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Original Research Article

Spectrum of Cardiac Rhythm Disturbance after Acute Ischemic Stroke using 24 Hours Holter Monitoring

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Abstract

Background: Acute stroke leads to imbalance of central autonomic control. It can cause over activity of sympathetic or parasympathetic control, myocardial injury, ECG abnormalities, cardiac arrhythmias and even sudden death. While evidence for cerebrally induced cardiac dysfunction is persuasive, predisposing factors, frequency and data on time course are limited and furthermore, various confounding factors hamper assessment.

Methods: This Cross-Sectional Study was conducted in Tripura Medical College &Dr BRAM Teaching Hospital, over a period of One and half year duration from February 2019 to July 2020 and included subjects of acute ischemic stroke confirmed by brain imaging. After performing a 12 lead ECG in emergency ward, all eligible stroke patients were subjected to 24-hour Holter monitoring.

Results: Out of 92 stroke patients, 35.28% had abnormal ECG. Changes included LVH in 10.87%, T-wave inversion in 9.78%, ST segment depression in 4.35% followed by QTc prolongation 3.26%. Holter monitoring for 24 hours revealed various cardiac rhythm disturbances viz ventricular ectopics (44.57%) supraventricular ectopics (30.43%), supraventricular tachycardia (11.96%), and atrial fibrillation (7.60%). Amongst brady-arrhythmias sinus pause was detected in 1.09%.

Conclusions: ECG changes occur commonly in case of acute ischemic stroke, even in those having no history of heart disease as suggested clinically. Identification of paroxysmal atrial fibrilation episodes is important due to its relevance for planning of long-term treatment.

Introduction

Cardiac abnormalities have been observed in 60 to 70 percent of patients after stroke [1]. The most common disturbance includes ECG abnormalities, cardiac arrhythmias, myocardial injury and dysfunction distinguishing cardiac abnormalities directly caused by stroke.

An observational study of stroke patients indicated an increase incidence of sudden death among patients with right insular strokes. Right middle cerebral artery

strokes were associated with increased incidence of supraventricular tachyarrhythmias [2]. Left parieto insular stroke was associated with an increased incidence of new onset atrial fibrillation. [3].

In 2 large studies, ECG disturbances were detected in 90% of patients, and it was reported that the most frequently observed ECG changes were QT prolongation, ST-segment depression, T-wave inversion, and U waves; the most frequently observed rhythm disturbances were atrial fibrillation (AF), sinus tachycardia, and atrial and ventricular premature beats (APB, VPB).[4,5] It was determined that the prognosis for patients with ischemic ECG changes and arrhythmia was worse than that of other patients[6].

Cardiac embolism is one of the most important causes of focal brain ischemia. In 5% of patients who had no risk factors for cardiac embolism, arrhythmias that might cause an embolism were detected on Holter monitoring[7].

Atrial fibrillation and flutter accounts for 10% of all strokes and 50% of cardio embolic strokes. Stroke associated with AF carries a poor prognosis as more than 50% of the survivors remain with a severe deficit, and recurrence may be as high as 12% per year[8].

Unfortunately, AF remains under diagnosed as it is often asymptomatic in up to 30% of cases. Moreover, the fibrillation pattern is intermittent in 30% of patients with stroke and may not appear on a single recording[9]. Because of the poor sensitivity of single standard ECG for paroxysmal AF, 24-hour ECG recording (Holter) is often used, allowing the detection of previously unrecognized AF in 2% of stroke patients[10].

However, as such data is limited regarding of ECG changes and incidence of paroxysmal AF and other rhythm disturbance after acute ischemic stroke. Keeping this in mind, this study has been undertaken to identify ECG changes and rhythm disturbances in patients of ischemic stroke using 24 hours Holter monitoring.

Aim and Objectives

1. To study ECG changes early after acute ischemic stroke.
2. Find out prevalence of paroxysmal atrial fibrillation and other cardiac rhythm disturbances within 24 hours of hospitalization.

Methods

It is a Cross Sectional Study conducted over a period of one and half year duration from February 2019 to July 2020.

