

Original Contributions

Efficacy of a Vapocoolant Spray in Reducing Pain During Capillary Glucose Testing: A Randomized Crossover Trial

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Abstract—Background: Capillary blood glucose measurement is frequently performed in emergency departments but may cause pain and discomfort. Vapocoolant spray is a rapid, non-invasive, and low-cost analgesic option, although its effectiveness during glucose testing remains insufficiently studied. **Objective:** This study aimed to investigate the pain-relieving effect of vapocoolant spray during blood glucose measurement. **Methods:** This study was a single-center, randomized, placebo-controlled crossover study conducted in the emergency department of a tertiary care hospital. Adult patients requiring at least 2 capillary glucose measurements were included. Patients received a vapocoolant spray and a placebo spray containing sterile water prior to the glucose measurement in a randomized sequence. The primary outcome was pain perception assessed immediately after each measurement using a 100-mm Visual Analog Scale (VAS). **Results:** Of the 109 patients evaluated, 80 were randomized, and 77 completed both measurements for the paired primary analysis. The median age of the patients was 65 years (interquartile range [IQR], 58–72), and 55.0% were male. The median VAS score was 29 mm (IQR, 18–43) with the vapocoolant spray, compared to 40 mm (IQR, 31–56) with the placebo. The vapocoolant spray significantly reduced pain, within-subject percent reduction in pain was 33.3% (IQR, 14.8%–47.3%, $p < 0.001$). No serious adverse events were observed during the study, and all observed adverse effects were mild and transient. **Conclusion:** Vapocoolant spray significantly reduced pain during capillary blood glucose testing and was well tolerated. Its rapid and practical application may improve patient comfort during this common emergency department procedure. Trial

registration: ClinicalTrials.gov Identifier: NCT06789055 © 2026 Elsevier Inc. All rights are reserved, including those for text and data mining, AI training, and similar technologies.

Keywords—vapocoolant spray; capillary blood glucose testing; pain; emergency department; procedural analgesia; visual analog scale

Introduction

Capillary blood glucose measurement is an essential procedure in emergency departments (EDs) for the assessment and management of many patients (1). Although it is routine, the skin puncture required for this test can cause varying degrees of discomfort or pain in patients (2). Pain management during minor procedures is often overlooked in busy ED settings; however, it supports broader goals such as enhancing patient comfort, improving quality of care, and reducing procedure-related stress (3).

Non-pharmacological interventions, such as topical cooling with a vapocoolant spray, offer a simple, affordable, and rapid approach to pain relief (4). Vapocoolant spray reduces pain sensation by inducing rapid skin cooling, which temporarily numbs sensory nerve endings (5). Previous studies have shown it to help reduce pain during procedures such as IV catheterization, injections, vaccinations, and blood gas sampling (6–9). However, its use in reducing pain during capillary blood glucose testing has

not been sufficiently studied. Since this procedure is common and can cause discomfort, it is important to evaluate whether vapocoolant spray, a non-invasive and low-cost option, is effective in this setting.

This study aimed to evaluate the efficacy of vapocoolant spray in reducing pain during capillary blood glucose measurements. The findings may inform patient care practices in emergency settings and influence standard pain management strategies for routine procedures.

Materials and Methods

Study Design and Settings

This study was a single-center, randomized, controlled crossover trial with a 1:1 allocation ratio, conducted in the Emergency Department of Bolu İzzet Baysal Training and Research Hospital. University Clinical Research Ethics Committee approved the study protocol (protocol number: 2024/384), and the trial adhered to the Declaration of Helsinki.

In reporting the study, the Consolidated Standards of Reporting Trials (CONSORT) guidelines (10) were followed, and the study was registered at ClinicalTrials.gov under the identifier NCT06789055.

Participants

Eligible participants were patients aged 18 years or older scheduled for at least 2 capillary blood glucose measurements for any clinical indication during their ED visit, and those who provided informed consent to participate in the study. Before enrollment, patients were asked whether they had any ongoing pain. Patients with any pre-existing pain were not included, as this could interfere with the assessment of procedure-related pain during capillary blood glucose measurement. Exclusion criteria were: (1) known allergy to vapocoolant spray components, (2) conditions affecting pain sensation (e.g., peripheral neuropathy, peripheral arterial disease), (3) cognitive impairments precluding visual analog scale (VAS) use (e.g., dementia, Alzheimer's disease), and (4) severe concurrent conditions that could confound pain evaluation (e.g., acute trauma or administration of analgesics in the ED). Participants were enrolled consecutively from the emergency department patient population during routine clinical care. Enrollment began on March 10, 2025, and was completed on March 14, 2025, upon reaching the target sample size.

