Advanced Medical Journal, Vol.10, No.1, P.1-9,2025 https://doi.org/10.56056/amj.2025.311

Common ECG Abnormalities in Patients with Acute Stroke

Rokan Abdulla Hama Ahmed* Sarwer Jamal Ismael Agha-Albajalan**

Abstract

Background and objectives: Stroke is one of the major causes that leads to death and disability globally. Electrocardiographic abnormalities are seen in acute stroke and may deliver valuable insights into stroke pathophysiology, outcomes, and administration. The aim of the study is to identify some common abnormalities in patients presenting with acute stroke.

Methods: In this hospital based cross-sectional prospective study, we analyzed and interpreted the ECG results of 100 patients presented to the emergency department of Shar hospital in Sulaymaniyah, Iraq, between February and August 2023. These patients were analyzed with either acute ischemic or hemorrhagic stroke according to the resuls of computed tomography scan of the brain. Electrocardiograms were acquired during a 24-hour timeframe after admission.

Result: The results show that the average age of the participants was 66.5 years. The direct risk factors specified in the study were diabetes (54%), hypertension (59%), smoking (51%), and ischemic heart disease (46%). The incidence of ischemic stroke was 68%, whereas hemorrhagic stroke accounted for 32% of cases. The most common electrocardiogram abnormalities in the study population were atrial fibrillation (31%) and sinus tachycardia (26%). In this study there was a statistically significant association between the electrocardiographic abnormalities and presence of ischemic stroke and heart disease ($p<0.05$), but no significant association was seen with diabetes or hypertension.

Conclusions: Atrial fibrillation and sinus tachycardia were the most common electrocardiogram findings in Iraqi patients presenting with acute stroke. Electrocardiogram abnormalities were related to ischemic stroke and cardiac disease, highlighting their diagnostic and prognostic potential.

Keywords: Atrial fibrillation, Electrocardiographic abnormalities, Ischemic stroke

*M.B.Ch.B, emergency medicine candidate at KHCMS, Email: rokanabdulla@yahoo.com , Corresponding author
**M.B.Ch.B, FIBMS (neurology), FEBN, Email: sarwar.ismael@univsul.edu.iq.

Introduction

Based on the latest assessments from the Global Burden of Disease (GBD), approximately 12.2 million new cases of stroke occurred in 2019, resulting in 6.6 million fatalities worldwide. This positions stroke as the second most common cause of death and the third most prevalent cause of disability.[1] A range of electrocardiographic (ECG) abnormalities often co-occur with acute strokes, particularly subarachnoid hemorrhage.[2] About 7 million people in the United States have experienced a clinical stroke, while 13 million have had a silent stroke. Most (87%) of these clinical strokes are ischemic.[3] The numerous prevalent ischemic stroke subtypes are large vessel thromboembolic and cardioembolic, among others.[4] Ischemic strokes are caused by a blockage or clot in an artery leading to the brain, and one common cause of this blockage is the presence of emboli. Emboli are small, traveling blood clots from various bodily sources, including the heart. Studies have shown that about one in five cases of ischemic stroke is caused by emboli that originate from the heart .[5]Electrocardiography (ECG) is a non-invasive technique to diagnose and predict cardiovascular diseases (CVDs). When assessing patients with hemorrhagic stroke, ECG can reveal abnormalities such as left ventricular hypertrophy (LVH), which are often associated with common risk factors like hypertension.[6] Electrocardiogram abnormalities can show signs of underlying coronary heart disease (CHD) before a thromboembolic stroke happens since both conditions share a common risk factor in atherosclerosis. This article focuses on how ECG can be used to predict the occurrence of cardioembolic stroke. The authors know that distinguishing cardioembolic stroke from other subtypes, massive vessel thromboembolic stroke, can be challenging clinically and through imaging. This poses a significant constraint when examining ECG predictors of stroke, as the TOAST Trial criteria consider the existence of atrial fibrillation (AF) a critical risk factor for the heart.[7]Many heart regions, such as the left atria, mitral or aortic valves, left ventricle, or transportation from the right-side circulation, can be the origin of a cardioembolism.[8] Another potential cause is a passage from the right side of the heart. Stasis or abnormal flow dynamics in a heart chamber that is either dilated or fibrillating is thought to be the root cause of increased thrombogenesis. Conditions such as valvular or nonvalvular atrial fibrillation, sick sinus syndrome, recent myocardial infarction with an aneurysm, dilated cardiomyopathy, or segmental akinesis might all contribute to thrombo-conducive situations.[8] Cardio embolism may also be caused by less frequent causes, like emboli from infective endocarditis, primary tumors, or mechanical valve thrombi. However, these causes can still lead to the condition.[8] Iatrogenic embolisms, which may develop due to medical procedures performed on the heart, are not discussed in this article.[8] Some studies have analyzed the occurrence of common arrhythmias during and behind stroke events, which may be caused by the hemodynamic changes that occur during acute stroke.[9,10]The aim of the study is to identify most common abnormalities in patients presenting with acute stroke.

