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Reverse Vagal Maneuver Versus Modified Valsalva Maneuver for Paroxysmal Supraventricular Tachycardia: A Randomized Controlled Trial

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Abstract

Background

To test whether the reverse vagal maneuver is superior to the modified Valsalva maneuver for electrocardiogram (ECG)-confirmed conversion to sinus rhythm in hemodynamically stable adults with paroxysmal supraventricular tachycardia.

Methods

We conducted a single-center, parallel-group randomized controlled trial in an academic emergency department between March 2024 and August 2025. Adults with ECG-confirmed, hemodynamically stable paroxysmal supraventricular tachycardia were randomized 1:1 to the reverse vagal maneuver or modified Valsalva maneuver. The assigned maneuver was repeated up to three times if sinus rhythm was not restored. The primary outcome was ECG-confirmed conversion to sinus rhythm after the assigned maneuver protocol and before rescue therapy.

Results

Among 142 randomized patients, 71 were assigned to each group. Conversion occurred in 35 patients (49.3%) in the reverse vagal maneuver group and 28 patients (39.4%) in the modified Valsalva maneuver group. The absolute risk difference was 9.9 percentage points in favor of the reverse vagal maneuver (95% CI, − 6.4 to 26.1; P = 0.24). Rescue medication was required in 40 patients (56.3%) and 44 patients (62.0%), respectively. No serious maneuver-related adverse events were recorded.

Conclusions

The reverse vagal maneuver did not demonstrate superiority over the modified Valsalva maneuver. The confidence interval was compatible with both no benefit and clinically important benefit, so the findings should not be interpreted as equivalence.

Trial registration

ClinicalTrials.gov NCT07785466, registered on 23 August 2026. Retrospectively registered.

Background

Paroxysmal supraventricular tachycardia (PSVT) is a common emergency department arrhythmia, usually presenting as a regular narrow-complex tachycardia with abrupt onset and termination. The

predominant mechanisms are atrioventricular nodal reentrant tachycardia and atrioventricular reentrant tachycardia. Although generally not life-threatening, PSVT can cause palpitations, chest pain, dyspnea, dizziness, and presyncope and may increase emergency department visits and use of intravenous therapy [1, 2].

Guidelines recommend vagal maneuvers as first-line treatment for hemodynamically stable patients with regular narrow-complex tachycardia [2, 3]. Evidence from randomized trials, observational studies, and meta-analyses indicates that modified Valsalva techniques achieve higher conversion rates than standard Valsalva techniques or usual practice [4–9]. However, the postural modified Valsalva maneuver (MVM) used in the present trial requires rapid supine repositioning and passive leg elevation.

The reverse vagal maneuver, also described as the reverse Valsalva maneuver (RVM), is a newer technique in which a seated patient exhales normally and then performs a forceful inspiratory effort against an occluded airway. Early evidence was limited to a small case series [10]. More recently, a multicenter retrospective cohort study reported higher first-attempt and cumulative conversion rates with a sequential reverse vagal maneuver followed by the modified Valsalva maneuver than with the modified Valsalva maneuver alone [11]. However, because the reverse maneuver was delivered as part of a combined protocol and treatment allocation was nonrandomized, its independent comparative efficacy remains uncertain.

We therefore aimed to test whether the reverse vagal maneuver alone was superior to the modified Valsalva maneuver for electrocardiogram-confirmed conversion to sinus rhythm in hemodynamically stable adults with PSVT.

Methods

Study design and setting

We conducted a single-center, parallel-group, randomized controlled superiority trial in the emergency department of Düzce University Faculty of Medicine. Participants were recruited between March 1, 2024, and August 1, 2025. Hemodynamically stable adults with electrocardiographically confirmed paroxysmal supraventricular tachycardia were randomly assigned in a 1:1 ratio to undergo either the reverse vagal maneuver or the modified Valsalva maneuver.

All participants provided written informed consent before randomization. The approved trial protocol is available from the corresponding author upon reasonable request, subject to institutional approval. A separate statistical analysis plan was not prepared because the prespecified analyses were described in the approved protocol. No important changes were made to the trial protocol after the trial commenced. Patients and members of the public were not involved in the design, conduct, interpretation, or reporting of the trial. This report was prepared in accordance with the CONSORT 2025 statement [12].

Participants

Patients were eligible if they were aged 18 years or older, presented with symptoms consistent with PSVT, had PSVT confirmed by electrocardiogram (ECG), and had received no acute antiarrhythmic medication or electrical therapy for the index episode. PSVT was defined as a regular narrow-complex tachycardia at 135 to 250 beats/min without clearly visible P waves. Hemodynamic stability was determined by the treating emergency physician.

