage; HA, heat application; CA, cold application; NI, no intervention; OH: alcohol; N[a], total sample size in the post-test.

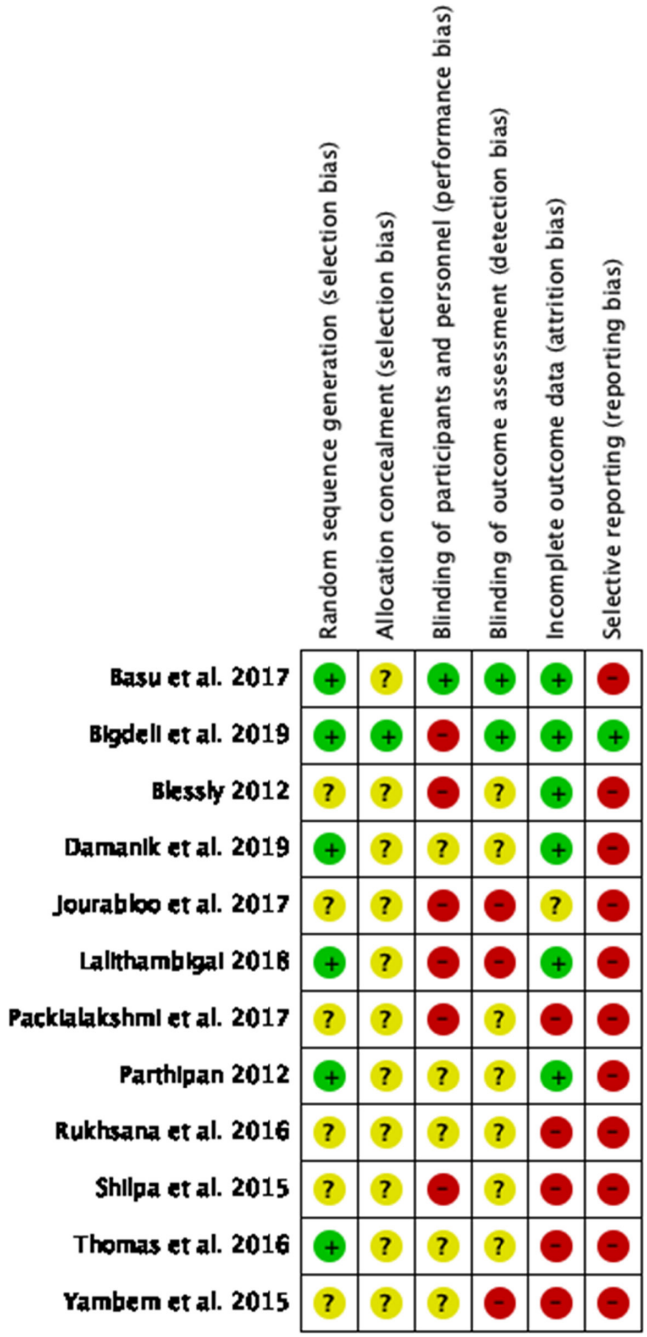


FIGURE 2 Risk of bias summary

was found with the heparinoids ($DM_+ = 2.15$; $p = .0002$), but again with high heterogeneity ($I^2 = 80\%$). The magnesium sulphate glycerine was the next most statistically significant effective treatment ($DM_+ = 1.99$; $p < .0001$) and additionally presented homogeneity between effect sizes ($I^2 = 0\%$). The only study which applied cold as active ingredient had a statistically significant DM of 1.74 ($p = .0005$), with the next highest statistically significant difference between means for the study which applied calendula (DM = 1.28; $p = .04$). The three studies which applied heat also obtained a statistically significant difference between means ($DM_+ = 1.17$; $p < .0001$). The only active ingredient which did not obtain a statistically significant pre-test to post-test improvement was the aloe vera (DM = 1.00, $p = .31$). The two control groups which did not apply any treatment showed a negative mean effect ($DM_+ = -0.34$), though not statistically significant ($p = .33$). When comparing the mean effects of all intervention types (including the control groups), statistically significant differences were observed between them ($\chi^2[7] = 34.97$, $p < .0001$; $I^2 = 80\%$). However, when the two control groups were removed from this analysis, no statistically significant differences were observed between the 7 intervention types ($\chi^2[6] = 7.55$, $p = .27$; $I^2 = 20.5\%$).

