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Study of association of ECG changes to the site of bleed (sob) in nontraumatic spontaneous intracerebral hemorrhage (ICH) patients

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Abstract

Background: The annual incidence of intra cerebral hemorrhage (ICH) is 25 cases per 1, 00,000/year. Although ECG abnormalities are well known in ischemic stroke and subarachnoid hemorrhage these change have been rarely been investigated systematically in patients with ICH. Present study was aimed to study any association between ECG changes to the Site of Bleed (SOB) in non-traumatic spontaneous intracerebral hemorrhage (ICH).
Material and Methods: Present study was a prospective, observational study, conducted in patients confirmed of ICH on CT scan. Each case was examined in detail with history, clinical features, ECG readings & CT scan findings.
Results: In present study, male to female ratio was 1.7:1. Maximum number of patients were from > 60 years age (52%). The various CT scan findings noted in the study were < 50 cc volume of hematoma (52%), presence of mass effect (40%) & presence of intra ventricular communication (38%). The most common site of bleeding was putamen (40%) followed by thalamus (30%), lobar (14%), brainstem (10%) & cerebellum (6%). The most common ECG findings in our study were Left Ventricular hypertrophy (56%) followed by prolonged QTc (54%), T wave inversion (56%), Left axis deviation (46%), Tachycardia (36%), ST-T changes (28%), Q waves (22%), Tall T wave (8%), VPC (8%) and RBBB changes (8%). In present study, there was statistically significant association was noted between LAD, IVC and LVH with ECG changes ($p<0.05$).
Conclusion: Significant association could not be established between specific site of bleed and ECG changes even though the proportions ECG changes to Site of bleed was significant.

Keywords: Intracerebral bleed, ECG abnormalities, QTc prolongation

Introduction

The annual incidence of intra cerebral hemorrhage (ICH) is 25 cases per 1, 00,000/year [1]. About 35%-45% patients with ICH die within first month [2]. The 12 lead ECG in patients with acute intracranial hemorrhage can demonstrate several findings associated with ICH and increased intracranial pressure, including deep inverted cerebral T waves, prolonged QT

interval, Osborn J waves and U waves [3, 4].
There are also studies that support the hypothesis of cardiac cortical rhythm control site probably lying within middle cerebral artery territory or in the anterior cingulate cortex, leading to ECG changes in patients of ICH [5, 6]. Vascular damage to this area could be followed by cardiac arrhythmias related to a disinhibition of right insular cortex with resulting increased sympathetic tone. Tachycardia and Pressor response are common to stimulation of right insular cortex and left vagus while bradycardia seems to be more common after stimulation of left insular cortex or right vagus nerve [7, 8, 9].
Although ECG abnormalities are well known in ischemic stroke and subarachnoid hemorrhage these change have been rarely been investigated systematically in patients with ICH. Present study was aimed to study any association between ECG changes to the Site of Bleed (SOB) in non-traumatic spontaneous intracerebral hemorrhage (ICH) patients which will be helpful to prevent further life threatening complications.

Material and Methods

Present study was a prospective, observational study, conducted in Department of Medicine, Vilasrao Deshmukh Government Medical College, Latur, India. Study was conducted 21 June 2021 to 31 March 2022. Study was approved by institutional ethical committee.

Inclusion criteria

- Patients confirmed of ICH on CT scan.

Exclusion criteria

- Patients with previous history of ischemic stroke, primary or secondary brain tumours, cortical vein thrombosis or on anticoagulation therapy.

Each case was examined in detail with history, clinical features, ECG readings & CT scan findings. ECG was obtained within 2 days after the initial hemorrhage, ECG was analyzed by one blinded observer for various characteristics such as rhythm, frequency, electrical axis, PQ interval, pathological Q waves, QRS width, ST elevation, ST depression, QT interval, negative T waves, and prominent U waves. Additionally, first-, second-, and third degree AV conduction blocks were recorded. Finally, presence of electrocardiographic signs of left ventricular hypertrophy (LVH) was recorded. On admission, cranial CT scans were done to note the absence/presence of intraventricular blood, subarachnoid blood, hydrocephalus, and ICH volume, midline shift were scored.
Data was collected in a predesigned proforma and later tabulated in a Microsoft excel sheet. Data was analyzed using SPSS software version 20, IBM Corporation. Comparison between ECG changes and SOB was done by Chi square test and Fisher exact test. The Chi Square test for goodness of fit used to test proportion of site of bleed (SOB). P value < 0.05 will be considered as statistically significant.

Results

In present study, 50 patients were studied. There were 32 male and 18 female. The male to female ratio was 1.7:1. Maximum number of patients were from > 60 years age (52%). The commonest clinical feature was weakness of one side (78%), followed by headache starting just before or soon after ictus (60%), vomiting (56%), loss of consciousness (50%) & cranial nerve symptoms (40%). Various risk factors noted in present study were smoking (78%),

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alcoholism (60%), preexisting hypertension (68%), diabetes mellitus (36%), and dyslipidemia (10%).

