Univariable and Group-wise Multivariable Analysis of Risk Factors for Intracerebral Hemorrhage

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Abstract: The present study involved a prospective analysis of the retrospective clinical information of patients with Intra-cerebral Hemorrhage. The data was collected using the International classification of diseases, Ninth revision diagnostic codes (431 for ICH). The diagnosis was confirmed by neuro-imaging in all patients.

The authors investigated the effects of covariates upon the outcome of ICH by performing univariable and group-wise multivariable analysis using chi-square and logistic regression.

The univariable analysis revealed that 50% of the covariates reached an acceptable significant level of $p < 0.05$. The group-wise multivariable analysis showed the improvement among ICH patients using antihypertensive medicine was 1.3 (ARR=1.3, 95% C.I. 1.1–1.4, p=0.0001) as compared to those who were not using antihypertensive medicine. However, at the time of discharge using antihypertensive medicine was 2.9 (ARR=2.9, 95% C.I. 2.7–3.1, p=0.0001) as compared to those who did not use antihypertensive medicine when adjusted with other variables of the group. Thus the increase in relative risk from 1.3 to 2.9 times concluded that the use of antihypertensive medication reduces the risk of occurrence of ICH due to hypertension.

Statistical inference demonstrates a direct proportion between the lowest SBP and ICH. The improvement among patients who belong to hypertensive lowest SBP group (141–160 mm Hg) was 1.02 times ($p < 0.0001$), for the range of (161–200) was 0.6 times ($p < 0.0001$) and for the range of (>200) was 0.5 times ($p < 0.0001$) as compared to the normal range (90 – 140), indicates that the circulatory strain levels are contrarily related.

In neurological symptomatology, headache, weakness, faintness, numbness, dizziness and unable to walk are significantly associated with ICH outcome variable in multivariable analysis. The location of the cerebellum was significantly associated with ICH. Mass effect on midline shift (p=0.0001), hydrocephalus (p=0.01) and normal (p=0.0001) were negatively associated with ICH when adjusted other variables.

Univariable and group-wise multivariable both analyses produce different outcomes. Thusly the utilization of proper schemes leads to inferences from the contemplated information.

Keywords: Intracerebral hemorrhage, Clinical factors, Group-wise multivariable analysis, Chi-square, Logistic regression.

INTRODUCTION

Spontaneous Intracerebral Hemorrhage (ICH) is a serious disease despite progressing medical knowledge, which often leads to severe disability and death [16]. ICH usually caused by the rupture of small penetrating arteries secondary to hypertensive changes or other vascular abnormalities [9, 12, 23]. Any patient with an altered level of consciousness or coma may be suspected of ICH. It is noted that people aged more than 55 years to be at maximum risk.

ICH is a major issue in third world countries and also in the USA and UK. Regrettably, it is estimated that the mortality of ICH is expected to become double by the year 2050 [9, 17, 21]. The Global Burden of Disease showed 47% increase in the absolute number of hemorrhagic strokes worldwide between 1990 and 2010. In developed countries, the incidence of ICH has decreased with the improvement of blood pressure control. However, in developing countries, ICH has not decreased. The overall incidence of spontaneous ICH worldwide is 24.6 per 100,000 people with approximately 40,000 to 67,000 cases per year in the United States [12, 20, 23]. The 30-day mortality rate ranges from 35% to 52% with only 20% of survivors expected to have full functional recovery at 6 months. Approximately half of this mortality occurs within the first 24 hours [20, 21, 23].

The purpose of this study is to evaluate, compare and correlate the clinical, neuro-radiological and study test variables to predict the outcome and functional recovery potential of patients suffering from Intracerebral Hemorrhage. During the literature search, it was noted that many crucial risk factors such as age,

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smoking, hypertension, diabetes mellitus, coagulopathy, cholesterol level, level of blood pressure, etc., were involved in the development of ICH [9, 12, 21].

A systematic statistical analysis is required to discover genuine clinical factors that influence the clinical result of ICH. In the past, different methods were used to analyze this type of data that include logistics, probit and log-linear methodologies. In the present data, the categorical binary response variable treated differently than the usual continuous response variables by using the logistic regression method.