3.5 | Control of pain and infiltration

Two studies (4 intervention groups) measured the reduction in pain. Of the 4 intervention groups, 2 applied sesame oil (Bigdeli Shamloo et al., 2019; Damanik, 2017), 1 massage (Damanik, 2017) and the other alcohol (Bigdeli Shamloo et al., 2019). Figure 4 shows a forest plot with the results. All three intervention types had statistically significant mean effect sizes, with the most marked reduction in pain obtained with sesame oil ($DM_+ = 5.83$), followed by alcohol (DM = 3.77) and massage (DM = 1.85). In addition, statistically significant differences were observed between these three active ingredients in terms of the degree of pain reduction ($\chi^2[2] = 16.45$, $p = .0003$; $I^2 = 87.8\%$).

Only 2 studies were found (Packialakshmi & Vidhya, 2017; Parthipan, 2012) which included as a variable infiltration associated to the phlebitis. Three intervention groups were included: ichthammol glycerine (1 group), heparinoids (1 group) and magnesium sulphate glycerine (1 group). Figure 5 shows a forest plot with the results. Of the three treatments, two obtained a statistically significant improvement: heparinoids (DM = 3.11, $p < .0001$) and ichthammol glycerine (DM = 2.56, $p < .0001$). The effect of the magnesium sulphate glycerine was not statistically significant (DM = 0.80, $p = .15$). The comparison of the three effect sizes reached statistical significance ($\chi^2[2] = 11.37$, $p = .003$; $I^2 = 82.4\%$).

4 | DISCUSSION

The results are presented in this paper of the efficacy of diverse topical treatments with respect to symptoms associated to PVC-related phlebitis. For this purpose, the degree of phlebitis, pain and infiltration were considered. A total of 12 studies were selected which met the inclusion criteria for their selection and analysis, with a total of 726 patients and 24 intervention groups.

In this review the effectiveness of the degree of phlebitis were evaluated through the VIP Score. The VIP Score has been recommended by the INS given that it has content validity, interrater reliability and is clinically feasible (Gallant & Schultz, 2006). This recommendation may have promoted its use at global level, as it is the only scale employed in the studies included in this meta-analysis to assess the degree of phlebitis. But, there are a reported 71 different

