

Cardiac evaluation in patients with stroke with special reference to echocardiography

Amit Das^{1*}, Dinesh Prasad Gupta²

¹Junior Resident, ²Associate Professor, Department of Medicine, Patna Medical College and Hospital, Patna, Bihar, INDIA.

Email: a.amitkumardas@gmail.com

Abstract

Background: A stroke is a medical condition in which poor blood flow to the brain results in cell death. There are two main types of stroke: ischemic, due to lack of blood flow, and hemorrhagic, due to bleeding. Both result in parts of the brain not functioning properly. **Methods:** It was hospital based prospective study. Those patients who were attending in O.P.D. and IPD of Patna Medical College and Hospital, Bihar. To know the ECG and echocardiography changes in stroke and whether they had any prognostic significance in stroke patients. 100 of stroke patients admitted to ICU and Medicine wards in our Hospital, during the period between November 2018 to November 2019. **Results:** hypertension was present in majority of the cases i.e., 45%, which is comparable with that found in the studies of Smith⁴⁸ (2005) and Carlos⁴⁶ (2003) i.e., 87% and 48% respectively and next commonest risk factor was smoking (28%) and history of stroke (8%), which are comparable with that found in Smith (2005) i.e., 35.22% and diabetes mellitus was present in 13% of the patients in the present study and the least was hyperlipidemia. **Conclusion:** ST segment depression, QTc prolongation and U are the common ECG abnormalities in hemorrhagic strokes. QTc prolongation and U-waves are the common ECG abnormality in ischemic stroke. LV dysfunction is the most common echocardiographic abnormality in stroke patients

*Address for Correspondence:

Dr Amit Das, Junior Resident, Department of Medicine, Patna Medical College and Hospital, Patna, Bihar, INDIA.

Email: a.amitkumardas@gmail.com

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INTRODUCTION

Ischemia Stroke is a condition in which there is insufficient blood flow to the brain to meet metabolic demand.¹ This leads to poor oxygen supply or cerebral hypoxia and thus to the death of brain tissue or cerebral infarction / ischemic stroke. It is a sub-type of stroke along with subarachnoid hemorrhage and intracerebral hemorrhage.^{2,3} Ischemia leads to alterations in brain metabolism, reduction in metabolic rates, and energy crisis⁴ There are two types of ischemia: focal ischemia, which is confined to a specific region of the brain; and

global ischemia, which encompasses wide areas of brain tissue. The main symptoms involve impairments in vision, body movement, and speaking. The causes of brain ischemia vary from sickle cell anemia to congenital heart defects. Symptoms of brain ischemia can include unconsciousness, blindness, problems with coordination, and weakness in the body. Other effects that may result from brain ischemia are stroke, cardiorespiratory arrest, and irreversible brain damage. An interruption of blood flow to the brain for more than 10 seconds causes unconsciousness, and an interruption in flow for more than a few minutes generally results in irreversible brain damage.⁵ In 1974, Hossmann and Zimmermann demonstrated that ischemia induced in mammalian brains for up to an hour can be at least partially recovered⁶. Accordingly, this discovery raised the possibility of intervening after brain ischemia before the damage becomes irreversible.⁷ Hemorrhage Stroke is bleeding into the subarachnoid space—the area between the arachnoid membrane and the pia mater surrounding the brain.⁸ Symptoms may include a severe headache of rapid onset, vomiting, decreased level of consciousness, fever, and sometimes seizures.^[8] Neck

stiffness or neck pain are also relatively common.⁹ In about a quarter of people a small bleed with resolving symptoms occurs within a month of a larger bleed. SAH occurs in about one per 10,000 people per year. Females are more commonly affected than males.⁸ While it becomes more common with age, about 50% of people present under 55 years old. It is a form of stroke and comprises about 5 percent of all strokes.¹⁰ Surgery for aneurysms was introduced in the 1930s.¹¹ Since the 1990s many aneurysms are treated by a less invasive procedure called endovascular coiling, which is carried out through a large blood vessel.¹²