PATIENTS AND METHODS

Patients

Retrospective data of clinical, neuroradiological and study test variables of ICH patients including both sex were collected from one of the largest hospitals situated in Karachi. The information of variables was collected and identified through all admitted patients of ICH using the International classification of diseases, ninth revision coding system. Diagnostic codes (434 for stroke and 431 for ICH). The diagnosis of ICH was confirmed by CT/ MRI in all patients.

Methods

Statistical Methods

Initially, the univariable analysis was performed to investigate any association between a covariate and response variable of ICH using Chi-square and logistic regression. After univariable analysis, group-wise multivariable analysis was performed to search association between the response variable and the variables of the group using logistic regression, and estimate the S.E., p-value & adjusted relative risk. The SPSS software (ver. 20) was used to perform all the statistical analyses.

ANALYSIS AND RESULT

In univariable analysis chi-square, likelihood ratio test and logistic regression were used for significant variable and odd ratio.

The results of all significant covariates (p-value <0.05) with improved %, odd ratios (OR), 95% confidence interval and p-value are given in Table **1**.

After investigation of the association between single covariate and response variable, group-wise multivariable analysis was performed to look at any association between the response and the independent group of variables using multiple logistic regressions. The groups of variables are; Risk factors (HTN, recent stroke, coagulopathy, DM, hyperlipid., AVM, smoking, drug abuse, MI), Med.(ASA, dipyridamole, ticlopidine HCL, warfarin, antihypertensive, antilipidemics & none), First Symptoms(headache, weakness, faintness, numbness, dizziness, slurred speech, unable to walk, diplopia, dysphagia & seizure), Initial & lowest BP(nor., mild hypo., mild htn., mod. htn., sev. htn.), CN palsy (olfactory, optic, occulomotor, trochlear, trigeminal, abducent, facial, vestibule-cochlear, glosso pharyngeal, accessory & hypoglossal), Speech(nor., dysarthria, G. aphasia, wernicke aphasia & brocas), Motor(nor., Rt./Lt. monoparesis, Rt. / Lt. hemiparesis, Rt./Lt. hemiplegia & Para paresis), Locations(Rt./ Lt. basal ganglia, putamen, pons, thalamus, cerebellum, fron./pari./tempo. lobe & brainstem), Mass effect(mid. shift, intraventricular blood, hydrocephalus & nor.), Received(IVABX, NG, F. catheter, O_2 & IV Antihyper.), Discharge medicines(antihypertensive, ASA & antilipidemics).

The result of significant variables of each group with standard error, adjusted relative risk, 95% confidence interval, and p-value are given in Table **2**.

DISCUSSION

The present study involved a prospective analysis of the retrospective clinical information of subjects with intracerebral hemorrhage (ICH).

The significant covariates in univariable analysis were risk factors such as recent stroke and coagulopathy, medications like warfarin and antihypertensive, first symptom (headache, weakness, faintness, numbness, dizziness, slurred speech and unable to walk), initial blood pressure, mental status, CN palsy (trochlear, trigeminal, abducent and facial), speech, motor (normal, right monoparesis, left hemiparesis, right hemiplegia and left hemiplegia), sensory, locations (cerebellum and temporal lobe), mass effect (midline shift, intraventricular blood, hydrocephalus and normal), WBC, lowest BP, received (IVABX, NG, Foley catheter and oxygen), complications (pneumonia, MI and gastrointestinal bleed), length of stay, discharge medicines such as antihypertensive, ASA and antihyperlipidemic.

Univariable and group-wise multivariable analysis exhibited a non-significant relationship between ICH

Table 1: Result of Univariable Analysis, Showing Improved Percentage, Odd Ratio with 95% Confidence Interval & P-Value of Statistically Significant Variables

Variables of Interest	Improved %	OR(95% C.I.)	p-value
Risk Factors			
Recent Stroke			
Not present	56.5	1	
Present	72.7	2.0(1.1,3.8)	0.01
Coagulopathy			
Not present	58.4	1	
Present	29.7	0.3(.14,0.6)	0.001
Medication			
Warfarin			
No	57.7	1	
Yes	27.3	0.3(.07,1.04)	0.04
Antihypertensive			
No	49	1	
Yes	61.8	1.7(1.3,2.2)	0.0001
None			
No	61	1	
Yes	49.7	0.6(0.5,0.8)	0.001
First Symptom			
Headache			
No	55.3	1	
Yes	65.3	1.5(1.1,2.1)	0.009
Weakness			
No	52.5	1	
Yes	62.6	1.5(1.2,1.9)	0.001
Faintness			
No	61.6	1	
Yes	41.7	0.4(0.3,0.6)	0.0001
Numbness			
No	56.9	1	
Yes	80	3(1.0,9.1)	0.03
Dizziness			
No	55.7	1	
Yes	70.5	1.9(1.2,3.0)	0.002
Slurred Speech			
No	55.4	1	
Yes	64.5	1.5(1.0,2.0)	0.018
Unable to Walk			
No	56.6	1	
Yes	75	2.3(1.1,4.7)	0.018

