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Short Communication

Internal Medicine Section

Clinical Significance of the Forsaken aVR in Evaluation of Tachyarrhythmias: A Reminder

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ABSTRACT

Introduction: Mechanism of a regular, monomorphic Wide QRS Complex Tachycardia (WCT) is an important diagnostic challenge in day to day practice for the clinicians and affects further management and prognosis. Many of the WCT and Narrow Complex Tachycardia (NCT) produce certain characteristic changes in lead aVR by which we can differentiate between them.

Aim: The present study was aimed to evaluate tachyarrhythmias in relation to lead aVR and to highlight the clinical significance of lead aVR, "The Neglected Lead".

Materials and Methods: This is prospective study in which 55 consecutive cases of tachyarrhythmias excluding sinus tachycardia, atrial fibrillation and atrial flutter were taken for the study admitted in from ICCU of Department of Medicine at S.S. Medical College and S.G.M. Hospital Rewa (M.P.), India, during July 2014 to September 2015, fulfilling the required study protocol. The data was collected regarding detailed history, physical examination; necessary investigations (including ECG and echocardiography) were done.

Results: Among 55 patients, 30 were of WCT and 25 were of NCT. The most common cause of WCT was Ventricular Tachycardia (VT) (83.3%) and rest were Supra Ventricular Tachycardia (SVT) with aberrancy (16.7%). The most common cause of NCT was Atrioventricular Nodal Tachycardia (AVNRT) (84%) followed by Atrioventricular Reciprocating Tachycardia (AVRT) (16%). The present study observed that 38.1% of the AVNRT cases and 50% of AVRT cases showed positive 'p' wave in lead aVR. The present study observed that 75% cases of AVRT showed ST segment elevation in lead aVR while only 33.3% cases of AVNRT showed ST elevation. In the present study 80% of the patients with WCT were diagnosed to have VT using Brugada algorithm while using Vereckei's new aVR algorithm, 83.3% were diagnosed to have VT.

Conclusion: Lead aVR, one of the most neglected leads on 12 lead ECG, is a very important diagnostic tool for identification and categorization of different type of tachyarrhythmias. The presence of ST elevation in lead aVR on ECG showing NCT is relatively sensitive for diagnosing AVRT. New aVR algorithm by Vereckei is more sensitive for differential diagnosis of WCT. One should pay careful attention to lead aVR which provides essential diagnostic information.

Keywords: Electrocardiography, Supraventricular tachycardia, Ventricular tachycardia

INTRODUCTION

Among the 12-leads of Electrocardiogram (ECG), the practicing physicians often neglect the lead aVR and consider it as 11-lead ECG. The lead aVR provides localized information from right upper side of the heart like right ventricular outflow tract and basal interventricular septum. Rather clinicians frequently consider that lead aVR provides reciprocal changes from left lateral side of heart which is represented by the aVL, II, V5 and V6 leads of ECG [1-5]. Because of this reason the lead aVR is usually ignored. Accurate and timely diagnosis of various tachyarrhythmias is important in the management of tachyarrhythmias as the common cause of sudden cardiac death is tachyarrhythmias. Hence, correct and timely diagnosis of various tachyarrhythmias is important in the management of tachyarrhythmias.

The differential diagnosis of a regular, monomorphic WCT mechanism represents a great diagnostic dilemma commonly encountered by the practicing physician, which has important implications for acute arrhythmia management, further work-up, prognosis and chronic management as well [6-9]. This study discusses the causes and differential diagnosis of WCT, and since the ECG remains the cornerstone of WCT differential diagnosis, focuses on the application and diagnostic value of different ECG criteria especially with respect to changes in lead aVR.

MATERIALS AND METHODS

This is prospective study in which 55 consecutive cases of tachyarrhythmias were taken for the study, admitted in from ICCU of Department of Medicine at S.S. Medical College and S.G.M. Hospital Rewa (M.P.) during July 2014 to September 2015 fulfilling the required study protocol approved by the Institutional Review Board including ethical issues.

Inclusion Criteria: Patient 15 years of age or above admitted in ICCU with tachyarrhythmias.

Exclusion Criteria: Sinus tachycardia, atrial fibrillation and atrial flutter.

The data was collected in a pre-tested proforma by meeting objectives of the study, detailed history, physical examination, thorough cardiovascular and other systemic examination and necessary investigations were done. A total of 55 patients (30 WCT and 25 NCT) were evaluated based on specific ECG criteria, all diagnosis were made on the basis of history (previous history of IHD, CHF), ECG criteria using Brugada algorithm [10] versus Vereckei's new aVR algorithm [11] and echocardiography.

