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Association of serum ferritin and hematoma volume with neurological outcome in patients of deep supratentorial spontaneous intracranial haemorrhage.

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Abstract

Background
Deep supratentorial spontaneous intracerebral hemorrhage (ICH) is a life-threatening neurological emergency with high morbidity. Identifying reliable prognostic markers is vital for early clinical decision-making. Serum ferritin, an acute-phase reactant, and hematoma volume have been suggested as potential indicators of ICH severity and outcome.
Objectives: To assess the association between serum ferritin and hematoma volume with neurological outcomes in patients with deep supratentorial spontaneous ICH.

Methods
A retrospective observational study was conducted on 80 patients diagnosed with deep supratentorial ICH at a tertiary care hospital in Dehradun. Serum ferritin levels were measured using ELFA within 72 hours of symptom onset. Hematoma volume was calculated via CT using the ellipsoid formula. Outcomes were assessed using the modified Rankin Scale (mRS).

Results
Patients with elevated serum ferritin had significantly worse neurological outcomes (100% poor outcome, $p<0.001$). Similarly, larger hematoma volumes were associated with increased rates of poor outcome, especially in the very high-volume group (87.5% poor outcome). High GCS scores correlated with better outcomes.

Conclusion
Both elevated serum ferritin and larger hematoma volumes are strongly associated with poor neurological outcomes in deep supratentorial ICH, highlighting their prognostic significance in clinical management.

Recommendations
Routine assessment of serum ferritin and hematoma volume at admission should be considered in all patients with deep supratentorial ICH to aid early prognostication. Integration of these parameters into clinical risk models can improve outcome prediction and guide therapeutic decisions. Future prospective multicentric studies are recommended to validate these findings and explore the therapeutic potential of iron-modulating agents in ICH management.

Keywords: *Serum ferritin, Hematoma volume, Intracerebral hemorrhage (ICH), Neurological outcome*
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Introduction

Intracranial hemorrhage (ICH) represents one of the most catastrophic forms of stroke, contributing to high mortality and significant disability among survivors. Particularly, deep supratentorial ICH, involving structures such as the thalamus and basal ganglia, is associated with severe clinical outcomes due to its central location and proximity to vital brain pathways. Despite advances in acute management, the prognosis for ICH patients remains poor, with a substantial portion of patients experiencing adverse neurological outcomes.[1][2]

The role of biomarkers in predicting the outcomes of ICH has gained attention in recent years. Serum ferritin, a ubiquitous intracellular protein that stores iron and releases it in a controlled fashion, is one such biomarker. Beyond its role in iron metabolism, serum ferritin serves as an acute-phase reactant and is elevated in various inflammatory and neurological conditions. Research has shown that excessive iron deposition following ICH can exacerbate secondary brain injury by promoting oxidative stress, inflammation, and neuronal death. This pathophysiological role of iron in brain injury makes serum ferritin a candidate biomarker for the progression and outcome of ICH.[3][4]

Moreover, hematoma volume is a well-established predictor of outcome in ICH. Larger volumes are associated with higher mortality and worse functional recovery. Accurate and early estimation of hematoma volume can aid in clinical decision-making and outcome prognostication. The relationship between serum ferritin levels and hematoma volume, however, has not been thoroughly investigated, particularly in the context of deep supratentorial hemorrhages.[5]

In a large prospective study, Salonen& coworkers showed that elevated serum ferritin was a strong risk factor for acute myocardial infarction. Stored iron in the form of ferritin is not essential for sustaining life or for preventing anemia, but when liberated, it can promote tissue injury by provoking iron iron-mediated Fenton reaction.

The liberation of iron and heme compounds from hemoglobin following hematoma, hemorrhagic infarction, or head and spinal cord injury is a critical factor in the initiation of neuronal death (Braugher et al)

Ikeda et al. (1989) showed the iron chelator deferoxamine to be protective against cold-induced brain edema.

Hall and Braugher showed that 21-amino steroids specifically developed to quench iron-induced free radical induction, ameliorated spinal cord and brain edema due to trauma.

Ferritin is the key storage protein in the brain. Fully assembled ferritin contains 24 subunits of H and L chains.

Iron and CVA

Iron-induced brain damage has been extensively studied by A. Davlos et al. They showed that elevated serum ferritin measured at the onset of symptoms increased the risk of progression to stroke by 33%, independent of other predictors of neurological outcome.

They demonstrated that serum ferritin levels are stable during the 72 hours after the acute stroke and are unrelated to the other biochemical markers of stress reaction, and the relation between plasma ferritin and progressing stroke was independent of the ultimate infarct volume. So, increased ferritin values predict early neurological worsening also in small cerebral infarcts.

Blood ferritin is a reliable indicator of tissue iron and, therefore, might be a suitable index of the availability of iron in the infarcted area of acute stroke patients without infectious or inflammatory disease.

Comparatively, serum iron and transferrin saturation have a high analytic variability due to hemolysis and extensive day-to-day variability (30 – 50 %). Coyle et al and others in various experimental works showed an interaction between iron and glutamate release and free radical injury, and subsequent neuronal death.

Intra-ischemic glutamate release in penumbra cortex correlates positively with enhanced free radical activity during reperfusion after transient middle cerebral artery occlusion.

Serum ferritin and perihematomal edema volume

Among other factors of morbidity and mortality in ICH, perihematomal edema volume also plays a significant role. In ICH, the edema occurs in two phases.

In the early phase, edema is due to the hydrostatic pressure of hematoma formation and clot retraction. The delayed phase is due to the hemolysis and neuronal toxicity, in part mediated by iron.