(Table 1). Contd…..

Variables of Interest	Improved %	OR(95% C.I.)	p-value
Initial SBP			
90-140, Normal	60.7	1	0.006
<90, Mild hypo.	26.7	0.23(0.1,0.8)	
141-160,Mild htn	59.5	0.95(0.6,1.4)	
161-200,Mod.htn.	59.9	1.0(0.7,1.4)	
>200,Sev.htn.	47.6	0.6(0.4,0.9)	
Mental Status			
Normal	77.3	1	0.0001
Sleepy	67.4	0.6(0.4,0.9)	
Confused	67.9	0.6(0.4,1.1)	
Poorly Responsive	45.6	0.3(0.1,0.4)	
Unresponsive	37.3	0.2(0.1,0.3)	
Coma	14.7	0.1(0.03,0.1)	
CN Palsy			
Troch Lear			
No	57.7	1	
Yes	22.2	0.2(.04,1.0)	0.031
Trigeminal			
No	57.7	1	
Yes	27.3	0.3(.07,1.04)	0.042
Abducent			
No	57.9	1	
Yes	37	0.4(0.2,0.94)	0.031
Facial			
No	53.4	1	
Yes	61.7	1.4(1.09,1.8)	0.008
Speech			
Normal	55.1	1	0.0001
Dysarthria	74.2	2.3(1.6,3.4)	
Global Aphasia	37.8	0.5(0.3,0.8)	
Wernicke Aphasia	91.7	8.9(1.1,69.8)	
Brocas	55	1.0(0.6,1.7)	
Motor			
Normal			
Yes	49.8	1	0.009
No	59.6	1.5(1.1,2.0)	
Rt.monoparesis			
No	57	1	
Yes	90	6.8(0.8,53.7)	0.022
Lt.hemiparesis			
No	54.5	1	
Yes	64.2	1.5(1.1,1.9)	0.005

(Table 1). Contd…..

Variables of Interest	Improved %	OR(95% C.I.)	p-value
Rt.hemiplegia			
No	58.4	1	
Yes	47.4	0.64(0.4,0.97)	0.039
Lt.hemiplegia			
No	59.3	1	
Yes	45.7	0.6(0.4,0.8)	0.003
Sensory			
Normal	54.9	1	0.0001
Hemihypoasthesia	77.7	2.8(1.7,4.7)	
Neglect	72.2	2.1(0.8,6.0)	
Location			
Cerebellum			
No	56.3	1	
Yes	77.6	2.7(1.3,5.3)	0.002
Temporal Lobe			
No	58.2	1	
Yes	45.2	0.6(0.3,0.99)	0.046
Mass Effect			
Midline Shift			
No	64.8	1	
Yes	31.5	0.3(0.2,0.32)	0.0001
Intraventricular Blood			
No	63.5	1	
Yes	40.8	0.4(0.3,0.5)	0.0001
Hydrocephalus			
No	60.1	1	
Yes	32.3	0.3(0.2,0.5)	0.0001
Normal			
Yes	70.7	1	0.0001
No	39.4	0.3(0.2,0.4)	
White Blood Cells			
$4x10^3$-10^4 /cc, normal	65.4	1	0.0001
<$4x10^3$ /cc, leukopenia)	40	0.4(0.1,1.01)	
>10^4 /cc, leukocytosis)	52.4	0.6(0.4,0.8)	
Lowest SBP			
90-140, Normal	65.5	1	0.0001
<90, Mild hypo.	18.9	0.1(0.1,0.2)	
141-160,Mild htn	66.4	1.0(0.7,1.5)	
161-200,Mod.htn.	43.1	0.4(0.2,0.7)	
>200,Sev.htn.	36.4	0.3(0.1,1.0)	

(Table 1). Contd…..

