World Journal of Environmental Biosciences

Available Online at: **www.environmentaljournals.org**

Volume 11, Issue 1: 4-8

https://doi.org/10.51847/7maH6sWjQy

ISSN 2277- 8047

Tachycardia Evaluation and its Management Approach, Literature Review

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ABSTRACT

Tachycardia is a term used to describe any abnormally elevated heart rate exceeding or equal to 100 beats per minute (bpm), it can occur as the result of a wide array of pathologies. The majority of patients are symptomatic and typically present complaining of palpitations or chest discomfort. Patients may also have more dreadful presentations such as shock, hypotension, dyspnea, altered conscious level, myocardial infarction, and heart failure. Tachycardias are classically classified into narrow complex tachycardia (NCT) and wide complex tachycardia (WCT) based on the width of the QRS complex on Electrocardiography (ECG). Our objective was to look into the literature concerning the different types of tachycardia and their diagnosis along with their management. PubMed database was used for articles selection, papers afterward were obtained and reviewed accordingly. Clinical presentations of tachycardia can vary from simple palpitations or lightheadedness to severe shock or even sudden death. Diagnosis is mainly through the use of ECG or Holter monitor. The first step in the management of any type of tachycardia is assessing the hemodynamic stability of the patient, where if they were found to be unstable prompt use of cardioversion is warranted to prevent progression into cardiac arrest. In cases of stable NCT vagal maneuvers and IV, adenosine is considered to be the initial line of the therapy, other treatment options include radiofrequency or catheter ablation.

Keywords: *Tachycardia, Diagnosis, Clinical features, Management*

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Received: 25 September 2021
Accepted: 10 December 2021

INTRODUCTION

Tachycardia is a term used to describe any abnormally elevated heart rate exceeding or equal to 100 beats per minute (bpm), it can occur as the result of a wide array of pathologies (Alzahrani *et al*., 2019; Permadi *et al*., 2020). The majority of patients are symptomatic and typically present complaining of palpitations or chest discomfort, other more dreadful presentations include shock, hypotension, dyspnea, altered conscious level, myocardial infarction, and heart failure. On the other hand, a fraction of patients will be completely asymptomatic or with only minor symptoms such as fatigue, especially during physical activity. Tachycardias are classically classified into narrow complex tachycardia (NCT) and wide complex tachycardia (WCT), this distinction is based on the width of the QRS complex on Electrocardiography (ECG), as NCTs have a QRS width of <120 milliseconds (ms) while the latter being ≥120 milliseconds.

MATERIALS AND METHODS

PubMed database was used for articles selection, and the following keys were used in the mesh ((tachycardia) OR (NCT)) OR (WCT). In regards to the inclusion criteria, the articles were selected based on the inclusion of one of the following topics; tachycardia, NCT, WCT, and their management. Exclusion criteria were all other articles that did not have one of these topics as their primary endpoint.

Narrow complex tachycardia (NCT)

NCT is an umbrella term that is used to describe any abnormal rhythm with a heart rate >100 bmp and a QRS duration of less than 120ms. Most arrhythmias that fall under this category are supraventricular (SVT) originating above the atrioventricular node (AV node) with few exceptions such as high septal or

fascicular ventricular tachycardias but such cases are rare and not frequently encountered (Katritsis & Josephson, 2015).

The mechanisms responsible for the production of NCT fall under one of the following (A) Enhanced automaticity (B) Triggered activity, and (C) Re-entry, with the latter being the most common. Re-entry phenomena happen due to the presence of abnormal anatomic or functional electrical circuits. Such circuits are made of 2 electrically conductive pathways that are linked together at both ends, with each pathway having its distinct conductive potential and speed (Padeletti & Bagliani, 2017; Shah & Badhwar, 2020).

Diagnosis of NCT is suspected when patients present with typical symptoms and signs or by detecting a rapid pulse during physical examination. Obtaining an ECG is usually sufficient to make the diagnosis as it will confirm the nature of the tachycardia whether it's NCT or WCT. Other diagnostic modalities include the Holter monitor which is an ambulatory electrocardiographic device used in cases with episodic attacks or non-sustained NCT (Pevnick *et al*., 2018). Another possible test is stress testing either by exercise or pharmacological drug and is used in cases with arrhythmias associated with physical activity (Garner *et al*., 2017). Finally, invasive electrophysiology testing is rarely required in NCT and has limited indications.