In a retrospective and prospectively collected clinical and laboratory data from 23 consecutive patients with acute spontaneous ICH, Manu Mehdiratta et al showed that

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delayed iron toxicity played a role in causing brain injury and edema formation after ICH.

Xi.G.et al infused lysed erythrocytes into the rat brain and found Marked edema formation within 24 hours. However, when they infused packed cells, edema peaked on day 3, coinciding with the RBC lysis and release of Hb.

Savman et al. compared the level of non-protein-bound iron (NPBI) in the CSF of 20 preterm infants with intraventricular hemorrhage and 10 preterm control infants. They found out NPBI in 75% of the patients with IVH and 0% in control infants. The NPBI was found in very high levels in CSF from patients with IVH and also in those with white matter lesions and subsequent disabilities.

Manu Mehdiratta found little correlation between the change in hematoma volume and the corresponding relative edema volume between admission and day 3.

They concluded that perihematoma edema formation cannot be solely considered an epiphenomenon.

Natalia Perez et al studied 92 consecutive patients with primary hemispheric ICH. They determined serum ferritin levels and other inflammatory markers. They found out 51 (55%) patients had a poor outcome (Rankin score >2). Advanced age, high stroke scores, large hematoma volume, intraventricular extension, mass effect, and high ferritin values at baseline were associated with poor outcome.

The higher the ferritin quartile, the worse the Rankin scores. Ferritin levels remained stable for 72 hrs and did not correlate with acute phase reactants. They concluded that high ferritin levels at admission are independently associated with poor outcome in patients with ICH and suggested the neurotoxic effect of increased body iron stores in patients with hemorrhagic stroke.

The study is conducted as there is no study conducted in the context of Northern India; however, similar studies were conducted in Southern India.

In this study, we aim to establish a correlation between various factors, which not only include hematoma volume, ferritin, and neurological outcome, but also the correlation of neurological outcome with site of ICH, gender, age, correlation with alcoholism, and neurological outcome, which was not explored in the previous studies as described. This study aims to assess the association of serum ferritin and hematoma volume with neurological outcomes in patients with deep supratentorial spontaneous intracranial hemorrhage. The objectives are to examine the relationship between serum ferritin levels and hematoma volume in patients suffering from deep supratentorial intracranial hemorrhage and to explore the association between serum ferritin levels and neurological outcomes in these patients.

Materials and methods

Study design

This was a retrospective observational study aimed at evaluating the association between serum ferritin and hematoma volume with neurological outcomes in patients presenting with deep supratentorial spontaneous intracerebral hemorrhage (ICH).

Study setting

The study was conducted at the Department of Neurology, Himalayan Institute of Medical Sciences (HIMS), Dehradun, Uttarakhand, India—a tertiary care center—over two years (January 2021 to December 2022).

Participants

Inclusion criteria

- Patients aged ≥18 years
- Diagnosed with spontaneous ICH in the deep supratentorial region (putamen or thalamus) confirmed by CT scan
- Presentation within 24 hours of symptom onset
- First-ever ICH episode

Exclusion criteria

- Recurrent ICH
- Secondary causes of hemorrhage (trauma, vascular malformation, coagulopathy)
- Lobar or cerebellar bleeds
- End-stage renal disease, malignancy, prior stroke, severe anemia
- Patients with physical or mental disabilities or psychiatric illness

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Study size

A total of 80 eligible patients were included based on the predefined inclusion and exclusion criteria.

Data collection

Data were extracted from hospital medical records using a structured data abstraction form. Hematoma volume was calculated using the ellipsoid formula from non-contrast CT scans. Serum ferritin levels were measured within 72 hours of onset using the ELFA method (VIDAS Ferritin Assay). The neurological outcome was assessed using the modified Rankin Scale (mRS) at discharge.

Bias

Selection bias was minimized by including all consecutive eligible patients. Information bias was reduced through standardized data abstraction and blinded outcome assessment using validated scales (mRS, GCS).

Statistical methods

Quantitative data were summarized using mean ± standard deviation, and qualitative data were expressed as percentages. Associations were assessed using Chi-square or Fisher's exact test, with significance set at $p<0.05$. Multivariate logistic regression was employed to assess independent predictors of poor outcome. Statistical analyses were performed using SPSS version 25.

Ethical consideration

Ethical approval for the study was obtained from the Institutional Ethics Committee of HIMS, Dehradun (Approval No: HIMS/IEC/2021/Neurology-007, dated 15th January 2021). All procedures were conducted by the Declaration of Helsinki.

Observation and results

The total number of patients included in the study was 80, of which 21 were female and 59 were male.

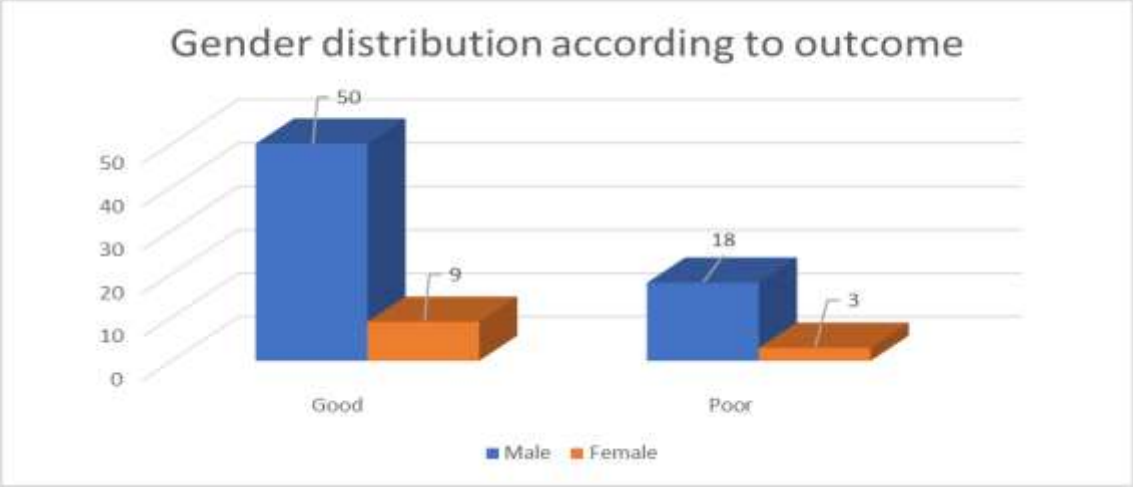

Figure 1: Correlation of gender and neurological outcome in ICH patients

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Association of gender with outcome

