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Neuro-Radiological Profile of Intracerebral Hemorrhage

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ABSTRACT

Introduction: Neuroimaging methods (Computed Tomography CT, Magnetic Resonance Imaging MRI) are the diagnostic arsenals of Intracerebral hemorrhage (ICH). The objectives of this study were to evaluate the topographical distribution, neuro-radiological profile and outcome of Intracerebralhemorhage and to identify and analyzeneuro-radiological predictors of mortality

Methods: It was a retrospective, observational, hospital-based study conducted among 211 patients aged more than 12 years and diagnosed with Intracerebralhemorrhage (based on CT scan).

Results: Topographical distribution: BG(32.70%), Thalamus (29.38%) were the two most common primary site of origin in ICH.Oedema,Intraventricular extension, Midline shift were observed with frequency of 63.03%, 51.66%,34.12% respectively. In-hospital mortality was 41.23% with peak within 48 hours. Maximum mortality were reported in ICH having large hemorrhage on admission (Width > 5 cm, volume > 60 ml), multiple topographical involvement and Brainstem hemorrhage.

Conclusion: CT findings as In-hospital mortality predictors of ICH were Width of hemorrhage >5 cm, volume of haemorrhage (>60 ml), midline shift, infratentorial location, intraventricular extension and multiple site hemorrhage.

Keywords: Intracerebral hemorrhage (ICH), Computed Tomography (CT), Magnetic Resonance Imaging (MRI), BasalGanglia (BG)

INTRODUCTION

Intracerebralhemorrhage(ICH) is defined as acute spontaneous bleeding into the brain parenchyma.[1]ICH consists of three distinct phases :1.Initial hemorrhage, 2.hematoma expansion and 3.perihematoma oedema.[2]Vomiting,elevated blood pressure (>220 mm Hg),severe headache,coma or decreased level of consciousness and progression of neurologic deficit over minutes or hours are suggestive of ICH,although none of these features are specific and therefore,neuroimaging evaluation is mandatory.[3]Computed Tomography(CT) has excellent sensitivity for ICH and is the mainstay of diagnosis.[4]CT readily demonstrates the size and location of the hematoma, any extension into the ventricular system, the degree of surrounding edema and tissue displacement such as midline shift,due to mass effect.[1]Approximately ½ of all ICH-related mortality occurs within 1st24 hour after intial hemorrhage[5] and approaches 50% at 30 day.[2,6]The present researchis conducted to study topographical distribution and neuro-radiological profile of intracerebralhemorrhage for identification and analysis of neuro-radiological predictors of mortalitywhich are essential for planning the level of care (specific evidence-based medical and/or neurosurgical therapy) and avoiding acute rapid progression of dynamic process during initial hours of ICH with ultimate aim to improve outcome of ICH.

MATERIAL AND METHODS:

The study was conducted on 211 patients admitted in PDUMC and Civil hospital, Rajkot, Gujarat, India from January 2014 to December 2016.The patients were selected as per protocol based on inclusion and exclusion criteria.

Inclusion Criteria: All patients, above 12 years of age, with CT diagnosedIntracerebralhemorrhage were included in the study.

Exclusion Criteria: 1 Patients with age <12 years, 2 Patient with associated epidural hematoma, subdural hematoma on CT scan were excluded.

This was a retrospective analysis of charts of patients admitted to a tertiary care hospital, from January 2014 to December 2016. Cases were selected from hospital records based on inclusion and exclusion criteria. Data of the selected patients was collected from the medical records. Neuroradio-imaging variables at presentation (site, volume of hemorrhage, maximum width, intraventricular extension, midline shift), hospitalization duration and outcome were analysed. The midline shift was determined by the distance between midline and septum pellucidum according to the CT scanning. P value <0.05 was taken as a point of minimal statistical significance.

The volume of haemorrhage was calculated by using the bedside formula of Kothari et al.[7] Hemorrhage volume (in ml) = A*B*C/2, where A = greatest hemorrhage diameter (in mm on CT), B = diameter 90 degree to A(in mm on CT), and C = approximate number of CT sections with hemorrhage * section thickness.[7,8]

RESULT

From 1st January 2014 to 31st December 2016, 211 patients were included in the study.

Topographical distribution of Intracerebralhemorrhage according to primary site of origin in descending order were Basal Ganglia (32.70%), Thalamus (29.38%), Brainstem (midbrain/ pons/ medulla) (7.58%), cerebellum (9.01%), Lobar (16.59%) and multiple sites (4.74%) with corresponding mortality of 28.98%, 27.42%, 93.75%, 42.11%, 54.29%, 80% respectively.(refer Table - 1).

Volume of Hemorrhage as determined by formula of a*b*c/2[7,8] were tabulated and analyzed.(Refer Table–2, 4) Maximum width of hemorrhage determined by CTwere tabulated and analyzed.(Refer Table–3, 4). CT imaging was suggestive of oedema, Intraventricular extension and Midline shift in 133, 109, 72 cases with associated mortality of 46.62 %, 49.54%, 68.05 % respectively.