Due to heterogeneity of the included tachycardias within NCT, they are subcategorized into regular and irregular rhythms. This division is necessary as each group has its management approach. The regularity of the rhythm is judged based on the consistency of the R-to-R intervals, as the variability of more than 20ms indicates an irregular NCT (Shah & Badhwar, 2020).

Regular narrow complex tachycardia

Sinus tachycardia (ST) and inappropriate sinus tachycardia

Sinus tachycardia occurs due to accelerated firing in the normal pacemaker of the heart which is the sinoatrial (SA) node. Such rapid rhythm is considered as a normal physiological response to heavy exercise, emotional factors, or pain and is only transient. But it can also happen due to periods of increased demand of cardiac output, stress, or an imbalance of sympathetic and parasympathetic drive, which could be the result of medical or pharmacological causes such as infections, anemia, volume depletion, and other forms of shock. In such cases, the tachycardia is more prolonged but will self-resolve once the underlying etiology is treated (Olshansky & Sullivan, 2019).

Some patients may have sustained rapid heart rate in absence of any identifiable cause. In these patients, a new term was coined known as Inappropriate Sinus Tachycardia (IST). IST is most commonly noted in young females leading them to have debilitating episodes of palpitations and lightheadedness, particularly during heavy physical activity. Fortunately, this condition is fairly benign and will hardly ever lead to any complication such as tachycardia-induced cardiomyopathy. Diagnosis is reached by ruling out any possible underlying cause of tachycardia, in addition, to meeting the criteria of a daytime sinus rate >100 beats/min or an average 24-h rate > 90 beats/min. There are no established guidelines for the management of IST. However, current recommendations advocate for a conservative approach for most patients, but in case of incapacitating symptoms treatment with ivabradine or beta-blockers may be warranted as it has shown to have beneficial effects in symptoms alleviation. Finally, radiofrequency-ablation is generally discouraged due to poor outcomes and therefore is reserved for severe cases with no response to other therapies (Olshansky & Sullivan, 2013; Olshansky & Sullivan, 2019).

AV nodal reentrant tachycardia (AVNRT)

AV nodal reentrant tachycardia is the most common form of regular NCT after ST (Wegner *et al*., 2021). It predominantly affects young females who are otherwise healthy (Katritsis & Josephson, 2015). The mechanism behind AVNRT is the re-entry phenomena is brought upon by a functional micro-circuit consisting of 2 pathways labeled alpha and beta that are located within the AV node and perinodal tissue. The alpha pathway is antegrade and slower in conduction speed, on the opposite side the beta is faster in signal propagation and runs in a retrograde direction. There are two possible forms of AVNRT known as typical (slow-fast) and atypical (fast-slow), with the former being more common as it accounts for 80% of all AVNRT, the difference between those entities is the order in which the pathways are excited. Patients are usually assigned a Holter monitor as most cases are paroxysmal, if the AVNRT is detected it will manifest as sudden onset of tachycardia preceded by a single premature atrial contraction (PAC). In the typical form, the PR interval is short leading to a masked P wave or it may appear after the QRS complex, while in the atypical form PR interval is longer allowing for the identification of inverted P waves. Management of acute attacks could be achieved through vagal maneuvers which are considered first-line therapy, in case of failure patients, should receive IV adenosine. But in patients with contraindication to adenosine such as bronchospasm calcium channel blockers may be used. High voltage cardioversion is regarded as a last resort in resistant cases or when primary management fails (Brubaker *et al*., 2018).

The need for long-term therapy should be based on severity and frequency of attacks, as patients with intolerable or recurrent symptoms may be candidates for Catheter ablation as it has shown to be curative and with minimal adverse effect (Wang, 2021).

There are numerous other types of regular NCT which include Focal atrial tachycardia, atrial flutter, non-paroxysmal or focal junctional tachycardia, and orthodromic AV reentrant tachycardia. But they will not be covered in our review due to their lower incidence as we intend to focus on the common types (Katritsis & Josephson, 2015).

Irregular narrow complex tachycardia

Atrial fibrillation

Atrial fibrillation is the most prevalent form of irregular NCT as it is estimated to affect around 0.5-4% of the general population, with the majority of cases being in the elderly population as the mean age of diagnosis is 56 years (Zulkifly *et al*., 2018; Lippi *et al*., 2021).

Researchers have identified multiple predisposing risk factors that have been linked to the development of AF most notably advanced age, male sex, hypertension, valvular heart disease, left ventricular dysfunction, increased weight, and alcoholism (Andrade *et al*., 2014). Pathogenesis of AF can be broadly

classified into either focal ectopic firing, reentrant mechanisms, or a combination of both, in addition to anatomical changes within the atrial tissue mainly dilation (Iwasaki, 2011).

