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The effectiveness of aloe vera gel versus 2% chlorhexidine gluconate in preventing phlebitis from peripheral venous catheters: A randomized controlled trial

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Abstract

Background: While intravenous injections are essential in life-saving situations, their routine use can lead to various complications, particularly phlebitis, which negatively impacts patients' physical and psychological health. This research aims to evaluate the effectiveness of topical aloe vera gel compared to 2% chlorhexidine gluconate in preventing phlebitis associated with peripheral venous catheters.

Methods: This three-arm randomized controlled trial, executed in 2024 at a university-affiliated hospital situated in southern Iran, enrolled 90 hospitalized individuals receiving intravenous therapy. The study employed convenience sampling for participant recruitment, followed by permuted block randomization with a block size of six to allocate participants into three distinct groups, each comprising 30 patients. Aa (Aloe vera group): Disinfection with 70% alcohol, and the catheter fixation with an adhesive dressing impregnated with aloe vera gel; Bb (Chlorhexidine group): Disinfection with 70% alcohol and chlorhexidine, followed by fixation with a chlorhexidine-impregnated adhesive dressing; and C (Control group): Disinfection with 70% alcohol and standard adhesive dressing. The catheter insertion site was systematically evaluated for the incidence of phlebitis using a standardized phlebitis checklist at discrete time points: 12, 24, 36, 48, 60, and 72 hours post-sampling. Statistical analysis of the collected data was performed employing SPSS version 25 statistical software. A significance threshold of $\alpha = 0.05$ was adopted for all statistical tests, which included Chi-square tests and one-way analysis of variance (ANOVA).

Results: At 72 hours post-intervention, the incidence of phlebitis demonstrated a statistically significant disparity between the groups ($p = 0.005$). Conversely, no significant intergroup differences were evident in the manifestation of phlebitis symptoms at the 12-hour ($p = 0.999$), 24-hour ($p = 0.493$), 36-hour ($p = 0.493$), 48-hour ($p = 0.186$), and 60-hour ($p = 0.064$) time points after the intervention. Specifically, out of 30 participants in the aloe vera group, 12 (40%) remained asymptomatic for phlebitis-defined by the absence of redness, edema, pain, and vein induration-up to the 72-hour assessment. In comparison, the chlorhexidine group exhibited 5 (16.7%) patients, while the control group presented with only 2 (6.7%) patients who did not display phlebitis symptoms during this period.

Conclusion: Based on the observed outcomes, nurses may consider using aloe vera gel to reduce phlebitis in patients requiring catheterization for more than 48 hours, due to its anti-inflammatory properties and non-pharmacological benefits. However, this recommendation should be approached cautiously, pending further rigorous research to validate these initial findings and develop standardized guidelines. Future studies should investigate the long-term effects of aloe vera gel, compare its effectiveness with other interventions, and assess patient outcomes in various clinical settings to better understand its role in preventing phlebitis.

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Highlights

What is current knowledge?

- Peripheral intravenous catheterization is a routine procedure, and phlebitis is a common complication associated with it.
- Chlorhexidine solution is frequently utilized as an antiseptic to minimize the risk of catheter-related infections and phlebitis.
- Aloe vera possesses anti-inflammatory properties and has been utilized to either prevent or treat infusion phlebitis.

What is new here?

This research specifically assesses the effectiveness of aloe vera gel compared to chlorhexidine solution in preventing phlebitis caused by catheters. The results suggest that aloe vera gel may be as effective, or potentially more effective, than chlorhexidine in reducing both the occurrence and severity of phlebitis.

Introduction

Intravenous therapy constitutes a fundamental aspect of medical intervention and ranks among the most frequently executed invasive procedures, with approximately 80% of patients admitted to hospitals receiving this treatment during their hospitalization (1). Globally, the annual placement of intravenous catheters exceeds 500 million to facilitate the administration of efficacious therapies (2). Despite the critical role of intravenous injections in numerous life-saving scenarios (1), their extensive and routine application is associated with several patient-related complications. These encompass fluid extravasation, venous inflammation, edema, hemorrhage, and infections at the insertion site. Notably, phlebitis represents the most prevalent complication, whereas infections pose the most severe sequelae (3).

