

## Comparison of the effectiveness of various valsalva maneuvers in the management of stable narrow and wide QRS complex tachycardia in the emergency department

*Acil serviste stabil dar ve geniş QRS kompleksli taşikardi tedavisinde çeşitli valsalva manevralarının etkinliğinin karşılaştırılması*

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### Abstract

**Purpose:** Narrow and wide QRS complex tachycardias are among the causes of arrhythmia in patients frequently admitted to the emergency department (ED). The first recommended step in the management of patients with a stable narrow and wide QRS tachycardia is a vagal maneuver. Although there are many maneuvers that can provide vagal stimulation, the most effective vagal maneuver is still unknown. This study aims at determining the most effective vagal maneuver by comparing the four most commonly used maneuvers.

**Materials and methods:** One hundred and thirty-two patients were included in this study; they were randomly and equally distributed into four groups. Carotid sinus massage (CSM) was applied to the first group, the REVERT method was applied to the second group (a 10-cc injector was used), a modified REVERT method was applied to the third group (a 60-cc injector was used), and the abeslang (wooden tongue depressor) method was applied to the fourth group. During these four applications, the patients' vital signs were monitored, and preparations were made for any emergency.

**Results:** Of the 132 patients included in the study, 61 (46.2%) were males, and 71 (53.8%) were females. The average age of the patients was 56.3 years. One hundred and twenty-six had narrow QRS tachycardias, and 6 had stable wide QRS tachycardias. The patients were randomly distributed into 4 groups. In the 1st group, 1 patient (3%) returned to a normal rhythm with the CSM method. In the 2nd group, 3 patients (9.1%) returned to a normal rhythm with the REVERT method. Nine patients (27.3%) in the 3rd group returned to a normal rhythm with the modified REVERT method. 6 patients (18.2%) in the 4th group returned to normal rhythm with the abeslang method. None of the stable wide QRS tachycardias responded to vagal stimulation methods.

**Conclusion:** The modified REVERT and abeslang methods are preferred primarily in patients entering the ED with the complaint of a stable narrow or wide QRS tachycardia in the case that a vagal maneuver is to be applied. On the other hand, a vagal maneuver is not effective in the management of a stable wide QRS tachycardia.

**Keywords:** Emergency department, narrow QRS tachycardia, wide QRS tachycardia, vagal maneuvers, valsalva maneuver.

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### Öz

**Amaç:** Dar ve geniş QRS kompleksli taşikardilerin acil servise sık başvuru aritimi nedenlerindedir. Stabil dar ve geniş QRS taşikardisi olan hastaların tedavisinde önerilen ilk basamak vagal manevradır. Vagal stimülasyonu sağlayabilecek pek çok manevra olmasına rağmen en etkili vagal manevra hala bilinmemektedir. Bu çalışma en sık kullanılan dört manevrayı karşılaştırarak en etkili vagal manevrayı belirlemeyi amaçlamaktadır.

**Gereç ve yöntem:** Bu çalışmaya dahil edilen 132 hasta rastgele ve eşit olarak dört gruba dağıtıldılar. Birinci gruba karotis sinüs masajı (KSM), ikinci gruba REVERT yöntemi (10 cc'lik enjektör kullanıldı), üçüncü gruba modifiye REVERT yöntemi (60 cc'lik enjektör kullanıldı), ve dördüncü gruba abeslang (tahta dil bastırıcı) yöntemi uygulandı. Bu dört uygulama sırasında hastaların yaşamsal bulguları izlendi ve herhangi bir acil durum için hazırlık yapıldı.

**Bulgular:** Çalışmaya alınan 132 hastanın 61'i (%46,2) erkek, 71'i (%53,8) kadındı. Hastaların yaş ortalaması 56,3 idi. Hastaların 126'sında dar QRS taşikardileri ve 6'sında stabil geniş QRS taşikardileri vardı. Hastalar rastgele 4 gruba dağıtıldı. 1. grupta 1 hasta (%3) KSM yöntemi ile normal ritme döndü. 2. grupta ise 3 hasta (%9,1) REVERT yöntemi ile normal ritmine döndü. 3. Gruptaki 9 hasta (%27,3) modifiye REVERT yöntemi ile normal ritme döndü. 4. gruptaki 6 hasta (%18,2) abeslang yöntemi ile normal ritme döndü. Stabil geniş QRS taşikardilerinin hiçbirisi vagal stimülasyon yöntemlerine yanıt vermedi.

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**Sonuç:** Acil servise stabil dar/geniş QRS taşikardi şikayetiyle başvuran hastalara vagal manevranın uygulanacağı durumda öncelikle modifiye REVERT ve abeslang yönteminin tercih edilmesini önerir. Öte yandan, stabil geniş QRS taşikardi yönetiminde vagal manevranın etkin olmadığı saptanmıştır.