Exclusion criteria were systolic blood pressure below 90 mm Hg; shock or hypoperfusion; altered mental status, ischemic chest discomfort, syncope, acute heart failure, or pulmonary edema attributable to tachycardia; need for immediate cardioversion or other urgent treatment; inability to perform a vagal maneuver; pregnancy; body weight above 130 kg; a comorbidity or previous operation making a vagal maneuver unsafe; prior familiarity with and ability to self-perform either study maneuver; reported acute use of a nonprescribed drug, stimulant, substance, or food expected to affect heart rate or rhythm; inability to consent; or spontaneous conversion before intervention. Prescribed chronic antiarrhythmic treatment was recorded but was not an exclusion criterion.

Randomization and blinding

An independent researcher with no role in recruitment, intervention delivery, outcome assessment, or analysis generated a computer-based permuted-block sequence with variable block sizes. Assignments were placed in sequentially numbered, opaque, sealed envelopes prepared by that researcher. Enrolling personnel had no access to the sequence. After eligibility and consent were confirmed, the next envelope was opened.

Patients and treating clinicians could not be blinded because the procedures were visibly different. ECGs used for outcome assessment were anonymized and coded, with identifiers, allocation, maneuver type, and revealing clinical notes removed. An independent physician unaware of allocation reviewed the recordings. Unreadable or uncertain ECGs were adjudicated by a second blinded physician who was not involved in enrollment or intervention delivery.

Interventions and data collection

Maneuver instruction, supervision, and verification were performed by emergency physicians or investigators trained in standardized procedures for both interventions. Before intervention, participants underwent baseline ECG recording and continuous cardiac monitoring. If sinus rhythm was not restored, the allocated maneuver was repeated, for a maximum of three attempts. This attempt limit and ECG reassessment 45 seconds after each attempt were prespecified to permit repeat performance without unnecessarily delaying rescue treatment. Continuous monitoring detected earlier rhythm changes, but the 45-second postmaneuver ECG was the standardized confirmation point.

Participants who remained in PSVT after completion or discontinuation of the allocated maneuver protocol received guideline-based rescue treatment. Rescue treatment could be initiated earlier for hemodynamic instability, clinical deterioration, intolerable symptoms, or concern that another attempt was unsafe. No crossover to the alternative maneuver was planned before rescue treatment. Baseline characteristics, ECG findings, protocol completion, response after each attempt, rescue treatment, disposition, follow-up outcomes, and adverse events were recorded prospectively on a standardized case-report form.

Modified Valsalva maneuver. Participants were positioned semirecumbent with the stretcher head elevated approximately 45° and instructed to blow into a 10-mL syringe for 15 seconds with sufficient force to move the plunger, aiming to generate approximately 40 mm Hg of expiratory pressure. Pressure was not measured by manometer. Immediately afterward, participants were placed supine and their legs were elevated to approximately 45°, without knee flexion, for 15 seconds (Fig. 1).

Reverse vagal maneuver. Seated participants exhaled normally without force, occluded the nose and mouth, and attempted forceful inspiration against the closed airway for 15 seconds. The supervising clinician verified airway occlusion and completion of the prescribed sequence and duration (Fig. 2).

Adverse events were defined before enrollment and actively assessed during each attempt and throughout emergency department observation. Prespecified events included dizziness, nausea, dyspnea, presyncope, syncope, chest pain, hypotension, worsening arrhythmia, and other clinically important maneuver-related events. A study investigator not involved in blinded ECG adjudication recorded event type, timing, and severity contemporaneously; medical records were used only for verification when needed. Safety observation ended at emergency department discharge or transfer to inpatient care. Events after admission were excluded unless they began during the maneuver or emergency department observation. Postconversion observation duration was determined by clinical status and the treating physician.

Outcomes

The primary outcome was ECG-confirmed conversion to sinus rhythm during any of the three permitted attempts of the allocated maneuver and before rescue therapy. Participants who remained in PSVT at completion or discontinuation of the assigned maneuver protocol were classified as non-converters for the primary outcome. Prespecified secondary outcomes were first-attempt conversion; attempt at conversion; rescue medication or electrical cardioversion; recurrent PSVT during emergency department observation; emergency department disposition; repeat emergency department presentation for PSVT; catheter ablation during follow-up; and adverse events. Rescue medication was defined as pharmacologic treatment administered for persistent PSVT after failure or early discontinuation of the assigned maneuver protocol, or for recurrent PSVT after an initially successful conversion during emergency department observation.