Mortality: In present study, 87(41.23%) patients were expired with frequency in numbers(%) of 14 (16.09%), 26 (29.89%), 12 (13.79%), 10 (11.49%), 8 (9.2%), 5 (5.75%), 4 (4.6%), 4 (4.6%), 2 (2.29%), 1 (1.15%), 1 (1.15%) from day 1 to 11 of hospitalization respectively. (Refer Graph - 1).

Table – 1: Topographical distribution of ICH and its relation with outcome (n=211)

Site of ICH	Patients (%)	Expired	Mortality (%)
Basal Ganglia(BG)	69 (32.7)	20	28.98
Thalamus	62 (29.38)	17	27.42
Brainstem *	16 (7.58)	15	93.75
Cerebellum	19 (9.01)	8	42.11
Lobar	35 (16.59)	19	54.29
Multiple sites	10 (4.74)	8	80.00
Total	211 (100)	87	41.23

*midbrain/pons/medulla

Table – 2: Relation of volume of intracerebral haemorrhage with outcome

Variables	Patients (n=211) (%)	Mortality (%)
Volume of hemorrhage* (in ml)		
< 15	82(38.86)	14 (17.07)
15-30	43(20.38)	12 (27.91)
31-45	22(10.43)	9 (40.90)
46-60	16(7.58)	8 (50)
61-75	12(5.69)	10 (83.33)
76-90	11(5.21)	11 (100)
>90	15(7.11)	15 (100)
Multiple***	10(4.74)	8 (80)
Total	211(100)	87(41.23)
Group**		
Group A (≤60 ml)	163 (81.09)	43 (54.43)
Group B (>60 ml)	38 (18.91)	36 (45.57)
Total	201(100)	79(100)

*** Multiple site 10(8%) is excluded for statistical analysis for correlation of volume of hemorrhage with outcome.*Volume of hemorrhage ≤60,>60 ml were **labeled as group A and B (after excluding multiple site) for statistical analysis. Chi-square value 60.36,p value <0.0001,Degree of freedom (Df) 1 indicates significant difference between A and B groups suggestive of very strong association of volume of hemorrhage and patient outcome.

Table – 3: Relation of width of ICH with outcome (n=211)

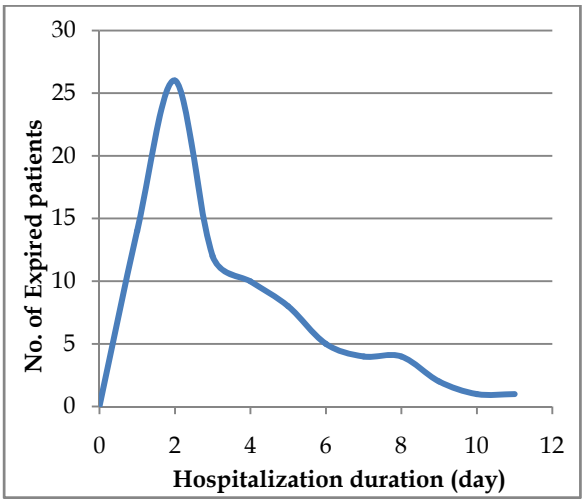
Variables	Patient (%)	Mortality (%)
Max width (in cm)		
<3	57 (27.01)	10 (17.54)
3-4	48 (22.75)	12 (25.00)
4-5	35 (16.59)	11 (31.43)
5-6	26 (12.32)	15 (57.69)
6-7	19 (9.01)	15 (78.95)
>7	16 (7.58)	16 (100)
Multiple*	10 (4.74)	8 (80)
Total	211 (100)	87 (100)
Group**		
Group C (≤5 cm)	140 (69.65)	33 (41.77)
Group D (>5 cm)	61 (30.35)	46 (58.23)
Total	201 (100)	79 (100)

*Multiple site 10(8) is excluded for statistical analysis for correlation of width of size of hematoma with outcome.**Width of hemorrhage ≤5 and >5 cm were labeled as group C and D (after excluding multiple site) for statistical analysis. Chi-square value 47.86, p value <0.0001, Degree of freedom (Df) = 1 suggestive of significant statistical difference between group C and D indicates strong association of width of hemorrhage and patient outcome.

Table – 4: Predictive value of mortality determinants in Intracerebral hemorrhage

Determinant	Survival	Died	Odd's ratio	95% CI*	P value
Width>5 cm	15	46	9.9434	4.9310-20.0513	P<0.0001 Z = 5.667
Volume of Hemorrhage>60 ml	2	36	50.2326	11.5972-217.5794	P<0.0001 Z = 5.237
IV extension**	55	54	2.0529	1.1732-3.5923	P=0.0118 Z = 2.519
Infratentorial location	12	23	3.7649	1.7457-8.1196	P=0.0007 Z=3.381
Mutliple site	2	8	6.1772	1.2785-29.8452	P=0.0235 Z = 2.266
Midline shift	23	49	7.0304	3.6993-13.3610	P<0.0001 Z = 5.953

*CI=Confidence Interval, **IV extension= Intraventricular extension



Graph – 1: Correlation of mortality with hospitalization duration in ICH

DISCUSSION

During the period of 1st January 2014 to 31st December 2016, 211 patients admitted to PDUMC and civil hospital, Rajkot were included in this study.