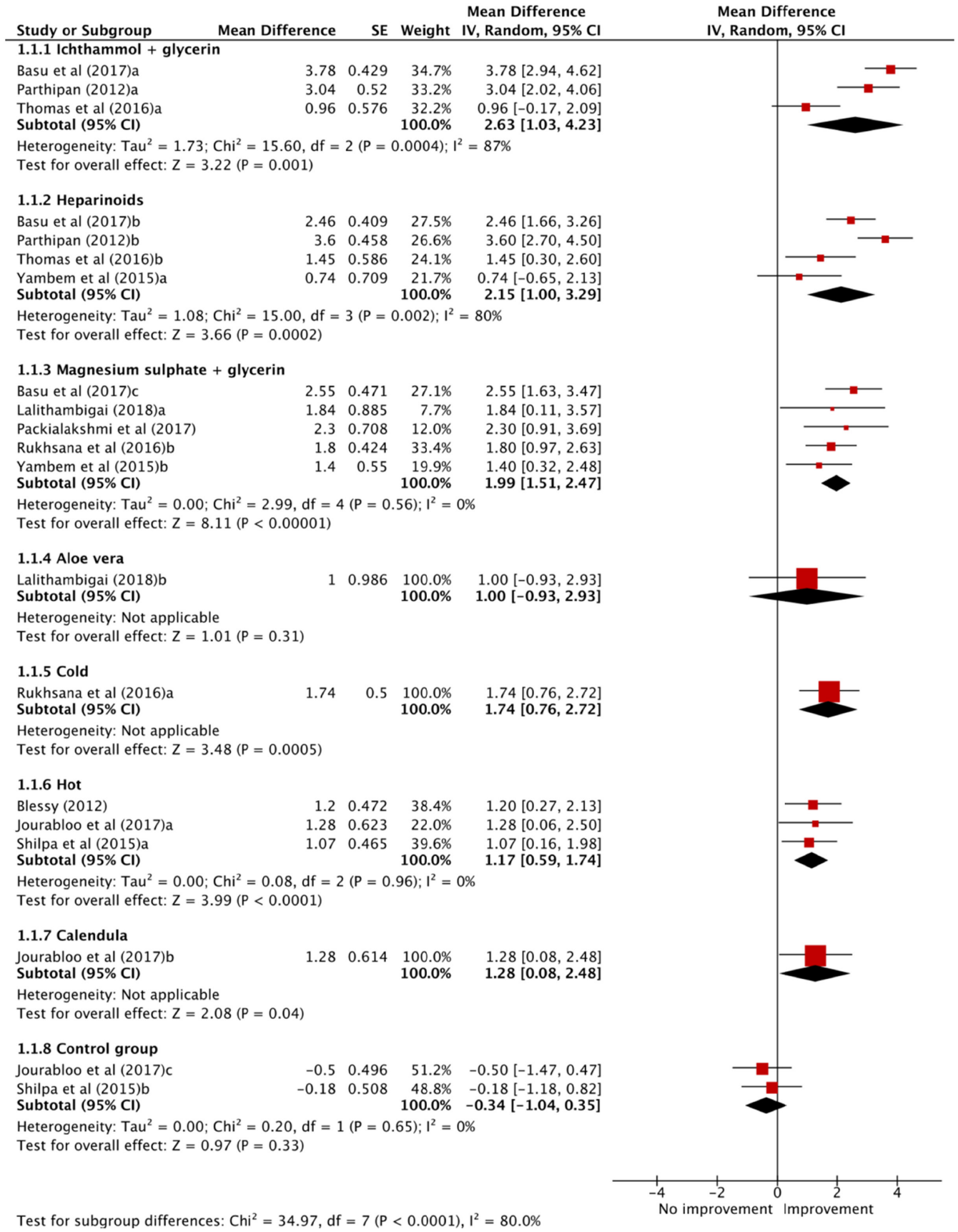


FIGURE 3 Multiple forest plots for the different treatments compared through the degree of phlebitis variable

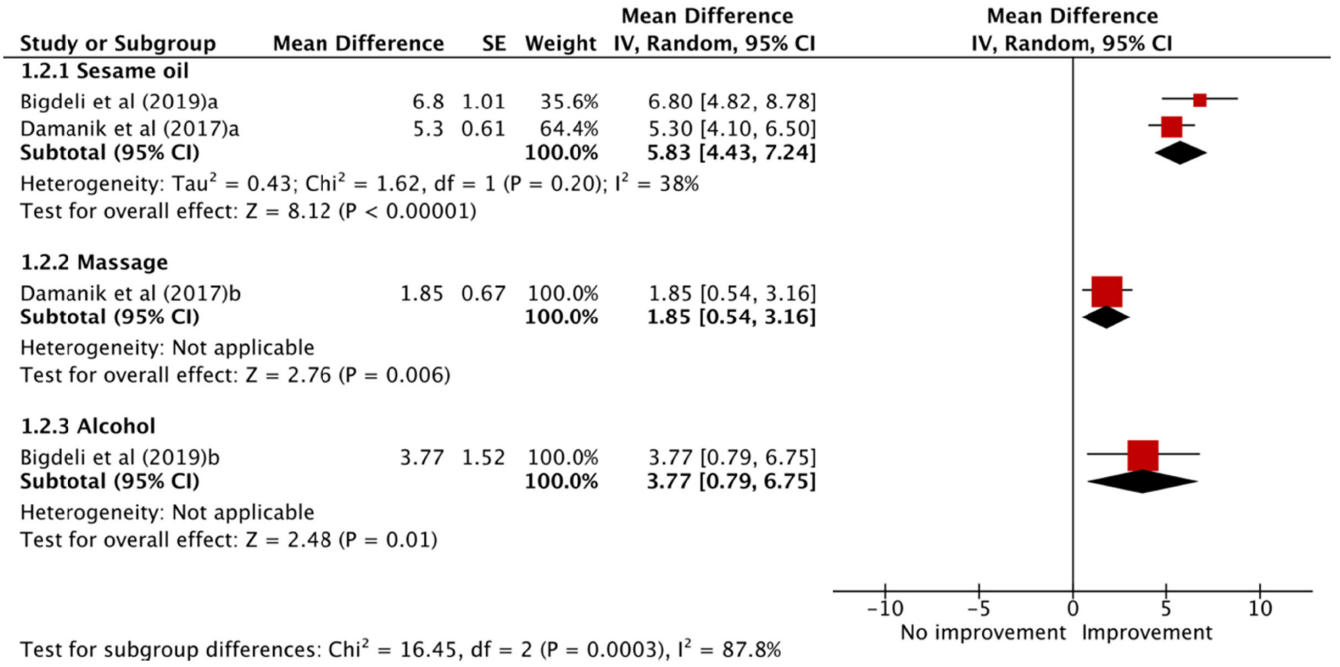


FIGURE 4 Multiple forest plots for the different treatments compared through the degree of pain variable