Patients with AF are classified into different types based on the duration of the episode. The first type is Paroxysmal AF where the patient regains their normal rhythm within 7 days of onset, but if the tachycardia lasted longer than 7 days then it's labeled as Persistent AF. The third form is Long-standing persistent AF in cases with more than 12 months of duration, lastly once a mutual agreement between patients and the clinicians is made to halt any further attempts of regaining normal rhythm and then these patients are considered to have permanent AF (January *et al*., 2014).

AF is characterized by an irregularly irregular PR interval with the absence of any detectable P waves (Johnson *et al*., 2018). The initial evaluation is aimed at distinguishing paroxysmal AF from other types therefore the use of a 7 day Holter monitor is recommended (Miyazaki *et al*., 2011). In addition, patients should be investigated to look for any underlying pathology causing AF, commonly performed tests include but are not limited to echocardiogram, stress testing, thyroid, and renal functions test, serum electrolytes, and complete blood count (Hindricks *et al*., 2021).

Management approach of AF can be broken down into different domains as follow: stroke prevention, risk-factor modifications, lastly acute and long-term rate or rhythm control.

Patients with AF have a 5-fold increase in the risk of stroke if compared to the general population (Son *et al*., 2017), which has led to the development of the CHA2DS2-VASc score to objectively assess stroke risk (Lee *et al*., 2021). Patients who are found to have increased risk using the score should be started on direct oral anticoagulants as first-line therapy, except for AF cases caused by valvular heart disease than warfarin is preferred (McCallum *et al*., 2019).

Another essential aspect to cover in the management is assessing the patient for any associated risk which may play a contributing hand in the progression of the disease such as hypertension, heart diseases, and hyperthyroidism, once patient's risk factors have been identified they should be offered medical treatment (Pathak *et al*., 2014).

In acute presentations, the first step in management is assessing the hemodynamic stability of the patient, if unfortunately, the patient was unstable they should undergo synchronized cardioversion followed by four weeks of full anticoagulation (Amin *et al*., 2016).

Long-term treatment of AF is aimed at controlling the ventricular rate to improve the symptoms and prevent tachycardia-induced cardiomyopathy, the available options of therapy include rate control drugs (beta-blockers, calcium channel blockers, and digoxin) and rhythm control drugs (such as Flecainide and propafenone). Both classes have similar efficacy and risk of adverse effects and the final choice is mainly dependent on patients' other co-morbid conditions. Patients who don't respond to the aforementioned therapy or who are intolerable to their adverse effects should be candidates for ablation therapy, as it has shown to have positive outcomes approaching 70 % of cases, the downside of this therapy is periprocedural complications which include death and cardiac tamponade (Amin *et al*., 2016).

Other possible causes of irregular NCT are an atrial flutter with varying block and Multifocal atrial tachycardia, and although they only account for a small fraction of cases with irregular NCT, they should be considered in cases where typical features of AF are absent.

Wide complex tachycardia WCT

Wide complex tachycardia is a term used to denote a heart rate >100 bpm and a QRS duration exceeding 120ms. The vast majority of WCT is caused by ventricular tachycardia which leads some researchers to regard it as the default diagnosis of any WCT, but such way of thinking should be avoided due to the possibility of other forms of tachycardia that can present with a similar ECG appearance. Therefore, numerous researches were conducted aiming to develop algorithms to help differentiate ventricular tachycardia from other mimicking arrhythmias particularly wide complex SVTs (Kashou *et al*., 2020).

A key point to keep in mind is regardless of the underlying etiology causing WCT the initial step in management remains the same, which is assessing the hemodynamic condition of the patient. Because WCT will frequently lead to hemodynamic instability. In patients who are deemed to be unstable, prompt use of cardioversion is mandatory to prevent the development of cardiac arrest (Roka *et al*., 2019; Kashou *et al*., 2020).

