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Efficacy of the modified Valsalva maneuver as a treatment for reversing supraventricular tachycardia: systematic review

Eficácia da manobra de Valsalva modificada como tratamento para reversão de taquicardia supraventricular: revisão sistemática

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ABSTRACT: *Introduction:* supraventricular tachycardia is a frequent arrhythmia with prevalence of 2.29 per 1000 people. Medical and electrical treatments are already written in guidelines such as those of the American Heart Association, however, accompanied by a risk of side effects such as shortness of breath and chest the compression sensation. Non-drug stimulation of the vagus nerve, such as the conventional Valsalva maneuver, has little side effect, however, low efficiency with about 17% of conversions. In this scenario, a new method of parasympathetic stimulation has been promising in the initial non-drug therapy: the modified Valsalva maneuver. This consists of the elevation of the lower limbs after expiration against resistance, in order to achieve a greater degree of vagal stimulation. *Objective*: to evaluate the success rate in the reversion of supraventricular tachycardia by the modified maneuver, analyzing the results of the execution of this maneuver, as well as comparing it with the conventional Valsalva maneuver. *Methodology*: searches were made in the SciELO and PubMed database using the terms "tachycardia AND modified Valsalva maneuver". Articles published from 2005 to 2020 were selected and passed by an individual filtering of their contents (title, abstract and methodologies) to homogenize the results. *Results and Discussion*: the article presented by SciELO did not match this type of study, and among the 29 listed by PubMed, after filtering time and criteria for individual analysis, 9 articles were compiled in this review, 3 of which make a teaching assessment of the modified maneuver while 6 demonstrate a direct comparison between the maneuvers. All point to greater efficiency in cardioversion of arrhythmia by the modified maneuver compared to a conventional one, with an average of the resolution percentages of 48.3% against 19.6%, respectively, with no significant differences in adverse events. *Conclusion*: The modified Valsalva maneuver generated a greater reversion of the arrhythmia than who used a conventional one, with no added effects and exposing fewer patients to drug therapies or electrical cardioversions.

Keywords: Tachycardia; Modified Valsalva maneuver; Vagal maneuver, Adenosine, Electric countershock.

RESUMO: *Introdução*: a taquicardia supraventricular é uma arritmia frequente com prevalência de 2,29 a cada 1000 pessoas. Tratamentos medicamentosos e elétrico já são bem delineados em diretrizes como da *American Heart Association,* porém, acompanhados de risco de efeitos incomodativos ao paciente como falta de ar e sensação de compressão torácica. A estimulação não medicamentosa do nervo vago, como a manobra Valsalva convencional, apresenta pouco efeito colateral, porém, baixa eficácia com cerca de 17% de conversões. Neste cenário, um novo método de estimulação parassimpática tem sido promissor na terapia inicial não medicamentosa: a manobra de Valsalva modificada. Esta consiste na elevação dos membros inferiores após uma expiração contra resistência, visando atingir um maior grau de estimulação vagal. *Objetivo*: avaliar a taxa de sucesso na reversão de taquicardias supraventriculares pela manobra modificada, por análise dos resultados da execução desta manobra, bem como comparando-a com a manobra de Valsalva convencional. *Metodologia*: foram feitas pesquisas no banco de dados da SciELO e PubMed pelos termos "tachycardia AND modified Valsalva maneuver". Artigos publicados 2005 a 2020 foram selecionados e passaram por uma filtragem individual de seus conteúdos (título, abstract e metodologias) buscando homogeneizar assim os resultados. *Resultados e Discussão*: o artigo apresentado pela SciELO não condizia com este tipo de estudo, e dentre os 29 relacionados pelo PubMed, após filtragem de tempo e critérios de análise individual, 9 trabalhos foram compilados nesta revisão, sendo que 3 fazem uma avaliação isolada da manobra modificada enquanto 6 demonstram uma comparação direta entre as manobras. Todos apontam uma maior eficácia na cardioversão da arritmia pela manobra modificada em comparação com a convencional, sendo uma média das porcentagens de resolução de 48,3% contra 19,6%, respectivamente, sem diferenças significativas nos eventos adversos. *Conclusão*: A manobra Valsalva modificada gerou uma maior reversão da arritmia do que aqueles que utilizaram a convencional, sem acréscimos de efeitos colaterais e expondo menor número de pacientes a terapias medicamentosas ou cardioversões elétricas.