Statistical analysis

All randomized participants were analyzed in the groups to which they were assigned according to the intention-to-treat principle, regardless of completion of or deviation from the allocated maneuver protocol. Primary and follow-up outcome data were available for all randomized participants; therefore, no imputation was required.

Continuous baseline variables were summarized as mean and standard deviation (SD) or median and interquartile range (IQR), as appropriate, and categorical variables as number and percentage. Baseline characteristics were described without formal null-hypothesis significance testing. Descriptive between-group differences were reported as mean differences for continuous variables summarized using means and as absolute percentage-point differences for categorical variables, together with 95% confidence intervals (CIs).

The primary outcome was compared between groups using Pearson's chi-square test without continuity correction. The treatment effect was expressed as the absolute risk difference, calculated as the event proportion in the reverse vagal maneuver group minus that in the modified Valsalva maneuver group, and as the risk ratio; both estimates were reported with 95% CIs. Confidence intervals for absolute risk differences were calculated using the unpooled Wald method, and CIs for risk ratios were calculated on the logarithmic scale.

Binary secondary outcomes were compared using Pearson's chi-square test without continuity correction or Fisher's exact test, as appropriate based on expected cell counts. Multicategory outcomes with sparse cells, including the assigned maneuver attempt at which conversion occurred and emergency department disposition, were compared using the Fisher–Freeman–Halton exact test. A single overall between-group P value was reported for each multicategory outcome; category-specific P values were not calculated. Attempt-specific conversion proportions were descriptive and were calculated among participants who remained in PSVT and underwent the corresponding attempt.

Secondary outcome analyses were considered exploratory, and no adjustment was made for multiple comparisons. All tests were two-sided, and $P < 0.05$ was considered statistically significant. No covariate-adjusted, subgroup, or sensitivity analyses were prespecified or performed. Analyses were performed using IBM SPSS Statistics for Windows, version 25.0 (IBM Corp., Armonk, NY, USA).

Ethics

The study protocol was reviewed and approved by the Düzce University Faculty of Medicine Clinical Research Ethics Committee (approval date: December 20, 2023; approval no: 2023/04). Written informed consent was obtained from all participants before randomization. The study was conducted in accordance with the Declaration of Helsinki and applicable national and institutional guidelines.

Sample size calculation

Sample size was calculated a priori in G*Power using a two-sided z test for two independent proportions under a superiority hypothesis. Because no randomized direct comparison was available, assumed conversion rates of 0.11 and 0.43 were derived indirectly from a previous randomized trial comparing standard and modified Valsalva maneuvers [13]. With a two-sided alpha of 0.05, 99% power, and equal allocation, 66 participants were required per group. The target was increased to 71 per group to allow for incomplete maneuver performance or protocol deviations, yielding 142 participants. No interim analyses or formal stopping boundaries were planned, and recruitment continued until the target was reached.

Results

During the study period, 232 patients presenting to the emergency department with suspected paroxysmal supraventricular tachycardia were assessed for eligibility. 90 were excluded because they had received antiarrhythmic medication before intervention (n = 32), declined participation (n = 19), were clinically unstable (n = 15), converted spontaneously before intervention (n = 10), had atrial fibrillation (n = 9), had a contraindication to vagal maneuvers (n = 4), or were pregnant (n = 1). The remaining 142 patients with electrocardiographically confirmed PSVT were randomized equally to the modified Valsalva maneuver or reverse vagal maneuver (Fig. 3).

All randomized participants initiated their assigned maneuver and were included in the intention-to-treat analysis. After the first assigned maneuver failed to restore sinus rhythm, 4 participants in the modified Valsalva group and 2 participants in the reverse vagal maneuver group declined further assigned attempts despite persistent PSVT. These participants remained in their randomized groups and were analyzed as non-converters for the primary outcome. No participant crossed over to the alternative vagal maneuver before pharmacologic or electrical rescue therapy.

Most baseline demographic and clinical characteristics were similar between groups, although coronary artery disease, congestive heart failure, and previous catheter ablation were more frequent in the reverse vagal group (Table 1).