Most cases of SAH are due to trauma such as a blow to the head.¹³ Traumatic SAH usually occurs near the site of a skull fracture or intracerebral contusion.^[14] It often happens in the setting of other forms of traumatic brain injury. In these cases prognosis is poorer, however, it is unclear if this is a direct result of the SAH or whether the presence of subarachnoid blood is simply an indicator of a more severe head injury.¹⁵ In 85 percent of spontaneous cases the cause is a cerebral aneurysm—a weakness in the wall of one of the arteries in the brain that becomes enlarged. They tend to be located in the circle of Willis and its branches. While most cases are due to bleeding from small aneurysms, larger aneurysms (which are less common) are more likely to rupture.^[10]

METHODS

Study Design: A hospital based prospective study.

Study Area: Department of General Medicine, Patna Medical College and Hospital, Bihar.

Study population: Those patients who were attending in O.P.D. and IPD of Patna Medical College and Hospital, Bihar. To know the ECG and echocardiography changes in stroke and whether they had any prognostic significance in stroke patients.

Sample Size and Sample technique: 100 of stroke patients admitted to ICU and Medicine wards in our Hospital, Patna Medical College and Hospital, during the period between November 2018 to November 2019. After applying the inclusion and exclusion criteria.

Ethical Clearance:

The thesis protocol was approved by ethical committees of Patna Medical College and Hospital.

Inclusion Criteria:

Cases of CVA (CT scan proved) admitted within 72 hours after the onset of stroke were selected for the study, patients admitted beyond 72 hours after onset of stroke were excluded as the incidence of ECG changes beyond this period were infrequent.

Exclusion Criteria:

- Traumatic cases producing neurological deficits, infection, neoplastic cases producing CVA, venous thromboses producing CVA, CVA cases with known underlying cardiac diseases which produce ECG and echocardiographic changes.
- After admission a detailed history regarding the temporal profile of the stroke including history of risk factors like hypertension, diabetes mellitus, smoking, history of IHD and rheumatic heart disease were obtained.
- Detailed neurological examination including fundoscopy and cardiovascular examination were carried out in all the cases.

The diagnosis of CVA was made on the basis of following criteria

- Temporal profile of clinical syndrome
- Clinical examination
- CT scan of brain

A 12 lead ECG and 2D echocardiography was done within 24 hours of admission. All patients were subjected to investigations like:

- Complete blood count
- Erythrocyte sedimentation rate
- Renal function test
- Serum electrolytes
- Lipid profile

In hospital follow-up was done to know their prognosis under two categories:

1. Live
2. Dead

- Results were analyzed with reference to age, sex and risk factors and clinical examination.
- Each case was subjected to 12-lead ECG and 2D echo within 24 hrs of admission and the following criterions were applied in their analysis

RESULTS

TABLE 1: AGE AND SEX DISTRIBUTION IN STROKE PATIENTS

Age (years)	Male	Female	Total	Percent
21-30	4	2	6	6.00
31-40	7	3	10	10.00
41-50	15	5	20	20.00
51-60	20	16	36	36.00
61-70	5	9	14	14.00
71-80	6	5	11	8.00
81-90	1	1	2	2.00
91-100	0	1	1	1.00
Total	58	42	100	100.00

As evident from the above table, the incidence of stroke in the present study was more common in 5th and 6th decade and there was slight male (58%) preponderance compared to females (42%) making male-female ratio of 1.4:1.

Table 2: Incidence of Risk Factors in stroke patients

Risk factors	No. of Cases	Percent
Hypertension	45	45.00
DM	13	13.00
Smoking	28	28.00
Hyperlipidemia	8	8.00
History of stroke	8	8.00

The above table shows that hypertension was the most common risk factor and was present in 45% of the cases, followed by smoking in 28%, diabetes mellitus in 13% of patients, history of stroke in 8%, and hyperlipidemia in 8% of stroke patients.

Table 3: Incidence of Infarct and Hemorrhage with reference to sex

Type of study	Male		Female		Total	Percent
	No	%	No	%		
Ischemic	38	55.88	30	44.12	68	68.00
Hemorrhage	20	62.50	12	37.50	32	32.00
Total	58		42		100	100.00

The above table shows the incidence of infarct was (68%) more common compared to hemorrhage (32%) and the incidence of stroke was little more common among males, but was statistically insignificant ($p > 0.05$).

