

# Holter Monitoring in assessing Cardiac Arrhythmias in Symptomatic Patients: A Prospective Observational Study

**Biplave Karki<sup>1</sup>, Jeet Ghimire<sup>1</sup>, Bikash Nepal<sup>1</sup>, Aditya Mahaseth<sup>1</sup>, Ajit Sah<sup>1</sup>, Swapnil Pandit<sup>1</sup>, Naveen Pandey<sup>1</sup>, Prashant Shah<sup>1</sup>, Prahlad Karki<sup>1</sup>**

<sup>1</sup>Department of Cardiology, BPKIHS, Dharan, Nepal



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## ABSTRACT

**BACKGROUND** The 24hr ECG Holter monitoring system is helpful in assessing cardiac arrhythmias in patients presenting with palpitation, dizziness, presyncope and syncope, which are not detected by standard office electrocardiogram.

**METHODS** This was a single center prospective observational study conducted to assess the prevalence of cardiac arrhythmias among 78 patients consisting of 41 males and 37 females referred for 24 hr ECG Holter monitoring in BPKIHS, Dharan, Nepal, between October 2021 to December 2021.

**RESULTS** The most common indication for 24 hr ECG Holter monitoring in these patients was unexplained palpitation. Ventricular ectopics were the most common arrhythmias detected, followed by supraventricular ectopics, most of which were benign. Among 18 patients with significant bradyarrhythmia, 3 had sinus bradycardia with significant pause, 3 had AF with significant pause, and 2 had high grade/complete AV block.

**CONCLUSIONS** The study showed that most of the arrhythmias detected are benign and prevalence of potentially fatal ventricular and supraventricular tachyarrhythmias are relatively low in our population.

Keywords: cardiac arrhythmias; ectopics; electrocardiogram; 24hr ECG Holter monitoring.

## BACKGROUND

Holter monitoring is commonly employed for the diagnostic evaluation of unexplained symptoms like palpitations, lightheadedness, blackouts, drop attacks and atypical chest pain.<sup>1</sup> It is particularly able to document bradyarrhythmic or tachyarrhythmic episodes which might be missed on normal 12-lead resting ECG recordings.<sup>2,3</sup>

Despite the widespread availability of this procedure abroad, its use in Nepal is still limited to some teaching hospitals and few private health-care facilities. Badri et al.<sup>4</sup> had published the prevalence of various arrhythmias in 255 patients with palpitation who underwent 24-h Holter ECG monitoring, about a decade ago. Since then, there have been few attempts at revisiting this interesting subject from different perspectives.

The aim of this study is to evaluate the prevalence of arrhythmias on the 24-h Holter ECG in patients referred to our cardiac facility at BPKIHS for evaluation of unexplained syncope, dizziness and palpitations.

## METHODOLOGY

A single center prospective observational study was conducted to assess the prevalence of cardiac arrhythmias in 78 consecutive patients presenting with unexplained

syncope, dizziness and palpitations using 24hr ECG holter monitoring from October 2021 to December 2021. Each patient provided an informed consent and the study was approved by institutional review committee (IRC), BPKIHS, Dharan (Ref No: 55/078/079).

**Inclusion Criteria** - Age greater than 18 years with a symptom of unexplained syncope, dizziness or palpitations, either as a chronic problem or a single episode.

**Exclusion Criteria** - Patients with any definitive evidence of myocardial ischaemia, which was detected on a resting electrocardiogram and with any definite evidence of arrhythmia, which was detected on a resting electrocardiogram. The patients with other known medical causes of the symptoms, a history of documented arrhythmias, or a history of or the current use of anti-arrhythmics, were also excluded.

The sampling method for this study was convenience sampling.