RESULTS

Among 55 patients, 30 WCT and 25 were NCT. The most common cause of WCT was VT (83.3%) and rest were SVT with aberrancy (16.7%). The most common cause of NCT was AVNRT (84%) followed by AVRT (16%). AVNRT was common in females in the

age group 30-44 years while AVRT was most common in the young adults (15-29 years and 30-44 years age groups) with no gender predilection. VT was most common in males in the middle and elderly age group (in the age group of 45-60 years and more than 60 years age groups). Maximum number of patients presenting with SVT had structurally normal heart (84%) while majority of patients with VT had ischemic heart disease (80%). Most common symptoms during tachyarrhythmia were palpitations (96%) followed by dizziness (70%). Majority (86.7%) of the SVT were terminated by pharmacotherapy while most of VT (72%) was terminated by Direct Current (DC) cardioversion. The present study observed that 38.1% of the AVNRT cases and 50% of AVRT cases showed positive 'p' wave in lead aVR. The present study observed that 75% cases of AVRT showed ST segment elevation in lead aVR while only 33.3% cases of AVNRT showed ST elevation. In the present study 80% of the patients with WCT were diagnosed to have VT using Brugada algorithm [10] while using Vereckei's new aVR algorithm [11], 83.3% were diagnosed to have VT.

DISCUSSION

Lead aVR is the most neglected ECG lead and some of the tachyarrhythmias produce certain characteristic changes in lead aVR. Patients with tachyarrhythmias, WCT and NCT were evaluated with respect to changes in lead aVR. The main aim of the study was to highlight the clinical significance of lead aVR in diagnosing and differentiating tachyarrhythmias.

We found that 83.3% of the patients who presented with WCT were having VT and 16.7% were having SVT with aberrancy. In a study conducted by Vereckei A et al., it was found that 75.8% of the patients with WCT were VT and 24.2% of the patients were having SVT with aberrancy [11]. In another study conducted by Akhtar M et al., it was found that 80% of the patients were having ventricular tachycardia [12]. Therefore, VT is the most common cause of WCT (around 80% of cases), and is strongly suggested by a history of heart disease [13] (myocardial infarction or congestive heart failure).

Present study showed that 84% of the patients of NCT had AVNRT and other 16% were having AVRT (only those NCT which produces characteristic changes in lead aVR were considered in the present study). In a study conducted by Porter MJ et al., it was found that 56% of patients with PSVT were AVNRT, 27% were AVRT and 17% were atrial tachycardia [14].

As shown in [Table/Fig-1], AVNRT was most commonly seen in age group of 30-44 years (66.7%) while 19% were observed in 45-60 years and 9.5% were of 15-29 years age group. The mean age of AVNRT was 40 years, which was similar to several studies like those conducted by Orejarena LA et al., (mean age 37 years) [15], Jazayeri MR et al., (mean age, 43 ±20 years) [16], Jackman WM et al., (mean age 42 ears) [17] and Sintetos A et al., (mean age 42 years) [18]. We also observed that 50% of AVRT cases were seen in the 15-29 year age group. This was corroborated by a study of Jung HJ et al., [19], in which 36% of the patients were of less than 30 years of age. The VT was most common in middle age (48%) followed by elderly population (44%); the mean age was 57 years similar to the study conducted by Vereckei A et al., [11] in which the mean age was 58 ± 18 years and another study by Jastrzebski M, et al., [20] in which the mean age was 61 years. This may be due to the fact that ischemic heart disease is the most common cause of VT and the incidence of ischemic heart disease increases with age. The incidence of ischemic VT increases with age, regardless of sex, as the prevalence of CAD increases. VT rates peak in the middle decades of life, in concert with the incidence of structural heart disease.

Age in years	SVT No (%)		SVT with Aberrancy No (%)	VT No (%)
	AVNRT	AVRT		
15-29	02 (9.5%)	02(50%)	-	01(4%)
30-44	14 (66.7%)	02(50%)	03(60%)	01(4%)
45-60	04 (19%)	-	01 (20%)	12(48%)
>60 years	01 (4.8%)	-	01(20%)	11(44%)
Total	21	04	05	25

[Table/Fig-1]: Age wise distribution of tachyarrhythmias.

Present study found that AVNRT was more common in females (61.9%). In a study conducted by Porter MJ et al., 62% were women [14]. Also, in study conducted by Orejarena LA et al., 55% were women [15], while 69% were women in study conducted by Lindsay BD et al., [21], and 76% were women in a study conducted by Jazayeri MR et al., [16]. On the other hand AVRT was found to be equally distributed among males and females in contrast to Porter MJ et al., study where majority of the patients were males (54%) [14].

We found that VT was predominant in males (64%) which is supported by Vereckei A et al., (84%) [11], this may be due to the fact that ischemic heart disease is more common in males. Among patients with Coronary Artery Disease (CAD) in the Framingham Heart Study, conducted by Gordon T et al., male patients were more common than female (46% v/s 34%, respectively) [22].

The study revealed that majority (84%) of the patients with SVT (AVNRT and AVRT) were having structurally normal heart while other causes were ischemic heart disease (8%), valvular heart disease (4%), and hyperthyroidism (4%). Jackman WM et al., study [17] and study by Chen SA et al., [23] found that 82% and 86% of the patients had structurally normal heart respectively. Similarly den Dulk K et al., study showed structurally normal heart in 78% of patients [24].