Variables of Interest	Improved %	OR(95% C.I.)	p-value
Lowest DBP			
60-90, Normal	65.1	1	0.0001
<60, Hypo.	40.9	0.4(0.3,0.5)	
91-110,Mild htn	60.7	0.8(0.6,1.2)	
111-120,Mod.htn.	41.2	0.4(0.1,1.0)	
>120,Sev.htn.	14.3	0.1(0.01,0.7)	
Received			
IVABX			
No	61.3	1	
Yes	41.3	0.5(0.3,0.6)	0.0001
NG			
No	61.7	1	
Yes	45.7	0.5(0.4,0.7)	0.0001
Foley Catheter			
No	60.6	1	
Yes	49.1	0.6(0.5,0.8)	0.001
Oxygen			
No	62.3	1	
Yes	32.7	0.3(0.2,0.4)	0.0001
Complication			
Pneumonia			
Not present	72.5	1	
Present	31.2	0.2(0.1,0.3)	0.0001
Don't know	58.3	0.5(0.4,0.7)	
Myocardial Infarction			
Not present	62.2	1	
Present	33.3	0.3(.09,1.03)	0.033
Don't know	55.5	0.8(0.6,0.99)	
Gastro-Intestinal Bleed			
Not present	61.8	1	
Present	30	0.3(.07,1.04)	0.041
Don't know	55.6	0.8(0.6,1.02)	
Discharge Medicine			
Antihypertensive			
No	28.1	1	
Yes	80.7	10.6(7.9,14.3)	0.0001
ASA			
No	56	1	
Yes	83.3	3.9(1.8,8.5)	0.0001
Antilipidemics			
No	55.7	1	

Yes	79.7	3.1(1.7,5.7)	0.0001
Disposition			
Home	82.3		0.0001
Hospital	7.7	Const.	
Length of Stay (days)	**Mean (S.E.)**		
Not Improved	5.38(0.36)		
Improved	8.22(0.29)	1.1(1.04,1.09)	<0.0001

Table 2: Result of Group-wise Multiple Logistic Regressions, Showing Standard Error, Adjusted Relative Risk & p-Value of the Effect of Covariates on the Outcome Variable of ICH

Group	Independent Factors	S.E.	ARR (95% C.I.)	p-value
Risk Factors	Recent Stroke	0.314	1.3(1.1,1.5)	0.015
	Coagulopathy	0.368	0.5(0.3,0.8)	0.001
Medicine	Antihypertansive	0.135	1.3(1.1,1.4)	0.0001
First Symptoms	Headache	0.171	1.2(1.1,1.3)	0.005
	Weakness	0.139	1.2(1.1,1.3)	0.002
	Faintness	0.164	0.8(0.6,0.9)	0.001
	Numbness	0.574	1.4(1.0,1.6)	0.04
	Dizziness	0.225	1.3(1.1,1.4)	0.004
	Unable to Walk	0.377	1.3(1.0,1.5)	0.04
Lowest SBP	90-140(Normal)			
	<90(Mild hypo.)	0.264	0.3(0.2,0.4)	
	141-160(Mild htn)	0.20	1.02(0.9,1.2)	0.0001
	161-200(Mod.htn)	0.266	0.6(0.4,0.8)	
	>200(Sev.htn.)	0.633	0.5(0.2,1.0)	
Cranial	Trigeminal	0.687	0.5(0.2,1.0)	0.05
Nerve	Abducent	0.409	0.6(0.3,1.0)	0.02
Palsy	Facial	0.131	1.2(1.1,1.3)	0.005
Speech	Normal			
	Dysarthria	0.183	1.3(1.2,1.5)	
	Global Aphasia	0.212	0.7(0.5,0.9)	
	Wernick's Phasia	1.048	1.0(0.8,1.2)	
	Brocas	0.272	1.0(0.8,1.2)	0.0001
Motor	Normal	0.16	1.3(1.2,1.4)	0.0001
	Rt.hemiplegia	0.223	0.7(0.6,0.9)	0.005
	Lt.hemiplegia	0.19	0.7(0.6,0.9)	0.0001
Location	Cerebellum	0.349	1.4(1.1,1.5)	0.005
Mass Effect	Midline Shift	0.212	0.7(0.5,0.8)	0.0001
	Hydrocephalus	0.258	0.7(0.5,0.9)	0.01
	Normal	0.189	0.8(0.6,0.9)	0.0001
Received	Oxygen	0.181	0.5(0.4,0.7)	0.0001
Discharge Meds.	Antihypertensive	0.152	2.9(2.7,3.1)	0.0001