Palavras-chave: Taquicardia; Manobra Valsalva modificada; Manobra vagal; Adenosina; Cardioversão elétrica.

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INTRODUCTION

Supraventricular tachycardias (SVT) are arrhythmias that require the participation of an atrial structure for the generation and continuity of this anomalous stimulus by means of impulse reentry, thus generating a heart rate greater than 100 beats per minute[1-3]. The main SVT are: nodal reentry tachycardia (NRT), atrioventricular reentry tachycardia (ART),[1,4] atrial tachycardia (AT), focal and multifocal atrial tachycardia, atrial flutter and atrial fibrillation[5], with NRT and ART being the main focuses in this work due to their types of stimulus reentry. The term paroxysmal refers to a particularity of the clinical picture that is characterized by the sudden start and end of tachyarrhythmia[6, 7].

In the general population, SVT affects the adult population more frequently, with a prevalence of 2.29 per 1,000 people[2], with an annual incidence estimated at 36 /100.000/year[1], when adjusted for age and sex in the US population[8]. Considering all age groups, the prevalence in women is 2 times higher than in men[6]. With the exception of atrial fibrillation, the most frequent SVT is NRT (56%), followed by ART (27%) and AT (17%)[6]. With regard to the mean age of symptom onset, AVT is 23 + 14 years and on NRT is 32 + 14 years, in contrast to patients who have atrial flutter or AT, where the age of presentation is over 60 years, usually associated with structural heart disease (ischemic, hypertensive or valve heart disease)[6, 9].

The anamnesis of a patient usually referring to chest discomfort /sudden palpitation, dyspnea and sometimes a "neck-beat" sensation (frog sign)[1, 10] and most has structurally normal heart[11]. These episodes can last only a few seconds or persist for several hours (rarely more than 12 hours)[11]. The electrocardiographic characteristics are important for diagnosis and treatment at an early stage of the patient[12]. This examination shows narrow QRS complexes, regular RR intervals and the absence of P waves or a not normal axis of these waves[13] (Figure 1). In most cases of reentry through the atrioventricular node, the retrograde P waves are found in the terminal portion of the QRS complex, about a third occur just after the QRS and the minority occurs before[6, 9]. The QRS complex is narrow, except when bundle branch block, antidromic tachycardia or reciprocal tachycardia with double accessory connection[10].

Figure 1 - Tachyarrhythmia of narrow QRS, regular RR and absence of P wave (ECG image by Al-Zaiti SS[13])

The conduct to SVT will depend on the hemodynamic status in which the patient is. If has signs and symptoms of hemodynamic instability, for example, altered mental status, chest pain, hypotension and shock, direct current electrical cardioversion is indicated[14,15]. In this context, the patient, being in hemodynamic stability, can be treated with vagal maneuvers or medications[13]. Among the drugs, the effectiveness of adenosine in the treatment of SVT is known, an antiarrhythmic agent from an endogenous nucleotide that acts by blocking or decreasing the impulse formation in atrial and the atrioventricular node, which reduces the excitability of electrical conduction helping to reverse paroxysmal arrhythmias 91.4% some cases[13,16]. However, the medication is used after non-invasive maneuvers, because this drug can generate effects such as a sensation of increased chest pressure and "imminent death"[15].

Regarding vagal maneuvers, some are written in the literature, such as sinus carotid compression[15], but this may present risks of detaching atheromatous plaques and apparently having less efficacy than the Valsalva maneuver[8] (VM). Therefore, performing the conventional Valsalva maneuver (CVM) can be the first step in the attempt to reverse the stable SVT[17,18]. This is a method in which a period of forced expiration against a closed upper airway is maintained, thereby increasing intrathoracic and abdominal pressure, decreasing venous return and systemic arterial pressure, activating baroreceptors in the aortic arch and carotid bodies, resulting in in stimulation of the vagus nerve, where the alteration caused by tachycardia normalizes[19]. Despite this theoretical value, the traditional maneuver has a low chance of achieving a successful cardioversion[20].

However, a recent change in this maneuver has been shown to be even more effective[21], with conversion rates of 43% compared to 17% of the classic maneuver[22]. This optimization is due to the sudden reduction in heart rate in response to the increase in venous return and blood pressure after the tension exercised[23].