Table 1
Baseline Characteristics According to Treatment Group

Characteristic	Modified Valsalva (n = 71)	Reverse Vagal Maneuver (n = 71)	Total (N = 142)	Difference, Reverse–Modified (95% CI)
Age, y, mean (SD)	54.3 (17.0)	55.2 (15.9)	54.8 (16.4)	1.0 (-4.5 to 6.4)
Female sex	46 (64.8)	43 (60.6)	89 (62.7)	-4.2 (-20.1 to 11.7)
BMI ≥ 25 kg/m²	52 (73.2)	53 (74.6)	105 (73.9)	1.4 (-13.0 to 15.8)
Arrival by ambulance	46 (64.8)	53 (74.6)	99 (69.7)	9.9 (-5.2 to 24.9)
Heart rate, beats/min, median (IQR)	175 (160–191)	174 (159–194)	175 (160–192)	—
MAP, mm Hg, mean (SD)	89.5 (18.5)	89.6 (17.6)	89.6 (18.0)	0.1 (-5.9 to 6.1)
Comorbidities				
No comorbidity	23 (32.4)	16 (22.5)	39 (27.5)	-9.9 (-24.5 to 4.7)
Thyroid dysfunction	6 (8.5)	6 (8.5)	12 (8.5)	0.0 (-9.1 to 9.1)
Anemia	2 (2.8)	1 (1.4)	3 (2.1)	-1.4 (-6.1 to 3.3)
Hypertension	31 (43.7)	42 (59.2)	73 (51.4)	15.5 (-0.7 to 31.7)
CAD	9 (12.7)	18 (25.4)	27 (19.0)	12.7 (– 0.1 to 25.4)
CHF	1 (1.4)	6 (8.5)	7 (4.9)	7.0 (0.0 to 14.1)
Medical history				
History of panic attack	8 (11.3)	7 (9.9)	15 (10.6)	-1.4 (-11.5 to 8.7)
Prior PSVT	39 (54.9)	39 (54.9)	78 (54.9)	0.0 (-16.4 to 16.4)
Prior ablation	1 (1.4)	7 (9.9)	8 (5.6)	8.5 (1.0 to 15.9)
Chronic antiarrhythmic therapy	29 (40.8)	34 (47.9)	63 (44.4)	7.0 (-9.3 to 23.3)

Values are presented as mean (SD), median (IQR), or n (%), as appropriate. Baseline characteristics were summarized descriptively without formal hypothesis testing. Comorbidity categories were not mutually exclusive; participants could have more than one condition.
Abbreviations: BMI, body mass index; CAD, coronary artery disease; CHF, congestive heart failure; CI, confidence interval; IQR, interquartile range; MAP, mean arterial pressure; SD, standard deviation; PSVT, paroxysmal supraventricular tachycardia.

Electrocardiogram-confirmed conversion to sinus rhythm before rescue therapy occurred in 28 of 71 patients in the modified Valsalva group and 35 of 71 patients in the reverse vagal group (39.4% vs 49.3%; absolute risk difference, 9.9 percentage points; 95% CI, − 6.4 to 26.1; P = 0.24) (Table 2). The risk ratio for conversion with the reverse vagal maneuver was 1.25 (95% CI, 0.86 to 1.81). Thus, superiority of the reverse vagal maneuver was not demonstrated.

Table 2
Primary and Secondary Clinical Outcomes

Outcome	Modified Valsalva Maneuver (n = 71)	Reverse Vagal Maneuver (n = 71)	Risk Difference, percentage points (95% CI)	P Value
Primary outcome				
ECG-confirmed conversion to sinus rhythm before rescue therapy	28 (39.4)	35 (49.3)	9.9 (-6.4 to 26.1)	0.24
Conversion by assigned maneuver attempt				**0.68[a]**
Conversion at first attempt	19/71 (26.8)	22/71 (31.0)	4.2 (-10.7 to 19.1)	
Conversion at second attempt	6/48 (12.5)	8/47 (17.0)	4.5 (-9.7 to 18.8)	
Conversion at third attempt	3/42 (7.1)	5/39 (12.8)	5.7 (-7.4 to 18.7)	
No conversion during assigned maneuver protocol	43/71 (60.6)	36/71 (50.7)	-9.9 (-26.1 to 6.4)	
Acute emergency department outcomes				
Rescue medication in the ED	44 (62.0)	40 (56.3)	-5.6 (-21.8 to 10.5)	0.50
Electrical cardioversion in the ED	2 (2.8)	2 (2.8)	0.0 (-5.4 to 5.4)	1.00
Recurrent PSVT during ED observation	4 (5.6)	8 (11.3)	5.6 (-3.5 to 14.7)	0.23
ED disposition				**0.40[b]**
Discharged from the ED	67 (94.4)	62 (87.3)	-7.0 (-16.5 to 2.4)	
Ward admission	3 (4.2)	7 (9.9)	5.6 (-2.7 to 14.0)	
ICU admission	1 (1.4)	2 (2.8)	1.4 (-3.3 to 6.1)	
1-year follow-up outcomes				
ED readmission for PSVT during follow-up*	13 (18.3)	16 (22.5)	4.2 (-9.0 to 17.5)	0.53