**\*Corresponding Author |**  
**Dr. Biplave Karki,**  
 Department of Cardiology, BPKIHS, Dharan, Nepal,  
 Email:biplave11837@hotmail.com,  
 Phone No: +977-9845093054

The sample size was estimated using following formula,

$$n = Z^2 \times p \times q / d^2$$

$$= (1.96)^2 \times 0.55 \times (1-0.55) / (0.05)^2$$

$$= 380$$

Where,

n = required sample size,

Z = 1.96 at 95% Confidence Interval (CI),

p = prevalence of cardiac arrhythmias in 24hr ECG holter based on study by Lipski et al.<sup>5</sup>

q = 1-p

d = precision, 5%

The average number of patients visiting cardiology department requiring holter monitoring was about 25-30 per month. The duration of the study was 3 months. Hence, about 90 subjects were estimated to be available for holter monitoring. Hence, corrected sample size was estimated using following formula:

$$N = n / (1 + n / \text{estimated sample size})$$

$$= 380 / (1 + 380 / 90)$$

$$= 73$$

A sample size of 78 patients was taken. A SEER 12 Digital Holter ECG Recorder unit was strapped to each patient after necessary ECG lead placement based on Mason-Likar 10 electrode 12 lead monitoring system.<sup>6</sup> The patients were admitted and advised to continue normal routine daily activities. They were advised to keep a record of the time they experienced significant symptoms such as palpitations, dizzy spells, presyncope or syncope. The 24-h Holter recording was subsequently transferred to a MARS computer based ECG analysis and editing system for the analysis of the reports using CARDIODAY holter ecg software. The reports were reviewed by the cardiologists (authors).

The Holter reports were evaluated for the presence of cardiac arrhythmias. For the study, patients were classified into those with (a) normal cardiac rhythm and (b) abnormal cardiac rhythm or arrhythmias. The specific arrhythmias were evaluated on the Holter ECG analysis based on standard ECG diagnostic criteria.<sup>7</sup> Extra-systoles include either Atrial or Ventricular Premature Contractions (infrequent and unifocal = Lown class 1, frequent and/or polymorphic = Lown class  $\geq 2$ ), Supra-ventricular tachyarrhythmias include paroxysmal supraventricular tachycardia (PSVT), atrial fibrillation (AFIB). Patients with Wolff-Parkinson-

White (WPW) syndrome which are also known to have predisposition to supra-ventricular tachyarrhythmias, were also included. Ventricular tachyarrhythmias include Sustained or Non-sustained Ventricular Tachycardia ( $\geq 3$  or more consecutive ventricular extrasystoles lasting less than 30 sec) and ventricular fibrillation. Severe bradyarrhythmias were defined in the study as Holter ECG evidence of Heart Rate  $< 40$  beats per minute, high grade second degree AV block (Mobitz type 2) or third degree AV blocks. The holter data collection also included the baseline rhythm, average heart rate, minimum heart rate, maximum heart rate and documentation of symptoms during recording. The prevalence of these arrhythmias were compared with the noted indications for the Holter test and also the clinically relevant age group distribution ( $< 45$  years, 45–64 years and  $\geq 65$  years).

All the data were analyzed by using SPSS, version 16 (SPSS Inc., Chicago IL). The prevalence of these abnormalities were expressed in terms of absolute numbers and percentages. The data were subjected to appropriate Chi-square statistical analyses, where applicable.

## RESULTS

Overall 78 consecutive patients including 41 (52.6%) males and 37 (47.4%) females within the age range of 19-88 years with mean age of 56.83 ( $\pm 18.30$ ) years were studied. Twenty two (28.1%) patients were young individuals of  $< 45$  years, 25 (32.1%) were middle-aged individuals between 45 and 64 years, and 31 (39.7%) were elderly patients of 65 years and above [Figure 1(a and b)]. Sixteen (20.5%) patients were hypertensive, 18 (23.1%) were diabetic, 10 (12.8%) were smoker and 19 (24.4%) were regular alcohol consumer. Palpitation (65.4%) was the most common indication for holter monitoring followed by dizziness (23.1%), presyncope (7.7%) and syncope (3.8%) as shown in figure 2(a and b). The mean minimum heart rate was 55 bpm, the mean maximum heart rate was 117 bpm and the mean average heart was 74 bpm. Twenty nine (37.2%) cases revealed normal Holter study and arrhythmias were detected in 49 (62.8%) cases as listed in Table 1.