OUTCOME	FEMALE	MALE	TOTAL	P VALUE	RELATIVERISK
GOOD	18(85.71%)	50(84.74%)	68(85%)	0.915	1.06
POOR	3(14.2%)	9(15.25%)	12(15%)		
TOTAL	21	59	80		

Table 1: Correlation of gender and outcome

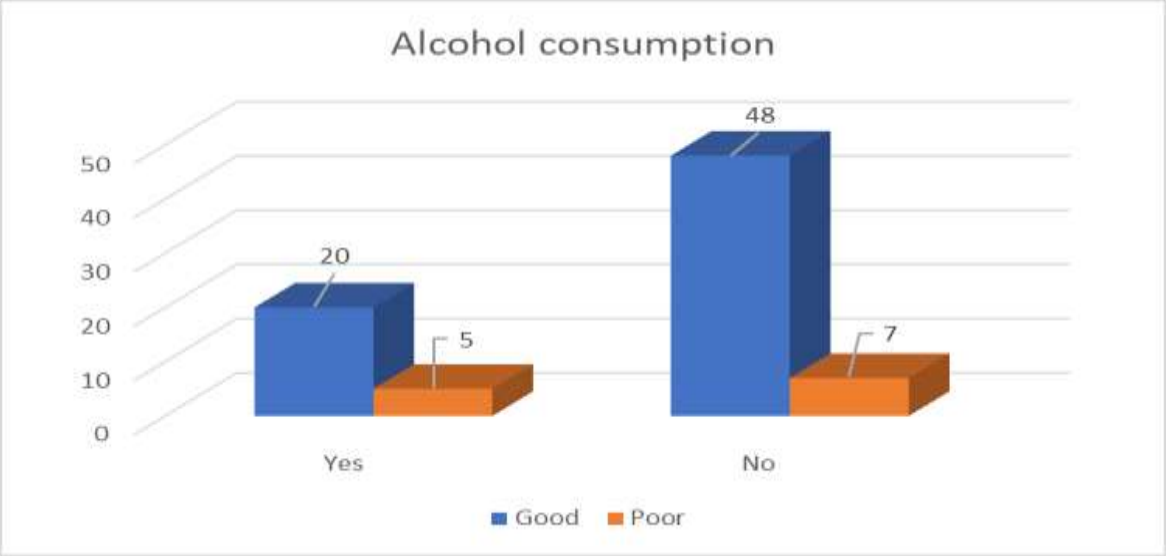

Figure 2: Correlation of alcohol consumption and neurological Outcome in ICH patients

OUTCOME	DID'NT TAKE ALCOHOL	TOOK ALCOHOL	TOTAL	P-VALUE	95% CI	RR
GOOD	48(87.2%)	20(80%)	68(85%)	0.398	0.732-2	1.21
POOR	7(12.72%)	5(20%)	12(15%)			
TOTAL	55	25	80			

Table 2: Correlation of alcohol consumption and outcome

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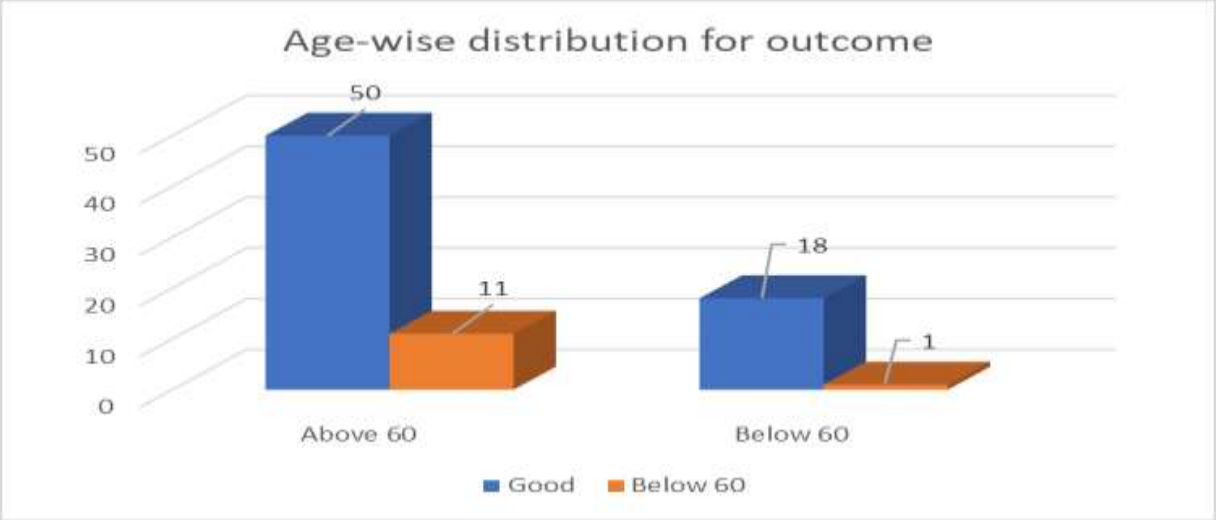

