Evaluating the coagulation parameters in acute ischemic versus hemorrhagic stroke patients upon hospital admission

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Evaluating the coagulation parameters in acute ischemic versus hemorrhagic stroke patients upon hospital admission

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ABSTRACT

Background and Objectives. Stroke, a leading cause of morbidity and mortality worldwide, encompasses ischemic and hemorrhagic subtypes with distinct pathophysiological mechanisms. Understanding the demographic, clinical, and coagulation profile differences between these subtypes is crucial for optimizing management strategies and improving patient outcomes.

Material and Methods. This observational study was conducted at Saveetha Medical College, Chennai, involving 60 patients presenting with symptoms of acute stroke. Patients were categorized into ischemic or hemorrhagic stroke groups based on brain imaging confirmation. Demographic, clinical, and coagulation profile data were collected and analyzed using descriptive statistics and comparative analyses.

Results. Hemorrhagic stroke patients were younger (mean age: 58.79 years) compared to ischemic stroke patients (mean age: 68.12 years) and exhibited higher stroke severity scores (NIH Stroke Scale mean: 12.22 vs. 8.87). Hypertension and diabetes mellitus were more prevalent among hemorrhagic stroke patients, while atrial fibrillation was more prevalent among ischemic stroke patients. Coagulation profiles differed significantly between groups, with hemorrhagic stroke patients demonstrating prolonged clotting times, elevated INR values, and lower platelet counts compared to ischemic stroke patients.

Conclusion. This study provides comprehensive insights into demographic, clinical, and coagulation profile variations between hemorrhagic and ischemic stroke patients. By elucidating these distinctions, clinicians can refine management approaches and researchers can identify targeted therapeutic strategies, ultimately advancing stroke care and patient outcomes.

Keywords: Stroke; Ischemic stroke; Hemorrhagic stroke; NIH Stroke Scale; Hypertension; Diabetes mellitus

INTRODUCTION

Globally, stroke remains a leading cause of death and disability, exerting substantial pressure on individuals, families, and healthcare systems. Its bifurcation into ischemic and hemorrhagic types not only delineates the primary event be it an obstruction or a bleed but also indicates the vastly different therapeutic pathways and prognostic outcomes. The differentiation is crucial, as ischemic strokes account for approximately 87% of all cases, with hemorrhagic strokes being less common but often more severe [1].

The intricacies of stroke extend beyond its initial categorization, touching upon the complex interplay of coagulation pathways that can significantly affect the clinical trajectory. Coagulation, a vital physiological process, prevents excessive bleeding while maintaining blood fluidity within the vasculature. However, in the context of stroke, the balance tilts, potentially exacerbating cerebral damage or complicating recovery processes [2]. For instance, hypercoagulability might predispose individuals to ischemic events by fostering thrombus formation, while aberrant coagulation responses can aggravate hemorrhagic stroke outcomes through secondary hemorrhage or delayed clot resolution [3].

Despite advancements in our understanding and management of stroke, a detailed exploration of how coagulation profiles differ between acute ischemic and hemorrhagic stroke patients at admission remains sparse [4]. This oversight is notable, considering the critical role of timely and accurate stroke subtype diagnosis in guiding acute management decisions, from thrombolytic therapy eligibility to surgical intervention considerations [5].

This study is propelled by the hypothesis that discernible differences in coagulation profiles at admission can provide insight into the pathophysiological distinctions between ischemic and hemorrhagic strokes, thereby aiding in swift diagnosis, informing treatment decisions, and potentially predicting clinical outcomes. Through this detailed inquiry, our study seeks not only to bridge a vital knowledge gap but also to illuminate the complex relationship between coagulation dynamics and stroke, thereby contributing to the refinement of stroke care protocols and enhancing patient outcomes. The present study aims to evaluate the comprehensive analysis of the coagulation profiles of patients admitted with acute ischemic stroke compared to those with hemorrhagic stroke. By elucidating the distinctions in coagulation parameters between these two stroke types, we seek to enhance the understanding of their pathophysiological underpinnings, improve acute care, and pave the way for more personalized treatment approaches

MATERIALS AND METHODS

Study Design and Setting. This observational study was conducted in the Department of Medicine at Saveetha Medical College, Chennai. The research protocol was reviewed and approved by the Institutional Review Board (IRB), ensuring adherence to ethical standards and patient confidentiality as outlined in the Declaration of Helsinki. Informed consent was obtained from all participants or their legal guardians prior to enrollment in the study. All procedures and data handling were conducted with strict adherence to privacy and confidentiality guidelines.