Patients and methods

The current study designed as cross-sectional prospective study which 100 patients were presented with acute cerebrovascular accidents. The study carried out during February 1st 2023 to August 1st 2023 at emergency department Shar hospital in Sulaymaniyah- Iraq. The researchers who were emergency physicians determined and reported the frequency of electrocardiographic (ECG) changes in acute cerebrovascular accident cases. This study

https://doi.org/10.56056/amj.2025.311

was submitted to the Ethics and Scientific committees at Kurdistan Higher Council of Medical Specialties. The sample size included Common ECG abnormalities in patients with acute stroke aged more than 18 years. Patients with new onset signs and symptoms of acute CVA occurred in less than 24 hours and ischemic and hemorrhagic stroke patients of both genders were included in the study. Exclusion criteria included patients with age of less than 18 years of both genders, signs and symptoms of acute CVA reported in more than 24-hour patients and transient ischemic attack cases. Patients who did not give consent were excluded from the study. The study conducted at the emergency department of Shar teaching hospital in Sulaymaniyah, Iraq. A total of 100 patients with acute cerebrovascular events were enrolled in the study, all the patients underwent ECG recording within fist 24 hours of admission using Philips Page Writer TC10 ECG machine and the results were analyzed by emergency physician. The data collection process included an English questionnaire designed and provided with questions such as socioeconomic conditions, Past medical history, mortality rate and the patients were categorized into ischemic and hemorrhagic group depending on the result of Computed Tomography (CT) scan of the brain. The collected data were analyzed using Statistical Package for Social Sciences (SPSS) version 28 and the results were compared between patients with different variables, with a statistical significance level of ≤ 0.05

Results

We enrolled 100 participants in our study with average age of 66.51 years and youngest represented with 37 years moreover, the oldest respondent was 91 years. Table (1) shows that 66 of the patients were male (66%) and 34 patients were female (34%). Regarding occupation most of the patients were laborers (75%). More than half (55%) of participants were urban resident. Most common clinical presentation was right side weakness (20%), followed by left side weakness and mouth deviation (18% for each).

Table (1): General characteristics and clinical presentation of participants.

Variables	Categories	Frequency	Percent
Gender	Male	66	66
	Female	34	34
Occupation	professional (skilled)	25	25
	laborer (unskilled)	75	75
Residence	Rural	45	45
	Urban	55	55
Clinical presentation	decreased level of consciousness	6	6
	left side weakness	18	18
	loss of consciousness	15	15
	mouth deviation	18	18
	right side weakness	20	20
	slurred speech	14	14
	vomiting and LOC	9	9
Total		100	100%

https://doi.org/10.56056/amj.2025.311

Regarding associated risk factors, hypertension was most common among patients (59%) followed by diabetes mellitus (54%). According to the results of CT scan of the brain, ischemic stroke was detected in 68 patients (68%) and hemorrhagic stroke in 32 patients (32%), the vast majority (99%) of them remained alive, only 1% of them died, Table (2).

Table (2): risk factors, and outcome of participants

Variables	Categories	Frequency	Percent
DM	Yes	54	54
Hypertension	Yes	59	59
IHD	Yes	46	46
Hyperlipidemia	Yes	42	42
Smoking	Yes	51	51
Alcohol	Yes	19	19
Type of stroke	Ischemic	68	68
	Hemorrhagic	32	32
Outcome	Alive	99	99
	Dead	1	1
Total		100	100%

Most common ECG findings detected in this study was atrial fibrillation (31%) followed by sinus tachycardia (26%) and T inversion (16%) as shown in Table (3).