The modified Valsalva maneuver (MVM) consists of forced expiration for 15 seconds with the patient in the supine position at 45º. Immediately afterwards, the patient is placed at 0º and the lower limbs are raised to 45º, maintaining this position also for 15 seconds. After this period, the patient is repositioned in the initial position and the rhythm is checked[24]. This postural change doesn't present risks and also indirectly reduces the need for antiarrhythmic medication[21].

Therefore, studies are needed to assess the preference of adopting MVM, given the potential for satisfactory results that it can generate compared to the traditional maneuver in a condition of high incidence in emergency rooms[25].

METHODOLOGY

Methodological strategy

This is a systematic review type study with meta-analysis.

To standardize the quality of this article, a checklist tool established in the routine of review studies named by PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) was used[26].

Regarding the importance of this clinical problem, the PICO strategy (Patient, Intervention, Control, Outcome)[27] was used, being:

• Patients: those who have SVT;

• Intervention: initial conduct through the MVM;

• Control: comparison between patients who received the MVM and those who received the standard Valsalva maneuver;

• Outcome result: Benefit from applying the modified technique.

Search criteria

The databases used were PUBMED (US National Library of Medicine Nation at Institutes of Health) and SciELO (Scientific Electronic Library Online).

The tools used to search for descriptors were DeCS (Health Science Descriptor) and MeSH (Medical Subject Headings). The definitions presented in the descriptor were "tachycardia" and "Valsalva maneuver" in English for searches in Pubmed and "tachycardia" and "Valsalva maneuver" for searches in Portuguese and English in Scielo. The MV has not yet been added to the term "modified" or "modified", however this term should be introduced in database searches to enhance the scope of this research, despite the fact that this topic is recent in the literature.

The search strategy used the Boolean AND operator to join words. And the search period was in July 2020.

Eligibility criteria

Case-control studies, cohort studies, randomized clinical trials and case reports are eligible. Literature review articles were excluded from the selection. Although the few reviews found in the database did not necessarily investigate the same line of research in this work, there was this option to avoid any level of ambiguity in the evaluation of the same author.

Due to the small number of articles selected in the research, since this line of study is recent, the only initial filter used was "published less than 15 years ago". After that, individual analysis criteria based on the title, abstract and methodology of the publications were used by 2 authors for the selection. Regarding the methodology, the chosen studies were those that incorporated the use of MVM analyzing only its outcome, as well as those that compared it with CVM.

The two authors responsible for the eligibility of the articles did so separately and afterwards, merging their results. This action was carried out individually in order to avoid bias of interference in the selections. After this filtering, as a statistical criterion of the degree of agreement between the selected texts, the Kappa coefficient method was applied as a methodological convergence meter for selection[28]. This calculation was made by a 2x2 contingency table and used the mathematical models below (Figure 2).

$$K = \frac{p_0 - p_e}{1 - p_e} \quad \text{Sendo } p_0 = \sum_{i=1}^{c} \frac{n_{ii}}{n_{Total}} \Big/ p_e = \sum_{i=1}^{c} \frac{n_{i\bullet} \cdot n_{\bullet i}}{n^2_{Total}}$$

Figure 2: equation for calculating Kappa coefficient

Not needing this criterion as filtering papers, but seeking to evaluate them in view of their degree of relevance, the degree of recommendation of the 9 articles, based on the level of scientific evidence from the Oxford Center for Evidence-Based Medicine[29], placed them mainly in the category B, and one case report being in category C.

RESULTS

No articles from the Scielo database were used, as the only work resulting from this database did not match the topics of methodological or thematic filtering.

The degree of agreement in the eligibility of the two authors designated for the choice of articles in the individual evaluation in the PubMed database, made by the kappa coefficient method, was 0.904 points, which was classified as almost perfect agreement. The contingency table obtained from the "selection" point of the eligibility steps for this calculation is shown below (Table 1):

Table 1 - Quantitative contingency table for articles selected by author

Author		Y		
		Sim	**Não**	**Total**
X	Sim	8	0	8
	Não	1	13	14
	Total	9	13	22

After the applied eligibility criteria, 9 articles were selected that added a homogeneous methodology that could be compiled for this review according to the algorithm below (Figure 3). The results of this research are organized below, totaling a sample of 1256 patients in the sum of all these trials.