Sample Size

The study group comprised of 92 patients who were admitted in the Tripura Medical College and DR. BRAM Teaching Hospital with history and clinical features suggestive of cerebrovascular accidents, fulfilling the inclusion and exclusion criteria.

Inclusion Criteria

- Patients of age between 20 years to 80 years of age, presenting within 24 hours of stroke.
- ECG revealing sinus rhythm at admission
- Patients willing to give consent

Exclusion Criteria

- Patients with known AF or other rhythm disturbance
- Those with rheumatic valvular heart disease, cardiomyopathy
- Patients with hemorrhagic stroke
- Hemodynamically unstable
- Patients using drugs known to affect ECG parameters and cardiac rhythm, such as digoxin, phenothiazines, lithium, erythromycin, theophylline, beta blockers, tricyclic antidepressants.

The study protocol was approved by the Ethics Committee of the Tripura medical college and DR. BRAM teaching Hospital

and written informed consent were obtained in all cases.

All subjects underwent a detailed history general and neurologic examination. Patients were questioned about risk factors for stroke, such as hypertension, diabetes, coronary artery disease (CAD), and hyperlipidemia.

Complete blood count, blood sugar and renal function test, fasting lipid profile levels were evaluated in all cases.

All subjects underwent CT scan/MRI of brain after stabilization. Infarct smaller than 15 mm in the pons, thalamus, basal ganglia and corona radiata were regarded as lacunar infarcts.

Resting 12-lead ECG performed in the emergency department up on arrival. ECG tracing was evaluated for ST-segment depression below the iso electrical line, T-wave flattening/inversion or any changes in QT interval. If the admission ECG was suggestive of suspected of acute coronary syndrome, the patients were subjected for cardiac troponin and 2D echocardiography. Electrocardiogram (ECG) was evaluated for rhythm changes.

There after patients were subjected to 24-hour, 3-channel ambulatory ECG monitoring by MT-101/ MT-200 Holter unit (schiller). The electrodes were then connected to a recording device and the respective wires verified. Amplitude, rate, and morphology of waveforms were recorded. Patients were instructed to keep a diary to recorded any symptoms of palpitation, slipped heart beats, shortness of breath, chest pain, or light headedness. Patients were also instructed to press a particular button on the recording device as soon as they would feel any symptoms.

After manual revision of recordings and elimination of artifacts and beat classification errors, analysis was carried out on computerized system. The minimum, maximum and average heart rate was calculated. Dynamic changes of ST segment was obtained from computer given data. Analysis included arrhythmias like Supra ventricular Ectopic (SVE), Supraventricular Tachycardia (SVT), Ventricular Ectopic (VE), Ventricular Tachycardia (VT), Paroxysmal Atrial Fibrillation (PAF), A-V block, and sinus pause. PAF is defined as intermittent periods of AF interspersed with episodes of normal sinus rhythm, usually lasting <7 days.[4]At the end, comprehensive data regarding heart rate and total burden of arrhythmia was generated in a printed format.

Statistical Analysis

Collected data of 92 subjects were checked for consistency and completeness and were entered in Microsoft Excel data sheet. Data were recognized and presented using the principles of descriptive statistics in the form of frequency and percentage. Categorical data were expressed in proportion. Mean and standard deviation was used for continuous data. Chi-square test and student unpaired T test was applied where applicable. P value of < .05 was considered as statistically significant. Analysis of the data was done by Microsoft Excel ADDIN-Megastat.

Results and Observations

0ut of 92 study subjects, stroke was most common in the age group of 56-65 years (34.78%) and least in 35-45 years (6.52%). Mean age of study population was 61±9.77 years. The incidence of stroke was more among males (55%) compared to females (37%).The Male: Female ratio was1.5:1.Table 1 shows baseline characteristics of study population.

Hypertension was the commonest risk factor present in 55.43 % whereas smoking in 35.87%, sedentary lifestyle in 25%, alcohol abuse in 21.74%, overweight in 21.74%, diabetes mellitus in 17.39% followed by hyperlipidemia in Mean total cholesterol was 172±26.4, Mean triglycerides was 159±52.5. Mean HDL

cholesterol was 40 ±6.56 and Mean LDL cholesterol was 133±24.1.