Groups and Interventions

Participants underwent a standardized protocol for capillary blood glucose testing (11) and received both in-

terventions (vapocoolant spray and placebo) in a randomized sequence in 2 different blood glucose measurements. Patients were randomly allocated into 2 groups:

- **Group 1:** For the first capillary blood glucose measurement, a placebo (sterile water) was sprayed onto the designated measurement site prior to the glucose testing procedure. For the second measurement, a vapocoolant spray was applied to the corresponding site on the contralateral hand before the glucose testing procedure.
- **Group 2:** For the first capillary blood glucose measurement, a vapocoolant spray was applied to the designated measurement site prior to the glucose testing procedure. For the second measurement, a placebo (sterile water) was sprayed onto the corresponding site on the contralateral hand before the glucose testing procedure (Fig. 1).

The crossover design allowed each participant to serve as their own control and minimized potential acclimatization effects associated with repeated capillary glucose testing. To address the possibility that the second measurement might be better tolerated due to reduced anticipatory anxiety and increased familiarity, the sequence of interventions was randomized to distribute this order effect equally between study conditions (12,13). Procedural comparability was maintained by performing the second measurement on the contralateral hand's corresponding finger according to the assigned sequence; for example, if the right index finger was used first, the left index finger was used for the second measurement. Finger selection for the initial glucose measurement was not otherwise restricted, and no additional punctures beyond those clinically indicated were performed. Given the highly localized and brief duration of action of ethyl chloride spray, any residual treatment effect between measurements was considered negligible.

Intervention Procedures

1) Spray applications

Patients underwent spray application to the designated measurement site prior to capillary blood glucose measurement, according to their assigned groups.

Vapocoolant spray application:

A vapocoolant spray containing ethyl chloride (Shutz Plus Clorethyl Cooling Spray) was applied to the fingertip from a distance of 30 cm for 10 seconds to provide short-term cutaneous analgesia through rapid evaporative cooling.

Placebo application:

A sterile water spray, identical in appearance to the vapocoolant spray, was applied to the fingertip from a distance of 30 cm for 10 seconds.

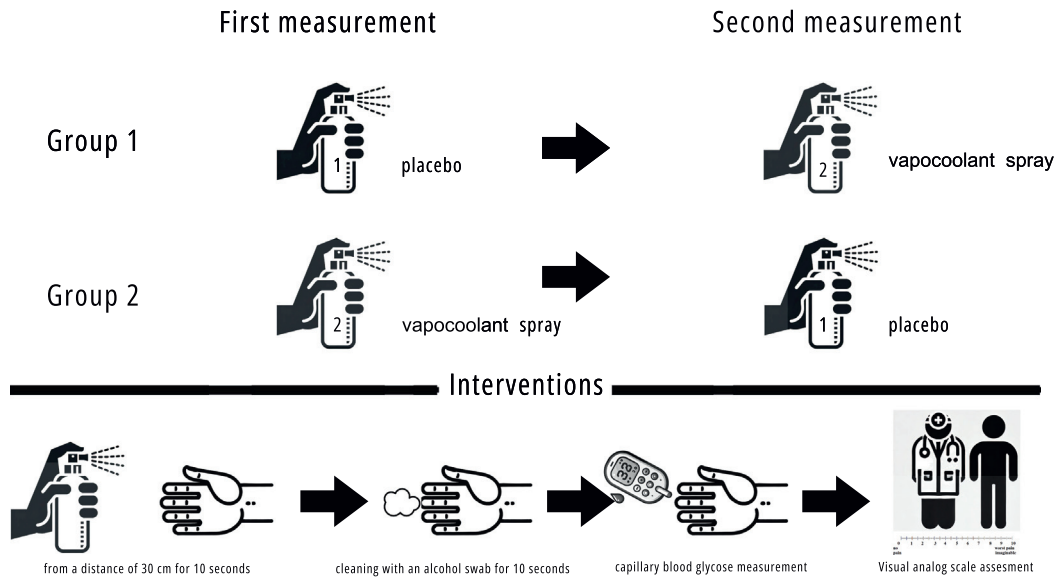


Figure 1. Study design and intervention sequence in the randomized crossover trial.