Phlebitis, defined by an inflammatory process affecting the tunica intima of blood vessels, clinically presents with localized erythema, pain, and edema at the site of vascular access, and may be accompanied by pyrexia in more pronounced instances (4). The etiology of phlebitis is multifactorial, with patient demographics such as age and gender, as

well as the temporal duration of catheter indwelling, identified as significant contributing factors (5). Epidemiological studies have reported a wide range of phlebitis prevalence rates, spanning from 0.1% to 63.6% in California (6), 20% to 80% in the United Kingdom (7), and 27% to 70% in Iran (6). It is noteworthy that the American Nurses Association (ANA) has established a phlebitis prevalence threshold of 5% or lower as an acceptable benchmark (3).

Phlebitis presents substantial clinical hazards, encompassing the potential for thrombus formation, thrombophlebitis, embolic events, and a reduction in the functional lifespan of indwelling venous catheters (8). This complication significantly impedes the delivery of intravenous therapies, leading to patient discomfort and pain, increased financial burdens on healthcare systems, inefficient allocation of staff resources, and the necessity for premature catheter removal. The frequent replacement of catheters not only depletes accessible venous insertion sites but also delays the timely administration of essential intravenous medications and consequently prolongs hospitalisation periods (9,10). Moreover, the presence of phlebitis constitutes a significant risk factor for systemic infections, elevating the probability of such infections by up to eightfold (11).

The skin microbiota at the catheter insertion site represents a significant reservoir of microorganisms that can translocate to the external surface of the catheter, leading to biofilm development and subsequent infection and phlebitis (12). This complication is observed in over half of catheterized patients and is recognized as a critical risk factor for severe infectious sequelae, particularly within intensive care unit (ICU) populations (13).

Complications arising from intravenous injections are often preventable (5), and nurses, as frontline healthcare providers, are crucial in both preventing and managing these occurrences. Despite progress in clinical settings, the selection of the optimal disinfectant for catheter insertion site maintenance remains a critical challenge. Certain investigations advocate for the application of chlorhexidine (14), emphasizing its prolonged antiseptic efficacy, which can extend to six hours or more, in contrast to other antimicrobial agents (15).

Studies indicate that the application of hydrocortisone filters, heparin, and anti-inflammatory gels can mitigate the incidence of phlebitis. Nevertheless, the widespread clinical adoption of these interventions has been limited due to concerns pertaining to their economic implications and safety profiles. Consequently, there is a salient demand for more accessible, safer, and economically viable alternatives (6). One potential strategy involves the utilization of aloe vera gel, which is well-documented for its therapeutic, anti-inflammatory, immunomodulatory, and hydrating properties (16).

Acknowledging the considerable incidence of phlebitis among hospitalized individuals and its detrimental effects on their physical and psychological well-being, it is critically important to identify more straightforward and efficacious prophylactic approaches. Consequently, this study was designed to evaluate and compare the efficacy of aloe vera gel and a 2% chlorhexidine solution against the conventional ethyl alcohol method in the prevention of phlebitis associated with peripheral intravenous catheters in patients within a hospital setting.

Methods

The present research employed a three-arm, single-blind, randomized controlled trial design, utilizing a post-test methodology. The primary outcome measured was the incidence of phlebitis symptoms in hospitalized patients undergoing intravenous therapy. Data on symptom occurrence were collected at 12-hour intervals over a 72-hour period (12, 24, 36, 48, 60, and 72 hours post-intervention). The research was conducted in 2024 at Amir al-Mo'menin Educational and Therapeutic Hospital, located in Zabol, Sistan and Baluchestan Province, Iran. The study population comprised 90 inpatients receiving intravenous therapy, recruited from three internal medicine wards. Participant enrollment commenced in April 2024.