Figure 3: Correlation of age group and neurological outcome in ICH patients

OUTCOME	Age above 60 years	Age below 60 years	TOTAL	P-VALUE	95 %CI	RR
GOOD	50(81.96%)	18(94.73%)	68(85%)	0.173	0.642-1	0.802
POOR	11(18.03%)	1(5.27%)	12(15%)			
TOTAL	61	19	80			

Table 3: Correlation of age and outcome

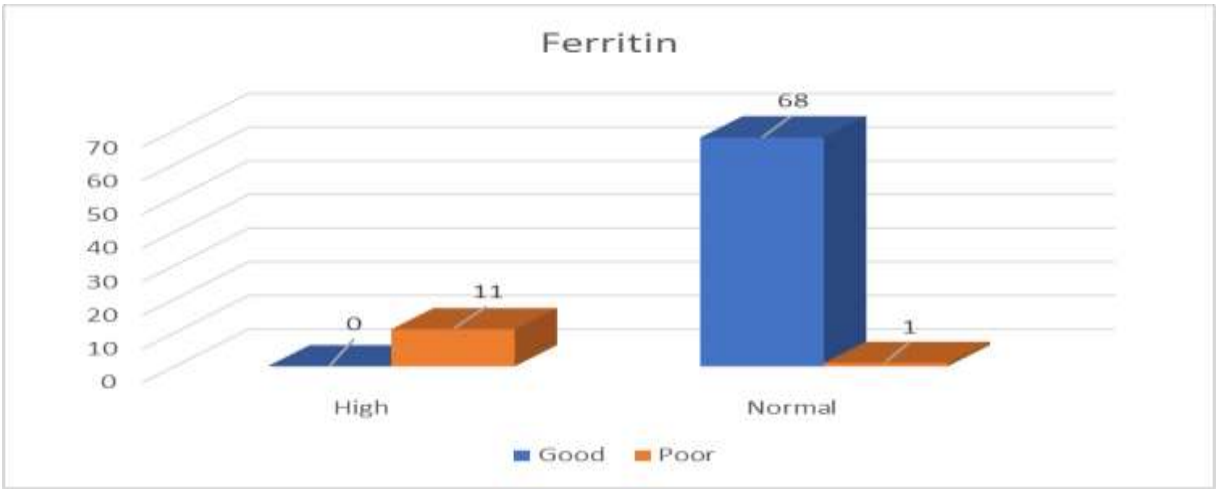

Figure 4: Correlation of serum ferritin levels and neurological outcome in ICH patients

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OUTCOME	High Ferritin levels	Normal Ferritin levels	TOTAL	P-VALUE	95 %CI	RR
GOOD	0	68(98.5%)	68(85%)	<0.001	0	NaN
POOR	11(100%)	1(1.5 %)	12(15%)			
TOTAL	11	69	80			

Table 4: Correlation of ferritin and outcome

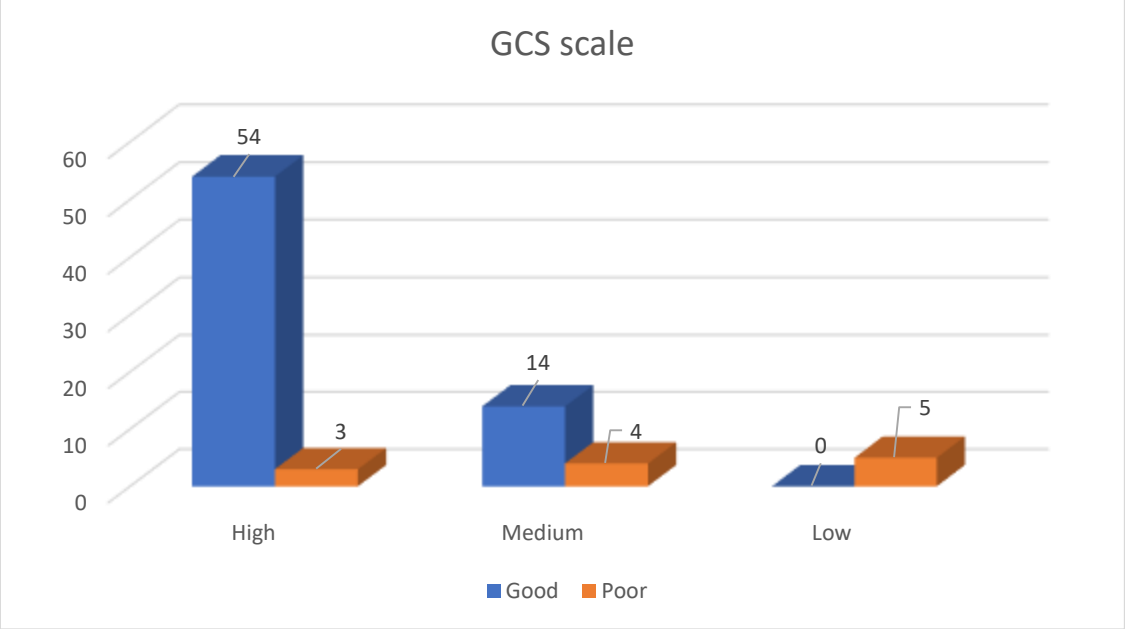

Figure 5: Correlation of Glasgow Coma Scale (GCS) Scores and neurological outcome in ICH patients