2) Glucose measurements

Following the spray application (either a vapocoolant spray or a placebo), the area was cleansed with an alcohol swab in a circular motion for 10 seconds. The fingertip was then punctured with a standard lancet (Ayset 30-gauge). The first drop of blood was wiped away, and the subsequent drop was used to measure glucose with the STANDARDTM GlucoNavii GDH device (11).

Data Collection

Demographic data (age, sex, comorbidities), diabetes medication use, glucose levels, and VAS scores were recorded on standardized forms. VAS scores from the first measurement were not shown to the participant during the second assessment. Measurements were taken during routine clinical care, minimizing the need for additional punctures beyond those medically necessary.

Outcome Measurement

The primary outcome of this study was pain perception during capillary blood glucose measurement, assessed using the VAS. The VAS consists of a 100-mm line, with endpoints labeled “no pain” (0) and “worst pain imaginable” (100). Participants were asked to mark their pain level immediately after each measurement. The pain score was determined by measuring the distance (in mm) from the “no pain” end to the participant’s mark on the scale (14). Secondary outcomes included adverse events (e.g., pruritus, coolness and numbness, erythema, burning sensation) (15).

Sample Size Calculation

The sample size was calculated using G*Power 3.1 software, with a Type I error rate (α) of 0.05 and statistical power ($1-\beta$) of 0.80 (16). Assuming a moderate effect size (Cohen’s $d = 0.5$) for the difference in pain scores between vapocoolant spray and placebo, corresponding to a clinically meaningful reduction of approximately 10 mm on the VAS, a total of 77 participants was determined to be sufficient (17,18). In this crossover design, each participant contributed 2 measurements (one with a vapocoolant spray and one with a placebo), resulting in 77 measurements per intervention (19).

Randomization and Masking

The random allocation sequence was generated by an investigator not involved in direct patient care. Participants were randomized into 2 sequence groups using an online randomization tool with block randomization. A fixed block size of 4 was used to ensure balanced allocation between groups. Following randomization, group assignments were placed in sequentially numbered, opaque, sealed envelopes.

- Group 1 received a placebo during the first measurement and a vapocoolant spray during the second measurement.
- Group 2 received a vapocoolant spray first, followed by a placebo during the second measurement.

To ensure blinding, both the vapocoolant spray and placebo containers were wrapped in opaque white paper to conceal their contents and labeled only as “1”

or “2” according to the assigned sequence. Apart from these numerical labels, the containers were identical in appearance. This labeling procedure was performed by an individual who was not involved in patient care, outcome assessment, or data analysis. Thus, both participants and the care providers administering the spray remained blinded to the intervention type.

Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics for Windows, version 23.0. The distribution of continuous variables was assessed visually using histograms. Categorical variables were presented as frequencies with percentages. Normally distributed variables were presented as mean and standard deviation, while non-normally distributed variables were presented as medians with interquartile ranges (IQRs).

The primary outcome was the within-patient difference in pain scores between vapocoolant spray and placebo applications, measured using the VAS. Because the study used a crossover design and pain scores were paired within the same participant, the primary comparison was performed using the Wilcoxon signed-rank test. For each participant, the percent change in pain score was calculated as $([\text{placebo VAS} - \text{vapocoolant VAS}]/\text{placebo VAS}) \times 100$. The median within-subject percent change was reported with its IQR and 95% confidence interval. Multiple-group comparisons were performed using the Kruskal-Wallis test.

Missing data for the primary outcome were handled using a complete-case approach. Participants who did not complete both capillary blood glucose measurements ($n = 3$) were excluded from the paired primary outcome analysis but were retained in the descriptive baseline summary. All statistical tests were 2-sided, and p -values < 0.05 were considered statistically significant.

