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Study on relationship of ECG, EEG and MRI findings in acute ischemic stroke cases attending emergency care facility in Bangalore

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Abstract
The pathological changes are evident in brain during stroke especially due to ischemic causes. There are significant changes seen in EEG and MRI among stroke cases along with ECG changes in the heart irrespective of pre-existing cardiac diseases. The objective of this study was to assess the frequency and relationship of ECG and EEG changes associated with acute stroke patients. A hospital based and cross-sectional study was carried out among the acute stroke patients attending the emergency care facility in Medical college Hospital in Bangalore during 2013-2014.Detailed history including the high-risk factors, attributing risk behaviour or habits and their clinical profile was prepared with complete clinical examinations of all the patients, EEG, MRI and ECG were done within 24 hour of hospitalisation with necessary blood tests at individual level. There were 125 and 55 male and female patients were eligible for analysis. The ECG abnormalities were observed in 60% and it was 63% and 52% in male and female cases. The EEG abnormal waves reported in males (8.8%) than females (14.5%). ACA, MCA and PCA affected in 19.3%, 52.3% and 28.4% cases respectively. ECG abnormalities predominantly LVH and Ischemia was seen in the age group of 56 years and above. EEG abnormalities were seen more in males than females. To conclude, stroke patients will have ECG and EEG abnormalities in acute ischemic stroke and can be correlating with infarct volume at local site. Further studies are needed to define brain heart interaction in high risk cases.

Keywords: relationship, ECG, EEG, MRI, ischemic stroke cases, emergency, facility

Introduction

Stroke and heart attacks are common conditions contributing as high as 20 percent case fatality rate if emergency intervention is not done in few cases [1, 2, 3]. This accounts for 8millions cases and the incidence of myocardial infarction and stroke were 138 and 106 per 1000 hospital cases respectively [1]. There are studies showing evidences co-existence of heart ailments in acute stroke patients [2, 4]. The findings of the combined investigation have been highlighted in many studies worldwide as well as in developing countries among patients affected with stroke in their middle or old age group. The technical findings of the investigations like ECG, EEG and MRI will have high impact on clinical decision making especially in acute stroke [2, 5]. The EEG findings are very relevant to know the functioning capacity of the brain after stroke and its impact as prognostic value [4]. Similarly the location of ischemia or haemorrhage are important for the localising the site of damage and extent of physical damage.

EEG is a useful tool in complex medical settings to study brain function safely and rapidly. Increased slow rhythms and decreased fast rhythms are directly linked with neuronal metabolism reflecting the ischemic brain injury [2]. In addition, functional MRI, PET and Tran's cranial Magnetic stimulations provides useful insights into the physiological effects of stroke.

EEG captures significant information about acute stroke effects then MRI among patients. Patients often have conditions like simultaneous hypertension or coronary artery atherosclerosis leading to ECG abnormalities. The objective of this study was to assess the frequency and relationship of ECG and EEG changes associated with acute stroke patients.

Material and Method

This is a hospital based and cross-sectional study conducted in patients reporting to the emergency care facility of Dr B R Ambedkar Medical College hospital, Bangalore with acute Central nervous system conditions during the period of one year 2013 -2014. Total of 253 cases of cerebro vascular conditions attended the emergency care facility. Among them, stroke cases were 230 and there were 4 deaths from head injury and severe intra cerebral haemorrhage conditions.

Pilot tested Standard questionnaire was administered for collecting data from all the patients. Detailed history and clinical profile was prepared taking criteria of clinical examinations, Recording Blood Pressure, complete blood profile including Blood sugar, lipids, ECG, EEG, CT scanning and MRI if indicated. The risk factors like hypertension, Diabetes Mellitus, Smoking, Alcohol, known metabolic chronic conditions and history of known cardiac diseases were considered while analysing the data. The progress of the patients was taken into account for the first 24 hours of observation in this study. Set of protocol suggested by the WHO is followed for all the cases [6]. Incomplete information or lack of results of investigations or deficits in information in the data were excluded for analysis.