Ventricular tachycardia (VT)

VT is the most commonly encountered form of WCT and is associated with high rates of mortality and morbidity (Dresen & Ferguson, 2018). It is defined by the presence of at least 3 consecutive complexes originating in the ventricles at a rate >100 bpm (Al-Khatib *et al*., 2018). Although its usually the result of organic heart disease, but 10% of cases occur in a structurally normal heart and are referred to as idiopathic VT (Pellegrini & Scheinman, 2010; AlKalbani & AlRawahi, 2019). VT is categorized based on the morphological appearance of the QRS into either monomorphic and/or polymorphic forms. Additionally, it is also classified based on the duration of the episodes into sustained (lasting more than 30 s or requiring medical intervention) or non-sustained (less than 30 seconds)

Monomorphic VT accounts for around 86–97% of all VTs (AlKalbani & AlRawahi, 2019). Most cases are the result of Scar-related reentry mechanisms and are usually a sequel of ischemic heart disease (IHD), inflammatory conditions, or other causes of cardiomyopathy (Sadek *et al*., 2014).

Polymorphic VT is a more serious form of arrhythmia due to its higher tendency to progress into ventricular fibrillation and subsequent arrest. Fortunately, its incidence is relatively low. It occurs due to malfunctioning of the heart's ion channels either from congenital or acquired causes (Viskin *et al*., 2021). There is a widespread misconception among health care providers as they commonly use the term Torsade de pointes and polymorphic VT interchangeably, but in reality, Torsade de pointes refers to a specific form of polymorphic VT caused by Q-T prolongation.

Long-term management of VT is centered on the treatment of any underlying pathology or co-comorbid condition, in addition to the utilization of beta-blockers as they have demonstrated to reduce the overall mortality. But the most important aspect of therapy relies on the identification of patients with a high risk of sudden cardiac death, in such patients the placement of an intra-cardiac defibrillator (ICD) plays a vital role to prevent the occurrence of such dire consequences. Antiarrhythmic

medications have failed to show any significant reduction of mortality but were shown to minimize the recurrence rate of arrhythmias, therefore, their use is limited to patients who experience recurrent ICD shocks or in patients unfit or unwilling to have an ICD. Finally, catheter or radiofrequency ablation are considered as alternative therapies for severe cases or have a contraindication for the previous lines of therapy (Al-Khatib *et al*., 2018).

Other forms of WCT

The physician should not take all WCT as VT for granted, as other types of SVT with aberrancy may mimic the wide QRS appearance, which might lead to patients receiving inappropriate lines of therapy. A most notable example of such tachycardia include Wolff-Parkinson-White syndrome (WPW), SVT with pre-existing or a functional bundle branch block BBB and pre-excited AF (Katritsis & Josephson, 2015; Al-Khatib *et al*. 2018).

Another possibility is when patients with SVT have a simultaneous metabolic condition causing wide QRS such in the case of hyperkalemia or other electrolyte imbalances. Additionally, the use of some antiarrhythmic drugs for example amiodarone might also lead to widening of the QRS complex in case of drug toxicity (Kashou *et al*., 2020).

Differentiating between VT and other arrhythmias causing wide QRS can be a difficult task, but some ECG clues that generally favor VT diagnosis include the following; the presence of fusion or capture beats, QRS duration exceeding 140ms, extreme axis deviation, and identifying negative QRS complexes in all chest leads. But you need to keep in mind that all of these futures are suggestive and not confirmatory as they may occur in SVT under specific scenarios. Other ECG components that could also be assessed to help in the differentiation include RS intervals and the morphological appearance of QRS and BBB in specific leads (Katritsis & Brugada, 2020).

CONCLUSION

Tachycardia is defined as having a heart rate exceeding or equal to 100 beats per minute (bpm), and is classified into two main groups NCT and WCT based on the QRS duration. Common clinical presentations of patients vary from simple palpitations or lightheadedness to severe shock or even sudden death. Diagnosis is mainly through the use of ECG or Holter monitor. The first step in the management of any type of tachycardia is assessing the hemodynamic stability of the patient, where if they were found to be unstable prompt use of cardioversion is warranted to prevent progression into cardiac arrest. In cases of stable NCT vagal maneuvers and IV, adenosine is considered to be the initial line of the therapy, other treatment options include radiofrequency or catheter ablation. The majority of WCT cases are due to ventricular tachycardia and will usually require the use of ICD to halt future development of Ventricular fibrillation. Moreover, Beta-blockers are frequently used as they have been shown to reduce overall mortality.

ACKNOWLEDGMENTS: None

CONFLICT OF INTEREST: None

FINANCIAL SUPPORT: None

ETHICS STATEMENT: None

REFERENCES

AlKalbani, A., & AlRawahi, N. (2019). Management of monomorphic ventricular tachycardia electrical storm in structural heart disease. *Journal of the Saudi Heart Association*, *31*(3), 135-144.