Results

A total of 109 patients were assessed for eligibility. Of these, 29 patients were excluded for the following reasons: 7 declined to participate, 3 had conditions that impaired pain perception, 4 had an insufficient level of consciousness for VAS assessment, and 15 had additional factors that could affect pain evaluation. A total of 80 patients met the inclusion criteria and were randomized into 2 equal groups ($n = 40$ each) in a crossover design. In the group starting with placebo treatment, one patient could not proceed to the second application (due to receiving analgesic treatment), while in the group starting with the spray treatment, 2 patients could not complete the second application (one patient underwent a surgical procedure, and one patient's consciousness deteriorated) (Fig. 2).

Table 1. Baseline Characteristics of Study Participants ($n = 80$).

Characteristics	n (%)
Age, median (IQR), years	65 (58–72)
Male gender	44 (55.0)
Diabetes mellitus	57 (71.3)
Oral antidiabetic use	45 (56.3)
Insulin therapy	19 (23.8)
Hypertension	45 (56.3)
Coronary artery disease	24 (30.0)
Chronic kidney disease	12 (15.0)

The median age of the all participants was 65 years (IQR: 58–72), and 55% were male ($n = 44$). The majority of patients ($n = 57$, 71.3%) had diabetes mellitus. Among all participants, 45 (56.3%) were taking oral antidiabetic medications, and 19 (23.8%) were receiving insulin therapy. Further demographic and clinical characteristics of the participants are summarized in Table 1.

Paired pain score analysis was performed in 77 patients with complete VAS data for both interventions. The median VAS score was 29 (IQR: 18–43) for measurements with vapocoolant spray, whereas the placebo measurements had a higher median of 40 (IQR: 31–56). The median within-subject percent reduction in pain with vapocoolant spray compared with placebo was 33.3% (IQR, 14.8% to 47.3%; 95% CI, 29.2% to 35.7%), indicating a statistically significant reduction in pain ($p < 0.001$) (Table 2).

When VAS scores were examined by finger used for measurement, values were numerically higher for the index finger in both treatment conditions; however, these differences did not reach statistical significance (Table 3).

No serious adverse events were observed. All adverse reactions were mild and transient, consisting of pruritus in one participant (1.3%) and coolness with numbness in 2 participants (2.5%) in the vapocoolant spray application, and coolness with numbness in 1 participant (1.3%) in the placebo application.

Discussion

In this randomized crossover trial, vapocoolant spray was associated with lower pain scores during capillary blood glucose testing compared with placebo. The magnitude of reduction indicates that the effect was both statistically significant and clinically relevant in the context of a brief, repetitive bedside procedure (20). No serious adverse events occurred, and all reported reactions were mild and transient. Collectively, these results indicate that