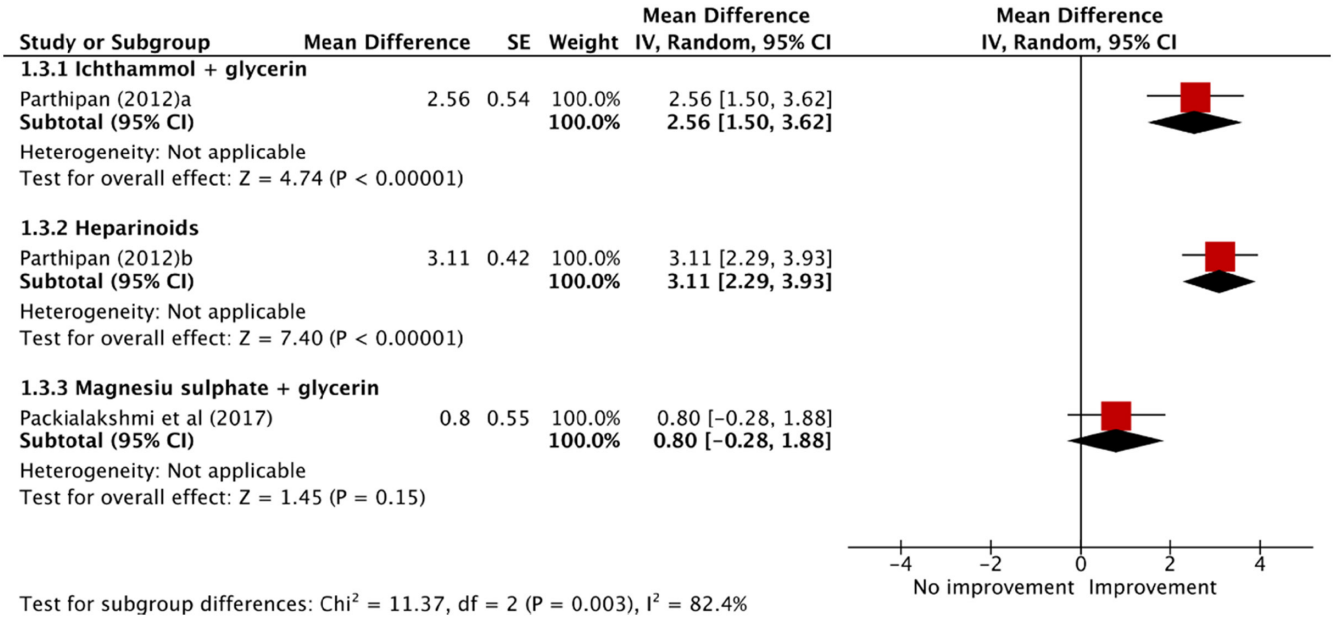


FIGURE 5 Multiple forest plots for the different treatments compared through the degree of infiltration variable

scales for phlebitis measurement, with major differences between them and no consensus about their use in clinical practice (Ray-Barruel et al., 2014).

The results between the product relationships established that ichthammol glycerine obtained the highest mean pre-test to post-test improvement, followed by the use of heparinoids, although the high degree of heterogeneity between the studies should be noted. Ichthammol glycerine has been used for its antibacterial, anti-inflammatory, analgesic and anti-fungal properties, but further studies with greater methodological rigour are required to support its clinical efficacy in PVC-related phlebitis (Parthipan, 2012). The results reported in this meta-analysis in relation to ichthammol glycerine concur with those of other previously published studies (Basu et al., 2017; Soloman et al., 2015).

The statistically significant improvement after treatment with heparinoids was due to the percutaneous anti-inflammatory and antithrombotic properties of its active ingredient, heparin (Soloman et al., 2015). The improvement reported in this review is supported by the findings of different trials (De Sanctis et al., 2001; Di Nisio et al., 2015; Mehta et al., 1975; Parthipan, 2012; Soloman

et al., 2015; Thomas et al., 2016). In contrast, a study carried out by Bergqvist et al. (1990) reported no statistically significant difference between the application of heparinoids and a placebo in the evolution of phlebitis. In a review by dos Reis et al. (2009), heparinoids were found to be as effective as topical anti-inflammatories, but less effective than notoginseny cream or nitroglycerine. A study by Parthipan (2012) reported a preference on the part of patients for heparinoids over ichthammol due to its mode of application, fragrance and a sensation of comfort. The positive effect in the treatment of phlebitis of magnesium sulphate glycerine is recognized to be due to its anti-inflammatory properties, and other studies have even reported better efficacy with this treatment than with heparinoids (Amuda et al., 2019) or cold compresses (Varghese & Kt, 2018).