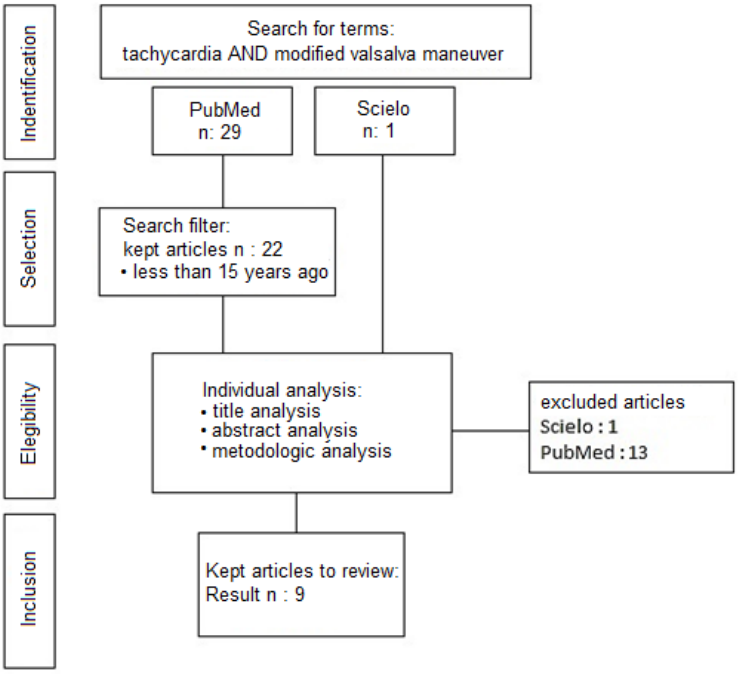

Figure 3 - Article eligibility algorithm

Table 2 - Evaluated works

AUTHOR	METHODOLOGY AND SAMPLING	RESULTS
Chen et al.[20]	Sampling: 119 patients Methodology: The patients were divided into a control group (CVM - sitting patient exhaling for 15 seconds against a syringe) and case (MVM - even the standard one, plus leg inclination at 90 ° for 15 s.), Both presenting SVT, assessed by the cardiac monitor. In both groups, their respective maneuver was offered up to three times, and for those refractory to the procedure, medication or electrical cardioversion was performed.	The outcome was conversion to first sinus rhythm after modifying the maneuver, confirmed by ECG, (46%) compared to the control group (16%). At the modified Valsalva group, the proportion of patients requiring treatment or electro-cardioversion was less than the control group (34% vs 50%). If, after 3 attempts, the conversion was not achieved, the ECG documented the last rhythm and the medication was administered.
Appelboam et al.[22]	Sampling: 428 patients Methodology: patients with SVT (excluding fibrillation and atrial flutter), divided into two groups, submitted to MVM and standard MV, in a 1: 1 ratio. Both performed an expiratory effort for 15 seconds. At MVM, at the end of the tension, the patients had their legs raised at 45 ° for 15 seconds, returning to the initial position.	7% patients who received the standard MV obtained an adjusted rhythm, while 43% obtained an adjusted rhythm with the MVM.
Appelboam et al.[24]	Sampling: 1 patient Methodology: 23-year-old patient with recurrent SVT (more than 30 occasions in 13 years), previously treated with standard VM, but always unsuccessful. He was submitted to MVM at 40 mmHg, in a semi-recumbent position for 15 s before being laid down with leg elevation at 45 ° for another 15 s.	The results were satisfactory for MVM, since the patient returned to sinus rhythm during leg lifting. The maneuver was added to the patient management plan.
Ceylan et al.[25]	Sampling: 98 patients Methodology: patients diagnosed with SVT were divided into 3 groups, who received standard VM, MVM and carotid sinus massage, recording patient responses and the recurrence of SVT after vagal maneuvers. The modified maneuver consisted of raising the legs at 45 ° (for an uninformed time) after forced expiration for 20 seconds against a syringe.	The group that received MVM showed treatment success in 43.7% of patients, while in the standard MV, 24.2% of patients were successful and with massage in the carotid sinus, 9.1% reached sinus rhythm.