Right sided hemiplegia/ hemiparesis was the presenting complaint in 48.91%, left sided hemiplegia/ hemiparesis in 43.48%, dysarthria in 5.43% followed by left sided monoplegia in 2.1% patients. Localization of stroke as detected by CT/MRI of brain are given in figure1

Out of all stroke patients, 35.28% had abnormal ECG. ECG abnormalities include LVH in 10.87%, T wave inversion in 9.78%, Tachycardia in 6.25% , ST segment depression in 4.35%, QTc prolongation 3.26%. Those who had ST depression on resting ECG, underwent estimation of TROP-T. However, all tested negative for cardiac biomarker. Figure 2 shows distribution of study subjects according to ECG finding.

24 hours Holter monitoring revealed that minimum heart rate was 56±7.31, maximum heart rate was105±16, average heart rate being 70.5±7.94%. Out of 44.57% VE in our study, 2% showed couplet, 4%showed bigeminy and 2% showed trigeminy. Frequency of other arrhythmias were as follows- Supraventricular ectopics (30.43%), supraventricular tachycardia (11.96%), non-sustained VT(2.17%), atrial fibrillation (7.60%) pause. The AF was noted to be intermittent and clinically silent followed by pause (1.09%) .Figure 3 and figure 4 shows distribution of study subjects according to 24 hours Holter monitoring . Figure 5, 6 and 7 shows ECG tracings of atrial fibrillation, supraventricular tachycardia and non-sustained ventricular tachycardia respectively on 24 hr monitoring.

In our study, out of 16 patients who were diabetic, none had AF on Holter monitoring whereas 9.2% (7/76) non diabetes had AF on Holter. It was observed that 11.7% (6/51) of hypertensive subjects had AF whereas 2.4% (1/41) non hypertensive subjects also had AF (P=0.45). Likewise 6.2% (2/32) of study subjects who had abnormality in resting ECG shows AF during 24 hours HOLTER whereas 8.3% (5/60) subjects without any abnormality in resting ECG also showed AF during 24 hours Holter monitoring (P=0.71).There was no statistical significant association of AF with variables like diabetes mellitus, hypertension or base line ECG abnormality (P >0.05).Table 2 shows comparison of study group between AF, hypertension, diabetes mellitus and ECG finding in study population.

Table 1: Baseline Characteristics of Study Population

Mean age	61±9.77 years
Gender, male	55(59.78%)
Smoker	33(35.87%)
Alcoholic	20(21.74%)
Sedentary life style	25(27.17%)
BMI ,overweight	20(21.74%)
Hypertension	51(55.43%)
Diabetic	16(17.39%)
Lipid profile	
Mean total cholesterol	172±26.4
Mean triglycerides	159±52.5
Mean LDL cholesterol	133±24.1
Mean HDL cholesterol	40±6.56
Neurological deficit	
Right sided hemiplegia/hemiparesis	45(48.91%)
Left sided hemiplegia/hemiparesis	40(43.48%)

Left sided monoplegia	2(2.1%)
Dysarthria	5(5.43%)
24 hours Holter analysis	
Average heart rate	70.5±7.94
Supra ventricular ectopic(SVE)	28(30.43%)
Supra ventricular tachycardia(SVT)	11(11.96%)
Ventricular ectopic(VE)	41(44.57%)
Non sustained ventricular tachycardia(NS VT)	2(2.17%)
Atrial fibrillation(AF)	7(7.60%)
Pause	1(1.09%)

Table 2: Comparison of Study Group Between AF, Hypertension, Diabetes Mellitus and ECG Finding in Study Population.