Inclusion criteria of cases for the study are patients aged

above 18 years, sudden onset of consciousness, sudden onset of hemiparesis with or without speech disturbance and clinical features suggestive of focal neurological deficits.
Exclusion criteria are recent head injury, pregnant women, and epileptic disorders. Recurrent stroke, mental retardation, stroke more than 7 days duration and known case TB meningitis or other bacterial meningitis.

ECG: A 12 lead ECG was recorded with a sensitivity of 10mm/v and paper speed of 25mm/s from all patients. criteria for LVH (left ventricular Hypertrophy): Larger R waves in I,V5, V6, & aVL and deep S waves in V1, V2. Criteria for Ischemic: T wave inversion and S-T segment depression

EEG: EEG was recorded in the resting conditions with both the eyes closed.
The categorical variables were expressed as frequencies of occurrences and percentages, and continuous variables as mean and standard deviation. Categorical variables were analysed by chi square test and differences between two proportions. Results are considered as statistically significant if p value is less than 0.05. The data was analyzed using statistical package for the social sciences (SPSS) version 20.

Results
There were 125 and 55 eligible cases of males and females in this study as shown in Table 1. The differences in ECG changes in males and female stroke patients were found to be statistically not significant. The LVH and ischemia changes were accounted in 64(35%) and 44(24%) of cases. The LVH was in higher proportion in males compared to females.
Table 2 showing the differences in the prevalence of ECG findings in different age groups and this difference is found to be statistically highly significant ($p<0.001$). The higher proportion of ischemia was seen in the age group of 56-65 years and less than 45 years.
The relationship of MRI findings and ECG changes among stroke patients are shown in Table 3. MCA affected in majority of the cases accounting to 70 % (127) and remaining 30% were with ACA and PCA respectively. LVH was observed as most common abnormal findings the among cases with involvement of MCA (39.3%) and PCA (47.8%).
Table 4 shows distribution and relationship in the left or right side stoke with ECG and EEG finding. ECG change abnormalities were noticed more on left side in both sexes. The proportion of LVH was almost equal in females affected either on left or right side. EEG abnormality was found on patients affected on right side compared to left side.
Table 5 shows the prevalence of abnormalities among different age groups with their ECG, EEG and MRI findings. Nearly two thirds of male patients in all age groups had ECG abnormalities compared to female patients. EEG abnormalities were seen more in male (11) patients than female patients (8). The cerebral arteries affected according to MRI findings suggest more than one artery affected in many patients.

Discussion
Stroke is one of the most prevalent pathologies around the world and the consequences after a stroke vary depending on the location and cause. Diagnostic tools like CT or functional MRI are commonly used to establish the extent of brain damage in acute and sub acute phase, providing functional prognostic for each case. Cardio vascular effects of stroke are modulated by pre existence or concomitant cardiac diseases and also related to the type of cerebrovascular disease and its localisation [7]. There are evidence of simultaneous cardiovascular diseases, atherosclerosis, hypertension, diabetes mellitus which are all known conditions leading to show ECG abnormalities.
The hypertension or the existing cardiac diseases leads to LVH. ECG changes are present in 5-20% of the ischemia stroke cases. Major ECG abnormalities are ST segment depression, prolonged Q-T interval. It is believed that stroke induced ECG changes are temporary and resolved over a period of days to months. The similar findings were found in this study contributing to more LVH cases [4. 8]. However the LVH in males were more than the female cases. In addition the arrhythmia accounted for underlying conditions in some cases. In this study arrhythmia were not reported. In acute stroke cases, it was found that T wave inversion was the common finding 33% and more in females (36.1%) than males (31.3%) [7]. LVH was high among males (25%) than females (13.9%). Similar to the findings of the study conducted in eastern India [7, 8, 9].
The LVH was accounted for 28 (49.1%) among stoke cases in the age group of 66 – 75 year and in all other age groups ischemic changes were dominant in this study as seen in Table 2. This could be attributed to the presence of existing cardiac problem, hypertension and cardimyopathies among old age. The other findings suggest the arrhythmias, abnormalities of the blood vessels, complications of hypertension and diabetes mellitus [6, 8, 9].
The common findings in most of the stroke cases were MCA involvement as shown in Table3. The better diagnostic tool like functional MRI will helps in knowing the extent of pathologies involved in regions of the brain by the cerebral artery or veins. More than one artery was involved in few cases and hence the total number was showing 243.
The ACA, MCA and PCA involvement accounted for 19.3%, 52.2% and 28.5% respectively in this study. The exact reasons for such differences may not be known clearly however the existing Dyslipedemia, atherosclerosis of small blood vessels, diabetes and hypertension and heart diseases could have contributed for MCA and PCA involvement [10, 11]. The facial nerve was affected in 28 number of stroke cases accounting to 15.5 % (Male 15.2% and female 16.3%).
More than one cerebral artery was affected in few cases among both sexes and the total number were more than the total cases of male and female cases as depicted in Table 5. However ECG and EEG and abnormalities in the arteries affected in the age group of 56 years and above, but higher proportion in male than female patients which is similar to