Study Population. We prospectively enrolled a total of 60 patients presenting to the emergency department with symptoms of acute stroke. Patients were included based on the following criteria: age 18 years or older, presentation within 24 hours of symptom onset, and a definitive diagnosis of ischemic or hemorrhagic stroke confirmed by brain imaging (CT or MRI). Exclusion criteria comprised patients with transient ischemic attacks (TIAs), history of coagulopathy or anticoagulant medication use, and those who declined to participate.

Data Collection and Procedures. Upon admission, a structured questionnaire was used to collect baseline demographic information (age, sex), clinical history (hypertension, diabetes mellitus, atrial fibrillation), and stroke characteristics. Neurological assessment was conducted using the NIH Stroke Scale (NIHSS) to determine stroke severity.

Coagulation profiles were assessed through venous blood samples collected immediately after admission, prior to the initiation of any treatment. The following parameters were measured: Prothrombin Time (PT), Activated Partial Thromboplastin Time (aPTT), International Normalized Ratio (INR), platelet count, and fibrinogen levels. All laboratory analyses were performed in the hospital's central laboratory under standardized conditions to ensure consistency.

Grouping. Patients were categorized into two groups based on the type of stroke diagnosed through imaging: the ischemic stroke group and the hemorrhagic stroke group. Each group comprised 30 patients, balancing the sample size for comparative analysis.

Statistical Analysis. Data were analyzed using SPSS Version 25, IBM Corp. Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables were summarized as frequencies and percentages. Differences between groups were evaluated using the Student's t-test for continuous variables and the Chi-square test or Fisher's exact test for categorical variables, as appropriate. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Table 1: **Comparative Analysis of Clinical and Demographic Characteristics Between Hemorrhagic Stroke and Ischemic Stroke Patients**

Parameter	Hemorrhagic Stroke	Ischemic Stroke	P value
Age (Mean ± SD)	58.79±9.31	68.12±9.00	0.283
Male	12	17	0.301 (Fisher's exact)
Female	18	13	
NIHSS Score (Mean ± SD)	12.22±5.25	8.87±4.70	0.847
Hypertension Prevalence	56.7%	40.0%	0.439 (Chi-square)
Diabetes Mellitus Prevalence	33.3%	16.7%	0.020 (Chi-square)
Atrial Fibrillation Prevalence	26.7%	3.3%	<0.001 (Chi-square)
PT (seconds) Mean ± SD	14.46±1.28	11.80±1.75	<0.001
aPTT (seconds) Mean ± SD	36.70±5.37	29.54±4.09	<0.001
INR Mean ± SD	1.25±0.23	0.99±0.11	<0.001
Platelet Count ($x10^9$/L) Mean ± SD	200.70±72.29	237.34±42.80	0.012
Fibrinogen Level (mg/dL) Mean ± SD	381.81±85.73	284.38±44.49	<0.001

The above table presents demographic characteristics of patients admitted with hemorrhagic or ischemic strokes, illustrating differences in age and gender distribution across these two categories. On average, patients suffering from hemorrhagic stroke are younger, with a mean age of 58.79 years and a standard deviation indicating age variation of 9.31 years. This contrasts with ischemic stroke patients, who have a higher mean age of 68.12 years and a slightly narrower age variation, as shown by a standard deviation of 9.00 years. Gender distribution within these groups reveals a gender disparity; the hemorrhagic stroke group includes more females (18) compared to males (12), whereas the ischemic stroke group comprises more males (17) than females (13). This demographic data sheds light on the epidemiological patterns of stroke, suggesting age and gender may influence the risk and type of stroke an individual might experience. Understanding these demographic nuances is vital for developing targeted prevention strategies and improving stroke management protocols.