	AF finding		p value
	Present	Absent	
Diabetes mellitus			
Present	2 (12.5%)	14 (87.5%)	0.95
Absent	7 (9.2%)	69 (90.8%)	-
Hypertension			
Present	6 (11.7%)	45 (88.3%)	0.45
Absent	1 (2.4%)	40 (97.6%)	0.45
ECG finding			
Abnormal	2 (6.2%)	30 (93.7%)	0.71
Normal	5 (8.3%)	55 (91.7%)	0.71

***Fisher exact test, p value <0.05 taken as a significant**

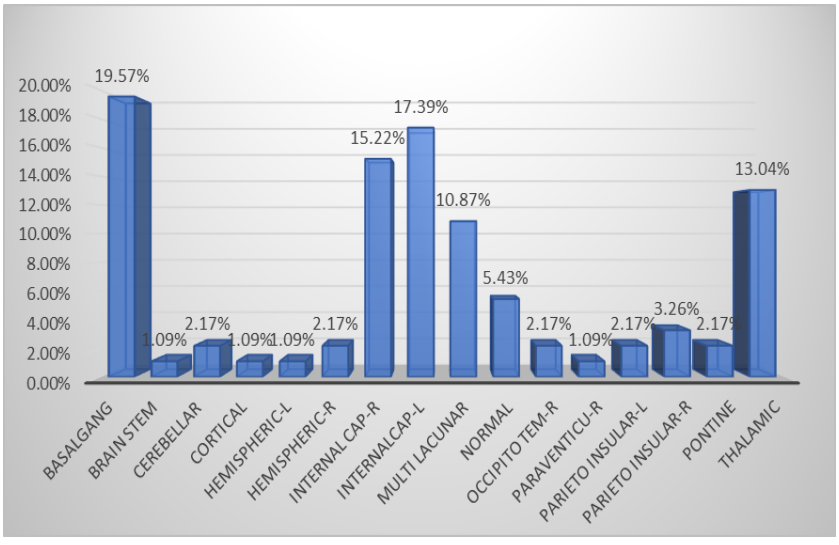

Figure 1: Distribution of Study Subjects according to Site of Infarction

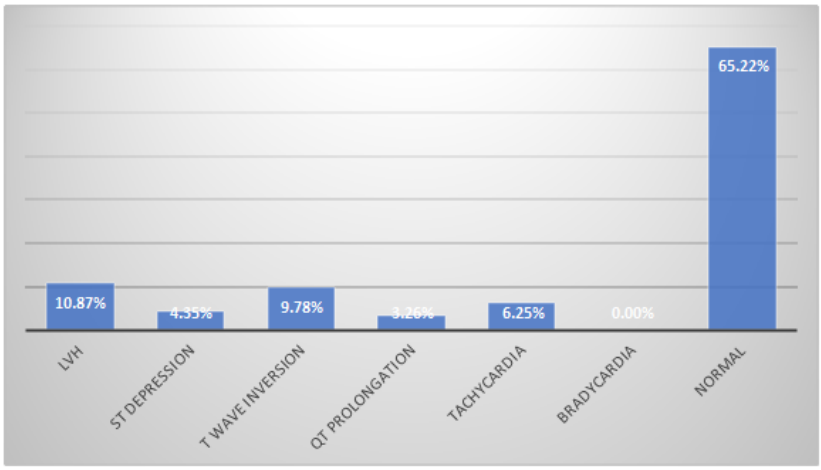

Figure 2: Distribution of Study Subjects According To ECG Finding

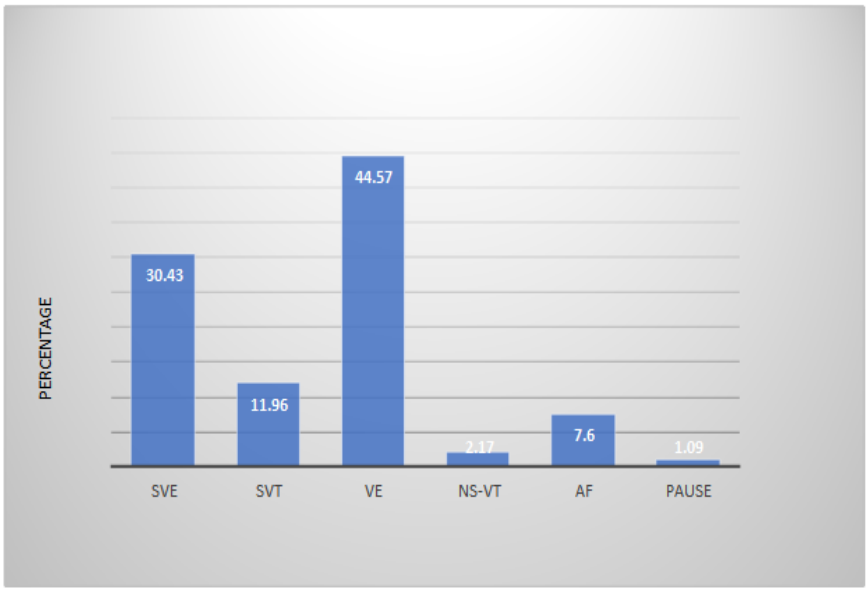

Figure 3: Distribution of Study Subjects according to 24 Hours Holter Finding

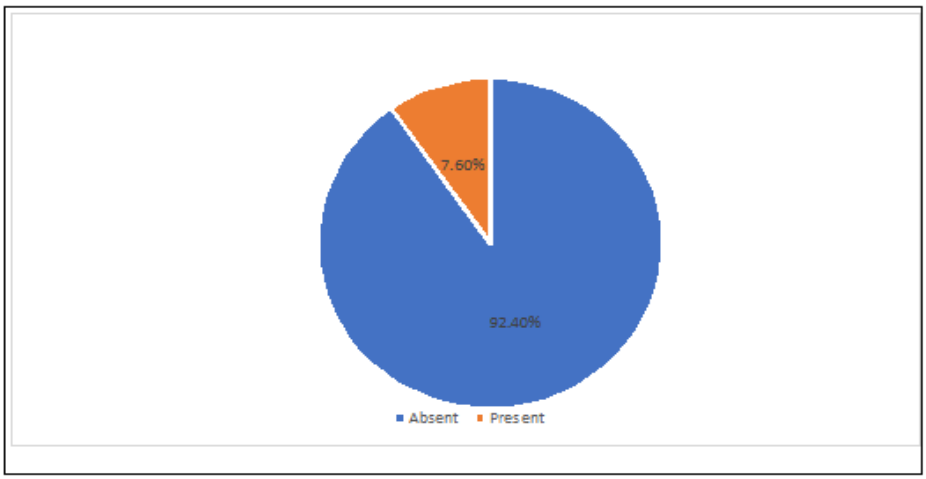

Figure 4: Distribution of study subjects according to Atrial Fibrillation

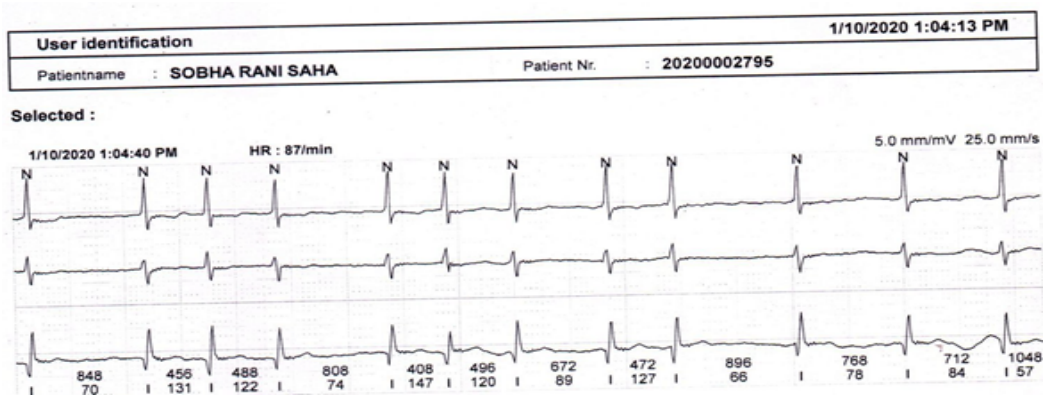

Figure 5: 24 Hours holter report showing atrial fibrillation

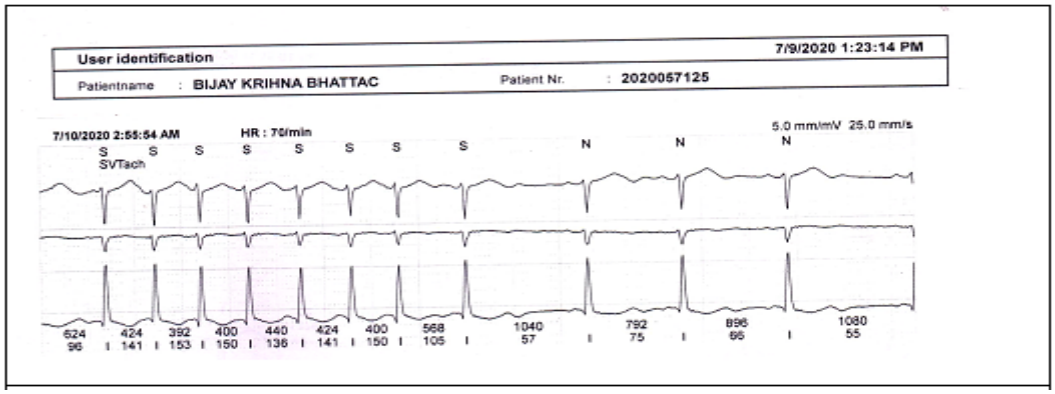