Table 1: General characteristics

Characteristics	No. of patients	Percentage
Age		
21 – 40	5	10.00%
41 – 60	19	38.00%
61 – 80	26	52.00%
Gender		
Male	32	64.00%
Female	18	36.00%
Clinical features		
Weakness on one side	39	78%
Headache	30	60%
Vomiting	28	56%
Loss of consciousness	25	50%
UMN facial palsy	20	40%
Meningeal signs	18	36%
Convulsions	10	20%
Gaze deviation	10	20%
Frozen eye balls	8	16%
Bladder incontinence	8	16%
Risk factors		
Smoking	39	78
Alcohol	30	60
Hypertension	34	68
Diabetes	18	36
Dyslipidemia	05	10

The various CT scan findings noted in the study were < 50 cc volume of hematoma (52%), presence of mass effect (40%) & presence of intra ventricular communication (38%).

Table 2: CT scan findings

CT scan parameters	No. of patients	Percentage
Volume of hematoma <50cc	26	52%
Presence of mass effect	20	40%
Presence of I.V communication	19	38%
Volume of hematoma 50-100cc	18	36%
Volume of hematoma >100cc	6	12%

The most common site of bleeding was putamen (40%) followed by thalamus (30%), lobar (14%), brainstem (10%) & cerebellum (6%).

Table 3: Site of bleed (SOB) on CT-scan

Site of bleed (SOB)	No. of Cases	Present study (%)	P value
Putamen	20	40	0.003
Thalamus	15	30	
Brainstem	5	10	
Lobar	7	14	
Cerebellum	3	6	

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The most common ECG findings in our study were Left Ventricular hypertrophy (56%) followed by prolonged QTc (54%), T wave inversion (56%), Left axis deviation (46%), Tachycardia (36%), ST-T changes (28%), Q waves (22%), Tall T wave (8%), VPC (8%) and RBBB changes (8%). In present study, there was statistically significant association was noted between LAD, IVC and LVH with ECG changes ($p<0.05$).

Table 4: Association of ECG changes and site of bleed

ECG changes	Putamen	Thalamus	Brainstem	Lobar	cerebellum	Total	$\chi 2$ value	P value
LVH	8	10	1	7	2	28	11.03	0.026*
prolong QTc	11	10	2	4	0	27	21.16	0.609
T wave inversion	10	7	1	5	0	23	32.16	0.958
Left axis deviation	7	6	2	4	1	20	29.96	0.018*
Tachycardia	9	6	1	1	1	18	0.84	0.932
ST-T changes	5	4	2	4	1	14	37.14	0.169
Q waves	4	3	2	2	0	11	8.74	0.776
Tall T wave	0	1	2	0	1	4	21.62	0.609
RBBB	1	1	0	0	0	2	32.42	0.982
VPC	1	1	0	0	0	2	29.96	0.016*

P value* < 0.05 is considered as statistically significant.

Discussion

Onset of cerebral hemorrhage is usually sudden. According to National Survey of stroke, 72% of all ICH presented with coma and over 8% stuporous. Among non-stuporous 60% hemiplegic, 43% speech deficit, 13% with pupillary asymmetry and 16% with convulsions [2]. In Harvard co-operative stroke registry, 60% of ICH had headache before/during/after onset of neurologic deficit [6]. In present study comprised of 50 patients with spontaneous intra cerebral hemorrhage, we studied various ECG changes and its association to site of bleed on CT scan was analysed.

In present study, spontaneous ICH was more in males & ratio between male to female was 1.7:1. Similar findings were noted in studies by Van Bree *et al.*, [8] (1.06:1), Walter Oleschko [10] (2.2:1) & Gambhir LS *et al.*, [11] (2.1:1). Thus showing male predominance more often to ICH owing to increasing age chronic smoking and chronic alcoholism.

Common clinical features noted in present study were weakness on one side of the body (78%), headache (60%), vomiting (56%) and loss of consciousness (50%). Debarata Goswami *et al.*, [12] noted clinical features such as were weakness on one side of the body (84%), headache (49%), vomiting (48%) and loss of consciousness (58.8%) while Omkar P *et al.*, [13] had were weakness on one side of the body (76%), headache (23%), vomiting (29%) and loss of consciousness (53%).

The various risk factors for ICH were Smoking (78%), Hypertension (68%), Alcohol (60%) and diabetes mellitus (36%). Similar findings were noted by Debarata Goswami *et al.*, [12] as hypertension (86.66%), DM (14%), Study done by A.K Srivastava., [14] had hypertension (87.5%), DM (67%), Alcohol (71%) and smoking (82%).