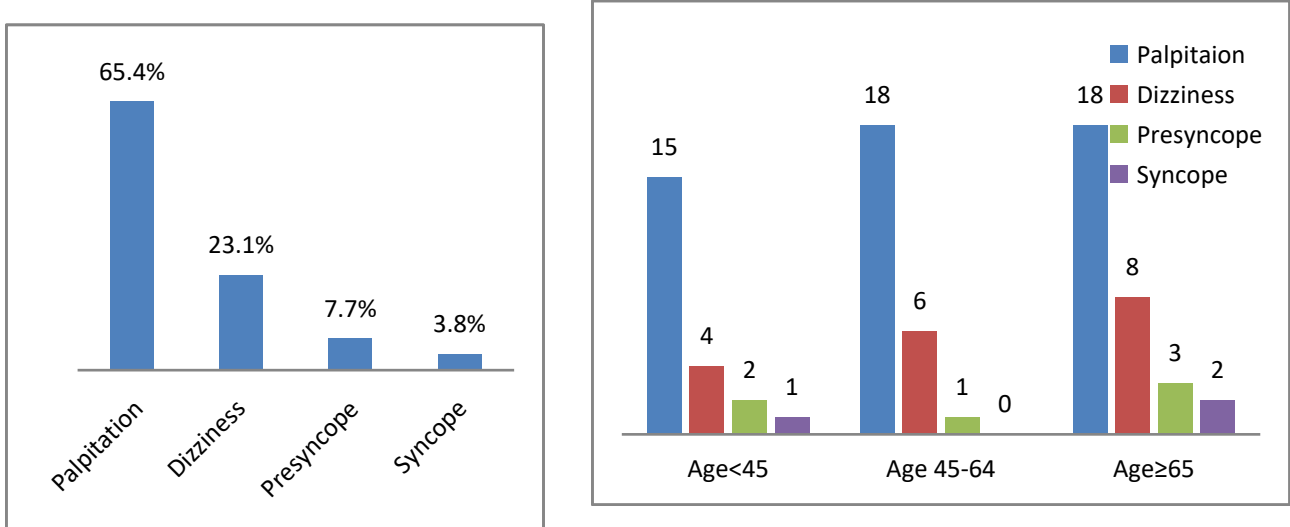
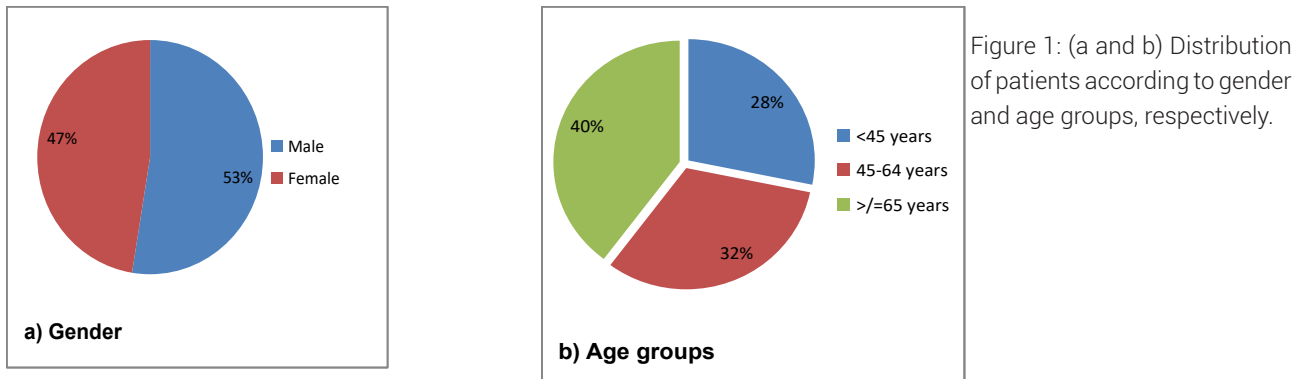


Figure 2: Indication of 24hr ECG holter in overall patients (a) and based on age groups in years (b) respectively.