The inclusion criteria for participation in this study mandated the provision of written informed consent. Participants were required to be within the age range of 20 to 70 years and possess healthy upper extremities, with no evidence of pre-existing phlebitis at the intended catheter insertion site prior to its placement, no history of anticoagulant use, skin disorders, acute or chronic infections, severe anemia, glaucoma, or hypotension (Defined as systolic blood pressure <100 mmHg), and no vasculitis, vascular involvement, diabetes, immune deficiency disorders, chemotherapy, or intravenous nutrition. Exclusion criteria encompassed patients who were discharged from the hospital within the initial three days after the intervention's commencement, those who revoked their consent or expressed unwillingness to continue their participation, instances of catheter rupture or removal prior to the 72-hour mark, pregnant individuals, cases where the patient's condition deteriorated for any reason, and individuals concurrently receiving two or more distinct antibiotic therapies.

Sample size calculation

According to a study conducted by Mohammadyan et al. (6), the sample size for each group was calculated using a 95% confidence level and an 80% test power. The required sample size was derived from the formula

$$N = \frac{C+[(1-p1)+p2(1-p2)}{(p2-p1)^2},$$

which indicated that 25 participants were needed per group. Here, C = 7.9 is a constant based on the confidence level and statistical considerations, while p1 = 0.20 represents the event proportion in the control group, and p2 = 0.56. The proportion of the event within the intervention group was considered. To account for a potential attrition rate of 20%, the final sample size for each of the three study arms was adjusted to 30 participants, resulting in a total sample of 90 individuals. This comprised 30 participants in the aloe vera gel group, 30 in the chlorhexidine group, and 30 in the control group.

Sampling and randomization method

In this study, the selection of eligible patients was conducted via convenience sampling. Notably, the three study groups were homogeneous with respect to the type and volume of intravenous fluids (Serum) administered, the pharmacological agents used within a 24-hour period, the therapeutic protocols implemented, and the specific diseases under investigation. A permuted block randomization method was employed to randomly allocate the study participants into three distinct intervention groups: Aa (Receiving the aloe vera intervention), Bb (Receiving the 2% chlorhexidine intervention), and C (Serving as the control group). To ensure balanced group sizes throughout the enrollment process, blocks of four participants were utilized. All six participants were aggregated into a single block for the randomization procedure. Each experimental unit was identified by a unique alphanumeric code. These codes corresponded to specific genetic combinations: AaAaCCBbBb, CAaAaBbBbC, and CAaCAa. From a total sample of 90 participants, 15 blocks, each comprising six individuals, were selected. As an illustration, within the AaAaCCBbBb block, four participants were randomly assigned to one of three intervention groups: Aloe vera, control, or 2% chlorhexidine. The group assignments were distributed within sealed envelopes based on a computer-generated randomization schedule. Subsequently, the researcher opened these envelopes in a sequential manner, leading to the random allocation of participants to either the intervention or the control group. All procedural steps were executed utilizing dedicated randomization software and under the direct supervision of a qualified statistician. Furthermore, given the single-blind design of the study, both the active and placebo substances were prepared with indistinguishable coatings to prevent participant identification.

Intervention implementation method

Prior to commencing the intervention, the administering nurse adhered to established hand hygiene protocols, which included a 30-second hand wash with soap and water, followed by the application of non-sterile gloves as a personal protective measure. Within the aloe vera gel intervention group, the intended catheter insertion site underwent initial disinfection using a 70% ethyl alcohol solution. Subsequent to the complete evaporation of the alcohol, a 22-gauge angiocatheter was introduced, and its position was stabilized through the application of an angiocatheter securement adhesive. Finally, 0.5 cc of aloe vera gel (Kaman brand, manufactured by Silaneh Sabz Company) was topically applied to the superior aspect of the aforementioned adhesive.

In the chlorhexidine solution intervention group, the insertion site underwent a comparable disinfection protocol using 70% ethyl alcohol, followed by a drying period before the placement of a 22-gauge angiocatheter. Subsequently, the catheter was affixed utilizing an angiocatheter adhesive that had been impregnated with 0.5 cc of a 2% chlorhexidine solution (Behban Chemi Pharmaceutical Company).

