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Original Article**Profile on ECG Changes in different types of Stroke in Patients at Tertiary Level Hospital in Eastern Nepal**

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Abstract**Background**

Physician knew for centuries that primary cardiac disorders leads to stroke, but it is recent realization that strokes may produce cardiac abnormalities. It is essential to distinguish whether cardiopulmonary abnormalities are caused by the stroke or unrelated. It is very difficult to distinguish because pre-existing cardiac abnormalities are highly prevalent in stroke. This study is designed to see ECG changes in stroke that can help for further evaluation and management.

Methods and Materials

This descriptive Cross-Sectional hospital-based study was conducted to describe the ECG changes, character of ECG abnormalities in patients with stroke. All the patients admitted in the Nobel Medical College in one-year meeting inclusion criteria and residing in Eastern part of Nepal were included. Both Ischaemic and Haemorrhagic stroke were taken. ECG changes includes QTc-prolonged, AF (Atrial Fibrillation), T inversion, QRS prolonged, PR prolonged, ST elevation, ST depression, Hyperacute T wave in different types of stroke was evaluated on the basis of age, sex, smoker, HTN and DM.

Result

The total participants were 100. Out of which 65 were male and 35 were female and 72.0% were 60 years and above and 28.0% below 60 years with Mean Age in year \pm Standard deviation of male and female was (64.74 \pm 12.62) and (63.69 \pm 13.53) respectively. Ischemic and Haemorrhagic stroke was 87.0% and 13.0% respectively. ECG changes were found in 84.0%.

Conclusion:

Ischaemic stroke (87.0%) was more common than Haemorrhagic stroke (13.0%). ECG changes were in 84.0% and QTc-prolonged (29.0%) was the most common followed by AF (27.0%).

Key words:

Atrial Fibrillation, CT-Head, Electrocardiography, Stroke.

Introduction

Heart electrical activity can be recorded over a period of time using electrodes placed on a patient's body. That is what we call as Electrocardiography. The tiny electrical changes on the skin that arise

from the depolarizing heart muscle during each heartbeat are detected by those electrodes. CNS Infarction: - brain, spinal cord, or retinal cell death due to ischemia, based on: Pathological, imaging, or other objective evidence of cerebral, spinal cord,

or retinal focal ischemic injury in a defined vascular distribution or clinical evidence of cerebral, spinal cord, or retinal focal ischemic injury based on symptoms persisting > 24 hours or until death, and other etiologies excluded. Intracerebral Haemorrhage: A focal collection of blood within the brain parenchyma or ventricular system, which is not due to trauma [1].

Physicians have known for centuries that primary cardiac disorders can lead to stroke, but it is very much recent realization that strokes may produce cardiac abnormalities. Following stroke cardiac disturbances are common. So, it is essential to distinguish whether cardiopulmonary abnormalities are caused by the stroke or unrelated to it. It is very difficult to distinguish because pre-existing cardiac abnormalities are highly prevalent among stroke patients.

So this study is designed to see the incidence of ECG changes in different types of stroke. As we encountered different ECG changes in stroke, so this study may help and give some information regarding the ECG changes and to carry out with the further evaluation and diagnosis of the patient. Also, in the previous study ECG changes were evaluated in patients with cardiac diseases but this study has ruled out the cardiac diseases from the study participants prior to Stroke. So, it has been challenging to find out the cases with ECG changes without the cardiac diseases as most of the patients with stroke come with the history of pre-existing cardiac diseases.

Previous study conducted reveals that regional left ventricular wall motion is common to SAH and possibly with other types of stroke in the absence of CAD. So if in those cases ECG changes may be mistaken for cardiac cause and patient got thrombolysed may lead to ultimate death of the patient would be the curse to medical science so this study aims to find the

different ECG changes in patient with both Ischemic and Haemorrhagic Stroke.

Previously, as this type of study was not conducted in our part of the country so this study might be helpful to the other physician to know the incidence of ECG changes in patients with stroke and formulate the treatment accordingly. Also, it is mandatory to do CT-Head in patient with stroke and also the ECG. So, this study is cost effective as well as Non-Invasive to the patient.