Table 1: Cardiac arrhythmias detected during 24hr ECG holter monitoring

Arrhythmias	Patients No (%) (N=78)	Age group(yrs)			p value
		<45 n=22	45-64 n=25	≥65 n=31	
Atrial premature contractions(APC)	24(30.8)	6	6	13	0.192
Lown class 1	13(16.7)	2	2	7	
Lown class ≥2	11(14.1)	4	4	6	
Ventricular premature contractions(VPC)	28(35.9)	6	9	13	0.548
Lown class 1	24(30.8)	6	8	10	
Lown class ≥2	4(5.1)	0	1	3	
Supraventricular tachyarrhythmias	9(11.5)	3	1	5	0.345
PSVT	3(3.8)	1	0	2	
Atrial fibrillation/flutter	6(7.7)	2	1	3	
Inappropriate sinus tachycardia	1(1.3)	1	0	0	
Ventricular tachyarrhythmias	0(0)	0	0	0	NA
Bradyarrhythmias	18(23.1)	6	4	8	0.590
Sinus bradycardia	11(14.1)	5	2	4	
Significant sinus pause(≥3 sec)	3(3.8)	0	1	2	
AF with insignificant pause(3-6sec)	2(2.6)	1	0	1	
AF with significant pause(≥6 sec)	3(3.8)	1	1	1	
High grade/complete AV block	2(2.6)	0	0	2	

On Holter monitoring, ventricular ectopics as an isolated event occurred in 28 (35.9%) patients with Lown class 1 in 30.8% and Lown class >1 in 5.1% patients. None of the patients were found to have ventricular tachycardia or fibrillation. Supraventricular events were noted in 24 (30.8%) patients with Lown class 1 ectopics in 13 (16.7%) patients and Lown class >1 in 11 (14.1%) patients. Among these patients, paroxysmal supraventricular tachycardia was noted in 3 (3.8%), atrial fibrillation in 6 (7.7%) and inappropriate sinus tachycardia in 1 (1.3%) patients. Similarly, among 18 (23.1%) patients with bradyarrhythmias, 11 (14.1%) had sinus bradycardia, 2 (2.6%) high grade/ complete heart block, 3 (3.8%) atrial fibrillation with significant pause ( $\geq 6$ sec) and 2 atrial fibrillation with insignificant pause (3-6sec). Among 11 patients with sinus bradycardia, 3 had significant sinus pause ( $\geq 3$  sec) suggestive of sick sinus syndrome. The prevalence of various arrhythmias based on different age groups is as shown in table 1.

Table 2: Prevalence of abnormal cardiac rhythm according to gender and age groups

Indication	Normal (n=49)	Abnormal (n=49)	Total (n=78)	P value
Palpitation	22	29	51	0.256
Dizziness	5	13	18	0.999
Presyncope	2	4	6	0.710
Syncope	0	3	3	0.647

As shown in table 3, out of 51 patients with palpitation referred for Holter, 22 had normal cardiac rhythm and 29 had an abnormal cardiac rhythm. Out of these, 7 patients had Lown class 1 APC, 6 had Lown class >1 APC, 17 had Lown class 1 VPC, 2 had Lown class >1 VPC, one had paroxysmal supraventricular tachycardia, 4 had atrial fibrillation with 2 patients having significant pause ( $>6$ sec) and one having insignificant pause (3-6sec), one inappropriate sinus tachycardia and 3 had sinus bradycardia. Likewise, out of 27 patients with dizziness/presyncope/syncope, 7 patients had normal cardiac rhythm and 20 patients had abnormal cardiac rhythm. Among these, 5 patients had Lown class 1 APC, 5 had Lown class >1 APC, 6 had Lown class 1 VPC, 2 had Lown class >1 VPC, 2 had paroxysmal supraventricular tachycardia, 2 had atrial fibrillation with one patient having significant pause ( $>6$ sec) and one having insignificant pause (3-6sec), 8 had sinus bradycardia with 3 of them having significant sinus pause, and 2 patients had high grade/complete heart block.