In the control group, the procedural site for catheter insertion underwent disinfection solely with a 70% ethyl alcohol solution. Subsequently, the catheter was affixed utilizing the institution's standard adhesive securement protocol. Documentation included the precise date and time of the procedure, along with the identification of the responsible researcher.

The insertion sites were monitored every 12 hours for a 72-hour period following catheter placement to detect any indications of phlebitis, which were documented dichotomously (Yes/No). Across all experimental groups, intravenous fluid administration sets were replaced at 24-hour intervals, and the indwelling time of the catheters was capped at 72 hours. To maintain blinding, two ostensibly identical coating materials were employed to prevent patient identification. All catheter insertions were performed on the forearm to mitigate the likelihood of catheter failure. The angiocatheter insertions were executed by a registered nurse with a decade of professional experience within the internal medicine department.

Data were collected using a demographic and medical information form, which comprised four items assessing age, gender, serum and medication type, and pre-existing conditions, including diabetes mellitus, dermatological

disorders, and hypertension. The diagnosis of phlebitis was evaluated based on the Phlebitis Diagnosis Checklist developed by the Iran Nursing Association.

Content validity was established in order to ensure the scientific validity and reliability of the questionnaire. The questionnaire was first developed and subsequently evaluated by faculty members at Zabol University of Medical Sciences. Their expert opinions and recommendations were then integrated into the finalized version of the questionnaire.

To evaluate the consistency of the phlebitis occurrence tool, inter-rater reliability was assessed. Two independent raters observed ten patients, employing the same standardized procedure, to determine the level of agreement in their evaluations.

The data underwent analysis utilizing SPSS version 25, with a threshold for statistical significance established at $p < 0.05$. Descriptive statistical methods, specifically the calculation of means, standard deviations, frequencies, and percentages, were employed to synthesize the dataset. Given the binary nature of phlebitis occurrence (Yes/No), the assumption of normal distribution was not evaluated. To compare baseline characteristics between groups, Chi-square tests and one-way analysis of variance (ANOVA) were utilized. Given that the primary outcome variable, the incidence of phlebitis, was a binary categorical variable (Yes/No), between-group comparisons were conducted using either Chi-square or Fisher's exact tests. Within-group comparisons for this outcome were performed using Cochran's Q-test. To mitigate data loss, data entry was performed directly into SPSS immediately following data collection. Due to the qualitative nature of the primary outcome variable, the calculation of effect size is not applicable, and consequently, a confidence interval cannot be provided. Furthermore, no confounding variables were identified in this study.

Results

The mean age and standard deviation of patients included 45.46 ± 11.76 years in the control group, 46.47 ± 16.85 years in the aloe vera group, and 45.16 ± 9.76 years in the chlorhexidine group. A majority of the participants in the chlorhexidine group were male (50%), while the aloe vera group predominantly consisted of females (66.7%). Baseline demographic characteristics showed no statistically significant differences ($P > 0.05$) across the groups, indicating homogeneity at the study's outset (Table 1).

A statistically non-significant difference in phlebitis symptoms was observed across the evaluated groups at 12 ($p = 0.999$), 24 ($p = 0.493$), 36 ($p = 0.493$), 48 ($p = 0.186$), and 60 hours ($p = 0.064$) post-intervention. However, a statistically significant disparity in the incidence of phlebitis was identified between the groups at the 72-hour post-intervention assessment ($p = 0.005$). A statistically significant increase in phlebitis incidence was noted across all groups from the 12-hour to the 72-hour mark post-intervention ($p = 0.001$). Notably, the aloe vera group exhibited the lowest rate of phlebitis, followed by the 2% chlorhexidine group, which demonstrated a lower incidence compared to the 70% alcohol group (Table 2).