**Anahtar kelimeler:** Acil servis, dar QRS taşikardi, geniş QRS taşikardi, vagal manevralar, valsalva manevrası.

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## Introduction

Narrow QRS complex tachycardias (NCTs) and wide QRS complex tachycardias (WCTs) are among the causes of arrhythmia in patients frequently admitted to the emergency department (ED) [1, 2]. Although such tachycardias frequently occur in patients with normal anatomies and/or cardiac functions and rarely represent life-threatening conditions, they are common sources of morbidity and mortality [2, 3]. Narrow QRS complex tachycardias are rapid heart rhythms with a QRS duration of 120 ms or less; wide QRS complex tachycardias are rapid heart rhythms with a QRS duration of 120 ms or more. Narrow QRS complex tachycardias originate on or within the His bundle. Wide QRS complex tachycardias may be ventricular tachycardias, supraventricular tachycardias with a bundle branch block, or an accessory pathway.

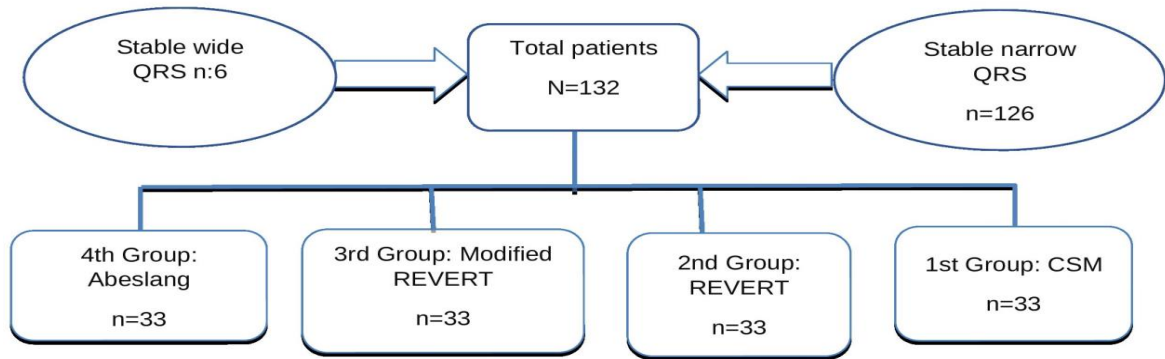
Correctly diagnosing NCTs is an arduous exercise because NCTs and WCTs can sometimes have similar presentations on an electrocardiography (ECG). Two studies have suggested that medical house staff and attending physicians diagnose NCTs incorrectly in approximately 40% of cases. A study by Mehta et al. [4] demonstrated that junior doctors operating in an accident and emergency department had difficulties distinguishing paroxysmal supraventricular tachycardia through fast atrial fibrillation and atrial flutter. Other studies have confirmed this challenge, underlining the difficulties encountered in distinguishing paroxysmal supraventricular tachycardia from other NCTs [5-7]. In addition to making incorrect diagnoses because of a lack of specific knowledge of NCTs, physicians are often misled by their excessive trust of frequently incorrect computer-generated interpretations of supraventricular tachycardias. Since the distinction between

NCTs and WCTs cannot be always made, the European Society of Cardiology (ESC) has published recommendations for this issue. According to the ESC-2019 guideline for the management of supraventricular tachycardia, the first recommended procedure for NCTs and WCTs is the vagal maneuver. There are many methods that provide vagal stimulation, but the most commonly practiced method is the valsalva maneuver. This study compares the effectiveness of carotid sinus massage (CSM), the REVERT method (10 cc injector), the modified REVERT method (60 cc injector), and uvula/pharyngeal stimulation with an abeslang stick (wooden tongue depressor).

## Materials and methods

### Study design

This study was carried out in the ED of Denizli Servergazi state hospital in Turkey, which admits approximately 190.000 patients annually. This study focuses on patients who were admitted to the hospital between March 17, 2022 and August 17, 2022 with symptoms of a stable NCT or WCT who were older than 17 years of age. In total, 132 patients agreed to participate in the study, and they were randomly and equally distributed into four groups. Carotid sinus massage was applied to the first group. The REVERT method was applied to the second group (a 10-cc injector was used). The modified REVERT method was applied to the third group (a 60-cc injector was used). Finally, the abeslang method was applied to the fourth group (Figure 1). A 60-cc syringe was used in the modified REVERT method because it is easier for patients to hold and allows for intrathoracic pressure to increase with more blowing. During the application of these four methods, patients' vital signs were monitored, and preparations were made for any emergency.