and hypertension as compared to non-hypertensive patients (p=0.207, RR=1.12, 95% C.I.: 0.95 –1.27). Many previous studies [1, 7, 12-14, 16, 23, 25, 29] showed a significant relationship between hypertension and ICH.

Univariable and group-wise multivariable analysis showed a positive significant relationship between ICH and antihypertensive medicine. The improvement among ICH patients using antihypertensive medicine was 1.3($p = 0.0001$, ARR=1.3, 95% C.I. 1.1 – 1.4) as compared to those who were not using antihypertensive medicine when adjusted with other variables of the group of medication.

Similarly, at the time of discharge, 56 % of subjects were using antihypertensive medicine. The improvement among ICH patients using antihypertensive medicine at the time of discharge was 2.9 ($p < 0.0001$, ARR=2.9, 95% C.I. 2.7 – 3.1) as compared to those who did not use antihypertensive medicine when adjusted with other variables of the group. Thus the change in adjusted relative risk from 1.3 to 2.9 times in antihypertensive medicine shows that the use of antihypertensive medicine and ICH outcome variable are positively associated.

Previous studies [26, 28] reported that the use of antihypertensive medicine decreases the risk of ICH due to hypertension. Thus it can be hypothesized that the use of antihypertensive medicine decreases the risk of occurrence of ICH due to hypertension.

The different range of blood pressure plays an important role in the improvement of subjects. There are four groups of a range of blood pressure in the present study. Two, at the time of admission after ICH, *i.e*., initial SBP and DBP and two, during the treatment in hospital, *i.e*., lowest SBP and DBP.

Before group-wise, initial SBP ($p = 0.006$), lowest SBP and DBP groups were significantly associated ($p <0.0001$) with ICH (Table **1**). In the group-wise analysis, a significant relationship found between the lowest SBP and ICH. The improvement among patients who belong to hypertensive lowest SBP group (141–160 mm Hg) was 1.02 times ($p < 0.0001$, ARR=1.02, 95% C.I. 0.9–1.2), for the range of (161–200 mm Hg) was 0.6 times ($p < 0.0001$, ARR=0.6 , 95% C.I. 0.4 – 0.8) and for the range of (>200 mm Hg) was 0.5 times ($p < 0.0001$, ARR=0.5 , 95% C.I. 0.2 – 1.0) as compared to the normal range (90 – 140 mm Hg) of BP when adjusted with other variables. Thus the change in adjusted relative risk of a hypertensive range of SBP also indicates that the blood pressure range and ICH outcome variable are negatively associated.

Results of current data analysis as reported in the multivariable case are in accordance with the results of many previous studies [12, 24, 28]. Statistical inference shows the direct proportion to high morbidity and mortality of hemorrhagic stroke with blood pressure level. Hence it would be prudent to enhance the awareness towards better control of hypertension.

The second highest frequency of risk factors was diabetes mellitus (24.3%). Most definitely; the results were interesting. Work done by researchers [3, 18, 22] showed that diabetes mellitus is not an independent risk factor for the development of ICH. A previous study [25] also showed that diabetes mellitus is not associated ($p > 0.05$) with ICH either in univariate and multivariate models. Another study [2] showed that diabetes mellitus increases the mortality rate in subjects with ICH. The univariable and multivariable analysis of the present data showed an insignificant relationship between ICH and DM.

The risk factor, recent stroke showed a significant relationship with ICH in univariable and group-wise multivariable analysis. The improvement among ICH patients with recent stroke was 1.3 times ($p = 0.015$, ARR=1.3, 95% C.I. 1.1 – 1.5) as compared to without recent stroke when adjusted other variables of the group. Another risk factor coagulopathy showed less improvement (0.5 times) with ICH, as compared to non-coagulopathic subjects ($p=0.001$, 95% C.I.: 0.3 – 0.8) when adjusted other variables.