Outcome	Modified Valsalva Maneuver (n = 71)	Reverse Vagal Maneuver (n = 71)	Risk Difference, percentage points (95% CI)	P Value
Primary outcome				
Catheter ablation after index ED visit*	17 (23.9)	13 (18.3)	-5.6 (-19.0 to 7.8)	0.41
Safety outcomes				
Any adverse event	3 (4.2)	3 (4.2)	0.0 (-6.6 to 6.6)	1.00
Serious maneuver-related adverse event	0 (0.0)	0 (0.0)	—	Not estimable
Data are presented as n (%) unless otherwise indicated. Risk differences are expressed as percentage points (95% CI) and were calculated as reverse vagal maneuver minus modified Valsalva maneuver. Two-sided P values were obtained using Pearson's chi-square, Fisher's exact, or Fisher–Freeman–Halton exact tests, as appropriate.				
□ Overall P value for the distribution across no conversion and conversion at attempts 1–3. Denominators for attempts 2 and 3 include participants who remained in PSVT and underwent the respective attempt; participants who declined further attempts were included in the no-conversion category.				
□ Overall P value for ED disposition.				
*Follow-up data were available for all randomized participants.Rescue medication included treatment for persistent PSVT after protocol failure or discontinuation and for recurrent PSVT after initial conversion. **Abbreviations**: CI, confidence interval; ED, emergency department; ECG, electrocardiogram; ICU, intensive care unit; PSVT, paroxysmal supraventricular tachycardia.				

Conversion after the first, second, and third assigned attempts occurred in 19, 6, and 3 patients, respectively, in the modified Valsalva group and in 22, 8, and 5 patients, respectively, in the reverse vagal group. The overall distribution across no conversion and conversion at the first, second, or third attempt did not differ between groups (P = 0.68). Rescue medication, administered for persistent PSVT after failure or discontinuation of the assigned maneuver protocol or for recurrent PSVT after initial conversion, was required in 44 patients (62.0%) in the modified Valsalva group and 40 patients (56.3%) in the reverse vagal maneuver group (P = 0.50). Electrical cardioversion was performed in 2 patients in each group.

Recurrent PSVT during emergency department observation occurred in 4 patients (5.6%) in the modified Valsalva group and 8 patients (11.3%) in the reverse vagal group (P = 0.23). Emergency department disposition did not differ significantly between groups overall (P = 0.40); 67 versus 62 patients were discharged, 3 versus 7 were admitted to a ward, and 1 versus 2 were admitted to intensive care.

During the reported follow-up period, emergency department readmission for PSVT occurred in 13 patients (18.3%) and 16 patients (22.5%), respectively (P = 0.53), and subsequent catheter ablation was performed in 17 patients (23.9%) and 13 patients (18.3%), respectively (P = 0.41). Any adverse event occurred in 3 patients in each group (4.2%). Events were minor and included dizziness, nausea, visual darkening or presyncope, and dyspnea; no serious maneuver-related adverse event was recorded.

Discussion

In this randomized head-to-head trial, RVM restored sinus rhythm before rescue therapy in nearly half of hemodynamically stable adults with ECG-confirmed PSVT and achieved a 9.9-percentage-point higher conversion rate than MVM (49.3% vs 39.4%; 95% CI, − 6.4 to 26.1). Although superiority was not demonstrated, the point estimate favored RVM, and the confidence interval remained compatible with a benefit of potential clinical importance. By providing direct randomized evidence for a maneuver previously supported mainly by a small case series and nonrandomized sequential data [10, 11], this study addresses an important evidence gap and supports further evaluation of RVM as a potentially useful alternative to MVM in adequately powered multicenter trials.

PSVT is frequently encountered in emergency care, and vagal maneuvers are recommended as first-line treatment for hemodynamically stable patients with regular narrow-complex tachycardia [1–3]. The effectiveness of the conventional Valsalva maneuver varies according to the technique used and the adequacy of the generated strain [9, 14–16]. By contrast, the MVM, which combines a standardized expiratory strain with immediate supine repositioning and passive leg elevation, has achieved higher conversion rates in the REVERT trial and subsequent randomized studies and meta-analyses [4–8, 13, 17–19]. This established evidence base made MVM an appropriate active comparator for evaluating the effectiveness of RVM.