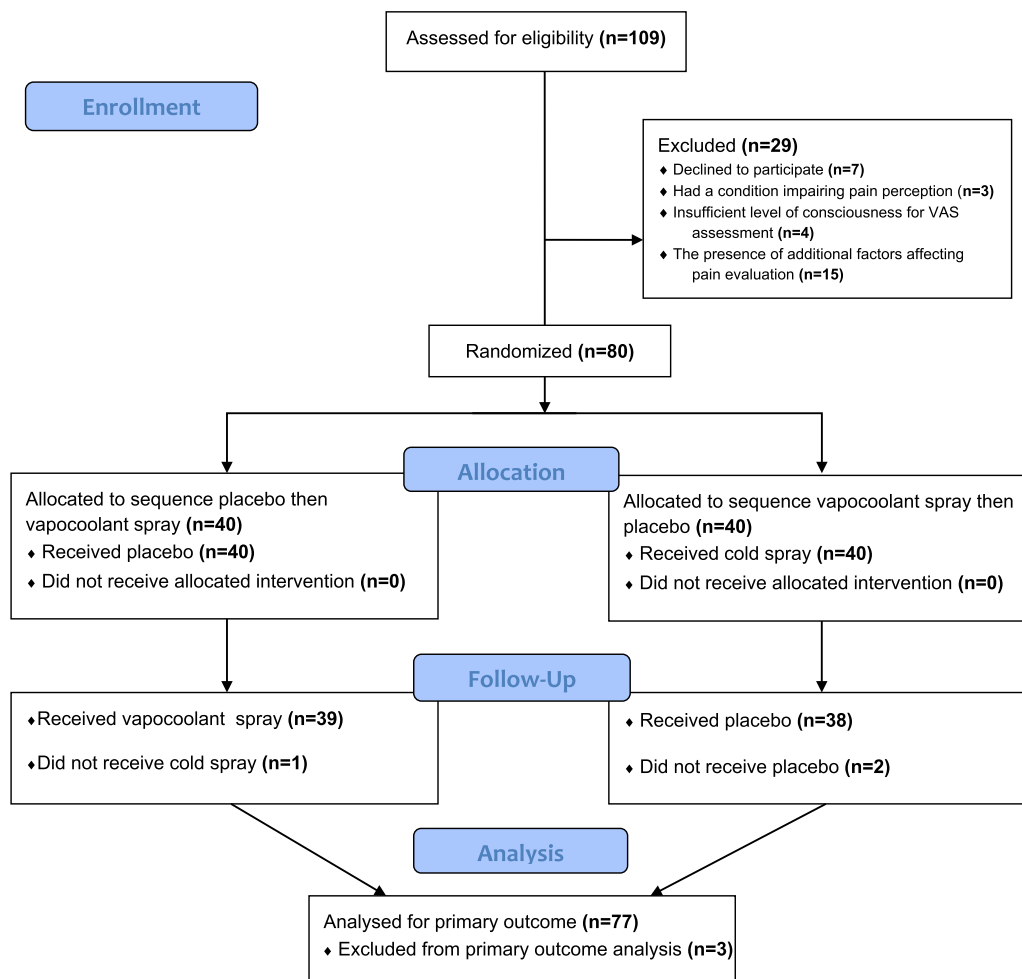


Figure 2. CONSORT flow diagram of participant enrollment, randomization, follow-up, and analysis. VAS = visual analog scale.

Table 2. Comparison of VAS Scores Between Spray and Placebo Treatments (n = 77).

Outcome	Vapocoolant Spray, Median (IQR)	Placebo, Median (IQR)	Within-Subject Percent Reduction [#] , (95% CI)	p [*]
VAS score	29 (18–43)	40 (31–56)	33.3 (14.8 – 47.3)	<0.001

CI: confidence interval, IQR: interquartile range, VAS: Visual analog scale.

* : Wilcoxon signed-rank test.

: Within-subject percent reduction in pain was calculated as follows: ((placebo VAS - vapocoolant VAS) / placebo VAS) × 100.

short-duration topical cooling can meaningfully reduce the discomfort of fingertip puncture without introducing a significant safety signal in routine ED practice.

These findings are consistent with the wider vapocoolant literature, which has generally demonstrated benefits for superficial needle-related procedures in adults. A systematic review and meta-analysis of 25 randomized trials found that vapocoolant spray was associated with

significant pain reduction during adult venous puncture procedures (15). Similarly, Mace reported significantly lower pain scores with vapocoolant than with placebo during adult venipuncture, with only minor, short-lived local reactions and high patient willingness to use the spray again (21). Additional studies in other superficial procedures have reported similar results. For example, Taddio et al. found that vapocoolant performed comparably to

Table 3. Comparison of VAS Scores According to the Finger Used for Capillary Glucose Measurement.

Variable	Finger [*]			<i>p</i> [#]
	Index (n = 6)	Middle (n = 40)	Ring (n = 34)	
VAS _{spray} , median (IQR)	39 (26–52)	36 (18–42)	22 (16–42)	0.144
VAS _{placebo} , median (IQR)	48 (38–55)	44 (32–58)	36 (27–56)	0.289

IQR: Interquartile range, VAS: Visual analog scale.

[#] :Kruskal–Wallis.

^{*} In the vapocoolant spray group, one measurement from the middle finger was missing; similarly, in the placebo group, there were missing measurements from one middle finger and one ring finger.

topical anesthetic approaches during adult vaccination, and Unal et al. reported reduced pain with vapocoolant before subcutaneous low-molecular-weight heparin injection, although without a clear effect on ecchymosis (22,23). Consistent with previous reports, the present study demonstrated that vapocoolant spray was effective in reducing pain when the primary pain-generating stimulus was a brief, superficial skin puncture.