Table 1. Participants' demographic characteristics at baseline (N = 90)

Characteristic	Groups			P-Value
	Control (N = 30)	Chlorohexidine (N = 30)	Aloe Vera (N = 30)	
	Mean ± SD	Mean ± SD	Mean ± SD	0.762**
Age (Year)	46.47 ±16.85	45.16 ±9.76	45.46 ±11.76	
Gender	N (%)	N (%)	N (%)	0.387*
Male	10 (33.3)	15 (50)	14 (46.7)	
Female	20 (66.7)	15 (50)	16 (53.3)	
Hypertension	N (%)	N (%)	N (%)	
Yes	17 (56.7)	15 (50)	17 (56.7)	0.836*
No	13 (43.3)	15 (50)	13 (43.3)	
Dermatological problem	N (%)	N (%)	N (%)	
Yes	0 (0)	0 (0)	0 (0)	1
No	30 (100)	30 (100)	30 (100)	
Diabetes	N (%)	N (%)	N (%)	
Yes	0 (0)	0 (0)	0 (0)	1
No	30 (100)	30 (100)	30 (100)	

*: P-value conducted from Chi-square test.
**: P-value conducted from one-way analysis of variance (ANOVA) test

Table 2. Between-group comparisons of participants' phlebitis rates (N = 90)

Phlebitis	Groups			P-Value
	Aloe vera (N=30) n (%)	Chlorohexidine (N=30) n (%)	Control (N=30) n (%)	
12 hours after the intervention				
Yes	1 (3.3)	1 (3.3)	2 (6.7)	0.999*
No	29 (96.7)	29 (96.7)	28 (93.3)	
24 hours after the intervention				
Yes	2 (6.7)	1 (3.3)	14 (13.3)	0.493*
No	28 (93.3)	29 (96.7)	26 (86.7)	
36 hours after the intervention				
Yes	2 (6.7)	1 (3.3)	4 (13.3)	0.493*
No	28 (93.3)	29 (96.7)	26 (86.7)	
48 hours after the intervention				
Yes	3 (10)	4 (13.3)	8 (26.7)	0.186**
No	27 (90)	26 (86.7)	22 (73.3)	
60 hours after the intervention				
Yes	9 (30)	13 (43.3)	18 (60)	0.064**
No	21 (70)	17 (56.7)	12 (40)	
72 hours after the intervention				
Yes	18 (60)	25 (83.3)	28 (93.3)	0.005**
No	12 (40)	5 (16.7)	2 (6.7)	

*: P-value conducted from Fisher exact test (Between-group comparison).
**: P-value conducted from Chi-square (Between-group comparison).

Discussion

The current research aimed to evaluate and compare the effectiveness of aloe vera gel and a 2% chlorhexidine gluconate solution in the prevention of phlebitis associated with peripheral intravenous catheters in hospitalized patients. The findings indicated a superior prophylactic effect of aloe vera gel over the 2% chlorhexidine solution in mitigating the incidence of phlebitis, as evidenced by the distributional frequency of phlebitis across the different intervention cohorts.

The homogeneity of the groups concerning demographic characteristics is noteworthy, as no statistically significant between-group differences were identified. Random assignment was implemented to mitigate between-group variability and control for potential confounding variables, thereby enhancing the likelihood that the observed outcomes can be attributed to the experimental interventions rather than extraneous factors.

The frequency distribution of phlebitis across the studied groups at 12, 24, 36, and 60 hours post-catheterization revealed no statistically significant between-group differences in phlebitis incidence. This homogeneity in outcomes may be attributed to the researcher's implementation of a standardized catheterization protocol, strict adherence to aseptic techniques, and consistent securement of the catheters. This interpretation is supported by analogous findings reported in the work of Poormohammadi et al. (3).

The findings demonstrated that an increase in catheterization duration correlated with a higher incidence of phlebitis in the chlorhexidine group compared to the aloe vera gel group; however, this difference was statistically significant. This outcome suggests that chlorhexidine solution exhibits effectiveness in mitigating phlebitis in the short term. Similarly, a study by Poormohammadi et al. (2015) investigating the efficacy of 2% chlorhexidine gluconate solution in preventing phlebitis associated with peripheral venous catheters also reported a statistically non-significant difference (3), which is consistent with the results of the current study.