Table (3): ECG findings of participants

Variables	Categories	Frequency	Percent
ECG findings	Normal	6	6
	sinus tachycardia	26	26
	AF	31	31
	LBBB	6	6
	RBBB	8	8
	T inversion	16	16
	LVH	7	7

Findings of Table (4) show that there was a significant statistical association between ECG findings and type of stroke, the researchers observed that AF was detected in 29 patients (42.6%) with ischemic stroke and only in 2 patients (6.3%) with hemorrhagic stroke. On the contrary T-inversion was detected in 15 patients (46.9%) with hemorrhagic stroke, while only 1 patient (1.5%) with ischemic stroke has T-inversion in ECG. Chi square test was done and p-value was 0.001

https://doi.org/10.56056/amj.2025.311

Table (4): Association between ECG findings and type of stroke.

Variable	Categories	Type of stroke		p-value
		ischemic	hemorrhagic	
ECG findings	Normal	5 (7.4%)	1 (3.1%)	0.001
	Sinus tachycardia	15 (22.1%)	11 (34.4%	
	AF	29 (42.6%)	2 (6.3%)	
	LBBB	5 (7.4%)	1 (3.1%)	
	RBBB	6 (8.8%)	2 (6.3%)	
	T inversion	1 (1.5%)	15 (46.9%)	
	LVH	7 (10.3%)	0 (0%)	
Total		68 (100%)	32 (100%)	

Table (5) shows that there was a non-significant statistical association between ECG findings and diabetes mellitus and p-value was 0.234.

Table (5): Association between ECG findings and DM.

Variable	Categories	DM		p-value
		no	yes	
ECG findings	Normal	1 (2.2%)	5 (9.3%)	0.234
	sinus tachycardia	13 (28.3%)	13 (24.1%)	
	AF	13 (28.3%)	18 (33.3%)	
	LBBB	4 (8.7%)	2 (3.7%)	
	RBBB	4 (8.7%)	4 (7.4%)	
	T inversion	10 (21.7%)	6 (11.1%)	
	LVH	1 (2.2%)	6 (11.1%)	
Total		46 (100%)	54 (100%)	

Table (6) shows that there was a non-significant statistical association between ECG findings and hypertension and p-value was 0.342.

Table (6): Association between ECG findings and HTN.

Variable	Categories	HTN		p-value
		No	Yes	
ECG findings	Normal	4 (9.8%)	2 (3.4%)	0.342
	sinus tachycardia	10 (24.4%)	16 (27.1%)	
	AF	16 (39%)	15 (25.4%)	
	LBBB	3 (7.3%)	3 (5.1%)	
	RBBB	2 (4.9%)	6 (10.2%)	
	T inversion	5 (12.2%)	11 (18.6%)	
	LVH	1 (2.4%)	6 (10.2%)	
Total		41 (100%)	59 (100%)	

https://doi.org/10.56056/amj.2025.311

Results of Table (7) reveal that there was a statistically significant association between ECG findings and IHD, 40.7% of sinus tachycardia cases had no IHD while only 8.7% of cases experienced IHD on the comparison 41.3% of AF cases had ischemic heart disease while 22.2% of AF cases were free of IHD. Chi square test was done and p-value was 0.003.

Table (7): Association between ECG findings and IHD.

Variable	Categories	IHD		p-value
		no	yes	
ECG findings	Normal	4 (7.4%)	2 (4.3%)	0.003
	sinus tachycardia	22 (40.7%)	4 (8.7%)	
	AF	12 (22.2%)	19 (41.3%)	
	LBBB	1 (1.9%)	5 (10.9%)	
	RBBB	4 (7.4%)	4 (8.7%)	
	T inversion	9 (16.7%)	7 (15.2%)	
	LVH	2 (3.7%)	5 (10.9%)	
Total		54 (100%)	46 (100%)	

Table (8) shows that there was a non-significant statistical association between ECG findings and hyperlipidemia and p-value was 0.186.

Table (8): Association between ECG findings and hyperlipidemia.

Variable	Categories	Hyperlipidemia		p-value
		no	yes	
ECG findings	Normal	4 (6.9%)	2 (4.8%)	0.186
	sinus tachycardia	19 (32.8%)	7 (16.7%)	
	AF	13 (22.4%)	18 (42.9%)	
	LBBB	3 (5.2%)	3 (7.1%)	
	RBBB	4 (6.9%)	4 (9.5%)	
	T inversion	12 (20.7%)	4 (9.5%)	
	LVH	3 (5.2%)	4 (9.5%)	
Total		58 (100%)	42 (100%)	

Results of Table (9) reveal that there was a statistically significant association between smoking and type of stroke, most (61.8%) of smokers had ischemic while more than quarter (28.1%) of smokers had hemorrhagic. Chi square test was significant and p-value was 0.002.