Al-Khatib, S. M., Stevenson, W. G., Ackerman, M. J., Bryant, W. J., Callans, D. J., Curtis, A. B., Deal, B. J., Dickfeld, T., Field, M. E., Fonarow, G. C., et al. (2018). 2017 AHA/ACC/HRS guideline for management of patients with ventricular arrhythmias and the prevention of sudden cardiac death: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines and the Heart Rhythm Society. *Journal of the American College of Cardiology*, *72*(14), e91-e220.

Alzahrani, S., Alosaimi, M., Malibarey, W. M., Alhumaidi, A. A., Alhawaj, A. H., Alsulami, N. J., Alsharari, A. S., Alyami, A. A., Alkhateeb, Z. A., Alqarni, S. M., et al. (2019). Saudi Family Physicians' Knowledge of Secondary Prevention of Heart Disease: A National Assessment Survey. *Archives of Pharmacy Practice*, *10*(4), 54-60.

Amin, A., Houmsse, A., Ishola, A., Tyler, J., & Houmsse, M. (2016). The current approach of atrial fibrillation management. *Avicenna Journal of Medicine*, *6*(1), 8-16.

Andrade, J., Khairy, P., Dobrev, D., & Nattel, S. (2014). The clinical profile and pathophysiology of atrial fibrillation: relationships among clinical features, epidemiology, and mechanisms. *Circulation Research*, *114*(9), 1453-1468.

Brubaker, S., Long, B., & Koyfman, A. (2018). Alternative treatment options for atrioventricular-nodal-reentry tachycardia: an emergency medicine review. *The Journal of Emergency Medicine*, *54*(2), 198-206.

Dresen, W. F., & Ferguson, J. D. (2018). Ventricular arrhythmias. *Cardiology Clinics*, *36*(1), 129-139.

Garner, K. K., Pomeroy, W., & Arnold, J. J. (2017). Exercise stress testing: indications and common questions. *American Family Physician*, *96*(5), 293-299.

Hindricks, G., Potpara, T., Dagres, N., Arbelo, E., Bax, J. J., Blomström-Lundqvist, C., Boriani, G., Castella, M., Dan, G. A., Dilaveris, P. E., et al. (2021). 2020 ESC Guidelines for the diagnosis and management of atrial fibrillation developed in collaboration with the European Association for Cardio-Thoracic Surgery (EACTS) The Task Force for the diagnosis and management of atrial fibrillation of the European Society of Cardiology (ESC) Developed with the special contribution of the European Heart Rhythm Association (EHRA) of the ESC. *European Heart Journal*, *42*(5), 373-498.

Iwasaki, Y. (2011). ki, Nishida K, Kato T. Atrial fibrillation pathophysiology. *Circulation, 124*(20), 2264-2274.

January, C. T., Wann, L. S., Alpert, J. S., Calkins, H., Cigarroa, J. E., Cleveland, J. C., Jr, Conti, J. B., Ellinor, P. T., Ezekowitz, M. D., Field, M. E., et al. (2014). 2014 AHA/ACC/HRS guideline for the management of patients with atrial fibrillation: executive summary: a report of the American College of Cardiology/American Heart Association Task Force on

practice guidelines and the Heart Rhythm Society. *Circulation*, *130*(23), e199-267.

Johnson, L. S., Persson, A. P., Wollmer, P., Juul-Möller, S., Juhlin, T., & Engström, G. (2018). Irregularity and lack of p waves in short tachycardia episodes predict atrial fibrillation and ischemic stroke. *Heart Rhythm*, *15*(6), 805-811.

Kashou, A. H., Noseworthy, P. A., DeSimone, C. V., Deshmukh, A. J., Asirvatham, S. J., & May, A. M. (2020). Wide Complex Tachycardia Differentiation: A Reappraisal of the State-of-the-Art. *Journal of the American Heart Association*, *9*(11), e016598.

Katritsis, D. G., & Brugada, J. (2020). Differential Diagnosis of Wide QRS Tachycardias. *Arrhythmia & Electrophysiology Review*, *9*(3), 155-160.

Katritsis, D. G., & Josephson, M. E. (2015). Differential diagnosis of regular, narrow-QRS tachycardias. *Heart Rhythm*, *12*(7), 1667-1676.

Lee, C. J. Y., Toft-Petersen, A. P., Ozenne, B., Phelps, M., Olesen, J. B., Ellinor, P. T., Gislason, G., Lip, G. Y., Torp-Pedersen, C., & Gerds, T. A. (2021). Assessing absolute stroke risk in patients with atrial fibrillation using a risk factor-based approach. *European Heart Journal-Cardiovascular Pharmacotherapy*, *7*(FI1), f3-f10.