Outcome	High GCS	Medium GCS	Low GCS	TOTAL	P-VALUE	RR	95%CI
Good	54(94.73%)	0(0%)	14 (77.77%)	68(85%)	<0.001	NaN	0
Poor	3(5.26%)	5(100%)	4(22.22%)	12(15%)			
TOTAL	57	5	18	80			

Table 5: Correlation of GCS and outcome

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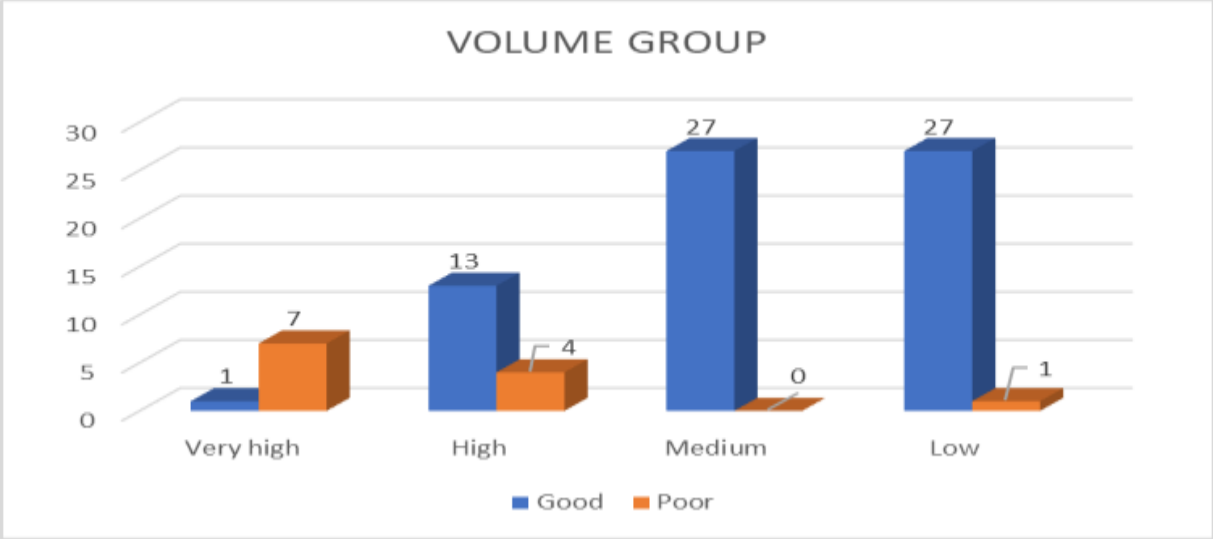

Figure 6: Correlation of hematoma volume and neurological outcome in ICH patients

OUTCOME	High Volume	Low Volume	Medium Volume	Very High Volume	TOTAL	P-VALUE	95%CI
	13(76.47%)	27(96.4%)	27(100%)	1(12.5%)	68(85%)	<0.001	0
POOR	4(23.5%)	1(3.57%)	0(0%)	7(87.5%)	12(15%)		
TOTAL	17	28	27	8	80		

Table 6: Correlation of Volume of ICH with outcome

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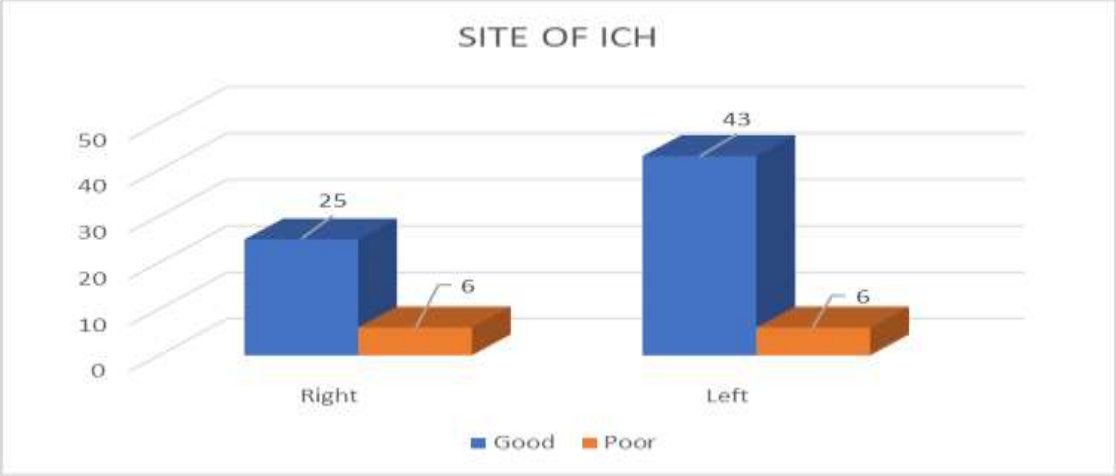

Figure 7: Correlation of side of intracerebral hemorrhage (Left vs. Right) and neurological outcome

OUTCOME	Left Side	Right Side	TOTAL	P-VALUE	95 %CI	RR
GOOD	43(87.75%)	25(80.64%)	68(85%)	0.386	0.698-2.29	1.26
POOR	6(12.24%)	6(19.35%)	12(15%)			
TOTAL	49	31	80			

