

## ELECTROCARDIOGRAM CHANGES IN PATIENTS WITH ACUTE STROKE IN THE EMERGENCY DEPARTMENT OF BAGHDAD TEACHING HOSPITAL

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### ABSTRACT

Strokes are a syndrome of rapidly developing clinical symptoms and signs of focal (or at times global) disturbance of cerebral function enduring more than 24 hours (unless interrupted by surgery or death), with no apparent cause other than of vascular origin. The majority are ischemic, secondary to arterial occlusion by in-situ thrombus or embolus, with the remainder being due to intracerebral haemorrhage or subarachnoid haemorrhage. The electro cardiac irregularities subsequent acute stroke are common and seen in both ischemic and hemorrhagic stroke. This research aims to find the relation of the Electrocardiogram (ECG) changes in patients with acute stroke and its pattern. A cross-sectional study conducted in the emergency department of Baghdad teaching hospital in Baghdad City/Iraq. Purposing sampling adopted, and the sample size were=100 patients. The central part of the sample was male 64. About half of them were 55–64 years old. Various ECG changes observed in the present study including rhythm disturbances (like S-T Depression, T Wave Inversion, Q-T Prolongation, Sinus Tachycardia, Sinus Bradycardia, U Wave, AF etc.) in 79 patients (79%), the association of various factors with mean values with ECG changes (Mean age, BMI, DBP, RBS) was more in patients with ECG changes than patients without ECG changes. However, this difference wasn't found to be statistically significant.

**KEYWORDS:** Electrocardiogram, Stroke, Emergency.

### INTRODUCTION

Most cerebrovascular diseases are manifested by the abrupt onset of a neurological deficit. A stroke can be defined as an abrupt onset of a neurologic deficit that is due to vascular cause,<sup>[1]</sup> World Health Organization (WHO) defined stroke as a syndrome of "rapidly emerging signs and symptoms of focal disorder of cerebral function for more than twenty-four hours (unless interrupted by surgery or death), with no apparent cause other than of vascular origin." The majority are ischemic, secondary to arterial occlusion by in-situ thrombus or embolus, with the remainder being due to intracerebral haemorrhage or subarachnoid haemorrhage. Acute stroke is a multifactorial condition concerning prognosis,<sup>[2]</sup> It is impossible to expect the exact outcome of stroke with accuracy. The chances of survival in stroke depend on a wide variety of variables; cardiovascular complications are extremely common after stroke and are a significant

form of morbidity. Subsequently, several studies looked at the effect of brain injury on the heart, and very few studies looked at the prognostic Significance of these changes. The prognostic value of various electrocardiographic changes in stroke-like arrhythmias has been well studied,<sup>[3]</sup> The anomalies of the electrocardiogram following an acute stroke are typical and seen in both ischemic and hemorrhagic stroke. The variations seen in the electrocardiogram (ECG) are repolarization irregularities such as elevation of ST, depression of ST, negative waves of T, and prolongation of QT. Atrial fibrillation is the most common among tachyarrhythmias, and the incidence of focal atrial tachycardia is infrequent,<sup>[4]</sup>

### MATERIALS AND METHODS

A cross-sectional study with analytic elements. The current study was conducted in the emergency

department of Baghdad teaching hospital in Baghdad city, the Republic of Iraq during the period extended between 15th Nov 2019 and 15th Jan. 2020 The study population included all patient with the feature of stroke by examination or history review in the Emergency Department at Baghdad teaching hospital, who was register and available in the emergency department at the time of the study. The study covered one hundred samples from the emergency department of Baghdad teaching hospital. The required sample size was chosen because of the time limitation. The data collected through self-administered forum distributed to all patients or their relatives included in the sample who complete a pre-constructed questionnaire sheet. A structured questionnaire was developed as per objectives of the study; this questionnaire was adopted from a study made in 2018 for Exploring the electrocardiogram In young adult stroke Helsinki University Hospital with modification. Each patient was asked to complete a questionnaire. The questionnaire consists of two elements—the first element containing the sociodemographic information about gender, age, speciality, marital status. The second element containing the questionnaire for health issues, it had 17 primary questions and six sub-questions. The answers were multiple choices "Yes/ No and Don't know" type or single choice type. One point is given for each correct answer (correct response) and zero for each incorrect answer (incorrect response). The questionnaires were designed in Arabic after reviewing the literature. 30 Min. period was provided to fill in the form in a calm environment. The questionnaires were completed and collected under the supervision of the researcher.