Most patients with VT in present study had ischemic heart disease (80%), 12% had dilated cardiomyopathies and 8% were having structurally normal heart (Idiopathic). In a study conducted by Jastrzebski M, et al., [20], 71% were having ischemic heart disease, 14% were having cardiomyopathy and 14% were having structurally normal heart (Idiopathic). In another study conducted by Vereckei A et al., [11], 74% were having ischemic heart disease, 15% were having cardiomyopathy and 11% were having structurally normal heart.

In the present study it was found that the most common symptoms during tachyarrhythmia were palpitations (96%), dizziness (70%), dyspnoea (40%), syncope (22%), chest pain (24%), diaphoresis (15%), nausea and vomiting (12%). A similar study by Wood KA et al., [25] showed that most frequent symptoms were palpitations (96%), dizziness (75%), dyspnoea (45%), similar findings were obtained by Bottoni N et al., [26] which showed palpitations (100%), presyncope (60%), chest discomfort (39.6%), sweating (37.5%), syncope (8.3%).

In present study, majority (86.7%) of the patients with SVT were terminated by pharmacotherapy (adenosine), 10% by Carotid Sinus Massage (CSM) and only one patient (3.3%) required cardioversion, which was comparable to the study by Lim SH et al., [27] in which the success rate of CSM was 10.5%. Di Marco JP et al., [28] in their study reported that 90% of the PSVT were reverted by intravenous adenosine.

Present study revealed that most of VT (72%) were terminated by DC cardioversion and remaining (28%) by pharmacotherapy (lignocaine or amiodarone) similar to Griffith MJ et al., [29] study in which 33.3% were terminated by pharmacotherapy. Also, study by Marill KA et al., [30] reported that VT termination was 25% by pharmacotherapy. This could vary depending upon the hemodynamic status of the patient as hemodynamically unstable patients were given DC shock first.

As shown in [Table/Fig-2], 38.1% of the AVNRT cases and 50% of AVRT cases showed positive 'p' wave in lead aVR. This is helpful in determining the site of origin of the tachycardia or the tachycardia

pathway. Any SVT with atrial activation in a caudocranial direction, such as AVNRT or AVRT, left Atrial Tachycardia (AT) or a circus movement tachycardia using a paraseptally located accessory pathway for ventriculoatrial activation will typically show positive 'p' waves in lead aVR which was demonstrated by a study conducted by Bar FW et al., [31]. The present study also observed that 75% cases of AVRT showed ST segment elevation in lead aVR while only 33.3% cases of AVNRT showed ST elevation. This is supported by a study done by Ho YL et al., [32] in which the prevalence of aVR ST-segment elevation was 71% for AVRT, 31% for AVNRT. Using this we can differentiate between AVNRT and AVRT by the help of lead aVR.

In the present study 80% of the patients with WCT were diagnosed to have VT using Brugada algorithm [10] and rest were diagnosed

	AVNRT (total 21 cases) No (%)	AVRT (total 4 cases) No (%)
Positive 'p'wave	08/21 (38.1%)	02/04 (50%)
ST elevation	07/21 (33.3%)	03/04 (75%)

[Table/Fig-2]: ECG changes during narrow complex tachycardia in lead aVR.

to have SVT with aberrancy [Table/Fig-3]; whereas, using Vereckei's new aVR algorithm [11], 83.3% were diagnosed to have VT [Table/Fig-4]. In a study conducted by Vereckei A et al., [11], the accuracy of new aVR algorithm was found to be superior to that of the Brugada algorithm [10] and it had greater sensitivity and negative predictive value for diagnosing VT and greater specificity and positive predictive value for diagnosing SVT [11].

The study highlights the significance of lead aVR in diagnosing and differentiating various tachyarrhythmias only by looking at lead

Type of Arrhythmia	No	%
SVT with Aberrancy	06	20
VT	24	80
Total	30	100

[Table/Fig-3]: Evaluation of WCT by Brugada's criteria.

Types of Arrhythmia	No	%
SVT with Aberrancy	05	16.7
VT	25	83.3
Total	30	100

[Table/Fig-4]: Evaluation of WCT by Vereckei's aVR algorithm.

aVR. So, more attention should be given to lead aVR in our clinical practice.

LIMITATION

Diagnosis was entirely based on clinical and electrocardiographic criteria due to non availability of electrophysiological study in the institution.

CONCLUSION

Lead aVR is one of the most neglected leads on 12 lead. ECG is a very important diagnostic tool for identification and categorization of different types of tachyarrhythmias. The presence of ST elevation in lead aVR on an ECG showing NCT is relatively sensitive for diagnosing AVRT. New aVR algorithm by Vereckei is a reasonably rapid, easy and accurate means for obtaining the correct diagnosis among differential diagnosis of WCT. One should pay careful attention to lead aVR which provides essential diagnostic information.

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