The study evaluates an area that has received surprisingly limited direct attention in the diabetes literature. Heinemann emphasized that finger-prick pain, despite being a highly recurrent burden for people self-monitoring blood glucose, has historically been underexplored and may reduce adherence to measurement over time (24). In this context, our study extends the evidence base on vapocoolants from venous access and injection-related procedures to capillary glucose testing, a simpler, more frequent, and highly relevant procedure in daily diabetes care (25). Taken together, these findings support the effectiveness of vapocoolant spray in reducing pain associated with brief skin puncture procedures such as capillary blood glucose testing. Although patients with known peripheral neuropathy were excluded, some degree of sub-clinical sensory impairment may still have been present in participants with diabetes (26). In this context, the observation of a significant analgesic effect may further support the consistency of the treatment effect.

Clinically, vapocoolant spray is a practical option for improving patient comfort during capillary glucose testing in the ED. The intervention is rapid, inexpensive, noninvasive, and easy to incorporate into the routine workflow, particularly when repeated glucose checks are required. Pain management remains a core component of high-quality emergency care, and even minor but repeated procedures may contribute to cumulative distress and negative care experiences over time. This consideration is especially relevant for older adults and patients with diabetes, who frequently undergo repeated fingertip

sampling and may accumulate negative procedural experiences (24). Although the protocol included skin cleansing after spray application, recent data from minimally invasive procedural settings indicate that ethyl chloride vapocoolant does not compromise post-antisepsis skin sterility, which is reassuring from an implementation perspective (27).

This study has several strengths. First, the randomized crossover design allowed each participant to serve as their own control, which reduced interindividual variability in pain perception. In addition, by applying both interventions to the same participant in a randomized sequence, the design helped limit between-subjects confounding and minimize potential order-related influences between measurements. Second, both interventions were tested during clinically indicated glucose measurements, thereby preserving real-world applicability and avoiding unnecessary additional punctures. Third, the use of the contralateral corresponding finger for the second measurement improved procedural comparability between intervention periods. Finally, the study evaluated not only efficacy but also immediate tolerability, and no serious adverse events were observed.

Limitations

Several limitations should be considered. The study was conducted at a single center with a modest sample size, which may limit generalizability. Three participants did not complete paired measurements, and the finger-based subgroup analyses were likely underpowered. The interval between the 2 glucose measurements was determined by clinical need rather than a fixed protocol, possibly causing in non-identical procedural contexts. Although blinding was implemented, the cooling feeling may have allowed some participants to identify the intervention. In addition, sterile water was used as the placebo to preserve procedural similarity and maintain blinding;

however, it may not have been entirely inert and could itself have produced a mild sensory stimulus, potentially influencing pain perception in the placebo condition. The study focused on immediate pain outcomes and did not assess broader patient-centered or implementation-related outcomes such as anxiety, satisfaction, future preference, procedural timing, or cost-effectiveness. These limitations are consistent with those reported in the wider vapocoolant literature, where protocol heterogeneity is still a concern. Future multicenter studies with larger sample sizes and more standardized application protocols are needed to confirm these findings and to determine whether pain reduction with vapocoolant improves patient experience and acceptance of repeated capillary glucose testing.

Conclusion

In conclusion, the application of vapocoolant spray prior to capillary blood glucose testing significantly reduces procedure-related pain compared to a placebo. As a rapid, inexpensive, and noninvasive intervention, it is well tolerated and easily incorporated into routine emergency department workflows. Future multicenter studies with larger sample sizes are needed to confirm these findings and further evaluate the impact of vapocoolant sprays on broader patient-centered outcomes, such as satisfaction and acceptance of repeated testing.

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All authors have agreed both to be personally accountable for the author's own contributions and to ensure that questions related to the accuracy or integrity of any part of the work, even ones in which the author was not personally involved, are appropriately investigated, resolved, and the resolution documented in the literature.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the author(s) used Grammarly for language editing and grammar checking. After using this tool, the author(s) carefully reviewed and edited the content as needed and take full responsibility for the content of the published article.

Data Sharing Statement

The datasets generated and/or analyzed during the current study are not publicly available, but are available from the corresponding author on reasonable request.