continue

Table 2 - Evaluated works *continuation*

AUTHOR	METHODOLOGY AND SAMPLING	RESULTS
Çorbacıoğlu et al.[30]	Sampling: 56 patients Methodology: patients were divided into two groups, those who received the first standard VM treatment (expiration against resistance for 15 seconds) and those who received MVM (lower limb inclination after 45º after expiration). The maneuvers were repeated up to 3 times in which the patient did not convert to sinus rhythm.	In the group that received the standard MV 3 patients (10.7%) returned to sinus rhythm after the intervention, while 12 patients (42.9%) from the VM group were successful. Regarding patients who needed rescue treatment, the standard VM group had a higher rate (89.3%) than the MVM group (57.1%).
Fitzgerald et al.[31]	Sampling: 75 patients Methodology: A study was carried out by repeating the two maneuvers (traditional and modified) twice, to observe changes in heart rate and tension after performing both maneuvers and their effectiveness. * traditional 40mmhg target expiration for 15 seconds * modified: traditional with subsequent lower limb inclination at 45º	The result in patients who performed MVM resulted in a 3.8 beats per minute (bpm) drop in HR compared to traditional VM.
Walker[32]	Sampling: 27 patients Methodology: After the diagnosis of SVT, patients were instructed to perform MVM, lying supine on the bed, in the Trendelenburg position, forcibly exhaling in a section of the suction tube and manometer for at least 15 seconds at a pressure of at least minus 40 mm Hg.	Of the 27 patients who were recruited for the study, 19 of whom were correctly diagnosed as having paroxysmal SVT. Of these 19 patients, 6 reverted with MVM.
Smith[33]	Sampling: 428 patients Methodology: Simple VM was evaluated using an expiratory tension of 40mmHg for 15 seconds, and MVM, with flat post tension raising the legs for 15 s at 45 ° and evaluating the response of each patient.	The results show a higher reversion rate of patients in the MVM group was 47% against 17% of the simple VM group. The results show a higher reversion rate of patients in the MVM group was 47% against 17% of the simple VM group.
Bronzetti et al.[34]	Sampling: 24 patients Methodology: Pediatric patients accompanied by SVT referred 1: 1, 1 for standard VM and 1 for MVM in the first attempt. If cardioversion fails, MVM is performed immediately, which in this study consisted of manually inverting the child for a period of 30 seconds and returned to the supine position.	The MVM compared to standard reached 67% against 33% of cardioversion in the first attempt and 50% to 0% for the refractories of the first test, according to the established methodology.

DISCUSSION

Vagal maneuvers have been applied for a long time as an initial approach to the treatment of SVT, a very common condition in emergency rooms[25]. Although they have limited efficacy, vagal maneuvers are of great clinical importance, since they can reduce the use of chemical or electrical procedures[22].

To date, CVM is a first-line technique commonly used in clinical practice to restore sinus rhythm. This occurs through a forced expiration against resistance, which increases intrathoracic pressure for a brief period, thus stimulating the activity of baroreceptors, which results in an increase in parasympathetic tone (vagus nerve)[19]. However, the efficacy rate of this method is low in reversing SVT, requiring the use of adenosine as an alternative in the treatment of the patient[35,36]. However, when using the medication, in addition to reversing the condition to the sinus rhythm, adverse effects such as nausea, dyspnea, chest pressure, hyperventilation, vertigo, headache, among others may also appear[37].

Recently, a new model of vagal performance, MVM, was approached. Its differential is that, after performing the forced expiration against resistance for a pre-established time (usually 15 seconds), an elevation of the lower limbs occurs (45° being the most used degree in research). There is still no fixed value in the literature for these numbers, however, theoretically these actions enhance venous return and, therefore, amplify the response in vagal tone[35,40].

The stimulation of this cholinergic innervation alters the entry of ions into cells (modifying action potentials), with this, decreases in the frequency of cardiac contractions and stimulus conduction are seen. Therefore, the increase in acetylcholine in this musculature decreases the conduction speed and prolongs the refractory period of structures such as the atrioventricular node[38], generating an important contribution for the patient with SVT.

All this hemodynamic action results in effects not previously obtained with conventional maneuvers. Among the 9 studies identified in this review, all demonstrate

the superiority of MVM over CVM. In these articles, comparative rhythm conversion values were on average 48.3%, against 19.6% of CVM studies, support the hypothesis that the maneuver, when performed according to this new protocol (elevation of the lower limbs after expiration against resistance), generates effective and quick solutions to the patient. Some studies suggest that this conversion made by the modified maneuver can reach 67%[34].