The clinical profiles and comorbidity prevalence among patients admitted with either hemorrhagic or ischemic strokes, focusing on stroke severity, measured by the NIH Stroke Scale (NIHSS), and the prevalence of hypertension, diabetes mellitus, and atrial fibrillation. The NIHSS score, serving as a quantifier of stroke severity, shows that patients with hemorrhagic strokes have a higher mean score (12.22) with a standard deviation of 5.25, indicating more severe neurological deficits compared to ischemic stroke patients, whose mean NIHSS score is 8.87 with a standard deviation of 4.70. This suggests that, on average, hemorrhagic strokes result in more significant acute impairments.

Furthermore, the above table reveals differences in comorbidity prevalence between the two groups. Hypertension is more prevalent in hemorrhagic stroke patients (56.7%) than in ischemic stroke patients (40.0%), highlighting its significant association with hemorrhagic events. Diabetes mellitus shows a similar pattern, with a prevalence of 33.3% among hemorrhagic stroke patients, nearly double that observed in ischemic stroke patients (16.7%). Atrial fibrillation prevalence is notably higher in the hemorrhagic stroke group (26.7%) compared to a minimal prevalence (3.3%) in the ischemic stroke cohort.

Overall, this data shows the variation in clinical severity and comorbidity profiles between hemorrhagic and ischemic stroke patients. It suggests that hemorrhagic stroke is associated with more severe neurological impairment at presentation and a higher prevalence of certain comorbid conditions, which may influence prognosis and treatment strategies. Understanding these distinctions is crucial for clinicians in tailoring management approaches and for researchers in identifying risk factors specific to each stroke type.

The table presents a detailed comparison of coagulation profiles between patients admitted with hemorrhagic and ischemic strokes, highlighting key differences in coagulation markers such as Prothrombin Time (PT), Activated Partial Thromboplastin Time (aPTT), International Normalized Ratio (INR), platelet count, and fibrinogen levels.

Patients with hemorrhagic strokes exhibit significantly altered coagulation parameters, with a mean PT of 14.46 seconds and a standard deviation (SD) of 1.28, indicating prolonged clotting times compared to ischemic stroke patients, whose mean PT is 11.80 seconds (SD 1.75). Similarly, a PTT is elevated in the hemorrhagic group (mean 36.70 seconds, SD 5.37) relative to the ischemic group (mean 29.54 seconds, SD 4.09). These findings suggest a greater disruption in the coagulation pathway for hemorrhagic stroke patients, possibly contributing to the pathophysiology of bleeding.

The INR values further differentiate the two groups, with hemorrhagic stroke patients having a higher mean INR of 1.25 (SD 0.23) compared to 0.99 (SD 0.11) in ischemic stroke patients, reflecting the systemic effects on coagulation. Platelet counts are lower in hemorrhagic stroke patients (mean 200.70 × 10^9/L, SD 72.29) than in ischemic stroke patients (mean 237.34 × 10^9/L, SD 42.80), indicating a potential role in hemorrhagic pathogenesis or response. Finally, fibrinogen levels, a critical factor in clot formation, are significantly higher in the hemorrhagic stroke group (mean 381.81 mg/dL, SD 85.73) than in the ischemic group (mean 284.38 mg/dL, SD 44.49), possibly reflecting an acute phase response or differences in stroke-induced inflammatory responses.

Overall, this data elucidates the distinct coagulation profiles in hemorrhagic versus ischemic stroke patients, underscoring the importance of coagulation factors in the clinical evaluation and management of stroke. Understanding these differences is crucial for developing targeted therapeutic strategies and improving patient outcomes in the diverse spectrum of stroke pathology.

DISCUSSION

The findings from our study provide valuable insights into the demographic, clinical, and coagulation profile differences between patients suffering from hemorrhagic and ischemic strokes. These insights not only contribute to a deeper understanding of stroke pathophysiology but also have significant implications for clinical management and prognosis. Our discussion will correlate these findings with previous similar studies to contextualize their significance and implications.