#### Exclusion criteria

- 1- Any patient with a previous medical history, including (previous stroke, heart disease, any medical disease affecting the typical ECG pattern).
- 2- Any patient with previous surgical history related to heart including (pacemaker, Cardiac catheterization, CABG).
- 3- Any patient with previous drug history affecting ECG pattern including (Sodium channel blockers ex: Quinidine, Flecainide, Propranolol, Amitriptyline, Chloroquine.), (Slow Calcium Channel Blockers (CCB) ex: Nifedipine, Amlodipine, Verapamil, Diltiazem), (Outward potassium channel blockers ex: Disopyramide, Diphenhydramine.), (Sodium-potassium ATPase blockers ex: Digoxin).
- 4- Any patient with electrolyte abnormalities affecting the ECG pattern.

#### Statistical analysis

The data were coded and each questionnaire assigned with an identifying serial number then entered by the researcher into the computer using Statistical Package for Social Sciences (SPSS) version 24 with the help of a consultant statistician. Data were presented in simple measures of frequency, percentage, mean, standard

deviation, and range (minimum-maximum values). The Significance of the difference in different percentages (qualitative data) was tested using the Pearson Chi-square test. Statistical Significance was considered whenever the P-value was equal or less than 0.05.

#### RESULTS

**Demographic Profile:** The current study was performed on 100 Patients; the majority of them were males 64 (64.0 %) while the rest were females (36.0 %). Among them were Housewife (36%), Employee (25%), Teachers (20%) and from other Occupations (Doctors... etc.) (19%) Regarding their age, This study includes a wide range of age distribution and mean age calculated was 60.73 years with a standard deviation of 7.922. It infers that with advancing age incidence of stroke increases, but stroke below the age of 45years (i.e. Young stroke) is uncommon. At the present study, there was only one patient (1%) with young stroke, about half of them were 55–64 years old (49.0 %), one third (29.0%) were 65-74 years, 17.0 % were 45-54 years, and 4.0 % were 75 years and above. Most of the patients were married (78.0 %) living in the urban area (86.0 %)—about 40.0 % of the patients' smokers while only 5 % of them alcoholic drinker.

Various ECG changes are observed in the present study including rhythm disturbances (like S-T Depression, T Wave Inversion, Q-T Prolongation, Sinus Tachycardia, Sinus Bradycardia, U Wave, AF etc.) in 79 patients (79%), bradycardia in 4 patients (4%), tachycardia ten patients (10%), prolonged QTc interval in 8 patients, ST-segment depression in one patient, T wave inversion in 33 patients (33%) and presence of U wave in 2 patients (2%).

T wave inversion at the admission was the most common finding observed i.e. in 33 patients, followed by AF, i.e. in 21 patients (21%) is the 2nd most common finding. Whereas different types of arrhythmia (including sinus tachycardia, sinus bradycardia, etc.) as a whole are the finding observed in this study, i.e. in 25 patients at the time of admission. (Fig 1)

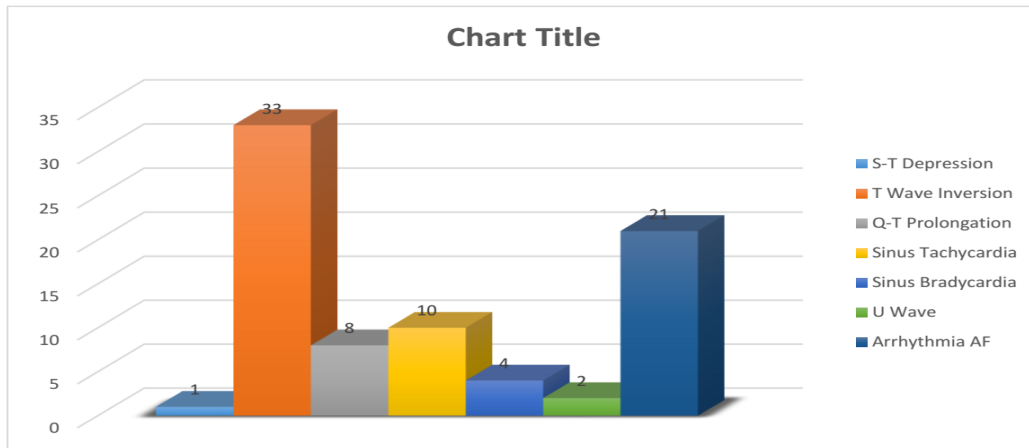


FIG 1: Graph showing different types of ECG changes in CVA

Table 1 shows that out of 100 patients who admitted to the emergency department for Disturb level of conscious had these signs and symptoms: more than half complaining Unilateral weakness (58 %), While other signs and symptoms include coma, nausea, Slurred Speech, vomiting, headache, Bilateral Weakness were

reported as (15, 11, 9, 4, 3 and 1 %) respectively. Regarding the Glasgow Coma Scale, more than half of the patients have a score between 11-15 while about one-third have a range between 6-10 and the rest 13.0 % between 3-5.

