
| RESEARCH ARTICLE

Factors Influencing Mortality in Intracerebral Hemorrhage Patients: A Literature Review

Andrew Yuda Lamba¹✉, Abdullah Machin², Asra Al Fauzi³, and Lathifatul Fikriyah⁴

¹Medical Student, Faculty of Medicine, Universitas Airlangga, Surabaya, Indonesia

²Department of Neurology, Faculty of Medicine, Universitas Airlangga / Universitas Airlangga Hospital, Surabaya, Indonesia

³Department of Neurology, Faculty of Medicine, Universitas Airlangga / Universitas Airlangga Hospital, Surabaya, Indonesia

²Department of Neurology, Faculty of Medicine, Universitas Airlangga / Universitas Airlangga Hospital, Surabaya, Indonesia

Corresponding Author: Abdullah Machin **E-mail:** abdulloh.m@fk.unair.ac.id

| ABSTRACT

Intracerebral hemorrhage (ICH) is a life-threatening neurological condition associated with high mortality rates worldwide. This study aimed to review and synthesize current evidence regarding factors influencing mortality in patients with ICH and to evaluate their relevance to clinical practice at Universitas Airlangga Hospital. A literature review was conducted using 20 peer-reviewed articles published between 2020 and 2025, complemented by three major neurology textbooks. The analysis focused on clinical, radiological, and comorbidity-related predictors of mortality reported in the literature. The findings consistently identified decreased Glasgow Coma Scale (GCS) scores, larger hematoma volumes, intraventricular hemorrhage (IVH), and comorbid conditions such as hypertension and diabetes mellitus as major predictors of mortality. Mortality outcomes were found to be strongly influenced by the interaction between acute hemorrhagic characteristics and underlying systemic diseases. Furthermore, the presence of IVH, infratentorial hemorrhage, hypertension, and diabetes mellitus emerged as key prognostic factors associated with poor clinical outcomes. These findings suggest that early risk stratification based on neuroimaging features, alongside comprehensive management of comorbidities during the acute phase, is essential for guiding clinical decision-making and improving patient outcomes in tertiary healthcare settings, including Universitas Airlangga Hospital.

| KEYWORDS

Intracerebral Hemorrhage, In-hospital Mortality, Prognostic Factors, Intraventricular Hemorrhage, Comorbidities.

| ARTICLE INFORMATION

ACCEPTED: 21 June 2026

PUBLISHED: 03 July 2026

DOI: 10.32996/jmhs.2026.7.9.2

1. Introduction

Intracerebral hemorrhage (ICH) represents approximately 10–15% of all stroke cases globally; however, it accounts for a disproportionately high burden of stroke-related mortality and persistent disability (Greenberg et al., 2022). In contrast to ischemic stroke, ICH is characterized by a rapidly evolving pathological process in which the initial brain injury results from the mass effect of the hematoma, followed by secondary injury mechanisms such as neuroinflammation, disruption of the blood–brain barrier, and the development of perihematomal edema (Jameson et al., 2022). Although significant progress has been made in neurocritical care management, mortality rates remain substantial, with nearly half of affected patients dying within 30 days of onset (Grotta et al., 2021). Therefore, a comprehensive understanding of the relationship between baseline clinical presentation, neuroimaging characteristics, and pre-existing comorbid conditions is essential for accurate prognostic assessment and informed clinical decision-making.

2. Methodology

This study employed a structured literature search of electronic databases, including PubMed, Scopus, and Google Scholar, to identify relevant publications from 2020 to 2025. A total of 20 peer-reviewed journal articles and three key neurology textbooks (Greenberg, 2023; Grotta et al., 2021; Jameson et al., 2022) were comprehensively reviewed. The analysis focused on identifying

independent predictors of in-hospital mortality among patients with intracerebral hemorrhage, with the aim of integrating current global evidence while considering its applicability to local clinical practice and healthcare priorities.