Declaration of competing 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.

CRediT authorship contribution statement

Emre Kudu: Writing – review & editing, Writing – original draft, Visualization, Project administration, Methodology, Investigation, Formal analysis, Conceptualization. **Faruk Daniş:** Writing – review & editing, Writing – original draft, Validation, Project administration, Methodology, Investigation, Data curation, Conceptualization.

References

1. ElSayed NA, Aleppo G, Aroda VR, Bannuru RR, Brown FM, Bruemmer D, et al. 2. Classification and diagnosis of diabetes: standards of care in diabetes-2023. *Diabetes Care*. 2023;46(Suppl 1):S19–40. doi:10.2337/dc23-S002.
2. Pamungkas RA, Chamroonsawasdi K. Psychological problems related to capillary blood glucose testing and insulin injection among diabetes patients. *Front Nurs* 2020;7(2):87–95. doi:10.2478/fon-2020-0015.
3. Motov SM, Khan AN. Problems and barriers of pain management in the emergency department: are we ever going to get better? *J Pain Res* 2008;2:5–11.
4. Farion KJ, Splinter KL, Newhook K, Gaboury I, Splinter WM. The effect of vapocoolant spray on pain due to intravenous cannulation in children: a randomized controlled trial. *CMAJ* 2008;179(1):31–6. doi:10.1503/cmaj.070874.
5. Puangrab S, Tawanwongsri W, Mordmuang A, Khocharoen W, Krainukun P. Efficacy of topical local anesthetic, topical cooling spray, and audiovisual distraction on relief of needle-related pain during blood collection: a randomized controlled trial. *Adv Clin Exp Med* 2024. doi:10.17219/acem/188106.
6. Çelik EG, Sönmez Düzkeya D. The impact of cold spray and ice application during intravenous access on pain and fear in children aged 7-15 years in the pediatric emergency unit: a randomized controlled trial. *J Emerg Nurs* 2024;50(2):264–72. doi:10.1016/j.jen.2023.11.012.
7. Gürdap Z, Cengiz Z. Comparison of cold spray and shotblocker to reduce intramuscular injection pain: a randomized controlled trial. *J Clin Pharm Ther* 2022;47(8):1249–56. doi:10.1111/jcpt.13663.
8. Gupta NK, Upadhyay A, Dwivedi AK, Agarwal A, Jaiswal V, Singh A. Randomized controlled trial of topical EMLA and vapocoolant spray for reducing pain during wDPT vaccination. *World J Pediatr* 2017;13(3):236–41. doi:10.1007/s12519-017-0004-y.
9. Farahmand S, Mirfazaelian H, Sedaghat M, Arashpour A, Saeedi M, Bagheri-Hariri S. Vapocoolant spray effectiveness on arterial puncture pain: a randomized controlled clinical trial. *Acta Med Iran* 2017;55(2):87–91.
10. Hopewell S, Chan AW, Collins GS, Hróbjartsson A, Moher D, Schulz KF, et al. CONSORT 2025 statement: updated guideline for reporting randomised trials. *BMJ* 2025;389, e081123. doi:10.1136/bmj-2024-081123.
11. Williams V, Vos A, Otworkbe K, Grobbee DE, Klipstein-Grobbsch K. Epidemiology and control of diabetes - tuberculosis