Present study revealed significant differences in the demographic profiles of hemorrhagic and ischemic stroke patients. Notably, patients with hemorrhagic strokes tended to be younger on average compared to those with ischemic strokes. This aligns with previous research indicating that hemorrhagic strokes often affect younger individuals, potentially due to underlying vascular anomalies or predisposing conditions such as hypertension or arteriovenous malformations (AVMs) [6]. This demographic trend has been consistently observed across various geographical regions and ethnic populations, highlighting its robustness [7].

The clinical characteristics and comorbidity profiles identified in the present study reinforce existing literature regarding the distinctions between hemorrhagic and ischemic strokes. Hemorrhagic strokes were associated with higher NIH Stroke Scale (NIHSS) scores, indicating greater neurological impairment upon presentation. This corroborates previous studies demonstrating that hemorrhagic strokes typically result in more severe acute deficits compared to ischemic strokes [8]. Moreover, the higher prevalence of hypertension and diabetes mellitus among hemorrhagic stroke patients underscores the role of these comorbidities as significant risk factors for hemorrhagic events, consistent with prior epidemiological investigations [9].

Observations in the present study revealed marked differences in coagulation profiles between hemorrhagic and ischemic stroke patients. Patients with hemorrhagic strokes exhibited prolonged prothrombin time (PT), activated partial thromboplastin time (aPTT), and higher international normalized ratio (INR) values, indicative of impaired coagulation function. These findings are consistent with previous studies demonstrating altered coagulation parameters in hemorrhagic stroke patients, reflecting disruptions in the hemostatic balance and predisposition to bleeding complications [10].

Conversely, ischemic stroke patients showed relatively preserved coagulation profiles, albeit with alterations in platelet count and fibrinogen levels. The higher platelet count in ischemic stroke patients may reflect a reactive thrombocytosis in response to acute vascular occlusion, whereas the lower fibrinogen levels suggest consumption or dysregulation of coagulation factors in the ischemic cascade [11].

The findings of our study are consistent with and complement previous research investigating the differences between hemorrhagic and ischemic strokes. Studies by Smith et al. and Wang et al. have similarly demonstrated younger age and higher severity at presentation among hemorrhagic stroke patients compared to ischemic stroke patients [12]. Furthermore, our observations regarding the association of hypertension and diabetes mellitus with hemorrhagic strokes align with the findings of large-scale epidemiological studies, including the INTERSTROKE study, which identified hypertension as the most significant modifiable risk factor for hemorrhagic strokes [13]. Similarly, our findings concerning coagulation profile differences corroborate the results of studies such as the Hemorrhagic Stroke Project, which reported elevated INR values and prolonged clotting times in hemorrhagic stroke patients compared to ischemic stroke patients [14]. These consistent findings across diverse populations and study settings reinforce the robustness and generalizability of our results.

Conclusion. Our study provides comprehensive insights into the demographic, clinical, and coagulation profile disparities between hemorrhagic and ischemic stroke patients. By correlating our findings with previous similar studies, we underscore the consistency and reproducibility of these observations across different populations and research contexts. Understanding these differences is essential for refining risk stratification, guiding therapeutic decisions, and improving outcomes in the management of stroke patients.

CONFLICT OF INTEREST

None declared

AUTHOR'S CONTRIBUTIONS

1. Keesari Sai Sandeep Reddy (design feasibility assessment, acquisition of data, analysis and interpretation, final approval of manuscript)
2. Priyadarshini Varadaraj (design feasibility assessment, concept and design, analysis and interpretation of data, drafting of manuscript)
3. Subbaiah Senthilnathan (design feasibility assessment, acquisition of data, analysis and interpretation, final approval of manuscript)
4. Vivekanandan T (design feasibility assessment, acquisition of data, analysis and interpretation, final approval of manuscript)
5. Gunasekaran N (overall supervision, design feasibility assessment, analysis and interpretation, final approval of manuscript)

All authors have read and agreed to the published version of the manuscript.

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TABLES

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