Figure 6: 24 Hours Holter report showing supraventricular tachycardia

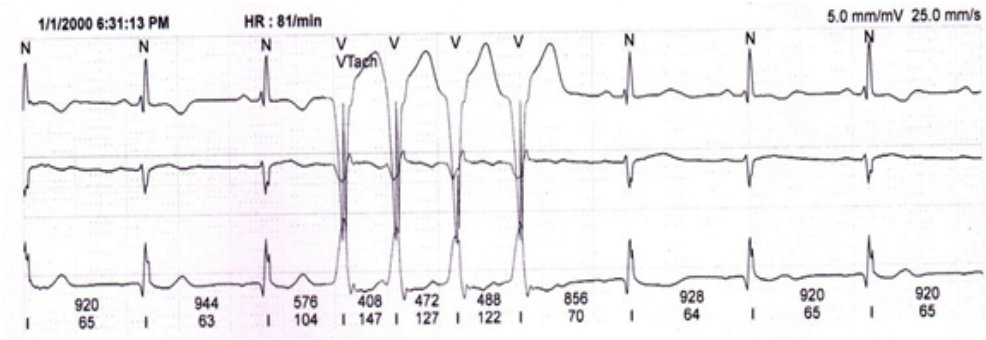

Figure 7: 24 Holter report showing non sustained- ventricular tachycardia

Discussion

This hospital-based study was done to detect spectrum of cardiac rhythm disturbances in patients of ischemic stroke using 24 hours Holter monitoring within 24 hours of hospitalization.

Out of 92 patients, 55 were males and 37 were females. The male: female ratio was 1.5:1 which is comparable to study done by Anand et al [11] . The lower incidence of stroke in women may be attributed to genetic factors, positive effects of estrogen on the cerebral circulation or to lesser history of smoking compared to men.

Cardiac abnormalities occur in 60 to 70 percent of patients after stroke. The most common disturbance include ECG abnormalities, cardiac arrhythmias and myocardial injury distinguishing it as a cardiac abnormality directly caused by stroke [3]. It however remains difficult because the prevalence of preexisting cardiac disease is high among patients with ischemic stroke.

In the present study, ECG changes was demonstrated in 34.78% of stroke patients. This conforms to the previous study done by Bozluolclay et al[12] and Rambabu et al[13] where ECG changes were demonstrated in 62.1% and 33% of patients respectively.

In our study 10.87% of the patients had LVH, whereas Kumar S et al [14] reported LVH in 15.6% cases. ST depression was present in 4.35% cases in our study, while Kumar S et al[(14)] reported ST depression in 16.4% cases and Tandur et al [15] reported in 20% of cases which is much higher than our findings.

In the present study T wave inversion was present in 9.78% cases which is lower than Shingade P et al [16] who reported T wave inversion in 28% cases. We observed QT prolongation in 3.26% cases in our study whereas Kumar S et al [14] observed QTc prolongation in ECG was 43.4% and Shingade P et al [16] reported in 10% cases.