- comorbidity in Eswatini: protocol for the prospective study of tuberculosis patients on predictive factors, treatment outcomes and patient management practices. *BMJ Open* 2022;12(6), e059254. doi:10.1136/bmjopen-2021-059254.
12. Tamalvanan V, Rajandram R, Kuppusamy S. Reduction of pre-procedural anxiety for repeat sessions in extracorporeal shock-wave lithotripsy (ESWL) reduces pain intensity: a prospective observational study. *Medicine (Baltimore)* 2022;101(37), e30425. doi:10.1097/md.00000000000030425.
 13. Passchier J, Verheij R, Tulen JH, Timmerman L, Peppinkhuizen L. Positive associations between anticipatory anxiety and needle pain for subjective but not for physiological measures of anxiety. *Psychol Rep* 1992;70(3 Pt 2):1059–62. doi:10.2466/pr0.1992.70.3c.1059.
 14. McCormack HM, Horne DJ, Sheather S. Clinical applications of visual analogue scales: a critical review. *Psychol Med* 1988;18(4):1007–19. doi:10.1017/s0033291700009934.
 15. Wang L, Fang L, Zhou Y, Fang X, Liu J, Qu G. Efficacy and safety of vapocoolant spray for vascular puncture in children and adults: a systematic review and meta-analysis. *PLoS One* 2023;18(2), e0279463. doi:10.1371/journal.pone.0279463.
 16. Kang H. Sample size determination and power analysis using the G*Power software. *J Educ Eval Health Prof* 2021;18:17. doi:10.3352/jeehp.2021.18.17.
 17. Kelly AM. Does the clinically significant difference in visual analog scale pain scores vary with gender, age, or cause of pain? *Acad Emerg Med* 1998;5(11):1086–90. doi:10.1111/j.1553-2712.1998.tb02667.x.
 18. Powell CV, Kelly AM, Williams A. Determining the minimum clinically significant difference in visual analog pain score for children. *Ann Emerg Med* 2001;37(1):28–31. doi:10.1067/mem.2001.111517.
 19. Akoglu H. User's guide to sample size estimation in diagnostic accuracy studies. *Turk J Emerg Med* 2022;22(4):177–85. doi:10.4103/2452-2473.357348.
 20. Kelly AM. The minimum clinically significant difference in visual analogue scale pain score does not differ with severity of pain. *Emerg Med J* 2001;18(3):205–7. doi:10.1136/emj.18.3.205.
 21. Mace SE. Prospective, randomized, double-blind controlled trial comparing vapocoolant spray vs placebo spray in adults undergoing venipuncture. *Am J Emerg Med* 2016;34(5):798–804. doi:10.1016/j.ajem.2016.01.002.
 22. Taddio A, Lord A, Hogan ME, Kikuta A, Yiu A, Darra E, et al. A randomized controlled trial of analgesia during vaccination in adults. *Vaccine* 2010;28(32):5365–9. doi:10.1016/j.vaccine.2010.05.015.
 23. Unal N, Tosun B, Aslan O, Tunay S. Effects of vapocoolant spray prior to SC LMWH injection: an experimental study. *Clin Nurs Res* 2021;30(2):127–34. doi:10.1177/1054773818825486.
 24. Heinemann L. Finger pricking and pain: a never ending story. *J Diabetes Sci Technol* 2008;2(5):919–21. doi:10.1177/193229680800200526.
 25. Mathew TK, Zubair M. Blood glucose monitoring. *StatPearls [Internet]*. Treasure Island (FL): StatPearls Publishing; 2026 Available from <https://www.ncbi.nlm.nih.gov/books/NBK555976/>.
 26. Tsilingiris D, Schimpfle L, von Rauchhaupt E, Sulaj A, Seebauer L, Bartl H, et al. Dysmetabolism-related early sensory deficits and their relationship with peripheral neuropathy development. *J Clin Endocrinol Metab* 2023;108(10), e979–e88. doi:10.1210/clinem/dgad248.
 27. Nowak K, Vander Woude T, Fayed M, Wang A, Attali A. Microbial safety of vapocoolant spray on sites for arterial line and epidural placement. *Br J Nurs* 2025;34(14), S4–s8. doi:10.12968/bjon.2025.0184.

Article Summary

1. Why is this topic important?

Capillary blood glucose measurement is one of the most common bedside procedures in emergency departments, but it may cause pain and discomfort. Pain related to minor but repeated procedures is often overlooked, despite its potential effect on patient experience.

2. What does this study attempt to show?

This study evaluates whether vapocoolant spray reduces pain during capillary blood glucose measurement compared with placebo in a randomized crossover design.

3. What are the key findings?

Seventy-seven patients were included in the paired primary analysis. Vapocoolant spray reduced median VAS pain scores compared with placebo, 29 mm versus 40 mm, with a median paired difference of 13.9 mm. No serious adverse events were observed, and all reported adverse effects were mild and transient.

4. How is patient care impacted?

Vapocoolant spray may provide a rapid, inexpensive, and non-invasive method to improve patient comfort during capillary glucose testing. It may be particularly useful when repeated fingertip measurements are required in emergency department care.