Material and Methods:

This is a descriptive and cross-sectional study, which was conducted only after getting Ethical Committee approval from Institutional Review Committee (IRC), Nobel Medical College, Kathmandu University. Patients and their care-givers were explained fully about study design, benefit and risks involved in the procedure and a duly signed written consent was taken from each patient. It was a descriptive cross-sectional study over a period of one year from April 2014 to March 2015. All patients from various parts of Eastern Nepal attended at Nobel Teaching Hospital Medicine department with Stroke as proved by CT-Head and ECG changes without any structural cardiac diseases had participated in this study.

Inclusion criteria:

Both male and female with age between 25-89 years diagnosed as Stroke clinically and with documented CT-Scan who gave written/verbal consent (consent can be given by the closest relatives of the patient if patient clinically unstable).

Exclusion criteria:

All patients less than 25 years old and more than 89 years old brought dead or who expired at emergency room, patients with previous documented cardiac disease and patients unwilling to undergo the study were not enrolled.

The ethical approval was taken from IRB. The patients arriving at emergency department with stroke symptoms was routinely examined and accordingly managed at emergency room (casualty). The patients were then admitted to Medical Ward/ ICU with respect to his/her clinical condition. ECG and CT scan of head was done at the Emergency/Medical ward/ICU and CT-Scan if necessary was repeated. For all patients who fulfilled the inclusion criteria was enrolled in the study. Other routine laboratory tests were done. Clinical diagnosis of the patients was made. Duration of stay at hospital and clinical condition of the patients was noted. Study questionnaire and consents was informed and recorded in predesigned proforma. The data thus obtained from the study was statistically analyzed in MS Excel 2007 and converted it into SPSS17 (Statistical Presentation Systemic Software). For the descriptive study: Percentage (%), Mean, Standard Deviation was calculated and also the graphical and tabular presentation was made. Categorical data was evaluated by Chi-square test (Pearson's Chi-Square). Level of significance for all analytical tests was set at 0.05 and p value ≤ 0.05 was considered significant.

Results

This study is a descriptive cross-sectional study conducted over one-year period. All patients from various parts of Eastern Nepal attended at Nobel Teaching Hospital Medicine department with Stroke and ECG changes without any structural cardiac diseases is participated in this study. There were total of 100 patients that were enrolled in the study. Out of which 65(65.0%) are male and 35(35.0%) are female.

Table 1: Mean age and standard deviation of male and female patients.

Sex of the patient	Mean \pm Std. Deviation	N
Female	63.69 \pm 13.53	35
Male	64.74 \pm 12.62	65
Total (n)		100

Table 2: Comparison of ECG changes in Ischaemic and Haemorrhagic Stroke on the basis of Age.

Age in years	≥ 60		< 60	
	Ischaemic	Haemorrhagic	Ischaemic	Haemorrhagic
Normal	7	2	6	1
QTc-prolonged	19	3	6	1
AF	17	3	6	1
T inversion	8	0	1	0
QRS prolonged	6	0	1	0
PR prolonged	1	1	2	0
ST elevation	1	1	1	0
ST depression	2	0	1	0
LVH	0	0	1	0
T Hyperacute	1	0	0	0
Total	62	10	25	3
P value	0.469		0.997	

On the basis of Sex, in male, QTc-prolonged is found in 17(28.81%) of the patient with Ischaemic stroke and 2(33.34%) patient with Haemorrhagic stroke. Similarly, AF is found in 17(28.81%) patients with Ischaemic stroke and 3(50%) patient with Haemorrhagic stroke. Similarly, QRS prolonged, T inversion, PR prolonged and LVH are found in 6(10.16%), 3(5.08%), 3(5.08%) and 1(1.60%) of the patient with Ischaemic stroke but above ECG changes are found in none of the patient with Haemorrhagic stroke. ST elevation is found in 2(3.30%) and 1(16.66%) of the male patients with

Ischaemic and Haemorrhagic stroke respectively. (CI 95%, P value = 0.629)
 In female, QTc-prolonged is found in 8(28.57%) of the patient with Ischaemic stroke and 2(28.57%) patient with Haemorrhagic stroke. Similarly, AF is found in 6(21.24%) patients with Ischaemic stroke and 1(14.28%) patient with Haemorrhagic stroke. Similarly, T inversion, ST depression, QRS prolonged and Hyperacute T wave are found in 6(21.42%), 3(10.71%), 1(3.57%) and 1(3.57%) of the patient with Ischaemic stroke. In patient with Haemorrhagic stroke 1(14.28%) patients have PR prolonged. ST elevation is found in none of the female patients with Ischaemic and Haemorrhagic stroke. (CI 95%, P value = 0.174)

Table 3: Comparison of ECG changes in Ischaemic and Haemorrhagic Stroke on the basis of Smoking.