Lippi, G., Sanchis-Gomar, F., & Cervellin, G. (2021). Global epidemiology of atrial fibrillation: An increasing epidemic and public health challenge. *International Journal of Stroke*, *16*(2), 217-221.

McCallum, C. J., Raja, D. C., & Pathak, R. K. (2019). Atrial fibrillation: an update on management. *Australian Prescriber*, *42*(6), 186-191.

Miyazaki, S., Shah, A. J., Scherr, D., & Haissaguerre, M. (2011). Atrial fibrillation: pathophysiology and current therapy. *Annals of Medicine*, *43*(6), 425-436.

Olshansky, B., & Sullivan, R. M. (2013). Inappropriate sinus tachycardia. *Journal of the American College of Cardiology*, *61*(8), 793-801.

Olshansky, B., & Sullivan, R. M. (2019). Inappropriate sinus tachycardia. *Ep Europace*, *21*(2), 194-207.

Padeletti, L., & Bagliani, G. (2017). General introduction, classification, and electrocardiographic diagnosis of cardiac arrhythmias. *Cardiac Electrophysiology Clinics*, *9*(3), 345-363.

Pathak, R. K., Middeldorp, M. E., Lau, D. H., Mehta, A. B., Mahajan, R., Twomey, D., Alasady, M., Hanley, L., Antic, N. A., McEvoy, R. D., et al. (2014). Aggressive risk factor reduction study for atrial fibrillation and implications for the outcome of ablation: the ARREST-AF cohort study. *Journal of the American College of Cardiology*, *64*(21), 2222-2231.

Pellegrini, C. N., & Scheinman, M. M. (2010). Clinical management of ventricular tachycardia. *Current Problems in Cardiology*, *35*(9), 453-504.

Permadi, A. W., Hartono, S., Wahjuni, E. S., & Lestari, N. K. D. (2020). The Combination of Physical Exercise Programs in Patients with Heart Failure. *International Journal of Pharmaceutical and Phytopharmacological Research*, *10*(1), 22-28.

Pevnick, J. M., Birkeland, K., Zimmer, R., Elad, Y., & Kedan, I. (2018). Wearable technology for cardiology: an update and framework for the future. *Trends in Cardiovascular Medicine*, *28*(2), 144-150.

Roka, A., Stead, T. G., Ramlatchan, S. R., Rubero, J. A., & Ganti, L. (2019). Electrical Cardioversion for Wide Complex Tachycardia. *Cureus*, *11*(7), e5174.

Sadek, M. M., Schaller, R. D., Supple, G. E., Frankel, D. S., Riley, M. P., Hutchinson, M. D., Garcia, F. C., Lin, D., Dixit, S., Zado, E. S., et al. (2014). Ventricular tachycardia ablation–the right approach for the right patient. *Arrhythmia & Electrophysiology Review*, *3*(3), 161-167.

Shah, R. L., & Badhwar, N. (2020). Approach to narrow complex tachycardia: non-invasive guide to interpretation and management. *Heart*, *106*(10), 772-783.

Son, M. K., Lim, N. K., Kim, H. W., & Park, H. Y. (2017). Risk of ischemic stroke after atrial fibrillation diagnosis: A national sample cohort. *PLoS One*, *12*(6), e0179687.

Viskin, S., Chorin, E., Viskin, D., Hochstadt, A., Schwartz, A. L., & Rosso, R. (2021). Polymorphic Ventricular Tachycardia: Terminology, Mechanism, Diagnosis, and Emergency Therapy. *Circulation*, *144*(10), 823-839.

Wang, N. C. (2021). Catheter ablation via the left atrium for atrioventricular nodal reentrant tachycardia: A narrative review. *Heart Rhythm O2*, *2*(2), 187-200.

Wegner Felix, K., Eckardt, L., Dechering Dirk, G., Habbel, P., Schuppert, P., Frommeyer, G., Ellermann, C., Lange Philipp, S., Leitz, P., Köbe, J., et al. (2021). Predictors of AVNRT Recurrence After Slow Pathway Modification: A Case Control Study. *International Heart Journal*, *62*(1), 72-77.

Zulkifly, H., Lip, G. Y., & Lane, D. A. (2018). Epidemiology of atrial fibrillation. *International Journal of Clinical Practice*, *72*(3), e13070.