Table 1: Patients distribution according to Signs and symptoms and Glasgow Coma Scale at time of admission (n=100).

	No	%
<b>Signs &amp; symptoms</b>		
Nausea	11	11.0
Vomiting	3	3.0
Headache	3	3.0
Slurred Speech	9	9.0
Unilateral weakness	58	58.0
Bilateral Weakness	1	1.0
Coma	15	15.0
<b>Glasgow Coma Scale</b>		
3-5	13	13.0
6-10	31	31.0
11-15	56	56.0

Total of 100 patients meeting inclusion and exclusion criteria's were enrolled. They were categorised into two groups as Brain CT findings; Ischemic group and Hemorrhagic group. The ischemic group includes 42

patients (42%), and the hemorrhagic group consists of 44 patients (44%). Further, Ischemic group consists of 14 patients with normal Brain CT scan finding. Fig 2

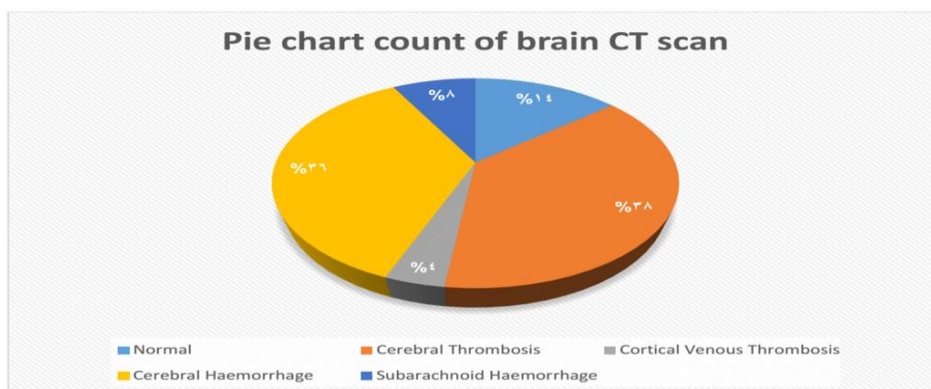


Fig 2 the distribution of the Brain CT scan in a patient with acute stroke

Overall, 79% of patients with acute stroke had ECG changes. ECG was normal in 21% of the cases. Based on the present study of ECG among subjects with acute stroke it was found that T wave inversion was the most

common ECG change found in 33% and this was more in females (36.1%) compared to 31.3% in males. (Table 2).

**Table (2): patients distribution according to gender and ECG changes.**

ECG changes	Male		Female		Total	
	Number	%	Number	%	Number	%
T wave inversion	20	31.3%	13	36.1%	33	33%
ST segment depression	0	0%	01	2.8%	01	01%
QRS changes	03	4.7%	05	13.9%	08	08%
Sinus Tachycardia	08	12.5%	02	5.6%	10	10%
AF	16	25%	05	13.9%	21	21%
U Wave	01	1.6%	01	2.8%	02	02%
Sinus Bradycardia	02	3.2%	02	5.6%	04	04%
No ECG changes	14	21.9%	07	19.4%	21	21%
ECG changes present	50	78.1%	29	80.6%	79	79%

AF was the next common complaint founded in ECG of acute stroke patients, but this time the incidence was more in males (25%) compared to females with only (13.9%). ST-segment depression was found in only one case, which was female. Eight cases showed changes in QRS out of which three were males and five were females. Sinus Tachycardia was found in 10 cases out of which the majority were males. U Wave was found in one case, and that was male, Sinus Bradycardia found in four cases out of which two were males, and two were females.

Table 3 shows the association of various factors with mean values with ECG changes. Mean age, BMI, DBP, RBS was more in patients with ECG changes than patients without ECG changes, but this difference was not found to be statistically significant. Other factors like mean TC, LDL was more in patients without ECG changes, but difference again was not significant. The only significant association was noticed between ECG changes with Smoking and both type of stroke.