Table 4: Relationship of CVA with ECG and Echocardiography Changes

	Normal		Abnormal	
	Total	%	Total	%
ECG	29	29.00	71	71.00
2D Echo	46	46.00	54	54.00

The above table shows the abnormalities of ECG (71%) and echocardiography (54%) were more common in stroke patients and was statistically significant.

Table 5: Relationship between stroke types and ECG changes

Type of Stroke	Total No. of Cases	ECG Changes			
		Normal		Abnormal	
		No	%	No	%
Ischemic	68	22	32.35	46	67.64
Hemorrhage	32	7	21.8	25	78.12

In the above table, it is evident that ECG abnormalities were more common in patients of stroke. ECG abnormalities were more in hemorrhagic stroke (78.12%) compared to infarct (67.64%), which is statistically insignificant ($p > 0.05$).

Table 6: ECG changes in stroke patients

ECG changes	Ischemic (n=68)		Hemorrhage (n=32)	
	No	%	No	%
QTC prolongation	25	36.76	16	50.00
T-wave inversion	21	30.88	9	28.13
ST Segment depression	21	30.88	18	56.26
U waves	35	51.47	18	56.26
Tachycardia	24	35.29	16	0
Bradycardia	0	0	2	0
Atrial fibrillation	5	7.35	0	0

From the above table, it is evident that ECG abnormalities among infarct group, U-wave (51.47%), QTc prolongation (36.76%) were the most common abnormalities followed by T-wave inversion (30.88%) and ST-segment depression (30.88%). In cases of hemorrhage group ST segment depression (56.26%) and U-wave (56.26%) were the most common abnormalities followed by prolonged QTc (50%) and T-wave inversion (28.13%).

Table 7: Echocardiography changes in stroke patients

Echocardiography changes	Ischemic (n=68)		Hemorrhage (n=32)	
	No	%	No	%
LV dysfunction	16	23.53	18	56.26
LV hypertrophy	14	20.59	17	53.12
Cardiac thrombus	3	4.41	0	0
Mitral valve abnormality	14	20.59	0	0
Aortic valve abnormality	3	4.41	0	0
Normal	24	35.30	2	6.25

From the above table, it is evident that echocardiography abnormalities among the infarct group, LV dysfunction (23.53%) was most common, followed by LV hypertrophy (20.59%), mitral valve (20.59%) and aortic valve (4.41%) abnormality. In cases of hemorrhagic strokes again LV dysfunction (56.26%) was most commonest abnormality. Normal echo was seen in 35.30% of infarct and 6.25% in hemorrhagic stroke.

Table 8: Mortality in stroke patients and its co-relation with ECG changes

Type of ECG Changes	Stroke patients				P Value	Chi-square
	Stroke Alive (n=78)		Stroke Dead (n=22)			
	No	%	No	%		
QTc prolongation	31	39.74	10	45.45	p>0.05	0.23
T Wave inversion	23	29.48	7	31.8	p>0.05	0.044
ST segment depression	29	37.17	10	45.45	p>0.05	0.49
U Waves	44	56.41	9	40.90	p>0.05	1.65

The above table shows, mortality was higher in patients of stroke with QTc prolonged (45.45) and ST segment depression (45.45%) followed by U waves (40.90) and least was with T-wave inversion (31.8%), but none of them were statistically significant.

Table 9: Mortality in stroke types and its co-relation with echocardiography changes

Echocardiography Changes	Ischemic				Hemorrhage			
	Alive		Dead		Alive		Dead	
	No	%	No	%	No	%	No	%
LV dysfunction	12	20.33	4	44.40	6	66.66	12	92.0
LV hypertrophy	10	16.95	4	44.40	6	66.66	6	46.15
Mitral valve abnormality	12	20.33	2	22.22	00	00	00	00
Aortic valve Abnormality	3	5.00	0	0.00	00	00	00	00
Normal	24	40.66	00	00	6	66.20	2	15.38

The above table shows, mortality was higher in hemorrhagic stroke with LV dysfunction (92%) compared to infarct group (44.4%) followed by mitral valve abnormality in case of infarct group (22.22%).