Table (9): Association between smoking and type of stroke.

Variable	Categories	Type of stroke		p-value
		ischemic	hemorrhagic	
Smoking	No	26 (38.2%)	23 (71.9%)	0.002
	Yes	42 (61.8%)	9 (28.1%)	
Total		68 (100%)	32 (100%)	

https://doi.org/10.56056/amj.2025.311

Discussion

The results from this study provide important insights into stroke presentation, risk factors, outcomes, and ECG findings. Overall, the findings align with and build upon prior research. Looking at the general characteristics and clinical presentation, the higher percentage of males (66%) concurs with previous data by Appelros et al. showing a higher incidence of stroke in men.[11] The prevalence of right side weakness (20%) was greater than left side weakness (18%), which is consistent with Vohryzek et al.'s study demonstrating right hemisphere predominance in ischemic strokes.[12] Furthermore, decreased consciousness (6%) and vomiting/LOC (9%) rates match those found in earlier analyses.[13]Analyzing the risk factors, outcomes and ECG findings, diabetes (54%) and hypertension (59%) were the most frequent, echoing extensive documentation of these as major stroke risk factors. This finding is in accordance with O'Donnell et al.'s study in which DM and HTN were the leading risk factors for stroke.[14] Smoking (51%) and alcohol use (19%) frequencies aligned with prior statistics as well.[15] The 1% in-hospital mortality rate was lower than in previous studies, likely attributable to differences in stroke severity and quality of care.[16] Additionally, atrial fibrillation (31%) and sinus tachycardia (26%) were the predominant ECG abnormalities, congruent with Hart et al.'s findings.[17] Regarding the association between ECG findings and stroke type, the significant relationship between atrial fibrillation and ischemic stroke reflects its established thromboembolic consequences.[18] According to Seet et al.'s systematic review,[18] there are researches involving with pacemakers that suggest a link between short periods of irregular heartbeats and increased risk of stroke. Atrial fibrillation can result in a stroke because of reduced blood flow within the intricate structure of the trabeculated left atrial appendage, encouraging the formation of blood clots through inflammation and the activation of factors like thromboxane and other coagulation-related elements.[18]Furthermore, T wave inversion's tie to hemorrhagic stroke concurs with data linking it to intracerebral hemorrhage.[1]The lack of association between ECG changes and diabetes/hypertension is in agreement with Soliman et al.'s findings.[20] Connections between atrial fibrillation, sinus tachycardia, and ischemic heart disease, is consistent with earlier findings.[21] The Framingham Heart Study revealed that atrial fibrillation (AF) was linked to double the cardiovascular mortality when compared to sinus rhythm. However, the study did not evaluate the separate or individual impact of AF on mortality.[21]

Conclusions

Electrocardiography is a cost-effective and accessible tool in the initial assessment and evaluation of patients presenting with acute stroke. In this study the most common ECG abnormalities detected in patients with acute stroke were atrial fibrillation and sinus tachycardia.

Conflict of interest

There were no conflicts of interest.

References

1.eClinicalMedicine. The rising global burden of stroke. EClinicalMedicine. 2023 May 23; 59:102028. doi: 10.1016/j.eclinm.2023.102028/

2.Togha M, Sharifpour A, Ashraf H, Moghadam M, Sahraian MA. Electrocardiographic abnormalities in acute cerebrovascular events in patients with/without cardiovascular disease. Ann Indian Acad Neurol. 2013;16(1):66-71. doi:10.4103/0972-2327.107710/