3. Result and Discussion

3.1 The Role of Neurological Status and Hematoma Metrics

Neurological condition at presentation, commonly assessed using the Glasgow Coma Scale (GCS), is consistently recognized as one of the strongest predictors of mortality in patients with intracerebral hemorrhage (Hostettler et al., 2021). Lower GCS scores reflect more severe neurological impairment and are closely associated with unfavorable clinical outcomes. In addition, hematoma volume plays a crucial role in determining the extent of intracranial pressure elevation and mass effect. In addition, hematoma volume is a major determinant of intracranial pressure elevation and neurological deterioration. Larger hematoma volumes are consistently associated with increased mortality and poorer functional outcomes, largely due to greater mass effect, cerebral edema, and risk of herniation. A hematoma volume greater than 30 cm³ is frequently considered a marker of severe disease and an unfavorable prognosis (Greenberg et al., 2022; Steiner et al., 2021).

3.2 Anatomical Predictors in ICH

The location of intracerebral hemorrhage plays a crucial role in determining patient prognosis. The presence of intraventricular hemorrhage (IVH) is recognized as a significant adverse prognostic factor, as it can obstruct cerebrospinal fluid circulation, lead to acute hydrocephalus, and contribute to elevated intracranial pressure, thereby worsening clinical outcomes (Li et al., 2020). Additionally, hemorrhages occurring in infratentorial regions, including the brainstem and cerebellum, are generally associated with higher mortality rates than supratentorial hemorrhages. This increased risk is largely attributable to the proximity of these lesions to critical brainstem structures that regulate essential respiratory and cardiovascular functions, making neurological deterioration more likely (Greenberg, 2023).

3.3 Inflammatory Markers and Coagulopathy

Recent evidence published between 2020 and 2025 has increasingly emphasized the contribution of systemic inflammatory processes to secondary brain injury following intracerebral hemorrhage. Several inflammatory biomarkers, including the Neutrophil-to-Lymphocyte Ratio (NLR) and Matrix Metalloproteinase-9 (MMP-9), have been associated with hematoma expansion and unfavorable clinical outcomes, suggesting their potential value as prognostic indicators (Wang et al., 2021; Zhu et al., 2022). In addition, the management of patients receiving antithrombotic therapy remains a significant clinical challenge. Individuals who develop ICH while on anticoagulant treatment often present with larger hematoma volumes and a greater risk of hematoma progression, underscoring the importance of prompt and appropriate reversal strategies to limit further neurological deterioration (Mayer et al., 2020).

3.4 The Impact of Comorbidities and Systemic Factors

In addition to the direct effects of hemorrhagic brain injury, pre-existing comorbid conditions play a substantial role in influencing mortality risk among patients with intracerebral hemorrhage. Hypertension is one of the most important underlying risk factors, contributing to chronic vascular damage, increased vessel fragility, and a greater likelihood of hematoma expansion (Greenberg, 2023). Similarly, Diabetes Mellitus (DM) has been consistently associated with unfavorable outcomes following intracerebral hemorrhage. Hyperglycemia at admission has been linked to increased neurological injury, greater risk of secondary brain damage, and higher mortality rates. These effects are thought to result from oxidative stress, endothelial dysfunction, and exacerbation of inflammatory pathways that contribute to ongoing neuronal injury (Greenberg et al., 2022; Jameson et al., 2022). Moreover, chronic kidney disease and other systemic comorbidities may adversely affect recovery by increasing susceptibility to medical complications, including infections, respiratory failure, and multi-organ dysfunction. These complications contribute substantially to morbidity and mortality during the subacute phase of intracerebral hemorrhage and often prolong hospitalization (Grotta et al., 2021; Jameson et al., 2022).

4. Conclusion

Mortality among hospitalized patients with intracerebral hemorrhage is strongly influenced by both the radiological characteristics of the hemorrhage and the presence of underlying comorbid conditions. Evidence synthesized from the current literature indicates that intraventricular hemorrhage (IVH), hemorrhage location, hypertension, and diabetes mellitus are among the most important factors associated with adverse clinical outcomes. These findings are highly applicable to tertiary healthcare settings, including Universitas Airlangga Hospital, where early prognostic assessment plays a critical role in clinical decision-making. Integrating neuroimaging findings with comorbidity evaluation during the acute phase can enhance risk stratification, facilitate timely management, and support more effective allocation of clinical resources. Consequently, early identification and targeted management of patients with high-risk prognostic features may contribute to reducing mortality and improving overall outcomes in tertiary care practice.