It is known that stroke alters autonomic functions, enhances cardiac arrhythmias, and causes myocardial damage. It has been shown that, during the first day of stroke, the imbalance between adrenergic and cholinergic systems that favors sympathetic activity promotes the incidence of arrhythmia and increases blood pressure. However, these changes are greatly reduced after the third day and eventually disappear. In patients with acute stroke, arrhythmias are frequently seen; the most common being AF, followed by sinus tachycardia, VPB, APB, and VT. [17]

Vingerhoets F et al [2] in their study have shown that atrial fibrillation was first diagnosed in patients with acute stroke during their hospital admission.[17,2] It has been suggested that AF found during the acute phase of stroke is a cause rather than a consequence, and that it indicates the presence of underlying cardiovascular disease.

In our study on 24 hours Holter monitoring the observed profile of arrhythmias are as follows supra ventricular tachycardia (11.96%), supra ventricular ectopic(30.43%), non-sustained ventricular tachycardia (2.17%) , ventricular ectopics (44.57%), atrial fibrillation was 7.60% and pause was 1.09%. Similar kind of result was influence with study by Kallmunzer et al [16].

In the present study, no significant relationship was identified between AF and other variables such as history of hypertension, diabetes, prior ECG changes. Similar observation were made by Gunalp M et al [18]. Results suggest that PAF may be a risk factor, independent of other major risk factors, in patients with thrombo embolic stroke. [19]

A stroke patient often required extensive work up, not only the imaging of brain but echocardiography for study of structural heart disease and doppler imaging of intra cranial neck vessel to determine the possible source of embolism.

As arrhythmias particularly atrial fibrillation and flutter is important risk factor for cardioembolic stroke, an effort to detect paroxysm of such rhythm disturbances should be a part of work up. Targeting subset of patients suspected to have embolic stroke based on stroke semiology like sudden onset of neurological deficit with rapid regression of symptoms, age > 75 years, global aphasia without hemiparesis, visual field abnormality, neglect, sudden onset of seizure, bi hemispheric combined anterior and posterior circulation or bilateral or multilevel posterior infarct is likely to give more yield. Similarly, LVH in ECG, left ventricular systolic dysfunction with left atrial enlargement in echo, should prompt search for atrial fibrillation using Holter monitoring.

In our study good number of patients showing paroxysmal atrial fibrillation without any known prior episodes of AF

give a hint that 24 hours Holter monitoring is cost effective should form integral part of stroke evaluation, particularly in cryptogenic stroke where etiology could be embolic. Detecting such episodes of AF will have a strong impact on management strategy and as well as risk reduction of future cardio embolic stroke.

In high-risk patients a prolonged Holter monitoring up to 72 hours or a event recorder may be contemplated to increase the yield of detection of arrhythmia.

However, our observation detecting of silent AF using 24 hours Holter cannot be generalized to all types of strokes unless, larger study is undertaken to confirm or refute our findings.

Conclusion

Electrocardiography changes and various rhythm disturbances occur commonly in case of acute ischemic stroke, even in those having no history of coronary heart disease. The major ECG abnormalities were LVH, ST-T changes, QTc prolongation.

24 hours Holter monitoring in various rhythm disturbances are frequently observed following acute ischemic stroke. 24 hours Holter monitoring can help in identification of PAF episodes on 24 hours Holter and focus an important tool for discerning the cause of stroke and for appropriate planning long-term treatment.

Limitation

This study has several strengths. Firstly, our study design excluded known patients of rhythm disturbance and structural heart disease, thus eliminating biases associated with their inclusion.

Our study has few limitations. Firstly, we acknowledge the present study is a single centre design with a restricted number of arrhythmia cases. Secondly as with all observational studies, residual confounding from unknown or unmeasured variable remains possible. Finally, as our result were focused to very early phase of stroke, thus it cannot be extrapolated for a general consensus regarding the prevalence risk and time profile of arrhythmia in the sub-acute phase or following discharge from hospital.

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