Poormohamadi et al. (2017) reported no statistically significant difference in the intensity and incidence of phlebitis between the intervention and control groups at 24, 48, and 72 hours post-intervention (3), a finding that aligns with the results of the current study. Conversely, Tayibi Miyane et al. (2019) found that chlorhexidine was significantly more effective in preventing phlebitis in neonates compared to povidone-iodine and alcohol solutions at the 48-hour mark after the intervention (17). This observation stands in contrast to the findings of the current research.

Abdollahi et al. (2014) also conducted a comparative analysis between chlorhexidine and 70% alcohol in the context of phlebitis prevention. Their observations revealed a lower incidence of phlebitis in the chlorhexidine group (17 cases) compared to the alcohol group (32 cases), indicating a statistically significant superior efficacy of chlorhexidine in this regard (18). Furthermore, Sarani et al. (2018) investigated the impact of alcohol, chlorhexidine, and a combination of both on catheter-related local infections. Their findings demonstrated that the alcohol-chlorhexidine combination group experienced a significantly reduced rate of local infections, providing additional evidence for the effectiveness of chlorhexidine in specific applications (19).

Statistical analysis of the phlebitis frequency distribution at the 72-hour post-catheterization time point revealed a statistically significant between-group variance. This finding suggests that the application of aloe vera gel exhibited superior efficacy compared to both chlorhexidine and alcohol in mitigating the occurrence of phlebitis. The observed effectiveness of aloe vera gel in the current study aligns with the outcomes reported in several extant studies that have similarly documented its utility in the management of phlebitis. A meta-analysis conducted by Gao et al. (2016) investigated the impact of aloe vera on chemotherapy-induced phlebitis, concluding that aloe vera presents promising clinical utility in both the prevention and management of this condition (20). Similarly, according to some study outcomes, aloe vera demonstrated superior effectiveness in preventing phlebitis compared to other antiseptic agents, including 2% chlorhexidine, magnesium sulfate, and 70% alcohol. This observation aligns with the findings of the present investigation (6-21).

Hajiabadi et al. (2021) conducted a comparative analysis of aloe vera compresses and warm compresses concerning their impact on the severity of phlebitis and concomitant pain in pediatric inpatients. The results of their research indicated a statistically more pronounced amelioration of both phlebitis severity and pain intensity in the group receiving aloe vera compresses as opposed to the group treated with warm compresses (22). Despite a comprehensive literature review, no studies were found to contradict the findings of this investigation. The results of the current research suggest that the duration of catheterization is a significant determinant in the development of phlebitis associated with intravenous therapy. Evidence indicates a substantial increase in the risk of phlebitis with prolonged catheter dwell time. This observation is consistent with prior research (4).

Evidence suggests a significant positive correlation between the length of indwelling venous catheterization and the occurrence of phlebitis (12,23,24). Specifically, research indicates that the prevalence of phlebitis is approximately 9% in cases where a venous catheter remains in situ for under 24 hours. This proportion escalates to 37% when the catheterization period extends beyond 24 hours, reaching 50% with catheterizations exceeding 72 hours (4). These findings highlight the critical need to limit the duration of catheter placement to mitigate the risk of phlebitis.

This study's findings indicate a statistically significant reduction in the incidence of phlebitis within the group treated with aloe vera gel when compared to both the chlorhexidine and control groups. These results likely underscore the therapeutic benefits of aloe vera gel, particularly in mitigating phlebitis development during prolonged indwelling catheterization exceeding 48 hours. Considering current clinical guidelines that recommend routine replacement of venous catheters every 72 hours, the application of aloe vera gel presents a potential strategy to extend this interval in patients necessitating long-term catheterization. This approach could constitute a cost-effective intervention by alleviating both financial strain and patient discomfort.