3.Virani SS, Alonso A, Aparicio HJ, Benjamin EJ, Bittencourt MS, Callaway CW,

et al. heart disease and Stroke Statistics-2021 Update: A Report from the American Heart Association. Circulation. 2021;143(8): e254-e743.
4.Adams HP Jr, Bendixen BH, Kappelle LJ, Biller J, Love BB, Gordon DL et.al. Classification of subtype of acute ischemic stroke. Definitions for use in a multicenter clinical trial. TOAST. Trial of Org 10172 in Acute Stroke Treatment. Stroke. 1993;24(1):35-41. doi: 10.1161/01.str.24.1.35/
5.Goldstein LB, Bushnell CD, Adams RJ, Appel LJ, Braun LT, Chaturvedi S. Guidelines for the primary prevention of stroke: a guideline for healthcare professionals from the American Heart Association/American Stroke Association. Stroke. 201;42(2):517-84. doi: 10.1161/STR.0b013e3181fcb238/
6.Erani F, Zolotova N, Vanderschelden B, Khoshab N, Sarian H, Nazarzai L, et al. Electroencephalography Might Improve Diagnosis of Acute Stroke and Large Vessel Occlusion. Stroke. 2020;51(11):3361-5. doi: 10.1161/STROKEAHA/
7.He J, Tse G, Korantzopoulos P, Letsas KP, Al-Saegh AL, Kamel H, et al. P-Wave Indices and Risk of Ischemic Stroke: A Systematic Review and Meta-Analysis. Stroke. 2017;48(8):2066-72. doi: 10.1161/STROKEAHA.117.017293/
8.Sacco RL, Kasner SE, Broderick JP, Caplan LR, Connors J, Culebras A, et al. An updated definition of stroke for the 21st century: a statement for healthcare professionals from the American Heart Association/American Stroke Association. Stroke. 2013;44(7):2064–89.
9.Seifert F, Kallmünzer B, Gutjahr I, Breuer L, Winder K, Kaschka I, et al. Neuroanatomical correlates of severe cardiac arrhythmias in acute ischemic stroke. J Neurol.2015;262:1182–90.
10.Grond M, Jauss M, Hamann G, Stark E, Veltkamp R, Nabavi D, et al. Improved detection of silent atrial fibrillation using 72-hour Holter ECG in patients with ischemic stroke: a prospective multicenter cohort study. Stroke. 2013;44(12):3357-64.
11.Appelros P, Stegmayr B, Terént A. Sex differences in stroke epidemiology: a systematic review. Stroke. 2009;40(4):1082-90.
12.Vohryzek M, Adamova B, Duris K, Kotoucova J, Laczova E. Differential involvement of the left and right hemispheres in ischemic stroke. Brain Behav. 2020;10(11): e01845.
13.Leira R, Dávalos A, Silva Y, Gil-Peralta A, Tejada J, Garcia M, et al. Early neurologic deterioration in intracerebral hemorrhage: predictors and associated factors. Neurology. 2004;63(3):461–7.
14.O'Donnell MJ, Xavier D, Liu L, Zhang H, Chin SL, Rao-Melacini P, et al. Risk factors for ischaemic and intracerebral haemorrhagic stroke in 22 countries (the INTERSTROKE study): a case-control study. Lancet. 2010;376(9735):112-23.
15.Siwat S, Pruphetkaew N, Chongphattararot P, Nanphan P, Sathirapanya P. Serum S100β as a predictor of severity and outcomes for mixed subtype acute ischaemic stroke. Singapore Med J. 2020: 61(4):206–211.
16.Vingerhoets F, Bogousslavsky J. Abnormal heart rate patterns at the onset of ischemic stroke. J Neurol Sci. 1990;96(1):1-9.
17.Hart RG, Pearce LA, Aguilar MI. Meta-analysis: antithrombotic therapy to prevent stroke in patients who have nonvalvular atrial fibrillation. Ann Intern Med. 2007;146(12):857–67.
18.Seet RCS, Friedman PA, Rabinstein AA. Prolonged rhythm monitoring for the detection of occult paroxysmal atrial fibrillation in ischemic stroke of unknown cause. Circulation. 2011;124(4):477-86.
19.Lip GY, Coca A, Kahan T, Boriani G, Manolis AS, Olsen MH, et al. Hypertension

and cardiac arrhythmias: executive summary of a consensus document from the European Heart Rhythm Association (EHRA) and ESC Council on Hypertension, endorsed by the Heart Rhythm Society (HRS), Asia-Pacific Heart Rhythm Society (APHRS), and Sociedad Latinoamericana de Estimulación Cardíaca y Electrofisiología (SOLEACE). Europace. 2017;19(6):891-911.

20.Soliman EZ, Prineas RJ, Case LD, Zhang ZM, Goff DC Jr. Ethnic distribution of ECG predictors of atrial fibrillation and its impact on understanding the ethnic distribution of ischemic stroke in the Atherosclerosis Risk in Communities (ARIC) study. Stroke. 2009;40(4):1204-11.

21.Anter E, Jessup M, Callans DJ. Atrial fibrillation and heart failure: treatment considerations for a dual epidemic. Circulation. 2009;119(18):2516-2525. doi:10.1161/CIRCULATIONAHA.108.821306/

https://doi.org/10.56056/amj.2025.311