**Table 3: Association of various factors with ECG changes in acute stroke (MEANS).**

Various factors	ECG changes (mean±SD)		P value	
	Present (N = 65)	Absent (N = 35)		
Age	60.2±13.5	57.3±10.7	0.2750	
Gender	Male	50	14	0.0943
	Female	29	7	0.1797
BMI	24.6±3.6	23.7±3.9	0.2497	
BP	SBP	153.7±28.4	153.7±26.4	1
	DBP	92.2±13.6	91.3±14.9	0.7609
TC	183.3±49.5	191.9±41.4	0.3834	
HDL	36.8±8.1	36.6±8.1	0.9065	
LDL	109.2±38.3	116.1±38.6	0.3936	
VLDL	33.5±18.1	36.5±18.3	0.4329	
TG	189.7±116.8	189.8±118.7	0.9968	
Smoking	39	61	0.0021	
RBS	191.7±104.5	181.5±105.5	0.6437	
Stroke type	Ischemic	42	14	0.0424
	Hemoragic	44	0	0.001

More females had ECG changes than males. Urban residents had shown more changes in ECG than rural residents. Family history of NCDs was more common in patients with ECG changes. Alcohol users' proportion

was more in patients with ECG changes compared to their counterparts, but these all changes were statistically insignificant. (Table 4).

**Table 4: Association of various factors with ECG changes (proportions).**

Various factors		ECG changes		Chi square value	P
		Present (N = 65)	Absent (N = 35)		
Sex	Male	40 (62.5%)	24 (37.5%)	0.2308	0.6309
	Female	25 (69.4%)	11 (30.6%)		
Residence	Urban	35 (66%)	18 (34%)	0.0004411	0.9832
	Rural	30 (63.8%)	17 (36.2%)		
Family history of NCDs	Yes	15 (78.9%)	04 (21.1%)	1.32	0.251
	No	50 (61.7%)	31 (38.3%)		
Alcohol	Yes	45 (66.2%)	23 (33.8%)	0.01818	0.8927
	No	20 (62.5%)	12 (37.5%)		

## DISCUSSION

The close relationship between stroke and cardiovascular disease is a well-known fact. Cardiovascular diseases can coexist or cause a stroke.<sup>[5]</sup> Numerous studies have recorded that primary neurological disorders such as CVA may cause changes in ECGs, such as affecting segment S-T, wave T, wave U, and interval Q-T. The central part of patients with acute stroke were over 55-64 years of age (49%), followed by the age group of 65-74 years (29%). Males were observed to be more affected than females by 64%. Urban residents had an acute stroke rate of 86 per cent compared with rural residents. Incidence of acute stroke in Married was higher than unmarried people. The occurrence was lower in educated and qualified persons (i.e. 48% compared to 52% among other occupation groups). Among addictions, smokers had the highest Incidence of 39% followed by Tobacco and Alcohol at 26% and 5% respectively. Cerebral Thrombosis and cerebral haemorrhages are more common in males; the incidence of cerebral embolism varies from 18- 23%. No cases of cerebral embolism were to be faced in this study. Since our study group was small, experiments with a more significant number of patients may be required to show the real occurrence of cerebral embolism. Majority of stroke cases were seen from 55-74 years as the risk factors are not strictly regulated, so the event of stroke is higher in the middle age range.

According to the National Institute of Neurological Diseases and Stroke, the incidence of Intracerebral haemorrhage is 40%,<sup>[6]</sup> which is near that in our study, 36%. In numerous studies, a comparison of ECG changes and arrhythmias seen in stroke patients were made with the ECG finding of age and sex-matched controls. The changes in the ECG findings were statistically significant, and these ECG changes were attributed to the cerebral cause. In the present study, 79% of stroke cases showed abnormal ECG changes, which was similar to the study conducted by Mathur *et al.*<sup>[7]</sup> We found that all cases of cerebral and subarachnoid

haemorrhage had ECG changes. 44.7 percent of cases of cerebral thrombosis and 4 cases of CVT were associated with irregular ECG. T wave inversion and AF were among the most common changes observed in stroke, were seen in almost all cases of stroke with or without associated heart disease, and were frequently seen in ischemic strokes rather than hemorrhagic strokes.<sup>[8]</sup> Arrhythmias are likely to contribute to the sudden unexpected mortality following a stroke; therefore, patients require continuous cardiac monitoring. In our study, all the 21 cases of Atrial Fibrillation became normal during the follow up in the ER. Other ECG changes like Q-T prolongation, sinus tachycardia, sinus bradycardia and prominent U waves were also met similar to other studies quoted in the literature.<sup>[9]</sup> Few ECG changes are specific to a particular type of stroke.<sup>[10]</sup> In Cerebral haemorrhages, all kinds of ECG alterations were detected, i.e., ST-T changes, Q-Tc prolongation, arrhythmias, sinus tachycardia excluding for sinus bradycardia and prominent U waves. four cases of CVT had sinus bradycardia and T wave inversion. An effort made to find out the prognostic importance of ECG changes in stroke patients. The patients who had insistent ECG changes had unfavorable prognosis compared to subjects with normal ECG, which was comparable to the observations made by Bozluoclay *et al.*, and Dogan *et al.*<sup>[10,11]</sup> This study concluded that ST-T segment changes, prolonged Q-Tc and abnormal U waves were univariate Predictors of mortality. Based on a previous study of ECG among patients with acute stroke, it was found that T wave inversion was the most common ECG change found in 33% and this was more in females (36.1%) compared to 31.3% in males, and this finding was close to The finding reported by Togha M *et al.*,<sup>[12]</sup> found that the T wave abnormality (39.9%) was the most common ECG changes followed by the presence of arrhythmias (27.1%) and prolonged QTc interval (32.4%).