## DISCUSSION

A Holter monitor is an ambulatory electrocardiographic system discovered by Dr. Norman J. Holter and his team in 1957. The Holter monitor is a device that works on Galvanometer's principle to record electrocardiographic

signals from an individual who is on his/her daily routine activities.<sup>8</sup> A twelve-lead Holter monitor is very accurate and can instantly diagnose various supraventricular and ventricular ectopics, tachyarrhythmias and bradyarrhythmias in symptomatic patients with unexplained palpitation, dizziness, presyncope and syncope.<sup>9</sup>

Like previous studies, the most common reason for Holter monitoring in our study was unexplained palpitation (65.4%), followed by dizziness, presyncope and syncope.<sup>10,11</sup> This is similar to the findings of Adebola et al.<sup>11</sup>, in which more than half of the patients complained of palpitation, Adebayo et al.<sup>10</sup> in which 71 (23%) of 310 patients and Joseph et al.<sup>12</sup> in which 174 of 281 patients with palpitations were referred for Holter ECG study. Palpitation is a very nonspecific symptom and can be due to non-cardiac causes such as anxiety, anaemia, thyrotoxicosis, febrile illness, or cardiac causes such as tachyarrhythmias arising from acute pericarditis, myocarditis, cardiomyopathies, hypertensive heart disease, congenital heart disease or primary cardiac arrhythmic problems such as paroxysmal tachyarrhythmias and WPW syndromes. In our study, 22 out of 51 patients with complaints of palpitation referred for 24 hr ECG Holter had no evidence of arrhythmias.

In the present study, dizziness, presyncope and syncope were the other indications for Holter monitoring in 18 (23.1%), 6 (7.7%) and 3 (3.8%) patients respectively. This finding is also similar to the findings of previous studies on this subject. Adebola et al.<sup>11</sup> reported that 17.6% of their patients presented with dizzy spells/ syncope, whereas Adebayo et al.<sup>10</sup> reported that 15% of their patients presented with a history of syncopal attacks. As in palpitation, the causes of these symptoms vary from extracardiac causes such as anemia, febrile illness, and exhaustion to severe tachy/bradyarrhythmias. Of the 27 patients referred with dizziness presyncope and syncope in the present study, 7 did not have Holter ECG evidence of cardiac arrhythmias.

Of the 78 patients in our study, 29 had normal cardiac rhythm devoid of any arrhythmias. Most of the patients with normal cardiac rhythm were young and middle age individuals and only 7 of the 31 elderly patients above the age of 65 years had a normal cardiac rhythm. Ventricular ectopics (35.9%) was the most common arrhythmia found on Holter ECG, followed by supraventricular ectopics (30.8%). Most of the ventricular and supraventricular ectopics were of Lown class 1. These findings are similar to that of previous studies.<sup>10,12</sup> Even though ventricular and supraventricular ectopics were common in all age groups, they were particularly more common in elderly age groups. In fact, 13 (42%) of the 31 elderly patients had ventricular and supraventricular ectopics, as compared to 6 (27%) of the 22 young individuals. This is similar to the findings of Adebayo et al.<sup>10</sup>, where only 19% of patients

below 50 years had ventricular ectopics compared to 31% of those above 50 years. In our study, 9 (11.5%) patients had supraventricular tachyarrhythmias. These were mostly atrial fibrillation, of which 3 out of 6 patients were of elderly age group. Likewise, PSVT was seen in 3 patients, 2 of them in elderly age group and one in younger age group. Inappropriate sinus tachycardia was seen in one patient of younger age group. These findings suggest that atrial fibrillation is more common in elderly population. Ventricular and supraventricular ectopics are generally assumed to be benign, especially if infrequent and monomorphic. However, frequent, polymorphic ventricular and supraventricular ectopics could be precursor to the development of dangerous sustained tachyarrhythmias and sudden deaths and such individuals could benefit from  $\beta$ -blocker therapy.<sup>11</sup>