Smoker	Yes		No	
	Ischaemic	Haemorrhagic	Ischaemic	Haemorrhagic
Normal	6	1	6	2
QTc-prolonged	13	0	12	4
AF	13	3	10	1
T inversion	7	0	2	0
QRS prolonged	4	0	3	0
PR prolonged	3	1	0	0
ST elevation	2	1	0	0
ST depression	3	0	1	0
LVH	1	0	0	0
T Hyperacute	1	0	0	0
Total	53	6	34	7
P value	0.613		0.731	

Out of the 100 study participants, 31.0% and 69.0% are alcoholics and Non-alcoholics respectively. And out of the 31.0% alcoholics, 27(87.09%) and 4(12.90%) have Ischaemic Stroke and

Haemorrhagic stroke respectively. Similarly, of the 69.0% Non-alcoholic 60(86.95%) and 9(13.04%) have Ischaemic and Haemorrhagic stroke respectively.

Out of the alcoholic's participants, QTc-prolonged is found in 8(29.62%) of the patient with Ischaemic stroke and none with Haemorrhagic stroke. Similarly, AF is found in 7(25.92%) patients with Ischaemic stroke and 3(75.0%) patient with Haemorrhagic stroke. Similarly, QRS prolonged, T inversion, ST elevation, PR prolonged and ST depression are found in 3(11.11%), 2(7.40%), 1(3.70%), 1(3.70%) and 1(3.70%) of the patient with Ischaemic stroke respectively. ST elevation is found in 1(25.0%) of the patients with Haemorrhagic stroke. (CI 95%, P value = 0.345)

Table 4: Comparison of ECG changes in Ischaemic and Haemorrhagic Stroke with and without HTN.

Hypertension	Yes		No	
	Ischaemic	Haemorrhagic	Ischaemic	Haemorrhagic
Normal	7	2	8	1
QTc-prolonged	13	2	12	2
AF	13	3	10	1
T inversion	6	0	3	0
QRS prolonged	5	0	0	0
PR prolonged	3	1	0	1
ST elevation	2	0	0	0
ST depression	3	0	0	0
LVH	1	0	0	0
T Hyperacute	0	0	1	0
Total	53	8	34	5
P value	0.842		0.249	

Table 5: Comparison of ECG changes in Ischaemic and Haemorrhagic Stroke in patients with and without DM.

Diabetes Mellitus	Yes		No	
	Ischaemic	Haemorrhagic	Ischaemic	Haemorrhagic
Normal	4	1	9	2
QTc-prolonged	6	1	19	3
AF	4	1	19	3
T inversion	1	0	8	0
QRS prolonged	4	0	3	0
PR prolonged	0	0	3	1
ST elevation	1	0	2	1
ST depression	1	0	1	0
LVH	0	0	1	0
T Hyperacute	0	0	1	0
Total	21	3	66	10
P value	0.842		0.249	

Discussion

In this study, there were 100 patients, 65.0% were male and 35.0% were female patients. 72.0% were above or equal to 60 years and 28.0% were below 60 years. The mean age of male and female subjects was 64.74 and 63.69 years respectively. 31.0% and 59.0% were alcoholic and smoker respectively, 61.0% and 24.0% were Hypertensive and Diabetes respectively and 87.0% and 13.0% have Ischaemic and Haemorrhagic stroke respectively.

Out of the Study participants, Normal ECG changes, QTc-prolonged, AF, T inversion, QRS prolonged, PR prolonged, ST elevation, ST depression, Hyper acute T wave and LVH were found in 16.0%, 29.0%, 27.0%, 9.0%, 7.0%, 4.0%, 3.0%, 3.0% and 1.0% respectively. QTc-prolonged was found in maximum number of the patient i.e. 29% followed by AF which was found in 27% of the patients.