Evidence supporting RVM remains limited. Gaudart et al. initially reported favorable outcomes in a small case series [10]. In the present trial, first-attempt conversion occurred in 31.0% of patients assigned to RVM and 26.8% of those assigned to MVM. Additional conversions occurred after the second and third attempts in both groups; however, the overall distribution of conversion across no conversion and conversion at the first, second, or third attempt did not differ significantly between the groups. These findings suggest that repeated attempts may increase cumulative conversion with either technique, but they do not establish greater effectiveness of repeated RVM compared with repeated MVM.

The two maneuvers differ in the intrathoracic pressure patterns they generate. MVM combines an expiratory strain with rapid supine repositioning and passive leg elevation, whereas RVM involves forceful inspiration against an occluded airway, producing negative intrathoracic pressure. These contrasting pressure patterns may elicit different hemodynamic and autonomic responses [14, 15, 20]. However, intrathoracic pressure, venous return, and autonomic activity were not directly measured in this trial; therefore, the physiological mechanisms underlying any differential treatment effect remain uncertain.

Li et al. evaluated a combined protocol in which RVM was immediately followed by MVM and reported a first-attempt conversion rate of 59.2% [11]. Because that study was retrospective and nonrandomized and evaluated a sequential intervention rather than either maneuver in isolation, its findings are not directly comparable with those of the present trial. Nevertheless, they raise the hypothesis that the two maneuvers may have complementary effects. This hypothesis warrants evaluation in a prospective randomized trial comparing predefined sequential strategies.

From a practical perspective, RVM may offer operational advantages when rapid repositioning, passive leg elevation, or physical assistance from additional staff is difficult, whereas MVM has a substantially more established evidence base. Other simple vagal techniques, including head-down deep breathing, have also been proposed as useful additions to emergency department care, particularly in resource-limited settings [21].

No statistically significant between-group differences were observed in the need for rescue medication, electrical cardioversion, recurrent PSVT during emergency department observation, or the overall frequency of adverse events. No serious maneuver-related adverse events were recorded. These observations are reassuring and are consistent with the generally favorable safety profile reported for vagal maneuvers [4, 6–8].

Limitations

These findings should be interpreted in light of several limitations. Because the two maneuvers were readily distinguishable, neither participants nor treating clinicians could be blinded; however, ECG outcomes were assessed by reviewers who were unaware of treatment allocation. We did not measure the pressures generated during the maneuvers, and variation in patient effort may therefore have affected the consistency of intervention delivery. The single-center setting may limit the applicability of our findings to other emergency departments, while the absence of electrophysiological confirmation prevented assessment of treatment response by PSVT subtype. In addition, the sample-size assumptions were derived indirectly, resulting in limited precision for modest between-group effects. Secondary outcomes were exploratory and were not adjusted for multiple comparisons.

Conclusion

In conclusion, RVM did not demonstrate superiority over MVM for conversion of hemodynamically stable, electrocardiogram-confirmed PSVT to sinus rhythm. Although the point estimate favored RVM, the confidence interval encompassed both no effect and a potentially clinically important benefit.

Abbreviations

BMI
body mass index
CAD

coronary artery disease
CHF
congestive heart failure
CI
confidence interval
CONSORT
Consolidated Standards of Reporting Trials
ECG
electrocardiogram
ED
emergency department
ICU
intensive care unit
IQR
interquartile range
ITT
intention-to-treat
MAP
mean arterial pressure
MVM
modified Valsalva maneuver
PSVT
paroxysmal supraventricular tachycardia
RVM
reverse vagal maneuver
SD
standard deviation.

Declarations

Author contributions

SK: Conceptualization, Literature Search, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing. EE: Conceptualization, Investigation, Methodology, Writing – review & editing. EŞ: Conceptualization, Investigation, Writing – review & editing. KS: Conceptualization, Investigation, Methodology, Writing – review & editing. Supervision. GA: Conceptualization, Investigation, Methodology, Writing – review & editing. Supervision. GC: Data collection & curation. ŞB: Conceptualization, Investigation, Methodology, Writing – review & editing. MA: Conceptualization, Data collection & curation, Investigation, Methodology, Writing – review & editing. SA: Conceptualization, Investigation, Methodology, Writing – review & editing. Supervision, Project administration. MB: Conceptualization, Investigation, Methodology, Writing – review & editing. Supervision, Project

administration. SK and MB had full access to and verified the underlying data. SK had final responsibility for the decision to submit for publication. All authors read and approved the final manuscript.

Informed consent

Written informed consent was obtained from all patients before randomization.

Human rights

No human rights were violated during this study and the study was in accordance with the Declaration of Helsinki.