Topographical distribution of Intracerebral haemorrhage according to primary site of origin were Basal Ganglia(32.70%), Thalamus(29.38%), Brainstem (midbrain/pons/medulla) (7.58%), cerebellum (9.01%), Lobar (16.59%) and multiple sites (4.74%). (Refer TABLE – 1).This finding was consistent with Sunil K Narayan et al[9],Doctor et al[10],namani et al[11]. Mortality was highest in Brainstem bleed 93.75% followed by Multiple site bleed 80%,lobar 54.29%, cerebellum 42.11%,BG 28.98% and thalamus 27.42 in similarity to RathodS et al[12], Yun-Zhen Hu et al[13],Smajlovic et al[14].

Volume of Hemorrhage was determined by formula of a*b*c/2[7,8] and tabulated with its relation to outcome.(reference TABLE - 2). In present study, volume of hemorrhage>60 ml, multiple site hemorrhage with frequency of occurrence of38(18.01 %), 10(4.74 %) were having maximum corresponding mortality 94.74%, 80% respectively.This finding was consistent with Namani et al[11], Rinconmayer et al[15].Volume of hemorrhage ≤60 and >60 ml were labelled as group A and B (after excluding multiple site) for statistical analysis. (Refer TABLE – 2) Chi-square value 60.36, p value <0.0001, Degree of freedom (Df) 1 indicates significant difference between A and B groups suggestive of very strong association of volume of hemorrhage and patient outcome.Volumeof hemorrhage>60 ml carries poor prognosis independentlyin present study in accordance to other studies.[9,11]

Maximum width as determined by CT was tabulated in relation to outcome. (Refer TABLE- 3) Width of hemorrhage ≤5 and >5 cm were labelled as group C and D (after excluding multiple site) for statistical analysis.Chi-square value 47.86, p value <0.0001, degree of freedom (Df) = 1 suggestive of significant statistical difference between group C and D indicates strong association of width of hemorrhage and patient outcome.Width >5 cm carries poor prognosis consistent with other literature[4]. Dogmatically,Large Hemorrhagesize is an important determinant of mortality after ICH and is strongly associated with poor outcome(increased mortality rate) in present study. This finding was consistent with the literature[5].In present study, Very large volumes greater than 60 ml were strongly associated with high mortality(94.74%), while small volumes of hemorrhage with high mortality(93.75%) was seen only in brainstem hemorrhages. Size and location of hemorrhage were significantly correlated to outcome of hemorrhage.[4,16,17,19]

CT imaging was suggestive of oedema, Intraventricular extension and Midline shift in 133, 109, 72 cases with associated mortality of 46.62 %,49.54%,68.05% respectively.Presence of Midline shift on initial CT had poor prognosis in similarity to Daverat P et al[17], Rathor MY et al[18]. ICH withIntraventricularextension (51.66%) was associated with significant corresponding mortality (49.54%) in present study whichwas in accordance to Daniel godoy et al[19], J. Claudhemphil et al[20].

Mortality was observed in 87(41.23%) patients of ICH with characteristic peak within 48 hour(reference Graph - 1) because of hematoma expansion and perihematoma oedema which was in accordance to Broderick JP et al[2], Brott T et al[5] and Fogelholm R et al[6].

In - hospital mortality determinants of Intracerebral Hemorrhage (Table - 4): Univariate logistic

regression of in-hospital mortality after ICH was performed in the neuro-radiological variables on initial CT (hemorrhagevolume, maximum width of hemorrhage, intraventricular extension, midline shift, site of hemorrhage) and outcome. Statistically significant In-hospital mortality determinants of ICH on admission were: >60 ml volume of hemorrhage (p<0.0001),>5 cm width of hemorrhage (p<0.0001), midline shift (p<0.0001), intraventricular extension (p=0.0118), infratentorial location (p=0.0007)and multiple topographical involvement(0.0235). (Refer Table – 4)In present study, site of hemorrhage (Infratentorial location, multiple topographical involvement), largesize (width of hemorrhage >5cm, volume of hemorrhage>60 ml), intraventricularextension and midline shift wereindependent, significant in-hospital mortality predictors of ICH and this was consistent with the literature [1,4,16,17,20]

LIMITATION

Limited resources, small-sized study population, retrospective, single centre hospital-based study does not aim to provide accurate predictors of mortality. Prospective, multicentric, larger, well-designed studies with longer period of follow up will be necessary to draw more robust conclusions on correlation of various neuro-radiological parameters affecting ICH with outcome the population.

CONCLUSION

From this study we conclude that the size and location of ICH were significantly correlated to outcome of ICH. CT findings as neuro-raiological predictors of in-hospital mortality of ICH were: Width of hemorrhage>5 cm, calculated volume of hemorrhage>60 ml, midline shift, Intraventricular extension, infratentorial location and multiple site hemorrhage. CT has immense prognostic value in ICH apart from proven role as diagnostic arsenal.

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