Table 7: Correlation of side of ICH and outcome

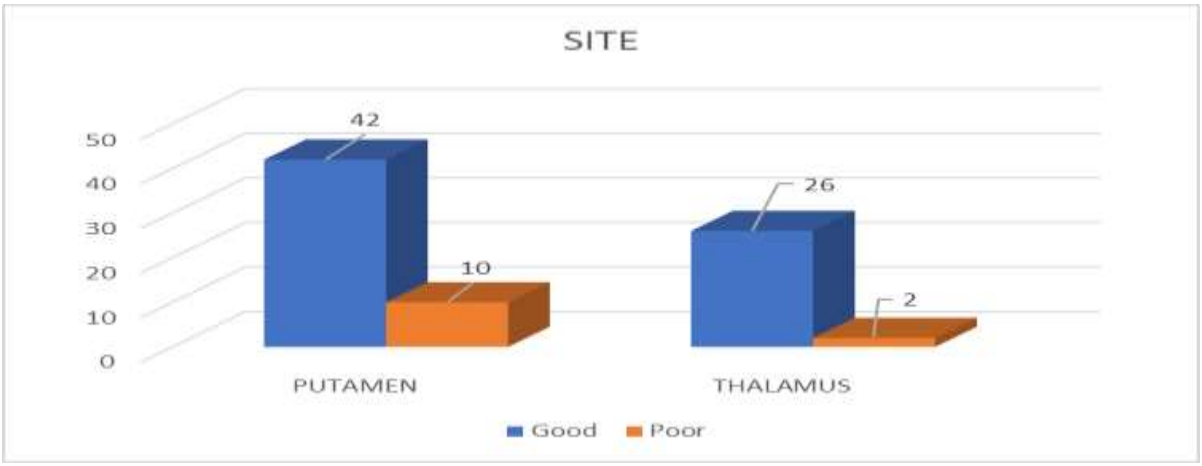

Figure 8: Correlation of site of ICH (Putamen vs. Thalamus) and neurological outcome

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OUTCOME	PUTAMEN	THALAMUS	TOTAL	P-VALUE	95%CI	RR
GOOD	42(80.76%)	26(92.85%)	68(85%)	0.149	0.541-1.02	0.741
POOR	10(19.23%)	2(7.14%)	12(15%)			
TOTAL	52	28	80			

Table 8: Correlation of the site of ICH and outcome

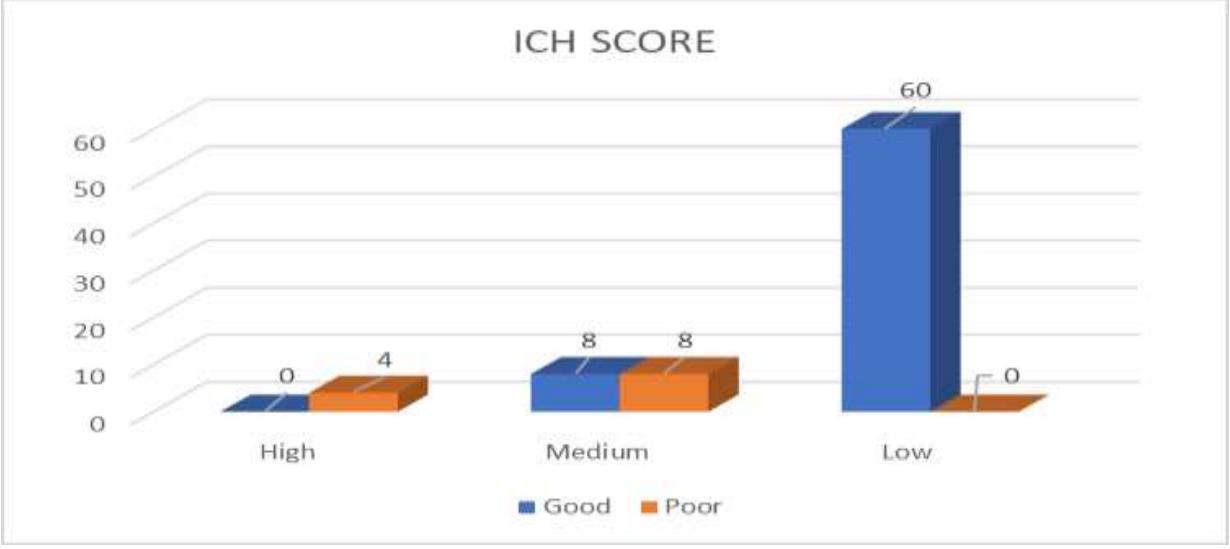

Figure 9: Correlation of ICH score and neurological outcome

OUTCOME	HIGH ICH SCORE	LOW ICH SCORE	MEDIUM ICH SCORE	TOTAL	P-VALUE	RR
GOOD	0	60	8	68	<0.001	NaN
POOR	4	0	8	12		
TOTAL	4	60	16	80		

Table 9: Correlation of ICH score with outcome

Discussion

Association of gender with outcome

Table 1 illustrates the gender distribution according to outcome, this table demonstrates that in the study out of 80 patients enrolled,59 were male which accounted to be 73.75 percent, and females were 21, which were 26.25 percent, out of the total male of 59 patients,50 patients showed good outcome which accounted to be 84.74 percent, and 9 which is 15.25 percent showed poor outcome, and amongst the females which were 21, 18 patients which is 85.71 percent showed good outcome and 3 patients, which were 14.2 percent showed bad outcome with p value of 0.915 and relative risk of 3.05. This data was not found to be statistically significant.

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Association of alcohol and outcome

Table 2 illustrates shows correlation of alcohol consumption and outcome, which was found to be not significant with p p-value of 0.398 and a relative risk of 2.98. This correlation was also not found to be statistically significant.

Association of age and outcome

Table 3 illustrates age wise distribution with outcome, it found that out of 80 patients, patients above 60 were found to be 61 which were found to be 76.25 percent, and 19 patients were below 60 years which were 19 patients which was found to be 23.75 percent, amongst the patient above 60 years, 50 patients that is 81.96 percent were found to have good outcome, and 11 patient that is 18.03 percent were found to have bad outcome and amongst the patient who were below 60 years, 18 out of 19 patients that is 94.73 percent were found to have good outcome and 5.27 percent were found to have bad outcome. The correlation between age and outcome was also not found to be statistically significant.