In neurological symptomatology, the univariable analysis revealed that all symptoms were significant (Table **1**). Later, the group-wise analysis was performed to observe the significant symptoms, it was found that headache, weakness, faintness, numbness, dizziness and unable to walk were significant symptoms (Table **2**). In the study [2] of ICH, subjects showed that limb weakness, dizziness and altered consciousness were significant symptoms of ICH.

The analysis of current data showed that 70 % of subjects have non-normal mental status. The inference of whole data of univariable analysis revealed a clear decrease in mental status from sleepy (0.9 times) to coma (0.3 times) as compared to normal mental status and exhibits a significant ($p<0.001$) relationship between ICH and mental status.

The univariable and group-wise multivariable analysis revealed a clear improvement (1.2 times) in facial palsy affected patients as compared to those not affected due to facial palsy($p=0.005$, ARR=1.2, 95%

C.I.: 1.1–1.3) for the outcome variable. However, trigeminal and abducent palsy showed less improvement. Researchers [2,18] reported that cranial nerve palsy is a factor that can be associated with higher in-hospital mortality.

The speech (62%) and sensations (89%) were noted to be normal in studied data. In univariable and multivariable analysis both were found positively associated ($p<0.001$) with ICH outcome variable.

The univariable analysis revealed that normal motor, right monoparesis, left hemiparesis, right and left hemiplegia were significant (Table **1**) for the outcome variable. However group-wise multivariable analysis showed that normal moter, right and left hemiplegia were significant (Table **2**)

Univariable analysis indicated that the cerebellum and temporal lobe were significantly associated (Table **1**) and multivariable analysis revealed that only the cerebellum was significantly related to ICH when adjusted other variables.

Previous studies presented multiple study outcomes. One study [11] shows that there is no association ($p = 0.67$) between the location and ICH. Another study [22] suggested that lobar ICH is associated with reduced mortality compared with the outcome from hemorrhage in the basal ganglia or thalamus. However, one more study [15] reported an opposite association between lobar ICH and mortality as compared with the outcome for hemorrhage in the thalamus. According to the present study, the first two most frequent locations are basal ganglia and lobar ICH, but they were found insignificant.

Many other studies present a different conclusion about the location of the putamen. One previous study [8] shows 54 % of ICH patients died with the location of putamen hemorrhage; the same conclusion was reported by [27]. Other studies analyzed the comparison between putamen, pons, cerebellum, thalamus with lobar ICH but this difference was not statistically significant [4,15]. Hence it can be concluded that ICH has a strong relationship with putamen and cerebellum.

In the present study, 57.5 % of subjects have a normal mass effect. The inference of univariable analysis revealed that mass effect on midline shift, intraventricular blood, hydrocephalus and normal were significantly associated ($p=0.0001$) with the outcome variable. The multivariable group-wise analysis revealed that mass effect on midline shift ($p=0.0001$), hydrocephalus ($p=0.01$) and normal ($p=0.0001$) were negatively associated with ICH when adjusted other variables. The previous study[8] indicated that the mass effect midline shift is significantly associated ($p <0.001$) with an outcome variable of ICH. Another study [19] presented that the mass effect of hydrocephalus is significantly associated with ICH.

White blood cells with the disease of ICH showed that 59 % of patients belong to leukocytosis, 2% leukopenia and 39% belong to the normal group. The univariable analysis revealed that the improvement among ICH patients who belonged to leucopenia range was 0.6 time (95% C.I.: 0.3 –1.0) and the leukocytosis range was 0.8 times (95% C.I.: 0.7 – 0.9) as compared to the normal group and the relationship was found highly significant ($p< 0.0001$).

Statistical analysis found that during the admission in the hospital, 50 % of patients received intravenous antihypertensive, 28% foley catheter, 27 % NG, 20 % IVABX and 17 % oxygen. Before group-wise analysis IVABX, NG, foley catheter and oxygen were found statistically significant (Table **1**) and after group-wise multivariable analysis, only received oxygen was found significantly associated with ICH as compared to those who did not receive any of these treatments when adjusted other variables.

Inferential analysis of complications of present data during admission in the hospital showed that 16% of patients suffered from a complication of pneumonia, 10.2 % from urinary tract infection 7.7 % from seizures, 1.5 % bed sores, 1.22 % myocardial infarction, 1.02 % gastrointestinal bleed and 0.2% with DVT. Before adjustment with other variables pneumonia, myocardial infarction and gastrointestinal bleed were found significantly associated (Table **1**) with the outcome variable.