Out of 78 patients in our study, 18 patients had significant bradyarrhythmias, of which 3 had sinus bradycardia with significant pause, 8 had sinus bradycardia without significant pause, 3 had AF with significant pause, 2 had AF without significant pause and 2 had high grade/complete AV block. Majority of these findings were common in the elderly age group. Both the patients with high grade/complete AV block were above the age of 65 years. In study done by Adebola et al.<sup>11</sup> 5 out of 85 patients had evidence of high-grade AV Block. Similarly, Adebayo et al.<sup>10</sup> found 11 patients with severe bradyarrhythmias (HR <40 bpm). Elderly patients who are more likely to present with symptomatic bradyarrhythmias could benefit from permanent pacemaker implantation.

### LIMITATIONS OF THE STUDY

Due to the short duration of our study, only limited number of patients could be included for analysis. The patients were admitted in the ward for 24 hr ECG Holter monitoring which might have affected their daily routine activities and might have missed the arrhythmias related to exertion.

### CONCLUSIONS

Among the patients with nonspecific symptoms like palpitation, dizziness, presyncope and syncope, 24 hr Holter monitoring has an important role in the diagnosis of cardiac arrhythmia as a cause of such symptoms, particularly in the elderly patients. The study showed that palpitation is the most common indication for 24 hr Holter monitoring and ventricular ectopics are the most common arrhythmias detected. Most of the arrhythmias detected are benign and prevalence of potentially fatal ventricular and supraventricular tachyarrhythmias are relatively low in our population.

Conflict of Interest: None.

### REFERENCES

1. Raby KE, Barry J, Treasure CB, Hirsowitz G, Fantasia G, Selwyn AP. Usefulness of holter monitoring for detecting myocardial ischemia in patients with nondiagnostic exercise treadmill test. *Am J Cardiol.* 1993;72(12):889-93. doi: 10.1016/0002-9149(93)91101-m. PMID: 8213544.
2. DiMarco JP, Philbrick JT. Use of ambulatory electrocardiographic (Holter) monitoring. *Ann Intern Med.* 1990;113(1):53-68. doi: 10.7326/0003-4819-113-1-53. PMID: 2190517.
3. Evenson KR, Lamar Welch VL, Cascio WE, Simpson RJ. Validation of a short rhythm strip compared to ambulatory ECG monitoring for ventricular ectopy. *J Clin Epidemiol.* 2000;53(5):491-7. doi: 10.1016/s0895-4356(99)00190-0. PMID: 10812321.
4. Paudel B, Paudel K. The Diagnostic Significance of the Holter Monitoring in the Evaluation of Palpitation. *J Clin Diagnostic Res.* 2013;7(3):480-3 doi: 10.7860/JCDR/2013/4923.2802. Epub 2013 Mar 1. PMID: 23634400; PMCID: PMC3616560.
5. Lipski J, Cohen L, Espinoza J, Motro M, Dack S, Donoso E. Value of holter monitoring in assessing cardiac arrhythmias in symptomatic patients. *Am J Cardiol.* 1976;37(1):102-7. doi: 10.1016/0002-9149(76)90507-5. PMID: 1244726.
6. Francis J. ECG monitoring leads and special leads. *Indian Pacing and Electrophysiology Journal.* Indian Pacing and Electrophysiology Group. 2016;16(3):92-5. doi: 10.1016/j.ipej.2016.07.003. Epub 2016 Jul 17. PMID: 27788999; PMCID: PMC5067828.
7. Chakrabarti S, Stuart AG. Understanding cardiac arrhythmias. *Archives of Disease in Childhood.* BMJ Publishing Group Ltd; 2005;90:1086-90. doi: 10.1136/adc.2005.076984. PMID: 16177167; PMCID: PMC1720109.
8. Gatzoulis KA, Karystinos G, Gialernios T, Sotiropoulos H, Synetos A, Dilaveris P et al. Correlation of noninvasive electrocardiography with invasive electrophysiology in syncope of unknown origin: implications from large syncope data base. *Ann Noninvasive Electrocardiol.* 2009;14:119-27. <https://www.banglajol.info/index.php/MEDTODAY/article/view/24223/16520>.
9. Wang R, Blackburn G, Desai M, Phelan D, Gillinov L, Houghtaling P, et al. Accuracy of wrist-worn heart rate monitors. *JAMA Cardiol.* 2017;2(1):104-6. doi: 10.1001/jamacardio.2016.3340. PMID: 27732703.
10. Adebayo RA, Ikwu AN, Balogun MO, Akintomide AO, Ajayi OE, Adeyeye VO, et al. Heart rate variability and arrhythmic patterns of 24-hour Holter electrocardiography among Nigerians with cardiovascular diseases. *Vasc Health Risk Manag.* 2015;11:353-9. DOI: 10.2147/vhrm.s81106. PMID: 26170685; PMCID: PMC4492626.
11. Adebola P, Daniel F, Ajibare A, Reima A. Prevalence of arrhythmias on 24-h ambulatory Holter electrocardiogram monitoring in LASUTH: A report on 414 patients. *Niger J Cardiol.* 2020;17(1):61-6. DOI: 10.4103/njc.njc\_26\_19.
12. Josephs, Sadoh W, Ikhidero J. Audit of 24 h ambulatory electrocardiography (Holter) of 281 Nigerian patients in Benin