**Figure 1.** Distribution of patients participating in the study

### Inclusion criteria

- Patients with symptoms of stable narrow/wide QRS complex tachycardia (palpitations, dyspnea, diaphoresis, angina, etc.)
- Patients with a heart rate of 150 beats per minute (bpm) or greater

### Exclusion criteria

- Pregnant patients
- Patients with a history of transient ischemic attack (TIA) or stroke
- Patients with unilateral carotid artery stenosis
- Patients with carotid artery murmur

### Data collection

Patients who entered the ED with symptomatic NCTs or WCTs were immediately monitored. After providing detailed information about their health status and the health history of their relatives, patients were also informed about the study. Only those patients who agreed to participate in the study and provided their consent were included. The type of vagal maneuver (SCM, REVERT, m.REVERT, abeslang) used on each patient was chosen based on a lottery; either the patient or their relatives drew their lots. In the drawing, a total of 132 cards were divided equally into four groups (SCM, REVERT, m.REVERT, abeslang). After the application of the vagal maneuver, the result was recorded. Patients who did not respond

to the vagal maneuver were given medical treatment. All patients included in the study were in generally good health condition after treatment, and no mortality was detected.

### Compliance with standards

This study was approved by Pamukkale University Faculty of Medicine Non-Interventional Clinical Research Ethics Committee and Denizli provincial health directorate in Turkey.

### Statistical analysis

Patient data was recorded using the SPSS 22.0 Windows software package (IBM Corp. Armonk, NY). Descriptive statistics were presented as percentages and median values. Fisher's exact test or Pearson's chi-square test analyzed the relationships between categorical variables. The Mann-Whitney U test evaluated variables that did not fit into the normal distribution.

### Results

Of the 132 patients included in the study, 61 (46.2%) were males, and 71 (53.8%) were females; the average age of patients was 56.3 years (Table 1). Of these patients, 126 had stable NCTs and six had stable WCTs. The patients included in the study were randomly divided into four groups. In the first group, one patient (3%) returned to a normal rhythm with the CSM method. Three patients (9.1%) in the second group returned to a normal rhythm with the REVERT method. Nine patients (27.3%) in the third group returned to a normal rhythm with the modified REVERT method. Six patients

(18.2%) in the fourth group returned to a normal rhythm with the abeslang method massage (Adjusted residual values were: 2.4, 0.7, -1.0 and -2.1 respectively) (Table 2). None of the stable WCTs responded to vagal stimulation methods. While 125 (94.7%) of the 132 patients included in the study were discharged within 24 hours, seven patients (3.6%) were hospitalized for further diagnosis and treatment. While 66% (n=87) of the patients stated that they had been

diagnosed with a cardiac arrhythmia before, 45 patients (34%) stated that they had no history of arrhythmia. Patients who did not respond to the vagal maneuver were given medical treatment. No adverse events were detected during the study period. The inclusion criteria for patients in this study included the criterion of "stability of the patients." All patients included in this study were in generally good health condition after treatment, and no mortality was detected.

**Table 1.** Demographic characteristics of the patients included in this study

Demographic Characteristics	Total	p
Average age/year	56.3	-
Male n (%)	61 (46.2)	0.608
Female n (%)	71 (53.8)	

**Table 2.** Effectiveness of the various vagal maneuvers applied in the management of stable tachycardias

Groups	Group analysis	Resolved rhythm/ return to normal	Unresolved rhythm/failure to return to normal	Total
1 <sup>st</sup> Group	N (%)	1 (3.0)	32 (97.0)	33 (100)
	Adjusted residual	-2.1	2.1	-
2 <sup>nd</sup> Group	N (%)	3 (9.1)	30 (90.9)	33 (100)
	Adjusted residual	-1.0	1,0	-
3 <sup>rd</sup> Group	N (%)	9 (27.3)	24 (72.7)	33 (100)
	Adjusted residual	2.4	-2.4	-
4 <sup>th</sup> Group	N (%)	6 (18.2)	27 (81.8)	33 (100)
	Adjusted residual	0.7	-0.7	-
<b>Total</b>	N (%)	19 (14.4)	113 (85.6)	132 (100)

Pearson's chi-squared test was used

## Discussion

Wide and narrow QRS tachycardias are frequently encountered in the ED. While some of these cases may be symptomatic and self-terminating, others lead to severe outcomes. According to the ESC's guideline for the management of supraventricular tachycardia (SVT) (ESC 2019), the first recommended procedure for stable NCTs and WCTs is the vagal maneuver [1]. With vagal maneuvers, the main goal is to provide vagal stimulation. The autonomic nervous system consists of two parts: the sympathetic and the parasympathetic systems. The entire autonomic nervous system regulates visceral functions. For example, in the

thorax and abdomen, the vagus nerve is the dominating nerve in terms of parasympathetic nervous system activity. This parasympathetic response can be created with various physical maneuvers, which can be used both diagnostically, such as in the case of carotid sinus hypersensitivity, and therapeutically, such as in the case of the termination of SVT. Through the provision of vagal stimulation, parasympathetic (vagal) stimulation in the heart causes the local release of acetylcholine, thus reducing the rate of impulse generation in the sinus node, slowing the conduction rate in the atrioventricular (AV) node, and prolonging the refractory period.