AF was the next common condition found on ECG of 21% acute stroke, but this time its incidence was bigger in males (25%) than females with only 13.9%. And this

was higher than what reported by Henrik Stig *et al.*<sup>[13]</sup> in 1996 that AF was diagnosed in 18% of the patients, in the same time another report in 2003 by Dulli D.A. *et al.*<sup>[14]</sup> showing that (20.3%) of patients with acute ischemic stroke, had AF. ST-segment depression was found in only one case, which was female. Tatschl C. *et al.* reported that QT prolongation was found in 31% of the acute stroke patients and this is higher than what we found in this study which is just 8% Q-T Prolongation out of which (three were males and five were female). Sinus Tachycardia was found in 10 cases out of which the majority were males. Mean age, BMI, DBP, RBS was more in patients with ECG changes than patients without ECG changes, and this is the same result of Rambabu, M. V *et al.*,<sup>[15]</sup> but this difference was found to be statistically insignificant. Other factors like mean TC, LDL was more in patients without ECG changes, but the difference was not Significant again.

More females had ECG changes than males, and this is the same result that reported by Latha G. *et al.* Urban residents had shown more changes in ECG than rural residents. Smoking, alcohol and tobacco users' proportion was more in patients with ECG changes compared to their counterparts, but these all differences were not found to be statistically significant, unlike Sridharan R. *et al.* which found it significant except alcohol intake. Khechinashvili GR *et al.* reported that most subarachnoid haemorrhage cases had ECG changes in the acute phase,<sup>[16]</sup> the same finding in our study that overall 76% of stroke cases due to subarachnoid haemorrhage had ECG changes. McDermott MM *et al.* observed that 29% of the patients had depression in ST-segment, and 35% had arrhythmias of ventricles in their study of 51 patients.<sup>[17]</sup> And that was against what we found in our research that the ST depression is just 1% of the cases and there is no case of Ventricular arrhythmias. They noted that ST-segment depression was significantly associated with increasing age. But in this study, age was not found to be statistically significant with ECG changes. Dogan A *et al.*<sup>[18]</sup> found that the mean age of patients with ischemic stroke was 64 years compared to 57 years inpatient with hemorrhagic stroke and this is almost similar to the finding in this study. They noted that the prevalence of "Ischemia-like ECG changes" was 65% in patients with ischemic stroke compared to 57% in patients with hemorrhagic stroke. Atrial fibrillation was significantly more, i.e. 34% in patients with ischemic stroke compared to only 13% in patients with hemorrhagic stroke. But other types of ECG changes were comparable in the two groups Liu Q *et al.*,<sup>[19]</sup> studied 304 patients, out of which 67.1% had ECG changes. In our study found that 79% had ECG changes. The list of these abnormal things as conduction block, QTc prolongation, T wave inversion, ST-T changes.

## CONCLUSIONS

- This study confirms the role of ECGs as a part of routine investigations of patients admitted with stroke.

- Knowledge of these ECG changes will prevent unnecessary delay in proper assessment and operative management of stroke patients.
- Morbidity and maybe mortality is high among the patients who had persistent ECG changes as all the studies show, therefore, it is essential to monitor cardiac activity in all the patients of the stroke to decrease it.
- T wave inversion besides left axis deviation along with left ventricular hypertrophy were common ECG findings in patients with acute stroke.
- No studied risk factors found to be associated with ECG changes in patients with acute stroke.

## Ethical consideration

- Verbal communication with each participant regarding the aim of this study was conducted.
- Verbal consent from each participant (Patient or relative) was obtained before data collection.
- As this was not an interventional study, written informed consent from each participant was not required.
- The data collected was kept confidential and not be used except for the study purpose.
- Approval of The Scientific Board of Emergency Medicine-Ethical Committee was obtained prior to the start of the study.
- Ethical clearance of the study was acquired from The Ethical Committee in the Iraqi MOH, after getting the scientific approval.

## Declaration of Interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this article.

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