As per the study ECG changes were found in 84% of Patients with stroke. Similar study was conducted in 1979 by Goldstein

DS as the electrocardiogram in stroke: relationship to pathophysiological type and comparison with prior tracings. In those Study ECG abnormalities was present in 92% of patients with acute stroke [1]. The most common abnormalities were also changes from prior tracings: QT prolongation (68, 45%), Ischemic changes (59, 35%), U waves (42, 28%), and arrhythmias (41, 27%).

In this study, QTc-prolonged was present in maximum number of patients (30.70% of patient with Haemorrhagic Stroke and 28.73% with Ischemic Stroke). This study was similar to the study conducted by Oppenheimer SM, Cechetto DF, Hachinski VC in 1990, Ibrahim GM, Macdonald RL in 2012, Khechinashvili G, Asplund K in 2002. According to the study, QT prolongation – The most common stroke-related ECG abnormality is QT prolongation, found in up to 71% of patients with Subarachnoid Haemorrhage, 64% of patients with Intraparenchymal Haemorrhage, and 38% of patients with Ischemic Stroke [2].

In this Study, AF was found in 27% of the patients. A study conducted in 1992 by Schuchert A, Behrens G, and Meinertz T reveal atrial fibrillation was the most common arrhythmia, occurring in 14% of patients. Advanced age, history of cardiovascular disease, and history of palpitations increase the likelihood of detecting post-stroke atrial fibrillation [3].

In this study, T inversion was found in 9 % of the study participants (found only in patient with Ischemic stroke). A study conducted in 1977 by Dimant J, Grob D concluded that T inversion is four times more prevalent in stroke patients. The characteristic large T waves previously known as “cerebral T waves” have been noted in 50 % of patients with Intracranial Haemorrhage and appear particularly common following left frontal haemorrhage [4].

Another study conducted in 2013 by Sunil K Agarwal, Elsayed Z Soliman reveal, the most common ECG abnormalities associated with stroke were T-wave abnormalities, prolonged QTc interval and arrhythmias, which were respectively found in 39.9%, 32.4% and 27.1% of the stroke patients and 28.9%, 30.7%, and 16.2% of the patients with no primary cardiac disease [5].

In this study ST changes was found in 11% of the patient's. Out of which 63.63% have ST elevation and 36.36% have ST Depression (with ST depression present only in patients with Ischemic Stroke and ST-Elevation present in 7.6% of patient with Haemorrhagic and 2.2% of patient with Ischemic Stroke). Similar study was conducted in 1974 by Lavy S, Yaar I, Melamed E, and Stern S in 1993 by Vingerhoets F, Bogouslavsky J, Regli F, et al. ST segment alterations- Nonspecific ST Change occur in 22 % of patients with stroke. Patients with stroke have a 7 to 10- fold higher incidence of ST segment depression when compared with controls, particularly if the left middle cerebral artery territory has been affected [6-8], but this study was not conducted for the side of the Ischemia and Haemorrhagic Stroke. The study reveals ST changes appeared to be more common among patients with Ischemic Stroke than among patients with Haemorrhagic Stroke.

Conclusion:

ECG changes in different types of stroke is very much high. Ischaemic stroke (87.0%) was more common than Haemorrhagic stroke (13.0%) and QTc-prolonged (29.0%) was the most common ECG changes followed by AF (27.0%).

QTc-prolonged, AF, PR prolonged and ST elevation were found more in patients with

Haemorrhagic Stroke than Ischemic Stroke. T inversion, QRS prolonged, ST depression, Hyperacute T wave and LVH were found in none of the patient with Haemorrhagic stroke.

On the basis of age, sex, smoker, alcoholic, HTN and DM, Ischaemic stroke was more common than Haemorrhagic Stroke and QTc-prolonged was the most common ECG changes followed by AF.

Abnormal ECG changes are common in patients with stroke. ECG and CT-Head should be done before initiating the treatment as ECG changes are not only due to Cardiac Diseases but also due to CVA.

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