Ethics approval and consent to participate

The study protocol was reviewed and approved by the Düzce University Faculty of Medicine Clinical Research Ethics Committee (approval date: December 20, 2023; approval no: 2023/04). National clinical trial authorization was obtained from the Turkish Medicines and Medical Devices Agency of the Ministry of Health of the Republic of Türkiye before participant enrollment (authorization no: 23-AKD-261). Written informed consent was obtained from all participants before randomization. The study was conducted in accordance with the Declaration of Helsinki and applicable national and institutional guidelines.

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Data availability

De-identified participant-level data supporting the findings of this study are available from the corresponding author upon reasonable request, subject to applicable ethical and institutional data-sharing requirements.

Declaration of competing interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Consent for publication

Not applicable

AI Disclosure

The authors used ChatGPT (OpenAI, San Francisco, CA, USA) to assist with translation and language refinement of this manuscript. After using this tool, the authors carefully reviewed and edited the text to ensure accuracy and take full responsibility for the content of the article.

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Figures

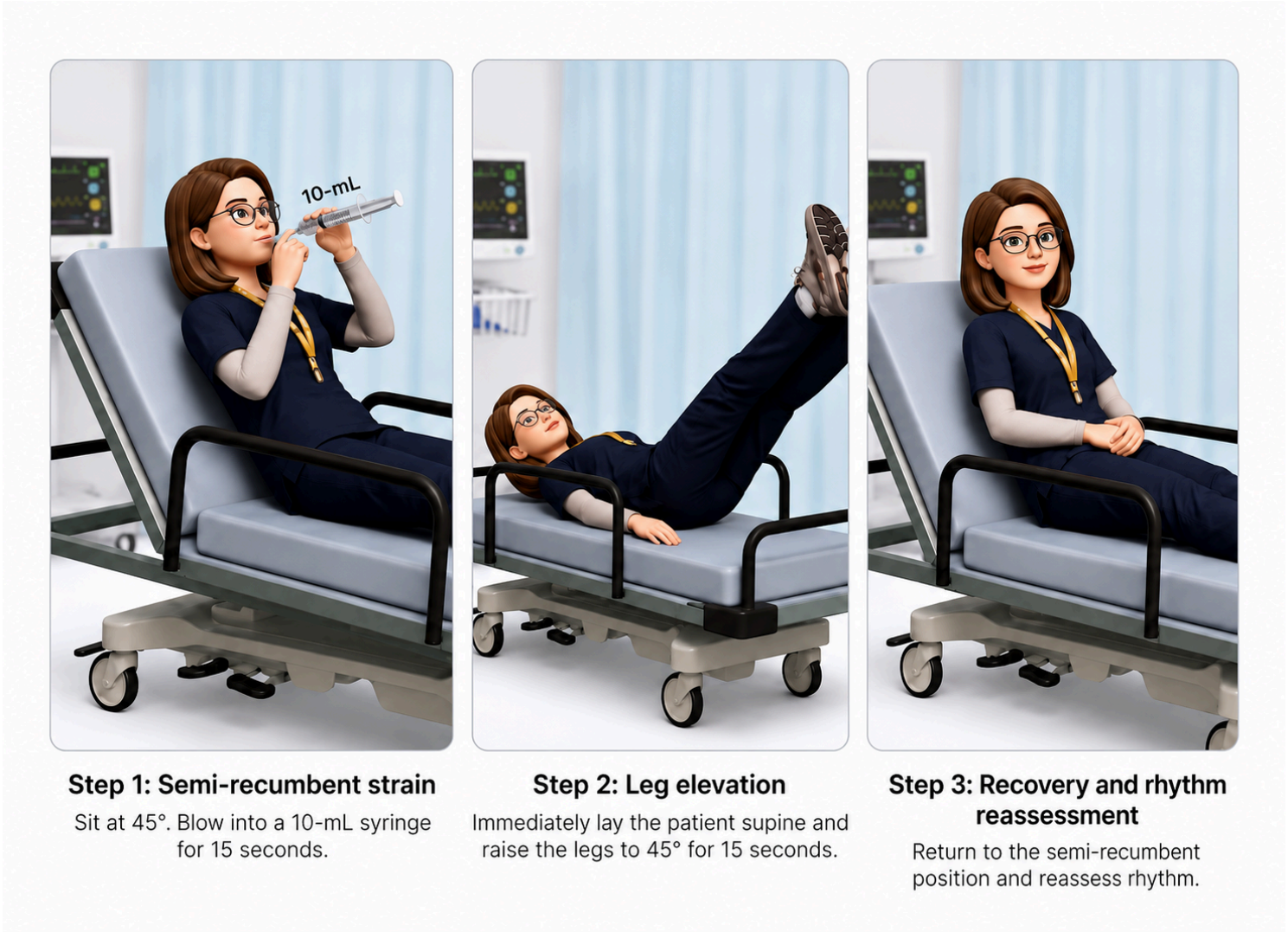


Figure 1

Modified Valsalva maneuver protocol



Figure 2

Reverse vagal maneuver protocol

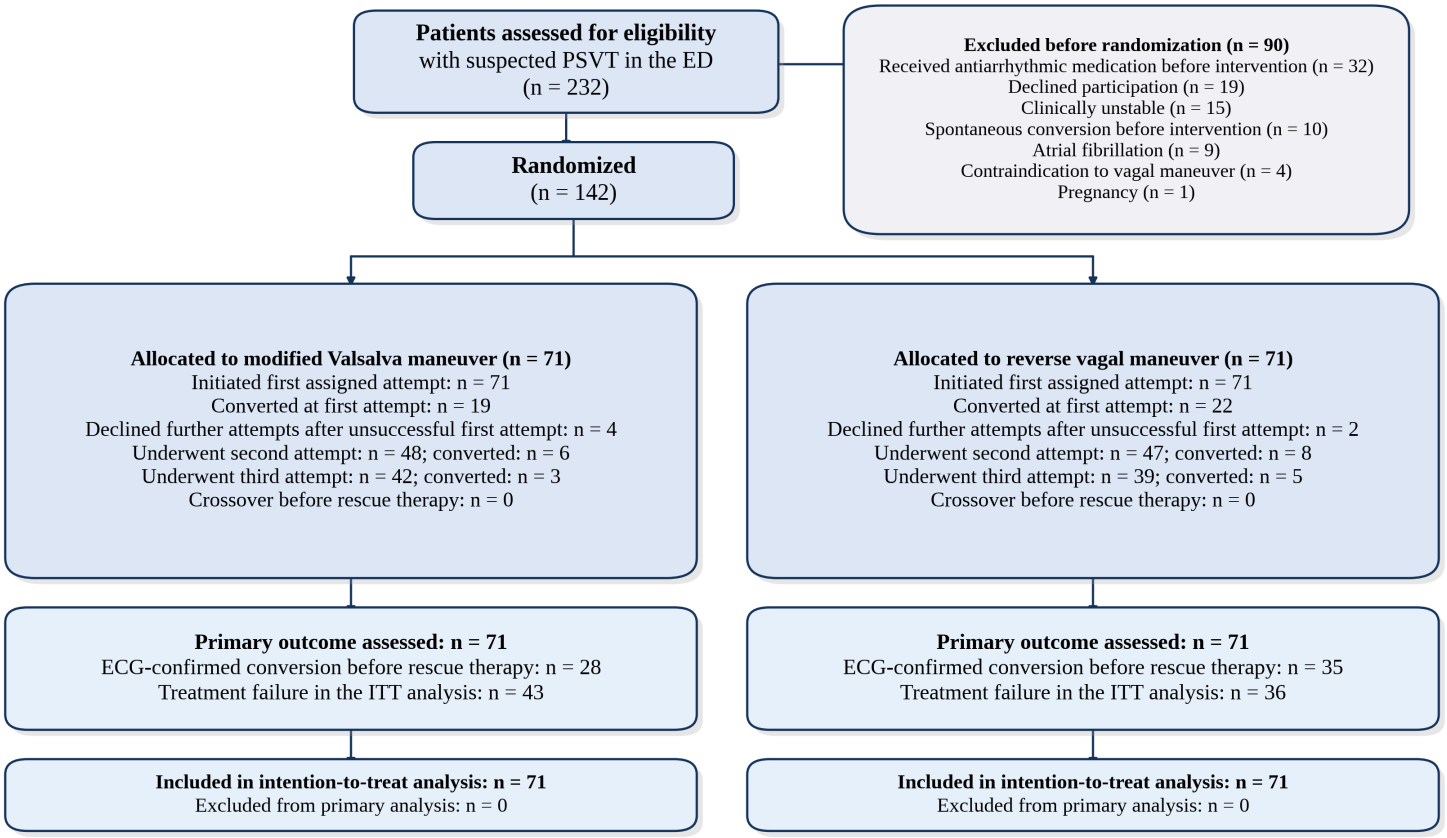


Figure 3

Flow diagram of participant enrollment, randomization, intervention, and analysis

Note: Participants who declined further attempts were retained in their randomized groups and analyzed as non-converters; no crossover occurred before rescue therapy.

Abbreviations: PSVT, paroxysmal supraventricular tachycardia; ED, emergency department; ECG, electrocardiogram; ITT, intention-to-treat.