Table 10: Total Analysis in patients of stroke who died

Type of stroke	No. of Died patients(n=22)	Percentage
ECG abnormalities		
QTc prolongation	10	45.00
T-wave inversion	7	31.81
ST-segment depression	10	45.00
U-waves	9	40.90
Echocardiographic abnormalities		
LV dysfunction	16	72.00
LV hypertrophy	10	45.45

Above table, it is evident that among the total number of patients who died of stroke, hemorrhage was the culprit in 60% and ischemia in 40%. QTc prolongation and ST depression was the common ECG abnormality present in 45% of cases. U-wave stood second with 40.90% and the least was T-wave inversion with 31.81%. LV dysfunction was the common echocardiography abnormality present in 72% of patient followed by LV hypertrophy with 45.45%.

DISCUSSION

A hospital based prospective study was done to know the ECG and echocardiography changes in stroke and whether they had any prognostic significance in stroke patients. In this study, CT scan was mandatory in the inclusion criteria to prove the stroke and type of stroke. Among the 100 patients 58 were males and 42 were females (sex ratio was M:F - 1.4:1), age ranged from 24-92 years and the mean age of patients of alive and dead were 58.73 and 54 years respectively. The cases of stroke were more common in the 5th and 6th decade, making 50%, which is comparable to Venkataramana *et al.*^[16] study in which the percentage of stroke cases above the age of 51 years was 41% and in the Carlo⁴⁶ study (2003) was 71.8%.

Comparison of association of risk factors in different studies

Risk factors	Smith (2005) ^[17] (%) (n=30)	Carlo <i>et al.</i> ^[18] (2003) (%) (n=100)	Present Study (%) (n=100)
Hypertension	87.00	48.00	45.00
Diabetes mellitus	50.00	20.90	13.00
Smoking	35.22	--	28.00
History of stroke	39.30	12.50	8.00
Hyperlipidemia	22.95	--	8.00

Comparison of Clinical Features in Patients with Stroke

Clinical features	Mohr <i>et al.</i> ^[19] (%)	Foulkes <i>et al.</i> ^[20] (%)	Present study (%)
Headache	36.00	41.00	38.00
Vomiting	44.00	49.00	38.00
Convulsions	7.00	9.00	10.00

Comparison of Type of Strokes

Type of Strokes	Present Study	Daniele <i>et al.</i> ^[21] (2002)	Roy <i>et al.</i> ^[22] (1995)	Mikolich <i>et al.</i> ^[23] (1981)
Ischemic	68.00	78.28	71.00	93.33
Hemorrhage	32.00	21.80	29.00	6.66

Increased QTc was seen in 32% of cases in Goldstein *et al.*, while in our study it is 41%. T-wave inversion was seen in 15% by Goldstein *et al.* while in our study it is 30%. ST- segment depression was seen in 13% in Goldstein while in the present study it was 20%. U-wave was seen in 28% in Goldstein *et al.*, while in our study it was seen in 53%. Tachycardia was seen in 2% in Goldstein *et al.* while in our study it was 40%. Atrial fibrillation was seen in 7.4% of cases which is seen in only 2% in Goldstein *et al.*

Comparison of Echocardiography Findings in Ischemic Stroke:

Echo Findings	Gagliardi <i>et al.</i> ^[24] (%)	Uma <i>et al.</i> ^[25] (%)	Present study (%)
LV dysfunction	22.00	26.00	23.53
LV hypertrophy	15.00	12.00	20.59
LA thrombus	--	--	4.41
Mitral valve abnormality	--	30.00	14.00
Aortic valve abnormality	18.50	20.00	3.00

CONCLUSION

ST segment depression, QTc prolongation and U are the common ECG abnormalities in hemorrhagic strokes. QTc prolongation and U-waves are the common ECG abnormality in ischemic stroke. LV dysfunction is the most common echocardiographic abnormality in stroke patients. ECG abnormalities in stroke patients do not have any prognostic significance. LV dysfunction has prognostic significance in predicting mortality in CVA.

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