- city metropolis. *Niger J Cardiol.* 2021;15(2):83. doi: 10.4103/njc.njc\_2\_17
13. Kohno R, Abe H, Benditt DG. Ambulatory electrocardiogram monitoring devices for evaluating transient loss of consciousness or other related symptoms. *J Arrhythm.* 2017;33(6):583-589. doi:10.1016/j.joa.2017.04.012
14. Winkle RA. Ambulatory electrocardiography. *Mod Concepts Cardiovasc Dis.* 1980;49(2):7-12. PMID: 7360111.
15. Rossen R, Kabat H, Anderson JP. Acute arrest of cerebral circulation in man. *Arch Neurol Psychiatry.* 1943;50(5):510-28. doi:10.1001/archneurpsyc.1943.02290230022002
16. Jonas S, Klein I, Dimant J. Importance of holter monitoring in patients with periodic cerebral symptoms. *Ann Neurol.* 1977;1(5):470-4. doi: 10.1002/ana.410010511. PMID: 363045.
17. Fisher M. Hotter monitoring in patients with transient focal cerebral ischemia. *Stroke.* 1978;9(5):514-6. doi: 10.1161/01.str.9.5.514. PMID: 705834.

VT – Ventricular Tachycardia

WPW – Wolf-Parkinsons-White Syndrome

#### Abbreviations

AF	–	Atrial flutter
AFIB	–	Atrial fibrillation
AV	–	Atrio-ventricular
CCU	–	Coronary care unit
CI	–	Confidence interval
CVD	–	Cardiovascular disease
DCM	–	Dilated cardiomyopathy
DM	–	Diabetes mellites
ECG	–	Electrocardiogram
ECHO	–	Echocardiography
HF	–	Heart failure
HTN	–	Hypertension
IHD	–	Ischemic heart disease
NYHA	–	New York heart association
OPD	–	Out patient department
PSVT	–	Paroxysmal Supraventricular Tachycardia
PVC	–	Premature Ventricular Contraction
SVT	–	Supraventricular Tachycardia
VHD	–	Valvular heart disease