As for the expiration time, according to the studies approached, the majority used the time of 15 seconds, both for CVM and MVM. The degree of inclination, for MVM, was different in only one, with elevation of the limbs below 90°[20], while the others performed the maneuver at 45°[22,24,25,30,31,33]. However, there were no significant differences in the success rates between the two angles.

One of the studies suggested the comparison of three types of vagal maneuvers as alternatives in the reversal of SVT, these being the traditional Valsalva maneuver, the carotid sinus massage and the modified Valsalva. After analyzing the effectiveness of these three actions, the rhythm normalized in 12% in the simple maneuver, only 6.1% in the carotid massage and 37% in the modified one[25].

In this regard, it is important to note that in addition to the carotid sinus massage demonstrating a lower success rate, it is also a procedure that may damage the carotid vessels, which can result in displacement of atheromatous plaques installed there[25], and may be the cause of a vascular occlusion brain. Therefore, massage of the carotid sinus should be rethought as an intervention option, in view of its inherent iatrogenic risk[39].

Regarding the adverse effects, very little was noticed about MVM, considering them to be small in view of the relevance of cardioversion. Points such as nausea, muscle pain or dizziness are among those described[22]. Studies show that serious adverse effects were not detected[22,25]. In addition, it is important to highlight that research that compared side effects of the two techniques confirm that there is no increase in adverse events in healthy volunteers in MVM compared to CVM[31,32].

With this, it is possible to notice the superiority in the SVT conversions with the use of the new modified maneuver in relation to the conventional one, with greater efficiency in the reversal of the sinus rhythm and the decrease in the need for alternative therapies such as electrical cardioversion and use of medications[41].

CONCLUSION

The fast, non-invasive and low adverse effect execution of MVM has effectiveness confirmed by all the research reviewed and compiled by this study, pointing to a great therapeutic potential of this maneuver. An increase in sampling based on future publications will help to transform this into a protocol, consistently determining certain details such as the optimal expiration time, degree of inclination, among others. However, it is already noticeable that this simple addition of elevation of the lower limbs in the already traditional execution of the maneuver, can make a rhythm, previously maladjusted by SVT, return to its normal state with a higher success rate.

REFERÊNCIAS

1. Tallo FS, Moraes Junior R, Vendrame LS, Lopes RD, Lopes AC. Taquicardias supraventriculares na sala de emergência: uma revisão para o clínico. Rev Bras Clin Med S Paul. 2012;10(6):508-12. Disponível em: http://files.bvs.br/upload/S/1679-1010/2012/v10n6/a3186.pdf.
2. Mahtani AU, Nair DG. Supraventricular tachycardia. Med Clin North Am. 2019;103(5):863-79. doi: 10.1016/j.mcna.2019.05.007
3. Galvis EO, Moreno-Quijano C, García SMV, González-Acevedo MC, Margarita S. Reporte de caso clínico: taquicardia supraventricular secundaria a irrigación con glicina. Rev Chil Anest. 2018;47:97-101. doi: 10.25237/revchilanestv47n02.06
4. Josephson ME, Wellens HJ. Differential diagnosis of supraventricular tachycardia. Cardiol Clin. 1990;8(3):411-42. doi: 2205383
5. Goodacre S, Irons R. Atrial arrhythmias. BMJ. 2002;324(7337):594-7. doi: 10.1136/bmj.324.7337.594
6. Lee KW, Badhwar N, Scheinman MM. Supraventricular tachycardia - part I. Curr Probl Cardiol. 2008;33(9):467-546. doi.org/10.1016/j.cpcardiol.2008.06.002
7. Dadi G, Fink D, Weiser G. High-dose adenosine for refractory supraventricular tachycardia: a case report and literature review. Cardiol Young. 2017;27(5):981-4. doi: 10.1017/S1047951116002626
8. Page RL, Joglar JA, Caldwell MA, et al. 2015 ACC/AHA/HRS Guideline for the Management of Adult Patients With Supraventricular Tachycardia: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines and the Heart Rhythm Society [published correction appears in Circulation. 2016;134(11):e234-5]. Circulation. 2016;133(14):e506-e574. doi: 10.1161/CIR.0000000000000311
9. Kotadia ID, Williams SE, O'Neill M. Supraventricular tachycardia: An overview of diagnosis and management. Clin Med. 2020;20(1):43. doi: 10.7861/clinmed.cme.20.1.3
10. Friedmann AA, Grindler J, Oliveira CAR, Fonseca AJ. O dilema da taquicardia de QRS largo. Diagn Tratamento. 2010;15(1):36-8. Disponível em: http://files.bvs.br/upload/S/1413-9979/2010/v15n1/RDTv15n1a1144.pdf.
11. Helton MR. Diagnosis and management of common types of supraventricular tachycardia. Am Fam Physic. 2015;92(9):793-800. Available from: https://www.aafp.org/afp/2015/1101/p793.html.
12. DeSimone CV, Naksuk N, Asirvatham SJ. Supraventricular Arrhythmias: Clinical Framework and Common Scenarios for the Internist. Mayo Clin Proc. 2018;93(12):1825-41. doi: 10.1016/j.mayocp.2018.07.019.
13. Al-Zaiti SS, Magdic KS. Paroxysmal supraventricular tachycardia: pathophysiology, diagnosis, and management.