Association of ferritin and outcome

Table 4 illustrates Ferritin levels with the outcome. It was found that out of 80 patients, 11 patients that is approximately 13.75 percent it were found to have high ferritin levels, and 69 patients out or 80 patients that is 86.25 percent they had normal ferritin levels.
Out of the patients who had high ferritin, almost all, that is 100 percent of patients, had poor outcome, and 68 patients out of 69 patients, that is 98.5 percent, had good outcome, and 1 patient, that is 1.5 percent, had poor outcome. This correlation was also not found to be statistically significant.
Several studies have suggested that elevated serum ferritin levels, indicative of an acute-phase reactant, are associated with greater tissue damage and poorer outcomes in neurological disorders. The study found poor outcomes in patients with high serum ferritin levels, supporting this perspective. For instance, studies by Puy L et al.(2023)[6] & Liu YT et al.(2024)[7] found that high ferritin levels were predictive of severe outcomes in patients with intracerebral hemorrhage, which is consistent with our findings

Correlation of GCS and outcome

Table 5 illustrates GCS with outcome, and it was found that out of 80 patients, 57 patients had good clinical outcome which accounts to 71.25 percent, and 18 patients out of 80 had medium GCS which accounts to 22.5 percentage and 5 out of 80 had medium GCS and 18 out of 80 patients had low GCS. In the study, 94.73 percent of patients who had high GCS had a good outcome, and 4 patients, i.e, 22.22 percent of patients had low GCS; this correlation was also not found to be statistically significant.

Correlation of volume and outcome

Table 6 illustrates association of volume with the outcome and it was found that out of 80 patients 17 patients had high volume and in that 4 out of 17 that is 23.5 percentage had poor clinical outcome and 13 out of 17 that is 76.47 percentage had good clinical outcome, amongst the one with the low volume 28 patients out of 80 patients had low volume, amongst the low volume 27 out of 28 patients showed good clinical outcome which accounts to 96.4 percentage and 1 out of 28 that is 3.57 percentage had poor clinical outcome amongst the one with medium volume 27 patients had medium volume and it was found that all patients that is 100 percentage patient had good clinical outcome and amongst the one with very high volume 1 patient had good clinical outcome which accounted to be 12.5 percentage and 7 out of 8 had poor clinical outcome which accounted to be 87.5 percentage. This correlation was also not found to be statistically significant.
The strong correlation between larger hematoma volumes (≥30 mL) and poorer neurological outcomes (OR 3.2) in our study echoes the conclusions of other research, such as that by Wan Y et al.(2023)[8], which documented that larger hematoma volumes are directly associated with increased mortality and functional dependency. This suggests that hematoma volume is a critical predictor of outcome, likely due to its impact on increased intracranial pressure and subsequent brain injury. Lee KH et al. (2023) [9]

Correlation of the side of the ICH and the outcome

Table 7 shows the association of the side of ICH with outcome, and it was found that 31 patients had right-sided Intracranial haemorrhage which accounted to be 38.75%

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percentage and 49 patients out of 80 patients had left-sided Intracranial Haemorrhage which accounted for 61.25% percentage There was no statistically significant data seen between the association of site and outcome. This correlation was also not found to be statistically significant.

Correlation of ICH score and outcome

Table 8 demonstrates ICH score and association of outcome and it was found that amongst the 80 patients 4 patients out of 80 had high ICH score which accounts to 5 percentage, out of which all 4 that is 100 percentage patients of patients with high ICH score had poor clinical outcome and if we talk about medium ICH score out of 80 patients 16 patients had medium ICH score which accounted to be 20 percentage, and in which 8 out of 16 patients had poor clinical outcome and 8 had good clinical outcome which accounts to be 50 percentage each, amongst the patient with low ICH score 60 out of 80 patients that is 75 percentage patients had low ICH score and in which all had good clinical outcome which is 100 percentage. This correlation was also not found to be statistically significant.

Correlation of site and outcome

This table illustrates the site of ICH with the clinical outcome, and it was found that 52 out of 80 patients had hemorrhage in the putamen and 28 out of 80 patients had haemorrhage in the thalamus, and there was no clinically significant correlation seen between the site and outcome. This correlation was also not found to be significant.

Generalizability

Although this study provides valuable insight into prognostic indicators in ICH, the single-center design and limited sample size may affect the generalizability. Further multicentric studies with larger populations are recommended to validate these findings across diverse settings.

Conclusion

The study conducted on the association of serum ferritin and hematoma volume with neurological outcomes in patients with deep supratentorial spontaneous intracranial hemorrhage provided significant insights into the predictive value of these parameters. The findings reveal that high serum ferritin levels and larger hematoma volumes are strongly associated with poorer neurological outcomes as measured by the modified Rankin Scale.

Specifically, patients presenting with elevated serum ferritin levels demonstrated increased risk of adverse neurological outcomes, which underscores the potential role of ferritin not only as a biomarker for brain injury severity but also as an indicator of inflammatory responses that may exacerbate the damage following an intracranial hemorrhage. Similarly, the relationship between larger hematoma volumes highlights the critical impact of initial hemorrhage severity on long-term recovery prospects.

These associations suggest that both serum ferritin and hematoma volume could serve as crucial factors in the early prognostication of stroke outcomes. Monitoring these parameters can aid clinicians in identifying patients at higher risk of poor recovery, thereby facilitating more tailored and aggressive management strategies. Furthermore, this study contributes to the growing body of literature that emphasizes the importance of integrating biomarker profiles with clinical imaging to enhance predictive accuracy in medical outcomes following intracranial hemorrhages.