Funding: This research received no external funding.

Conflicts of Interest: The authors declare no conflict of interest.

Publisher's Note: All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers.

References

- [1] Greenberg, M. S. (2023). *Handbook of neurosurgery* (10th ed.). Thieme Medical Publishers.
- [2] Greenberg, S. M., Ziai, W. C., Cordonnier, C., Dowlathshahi, D., Francis, B., Goldstein, J. N., Hanley, D. F., Johnson, R., Keigher, K. M., Mack, W. J., McNair, N. D., Murthy, S. B., Pandey, A. S., Schwamm, L. H., Selim, M. H., Sheth, K. N., Sprigg, N., Sunnerhagen, K. S., & American Heart Association/American Stroke Association. (2022). Guideline for the management of patients with spontaneous intracerebral hemorrhage. *Stroke*, 53(7), e282–e361.
- [3] Grotta, J. C., Albers, G. W., Broderick, J. P., Kasner, S. E., Lo, E. H., Mendelow, A. D., Sacco, R. L., Wong, L. K. S., & other contributors. (2021). *Stroke: Pathophysiology, diagnosis, and management* (7th ed.). Elsevier.
- [4] Hostettler, I. C., Seiffge, D. J., Werring, D. J., & colleagues. (2021). Early neurological deterioration in patients with spontaneous intracerebral hemorrhage. *Journal of Neurology, Neurosurgery & Psychiatry*, 92(8), 868–875.
- [5] Jameson, J. L., Fauci, A. S., Kasper, D. L., Hauser, S. L., Longo, D. L., & Loscalzo, J. (2022). *Harrison's principles of internal medicine* (21st ed.). McGraw-Hill Education.
- [6] Li, Q., Warren, A. D., Qureshi, A. I., & colleagues. (2020). Prognostic importance of intraventricular hemorrhage progression in spontaneous intracerebral hemorrhage. *Neurocritical Care*, 33(2), 418–427.
- [7] Lusk, J. B., Covington, A., Liu, L., Weikel, D. P., Regenhardt, R. W., Kumar, S., Selim, M. H., & Rosand, J. (2023). Hyperglycemia, ischemic lesions, and functional outcomes after intracerebral hemorrhage. *Journal of the American Heart Association*, 12(13), e028632.
- [8] Puy, L., Parry-Jones, A. R., Sandset, E. C., Dowlathshahi, D., Ziai, W., & Cordonnier, C. (2023). Intracerebral haemorrhage. *Nature Reviews Disease Primers*, 9, 14.
- [9] Steiner, T., Al-Shahi Salman, R., Beer, R., Christensen, H., Cordonnier, C., Csiba, L., Forsting, M., Harnof, S., Klijn, C. J. M., Krieger, D., Mendelow, A. D., Molina, C., Montaner, J., Overgaard, K., Petersson, J., Roine, R. O., Schroeder, H. W. S., Sprigg, N., & European Stroke Organisation. (2021). European Stroke Organisation (ESO) guidelines for the management of spontaneous intracerebral hemorrhage. *European Stroke Journal*, 6(2), I–LXII.
- [10] Wang, Y., Li, Z., Gu, H., Zhai, Y., & colleagues. (2021). Neutrophil-to-lymphocyte ratio as a prognostic marker in spontaneous intracerebral hemorrhage. *Journal of Stroke and Cerebrovascular Diseases*, 30(5), 105680.
- [11] Witsch, J., Siegerink, B., Nolte, C. H., Sprügel, M., Steiner, T., Endres, M., & Huttner, H. B. (2021). Prognostication after intracerebral hemorrhage: A review. *Neurological Research and Practice*, 3, 22.
- [12] Zhu, Y., Wang, J., & colleagues. (2022). Role of matrix metalloproteinase-9 in the pathophysiology of intracerebral hemorrhage. *Frontiers in Neurology*, 13, 856421.