few studies [4, 11, 12].

Table 1: Distribution of ECG abnormalities among male and female cases

Gender	ECG abnormalities			Total*
	Normal N (%)	LVH	Ischemic	
		N (%)	N (%)	
Male	46(36.8)	47(37.6)	32(25.6)	125(100)
Female	26(47.3)	17(30.9)	12(21.8)	55(100)
Total	72(40)	64(35)	44(25)	180(100)

**P* value =0.41

Table 2: Distribution of prevalence of ECG abnormalities among different age groups

Age group	ECG abnormalities			Total* N(%)
	Normal N (%)	LVH N(%)	Ischemic N(%)	
<45	14(43.7)	7(21.8)	11(36.8)	32(100)
46-55	18(60)	8(26.7)	4(13.3)	30(100)
56-65	16(31.4)	14(27.5)	21(41.2)	51(100)
66-75	21(36.8)	28(49.1)	8(15.7)	57(100)
>75	3(30)	7(70)		10(100)
Total	72(40)	64(35)	44(25)	180(100)

*Chi square test statistic value with 8 df is 27.653. *p* value =0.001

Table 3: Distribution of conditions as ECG abnormalities among to MRI findings

MRI findings	ECG Changes			Total N (%)
	Normal N(%)	LVH N(%)	Ischemic N(%)	
ACA	21(44.7)	8(17)	18(38.3)	47(100)
MCA	50(39.3)	50(39.3)	27(21.3)	127(100)
PCA	25(36.2)	33(47.8)	11(15.9)	69(100)

ACA – Anterior Cerebral Artery, MCA – Middle Cerebral Artery, PCA – Posterior Cerebral Artery

Table 4: Distribution of ECG and EEG abnormalities among male and female affected on left or right side hemiparesis

Category		Left side		Right side	
		Male	Female	Male	Female
ECG	Normal	39	11	7	15
	LVH	40	9	7	8
	ISCHEMIC	18	8	14	4
EEG	Normal	97	24	21	23
	Abnormal	0	4	7	4

Table 5: Distribution of ECG, EEG and MRI abnormalities in different age groups among sex wise

Abnormalities		Age group in years				
		<45	46-55	56-65	66-75	>75
Total Male		28	20	32	35	10
Total Female		4	10	19	22	0
ECG	Male Number	18	12	20	22	7
	(%)	64.3	60	62.5	62.9	70
	Female Number	-	-	15	14	-
	(%)			78.9	63.6	
	P-value			0.22	0.95	
EEG	Male Number	4	-	3	1	3
	(%)	14.3	-	9.4	2.9	30
	Female Number	-	-	5	3	-
	(%)		-	26.3	13.6	
	P-value			0.1	0.12	
MRI	Male Number	13	21	46	33	7
	Female Number	7	4	10	12	-

Weighted percentage for abnormalities in each group and sex wise calculated

Conclusion

The stroke patients will have ECG and EEG abnormalities in acute ischemic stroke and can be correlating with infarct volume at local site. Further studies are needed to define brain heart interaction in high risk cases.

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