With respect to the physical treatments, the beneficial effect of both cold and heat is surprising given the opposing effects of vasoconstriction and vasodilation. This contrast is evidenced in other studies, which report the benefit of both warm compresses (Hidayah et al., 2017) and cold compresses (Rukhsana et al., 2016). Calendula is another of the products analysed. Its anti-inflammatory effect has been recognized (Jourabloo et al., 2017). According to the results obtained, the only active ingredient, which did not result in a statistically significant improvement in the degree of phlebitis was aloe vera, although this finding contradicts those of other studies (Martín et al., 2017; Zheng et al., 2014). Importantly, however, all the studies consulted recommend further research into the use of this product.

The VAS was used to measure the degree of pain variable. According to the criteria of nursing professionals, the presence of pain at the site of insertion of the PVC is the fundamental clinical sign for the detection of phlebitis (Mihala et al., 2018; Salgueiro-Oliveira et al., 2019). The findings of this review show that sesame oil was the treatment that resulted in the most marked reduction of pain, followed by alcohol and massage. In line with these findings, other study have reported the efficacy of sesame oil for both the prevention and treatment of phlebitis (Mosayebi et al., 2017).

As for the degree of infiltration, heparinoids and ichthammol glycerine were the only products, which obtained a statistically significant improvement. Other studies have reported a positive effect of the application of cold and heat in terms of reducing the infiltration (Babu et al., 2016).

Finally, given that PVC-related phlebitis is a worldwide problem (Muniz Braga et al., 2018; Simin et al., 2019), it is somewhat surprising that all the studies that could be included in this review were Asian in origin. It is important to note that such studies are frequently associated to research into phytotherapeutic products (Di Nisio et al., 2015; Zheng et al., 2014). Products like notoginseny cream (and others) are not marketed in other contexts (Martín et al., 2017), and so this may be an important limiting factor for future studies. However, it is clear that phlebitis continues to be an unresolved issue in western culture given the high incidence of PVC-related phlebitis, the wide range of treatments and the scarcity of studies that tackle this problem in current research. This is made clear in the recommendation, based on the evidence for PVC-related phlebitis, made in different clinical practice guidelines such as Joanna Briggs Institut (JBI) or Registered Nurses' Association of Ontario (RNAO) for further investigation into this issue.

5 | RESEARCH LIMITATIONS

The main limitation of this meta-analysis is the low number of studies that met the selection criteria. This, together with the wide variety of treatments considered, meant that an analysis of the moderator variables (extrinsic, methodological, substantive) in all the included studies was not feasible. These variables may be related to the efficacy of the treatments applied and, therefore, to the results obtained, although this was one of the initial objectives of the study. For the same reason, sensitivity analyses could also not be performed, including verification of whether the publication bias could undermine the validity of the results of the meta-analysis.

Some of the trails selected in the study did not report on allocation concealment, nor on the number of patients who did not conclude or who abandoned the trial. In addition, the parameters included in various of the studies were incomplete and different patient grouping methods were employed. Likewise, differences in terms of patient characteristics or intervention time, among other potentially influential factors, were not analysed in the studies included in this review. Nonetheless, the results are valuable for future studies to provide details about the products and their therapeutic effects.

Finally, further studies and a consensus on phlebitis assessment are vital to allow progress not only in terms of its diagnosis but also on how best to prevent and treat this problem (Goulart et al., 2020).

6 | IMPLICATIONS FOR CLINICAL PRACTICE AND RESEARCH

The methodological deficiencies detected in the studies analysed in the present meta-analysis need to be resolved in future research in this field in order to increase the validity of the evidence (Goulart et al., 2020). Firstly, very few studies reported patient follow-up data. Secondly, factors should be reflected in the studies that could impact the evolution of the phlebitis (sociodemographic, comorbidities, personal or material), as the inclusion of such data would allow analysis of any variation in the benefits of the applied product. Thirdly, another recommendation for future studies would be to include a control group with pharmacological treatments, phytotherapeutic treatments, physical measures or a placebo in order to control for non-specific effects of the therapy.

We are, therefore, dealing with a still unresolved common problem due to its association with venous catheterization, which has negative implications for patient safety. It is of fundamental importance that treatments be based on the best evidence available, as this facilitates clinical decision-making and good nursing practices and optimizing results for the patients.

7 | CONCLUSIONS

On the basis of the results of this study, and considering the limitations that have been detailed, ichthammol glycerine and topical heparinoids are the products that most statistically significantly reduce the degree of phlebitis and infiltration. The product with the greatest efficacy in reducing pain is sesame oil. Finally, the undertaking of more trials with greater methodological quality and in different global contexts is strongly recommended.

CONFLICT OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request

ETHICAL APPROVAL

The meta-analysis study is exempt from ethics approval as the study authors collect and synthesizing data from previous clinical trials and other studies in which informed consent has already been obtained by the trial investigators.

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