In conclusion, this study underscores the importance of serum ferritin and hematoma volume as significant prognostic tools in managing deep supratentorial spontaneous intracranial hemorrhage. These findings could pave the way for future research to explore targeted therapies that could mitigate the inflammatory responses and manage the hematoma expansion to improve neurological outcomes in affected patients.

Limitations of the study

Retrospective design limits causal inference
Single-center study may limit generalizability.
Ferritin may be influenced by other subclinical inflammatory states not captured in this study.
Follow-up beyond hospital discharge was not performed, limiting long-term outcome assessment.

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and diagnostics. Special thanks to the medical record department for their assistance in record retrieval.

List of abbreviations

ICH: Intracerebral Hemorrhage
CT: Computed Tomography
ELFA: Enzyme-Linked Fluorescent Assay
mRS: Modified Rankin Scale
GCS: Glasgow Coma Scale
HIMS: Himalayan Institute of Medical Sciences

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Conflict of interest

The authors declare no conflict of interest.

Author biography

Dr. Aniruddh Shrivastava is a DM Neurology Resident at HIMS, Dehradun. His research interests include cerebrovascular disorders and neurocritical care.

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Dr. Ashwani Bhat is a Consultant Neurologist at HIMS, specializing in acute neurological emergencies and neuroimaging.

Data availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

References

1. Mendiola JM, Arboix A, García-Eroles L, Sánchez-López MJ. Acute Spontaneous Lobar Cerebral Hemorrhages Present a Different Clinical Profile and a More Severe Early Prognosis than Deep Subcortical Intracerebral Hemorrhages-A Hospital-Based Stroke Registry Study. Biomedicines. 2023 Jan 16;11(1):223. https://doi.org/10.3390/biomedicines11010223 PMid:36672731 PMCid:PMC9856131
2. Amer HA, El-Jaafary SI, Sadek HM, Fouad AM, Mohammed SS. Clinical and paraclinical predictors of early neurological deterioration and poor outcome in spontaneous intracerebral hemorrhage. The Egyptian Journal of Neurology, Psychiatry and Neurosurgery. 2023 Jun 6;59(1):74. https://doi.org/10.1186/s41983-023-00675-x PMid:37305215 PMCid:PMC10242586
3. Dang LH, Thach KN, Nguyen YT, Nguyen TV, Dinh HH, Nguyen LT, Nguyen CT. Prediction of functional outcome in supratentorial intracerebral hemorrhage patients treated with stereotactic computed tomographic-guided aspiration and recombinant tissue plasminogen activator (rt-PA). Interdisciplinary Neurosurgery. 2024 Sep 1;37:101979. https://doi.org/10.1016/j.inat.2024.101979
4. Huang YW, Huang HL, Li ZP, Yin XS. Research advances in imaging markers for predicting hematoma expansion in intracerebral hemorrhage: a narrative review. Frontiers in Neurology. 2023 Apr 25;14:1176390. https://doi.org/10.3389/fneur.2023.1176390 PMid:37181553 PMCid:PMC10166819
5. Schaefer PW, Edjlali M. Nontraumatic Intracranial Hemorrhage. In Diseases of the Brain, Head and Neck, Spine 2024-2027: Diagnostic Imaging 2024 Feb 11 (pp. 49-68). Cham: Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-50675-8_5 PMid:39495870
6. Puy L, Parry-Jones AR, Sandset EC, Dowlatshahi D, Ziai W, Cordonnier C. Intracerebral haemorrhage. Nature Reviews Disease Primers. 2023 Mar 16;9(1):14. https://doi.org/10.1038/s41572-023-00424-7 PMid:36928219
7. Liu YT, Lei CY, Zhong LM. Research advancements on the correlation between spontaneous intracerebral Hemorrhage of different Etiologies and imaging markers of cerebral small

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vessel disease. Neuropsychiatric Disease and Treatment. 2024 Dec 31:307-16. https://doi.org/10.2147/NDT.S442334 PMid:38405425 PMCid:PMC10893791

8. Wan Y, Holste KG, Hua Y, Keep RF, Xi G. Brain edema formation and therapy after intracerebral hemorrhage. Neurobiology of disease. 2023 Jan 1;176:105948. https://doi.org/10.1016/j.nbd.2022.105948 PMid:36481437 PMCid:PMC10013956
9. Lee KH, Carvalho F, Lioutas VA, Heistand E, Das AS, Marchina S, Shoamanesh A, Katsanos AH, Shehadah A, Incontri D, Selim M. Relationship between prior statin therapy and radiological features and clinical outcomes of intracerebral hemorrhage. Journal of Stroke and Cerebrovascular Diseases. 2023 Dec 1;32(12):107378. https://doi.org/10.1016/j.jstrokecerebrovasdis.2023.107378 PMid:37837803
10. Trong YN, Hoai LD, Thach TN, Thi CN, Dinh TN, Quang DT. Useful treatment paradigms: Decompressive hemicraniectomy with hematoma evacuation in larger intracranial hemorrhage. Insights from a leading Vietnamese hospital. Interdisciplinary Neurosurgery. 2024 Jun 1;36:101902. https://doi.org/10.1016/j.inat.2023.101902
11. Wang X, Sun H, Wang X, Lan J, Guo Y, Liu W, Cui L, Ji X. More severe initial manifestations and worse short-term functional outcome of intracerebral hemorrhage in the plateau than in the plain. Journal of Cerebral Blood Flow & Metabolism. 2024 Jan;44(1):94-104. https://doi.org/10.1177/0271678X231201088 PMid:37708253 PMCid:PMC10905638

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