Two variables, age and length of stay were continuous. The mean (S.E) of age was 57.11(0.73) for improved ICH patients. Age is an important factor for ICH but it is statistically insignificant. The length of stay was statistically significant ($p <0.0001$) when used as a continuous variable. The mean (S.E) of the length of stay was 8.22(0.29) for improved ICH patients.

Many previous studies [5, 10, 22] showed that the neurologic injury caused in ICH is worse in older age

patients and the recovery is more limited. However, another study [6] showed that age was not significantly associated with mortality.

CONCLUSION

Initially, the univariable analysis was performed to measure the association between the patient's outcome and each potential prognostic factor. According to the criteria of the p-value (*i.e*. p<0.05) it was found that 50% of covariates were significant in univariable analysis.

Subsequently, group-wise multivariable analyses were conducted to look for any association between the patient's outcome and the variables of the group. It was based on a preliminary analysis of a separate set of group variables. Out of twenty groups of factors, eleven were discovered significant (Table **2**).

Univariable and group-wise multivariable analysis exhibited a significant relationship between ICH and antihypertensive medicine. The improvement among ICH patients using antihypertensive medicine was 1.3 as compared to those who were not using antihypertensive medicine when adjusted with other variables of the group of medication.

Similarly, at the time of discharge, 56 % of subjects were using antihypertensive medicine; both methods of analysis exhibited a significant relationship between ICH and antihypertensive medicine. The improvement among ICH patients using antihypertensive medicine at the time of discharge was 2.9 when adjusted with other variables of the group. Thus the change in adjusted relative risk from 1.3 to 2.9 times in antihypertensive medicine shows that the use of antihypertensive medicine and ICH outcome variable are positively associated. Hence it is concluded that the use of antihypertensive medication diminishes the risk of occurrence of ICH due to hypertension.

Before multivariable analysis, initial SBP (p=0.006), lowest SBP & DBP were significantly associated (p <0.0001) and after group analysis, a significant relationship was found between lowest SBP and ICH. The improvement among patients who belong to hypertensive lowest SBP group (141–160 mm Hg) was 1.02 times, for the range of (161–200) was 0.6 times and for the range of (>200) was 0.5 times as compared to the normal range (90–140) when adjusted with other variables. Thus the change in adjusted relative risk of a hypertensive range of SBP also indicates that the blood pressure range and ICH outcome variable are negatively associated. Statistical inference demonstrates direct proportion to high morbidity and mortality of hemorrhagic stroke with circulatory strain level. Hence it would be prudent to enhance the community awareness towards better control of blood pressure level.

Previous studies showed that diabetes mellitus has an indirect correlation with ICH. Both analyses of present data pointed out an insignificant relationship between ICH and DM.

The improvement among ICH patients with recent stroke was 1.3 times (p = 0.015) as compared to without recent stroke. Another risk factor coagulopathy showed less clinical improvement (0.5 times) with ICH, as compared to non-coagulopathy subjects (p=0.001) when adjusted other variables.

During the analysis of neurological symptomatology, it is found that headache, weakness, faintness, numbness, dizziness and unable to walk are significantly associated. An analysis of motor the normal, right and left hemiplegia was found significant with the ICH outcome variable.

The inference of data revealed a clear decrease in mental status from sleepy (0.9 times) to coma (0.3 times) as compared to normal mental status in univariable analysis with the outcome variable of ICH.

Univariable analysis indicated that the cerebellum and temporal lobe are significantly associated with the outcome variable. However, group-wise multivariable analysis showed the only cerebellum was significantly related to ICH. The group-wise analysis revealed that mass effect on midline shift (p=0.0001), hydrocephalus (p=0.01) and normal (p=0.0001) were negatively associated with ICH.

In present data two variables, age and length of stay were continuous. Age is an important factor for ICH but it is statistically insignificant. The length of stay was statistically significant (p <0.0001).

Finally, it is proved that univariable and group-wise multivariable both analyses produce different outcomes in terms of p-value and relative risk. Thusly we conclude that the utilization of proper schemes leads to inferences from the contemplated information.

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