The beneficial effects observed with aloe vera gel can be scientifically explained by its diverse array of bioactive constituents. These include anthraquinones, carbohydrates, enzymes, mineral compounds (Such as iron, copper, and potassium), non-essential amino acids (e.g., alanine), proteins, and vitamins (e.g., thiamine). Functionally, these components exhibit anti-inflammatory actions, promote the acceleration of tissue regeneration, and contribute to the attenuation of venous damage, thereby playing a role in reducing phlebitis incidence (25).

In conclusion, the integration of aloe vera gel into clinical protocols presents a promising, secure, and efficacious approach for mitigating complications associated with catheterization and thereby elevating the standard of venous care administered by nursing professionals. These findings furnish significant insights that could inform the refinement of current healthcare guidelines and contribute to improved patient outcomes in cases necessitating prolonged catheter use.

This study is subject to several limitations that warrant consideration. Firstly, the confinement of the research to a singular treatment facility may have introduced potential biases stemming from the institution's specific protocols and healthcare delivery models. To enhance the external validity and applicability of the findings, future research should consider expanding the study to encompass multiple hospital settings. Secondly, while all catheter insertions were performed by experienced nurses possessing a minimum of 10 years of clinical practice, it is plausible that variations in individual proficiency or situational factors could have influenced the observed outcomes.

Thirdly, despite attempts to standardize the experimental conditions, the presence of uncontrolled variables, such as heterogeneity in patient immune function or varied individual responsiveness to the administered intervention materials, may have influenced the observed outcomes. Fourthly, the established inclusion criteria, for instance, the exclusion of individuals with diabetes mellitus or those receiving specific medications, may have constrained the applicability of the findings to a more extensive patient demographic, thereby limiting the generalizability of the results to individuals exhibiting diverse medical profiles.

To overcome these inherent limitations, future research should prioritize the inclusion of a more heterogeneous spectrum of healthcare environments and patient demographics. Furthermore, the adoption of research designs that meticulously account for these confounding variables will help establish the robustness and enhance the generalizability of the resultant findings.

Conclusion

Based on these findings, nurses may find it advantageous to consider topical application of aloe vera gel as a potential non-pharmacological intervention to mitigate the incidence of phlebitis in patients requiring extended indwelling catheterization (Exceeding 48 hours), given its established anti-inflammatory properties. However, this recommendation warrants cautious interpretation, pending further rigorous investigation to corroborate these preliminary outcomes and to establish standardized application protocols. Future research endeavors should focus on elucidating the long-term effects of aloe vera gel, comparatively evaluating its effectiveness against existing preventative strategies, and assessing patient outcomes across diverse clinical populations to achieve a more comprehensive understanding of its role in phlebitis prophylaxis.

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Ethical statement

This study received ethical approval as part of a broader research initiative from the Ethics Committee of Zabol University of Medical Sciences, located in Sistan and Baluchestan, Iran (IR.ZBMU.REC.1401.152). The ethical aspects of the research were rigorously reviewed, supervised, and ultimately endorsed by this committee. Furthermore, the project was prospectively registered in the Iranian Registry of Clinical Trials (IRCT20231108059996N1) on December 5, 2023. Prior to their involvement, all participants received comprehensive information regarding the study's objectives, interventional strategies, and methodological framework. Subsequently, documented informed consent was secured from each participant, thereby authorizing their inclusion in the research and the potential dissemination of the findings. Participants were explicitly guaranteed the prerogative to withdraw from the study at any point without consequence, and the confidentiality of their data was assured.

Conflicts of interest

The authors declare that they have no conflict of interest.

Author contributions

HNM: Idea Formation, Study Design, Data Collection, Drafting the Initial Manuscript, Finalizing the Manuscript. RM: Idea Formation, Study Design, Drafting the Initial Manuscript, Finalizing the Manuscript. A.A: Study Design, Data Analysis, Finalizing the Manuscript. NFM: Idea Formation, Study Design, Drafting the Initial Manuscript, Finalizing the Manuscript.

All authors have perused and endorsed the final manuscript. Furthermore, each author assumes accountability for the veracity of the data presented and the precision of the statistical analyses conducted.

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