There are many types of maneuvers to provide vagal stimulation, but CSM is the most commonly used approach. In addition to the lack of clear information about the effectiveness of CSM, it is not recommended in patients with a history of transient ischemic attack and stroke, unilateral carotid artery stenosis, or carotid artery murmur. Although the choice of vagal maneuver in SVT patients depends on the clinical scenario and the patient's ability to successfully perform the maneuvers, there is no clear indication as to which maneuver should be preferred first.

Although the effectiveness of these maneuvers has been frequently compared in pairs in many studies, there have not been enough studies that explore multiple maneuvers and consider whether the effects of the maneuvers are permanent. This study conducted a clinical comparison of four different vagal maneuvers in terms of their ease of use in the ED. Of the 132 patients included in our study, 61 (46.2%) were males, and 71 (53.8%) were females. There was no statistical difference between the two groups ( $p=0.608$ ). The average age of the patients was 56.3. In the electrophysiological study conducted by Brembilla et al. [2] where the relationship between Paroxysmal Supraventricular Tachycardia (PSVT) and age was examined, most patients were found to be between 50 and 60 years of age. However, at the end of the study, the authors state that age had no effect on the mechanism of tachycardia in patients with PSVT [2].

In our study, modified REVERT was found to be the most effective vagal maneuver method to return stable NCTs and WCTs to a normal rhythm, followed by the abeslang method and then the REVERT method. The least effective maneuver was carotid massage (Adjusted residual values were: 2.4, 0.7, -1.0 and -2.1 respectively). In a study on spontaneous PSVT patients conducted by Ornato et al. [3], the success rate of CSM was found to be 11.8%. The study also concluded that it was much more difficult to return spontaneously developing SVTs to a normal rhythm with CSM. Mehta et al. [4] and Wen et al. [5] have argued that the Valsalva maneuver, such as REVERT, is more effective than carotid massage. In a randomized controlled study in an ED, Lim et al. [6] achieved a success rate of 10.5% with

CSM and a 19.4% success with the Valsalva maneuver, which includes REVERT in the initial treatment. In a randomized controlled study conducted by Appelboam et al. [7], the response to the REVERT method was found to be around 43%. These results suggest that the REVERT method is superior to the carotid sinus massage method. Unfortunately, no study on the modified REVERT and abeslang methods could be found, except for one by Nicolas and Collins. Conducted in 2015, their study compared the benefit-harm situation by examining previous articles about the clinical use of CSM. In their conclusion, they express their opinion in favor of the use of safer and more effective alternative maneuvers due to the potential devastating side effects [8].

Although vagal maneuvers are primarily effective in the case of SVT, they are sometimes recommended to be used to differentiate SVT from stable ventricular tachycardias. In our study, no WCTs returned to a normal rhythm with vagal maneuvers [1, 9].

With regard to the limitations of this study, the effect of vagal maneuvers on WCTs could not be clearly determined due to the small number of patients with stable WCTs included in the study. It should be noted, however, that some of the patients with symptomatic tachycardia did not consent to participate in any study before they were treated and recovered because of anxiety and death guard. Another limitation of our study was its short duration; as a result, other modified vagal maneuvers could not be studied.

This study recommends that the modified REVERT and abeslang methods should be preferred primarily in patients visiting the ED with the complaint of stable NCTs or WCTs in the case that a vagal maneuver is to be applied. We do not recommend carotid massage, especially in the elderly and patients with a history of TIA/CVO, unilateral carotid artery stenosis, and carotid artery murmur due to its high complication rate and low effectiveness. Additionally, this study, which has found that vagal maneuvers are not effective in the management of stable WCTs, suggests that researchers conduct further studies on this subject with larger samples.

**Conflict of interest:** No conflict of interest was declared by the authors.



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**Ethics committee approval:** This study was approved by Pamukkale University Faculty of Medicine Non-Interventional Clinical Research Ethics Committee (date: 15.11.2022, number: E-60116787-020-287527) and Denizli provincial health directorate in Turkey.

## Authors' contributions to the article

Authors' contributions to the article R.B. constructed the main idea and hypothesis of the study. R.B. and M.O. developed the theory and arranged/edited the material and method section. R.B. has done the evaluation of the data in the results section. Discussion section of the article was written by R.B., M.S. and M.O., R.B. reviewed, corrected and approved. In addition, all authors discussed the entire study and approved the final version.