Crit Care Nurs Clin North Am. 2016;28(3):309-16. doi: 10.1016/j.cnc.2016.04.005.

14. Brugada J, Katritsis DG, Arbelo E, et al. 2019 ESC Guidelines for the management of patients with supraventricular tachycardia. Eur Hear J. 2020;41(5):655-720. doi: org/10.1093/eurheartj/ehz467
15. Chierice, JRA, Pavão MLRC, Miranda CH. Taquiarritmias na sala de urgência. Rev QualidadeHC FMRP-USP. 2018:1-5. Disponível em: https://www.hcrp.usp.br/revistaqualidade/uploads/Artigos/200/200.pdf.
16. Rueda CO, del Olmo Izuzquiza IR, Gómez LO, Hernández IG, Cajal MD, Montañés LJ. Taquicardia supraventricular tipo reciprocante AV incesante y refractaria a cardioversión. Rev Esp Pediatr. 2017;73(2):100-101. Disponível em: https://www.seinap.es/wp-content/uploads/Revista-de-Pediatria/2017/REP-73-2.pdf.
17. Morley-Smith EJ, Gagg J, Appelboam A. Cardioversion of a supraventricular tachycardia (SVT) in a 7-year-old using a postural modification of the Valsalva manoeuvre. BMJ Case Rep. 2017;2017:bcr2016218083. doi: 10.1136/bcr-2016-218083.
18. Bibas L, Levi M, Essebag V. Diagnosis and management of supraventricular tachycardias. CMAJ. 2016;188(17-18):E466-E473. doi:10.1503/cmaj.160079
19. Smith GD, Fry MM, Taylor D, Morgans A, Cantwell K. Effectiveness of the Valsalva Manoeuvre for reversion of supraventricular tachycardia. Cochrane Database Syst Rev. 2015;2015(2):CD009502. doi: 10.1002/14651858.CD009502.pub3
20. Chen C, Tam TK, Sun S, et al. A multicenter randomized controlled trial of a modified Valsalva maneuver for cardioversion of supraventricular tachycardias. Am J Emerg Med. 2020;38(6):1077-81. doi:10.1016/j.ajem.2019.158371
21. Michaud A, Lang E. Valsalva maneuver for lifting legs to treat supraventricular tachycardias CJEM. 2017;19(3):235-7. doi: 10.1017 / cem.2016.341.
22. Appelboam A, Reuben A, Mann C, Gagg J, Ewings P, et al. Postural modification to the standard Valsalva manoeuvre for emergency treatment of supraventricular tachycardias (REVERT): a randomised controlled trial. Lancet. 2015;*386*(10005):1747-53. doi: 10.1016/S0140-6736(15)61485-4.
23. Pstras LA modification to the Valsalva manoeuvre improves its effectiveness in treating supraventricular tachycardia. Evid Based Nurs. 2016;19(3):77. doi: 10.1136/ebnurs-2016-102329.
24. Appelboam A, Gagg J, Reuben AR. Modified Valsalvamanoeuvre to treat recurrent supraventricular tachycardia: description of the technique and its successful use in a patient with a previous near fatal complication of DC cardioversion. BMJ Case Rep. 2014;2014 (pii: bcr2013202699). doi: 10.1136/bcr-2013-202699.
25. Ceylan E, Ozpolat C, Onur O, Akoglu H, Denizbasi A. Initial and Sustained Response Effects of 3 Vagal Maneuvers in Supraventricular Tachycardia: A Randomized, Clinical Trial. J Emerg Med. 2019;57(3):299-305. doi: 10.1016/j.jemermed.2019.06.008.
26. Zorzela L, Loke YK, Ioannidis JP, et al. PRISMA harms checklist: improving harms reporting in systematic reviews [published correction appears in BMJ. 2016;353:i2229]. BMJ. 2016;352:i157. doi: 10.1136/bmj.i157