Circulating blood normally cannot be seen on the scan as its absorption coefficient equals that of brain tissue. Attenuation of normal brain is 30-38 H.U. (Hounsfield Unit) whereas attenuation of whole blood hematocrit (45%) is 53-56 H.U; a value significantly higher. Hence fresh blood in the parenchyma, subarachnoid cisterns and the ventricle can easily be recognized & CT scan is preferred modality for diagnosis of ICH.

In present study, common sites of intra-cranial bleed were putamen (40%), thalamus (30%), lobar (14%), brainstem (10%) and cerebellar (6%). The observed proportion of site of bleed distribution was statistically significant (P=0.003, x2=20.80), thus the observed proportion in our data differ significantly statistically. Similar findings were noted by Mattis A *et al.*, [15]

deep bleed (44.9%), lobar bleed (40.9%), cerebellum (8.2%), brainstem (5.1%) were common findings. Study done by Debarata Goswami., [12] noted that putamen (51.11%), thalamus (27.77%), lobar (16.6%), cerebellum (2.22%), brainstem (2.22%) were common sites of bleed. The study by Gambhir LS *et al.*, [12] putamen (18%), thalamus (9%), lobar (36%) & cerebella (16%) were common sites of ICH.

In present study, various CT scan findings were volume of hematoma <50cc (52% patients), 50-100 cc (36% patients), >100cc (12% patients), Intra ventricular communication 38% & presence of mass effect (40%). Debarata Goswami *et al.*, [12] noted similar findings. Mattis A *et al.*, [15] noted volume of hematoma <30 cc (65.9%), 30-60 cc (14.8%), > 60ml (18.1%), intra ventricular communication (41.2%). Study by Van Bree *et al.*, [8] also noted similar findings as deep bleed (64%), lobar bleed (36%), cerebellum (6%), brainstem (3%), IVC communication (26%), mass effect in (45%).

E.C.G. often suggests cardiac hypertrophy secondary to long standing hypertension and provide a clue to the etiology of I.C.H. Definitive diagnosis is by C-T Scan. Changes in the ECG in ST segment, T waves QT interval, abnormal U wave's arrhythmias and bundle branch blocks have been described as arising due to intracerebral haemorrhage without any primary cardiac abnormality.

The various ECG changes in our study were: prolong QTc (proportion 54%, chi x^2 value=21.16. P value=0.609), LVH (proportion 60%,chi x^2 value=11.03,p=0.026),T inversion (proportion 46%,chi x^2 value=32.16, p=0.958), LAD (proportion 40%, chi x^2 value=29.96, p=0.018), Tachycardia (proportion 36%, chi x^2value=0.84, p=0.932), ST-T changes (proportion 32%,chi x^2 value=37.14, p=0.169),Q wave (proportion 22%, chi x^2 value=8.74, p=0.776), Tall T wave(8%), RBBB(4%) and VPC(4%). In this statistic analysis there is no association between Tachycardia, prolong QTc, T wave inversion, ST-T changes and Q wave to site of bleed. P value <0.05 for LAD, IVC, LVH while there was statistically significant association noted between LAD, IVC and LVH with ECG changes. However the statistical significance for LAD, LVH is mostly due much of patients were having history of hypertension or undiagnosed until the cerebral insult .Still it should be kept in mind ECH changes simulating myocardial ischemia may occasionally occur in patients with ICH.

Van Bree *et al.*, [8] had prolonged QTc (36%), LVH (16%), T inversion (16%), Tachycardia (13%), ST-T changes (26%) & Q wave (13%). Study by Walter Oleschko *et al.*, [10] had prolong QTc (67.2%), T inversion (35%), ST-T changes (35%), Q wave (10%). Study by Abdullah Md. Hassan *et al.*, [16] QTc prolonged (81%), ST-T changes (18%), LAD (20%), Tachycardia (25%). Study by David S. Goldstein *et al.*, [17] noted common ECG findings as Prolonged QTc (52%), T wave inversion (44%), Tachycardia (44%), Q waves (21%), LVH (44%), ST-T changes (26%), PVC (6%), RBBB (6%).

Most of the changes are seen best in the anterolateral and inferolateral leads. If the ECG is read by an individual who is not aware the clinical history it is often said, to represent subendocardial infarction or anterolateral ischemia. The ECG abnormalities improve often dramatically with brain death. Experimentally ECG changes have been produced both by both vagal stimulation and suppression Prolonged stimulation of the vagus has been shown to produce T wave inversion.

Conclusion

In patients with nontraumatic intraparenchymal bleed, the Proportion ECG abnormalities that are Common especially QTc prolongation, LVH, T wave inversion, left axis deviation, tachycardia, ST-T changes which are mostly due to extension of bleed from or to insular cortex. Significant association could not be established between specific site of bleed and ECG changes even though the proportions ECG changes to Site of bleed was significant.

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