27. Linares-Espinós E, Hernández V, Domínguez-Escrig JL, et al. Methodology of a systematic review. Metodología de una revisión sistemática. Actas Urol Esp. 2018;42(8):499-506. doi: 10.1016/j.acuro.2018.01.010.
28. Bloch DA, Kraemer HC. 2 x 2 kappa coefficients: measures of agreement or association. Biometrics. 1989;269-87. doi: 10.1002 / 0471667196.ess3164.pub2.·
29. Phillips B, Ball C, Sackett D. Oxford Centre for Evidence-based Medicine: levels of evidence. Centre for Evidence Based Medicine; 2009. Available from: https://www.cebm.ox.ac.uk/resources/levels-of-evidence/oxford-centre-for-evidence-based-medicine-levels-of-evidence-march-2009.
30. Çorbacıoğlu ŞK, Akıncı E, Çevik Y, et al. Comparing the success rates of standard and modified Valsalva maneuvers to terminate PSVT: A randomized controlled trial. Am J Emerg Med. 2017;35(11):1662-5. doi: 10.1016/j.ajem.2017.05.034.
31. FitzGerald I, Ewings P, Lang I, Appelboam A. Testing of a novel Valsalva Assist Device with supine and modified positions in healthy volunteers. Emerg Med J. 2019;36(1):27-31. doi: 10.1136/emermed-2018-208004.
32. Walker S, Cutting P. Impact of a modified Valsalva manoeuvre in the termination of paroxysmal supraventricular tachycardia. Emerg Med J. 2010;27(4):287-91. doi: 10.1136/emj.2009.073866.
33. Smith GD. A modified Valsalva manoeuvre results in greater termination of supraventricular tachycardia than standard Valsalva manoeuvre. Evid Based Med. 2016;21(2):61. doi: 10.1136/ebmed-2015-110357.
34. Bronzetti G, Brighenti M, Mariucci E, et al. Upside-down position for the out of hospital management of children with supraventricular tachycardia. Int J Cardiol. 2018;252:106-9. doi: 10.1016/j.ijcard.2017.10.120.
35. Pstras L, Bellavere F. In search of the optimal Valsalva maneuver position for the treatment of supraventricular tachycardia. Am J Emerg Med. 2016;34(11):2247. doi: 10.1016/j.ajem.2016.09.005.
36. Alabed S, Sabouni A, Providencia R, Atallah E, Qintar M, Chico TJ. Adenosine versus intravenous calcium channel antagonists for supraventricular tachycardia. Cochrane Database Syst Rev. 2017;10(10):CD005154. doi: 10.1002/14651858.CD005154.pub4.
37. Holdgate A, Foo A. WITHDRAWN: Adenosine versus intravenous calcium channel antagonists for the treatment of supraventricular tachycardia in adults. Cochrane Database Syst Rev. 2012;(2):CD005154. doi:10.1002/14651858.CD005154.pub3.
38. Hayes DD. Teaching the modified Valsalva maneuver to terminate SVT. Nursing. 2018;48(12):16. doi: 10.1097/01.NURSE.0000547735.82178.71.
39. Collins NA, Higgins GL 3rd. Reconsidering the effectiveness and safety of carotid sinus massage as a therapeutic intervention in patients with supraventricular tachycardia. Am J Emerg Med. 2015;33(6):807-9. doi:10.1016/j.ajem.2015.02.047.
40. Verdú Solans J, Soler Costa M, Molero Arcos A, Ojeda Cuchillero I. Taquicardia paroxística supraventricular (TPSV): dos presentaciones. Dos aproximaciones. Semergen. 2017;43(3):240-2. doi: 10.1016/j.semerg.2016.04.006.
41. Steurer J. Modified Valsalva maneuver in patients with supraventricular tachycardia. Praxis (Bern 1994). 2015;104(24):1349-50. doi: 10.1024/1661-8157/a002210.

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