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ORIGINAL ARTICLE

Predictors of Mortality and Neurological Recovery in Patients with Intracerebral Hemorrhage

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ABSTRACT

Background: High mortality and long-term neurological impairment are linked to intracerebral hemorrhage (ICH), a severe type of hemorrhagic stroke. Improving patient outcomes requires early identification of mortality and recovery determinants.

Objective: The goal is to identify the factors that influence patients with intracerebral hemorrhage in terms of neurological recovery and mortality.

Material & Mathods: From August 2022 to August 2023, this descriptive observational study was carried out at Allied Hospital Faisalabad. There were 150 patients in all who had been diagnosed with spontaneous intracerebral hemorrhage. Clinical information was collected, including the Glasgow Coma Scale (GCS), comorbidities, and radiological findings such the location, volume, and intraventricular extension of the hematoma. The Modified Rankin Scale (mRS) was used to evaluate the results. SPSS version 26 was used to analyze the data, and $p < 0.05$ was deemed significant.

Result: Findings: The patients were 58% male and had a mean age of 61.4 ± 13.2 years. The overall death rate was 34%. Low GCS (≤8), high hematoma volume (>60 mL), intraventricular extension, and brainstem involvement were all substantially linked to poor outcomes ($p < 0.05$). Patients with smaller hematoma volumes and higher GCS scores showed better neurological recovery.

Conclusion: In conclusion, intraventricular extension, a big hematoma volume, and a low GCS score are all significant indicators of mortality in cases of intracerebral hemorrhage. For prompt care and better neurological outcomes, early identification of these factors is crucial.

Keywords: Allied Hospital Faisalabad intracerebral hemorrhage, mortality predictors neurological recovery; Glasgow Coma Scale hematoma volume stroke outcomes.

INTRODUCTION

One of the most serious types of stroke and a significant neurological emergency globally is intracerebral hemorrhage (ICH). It is characterized by bleeding straight into the brain parenchyma, usually as a result of small penetrating arteries rupturing as a result of long-term hypertension. Intracerebral hemorrhage is linked to disproportionately high rates of death and disability, although making up a smaller percentage of all strokes than ischemic stroke. ICH is one of the most deadly cerebrovascular disorders, accounting for 10–15% of all strokes and over 40% of stroke-related fatalities, according to global stroke data. (WHO, 2023)The pathophysiology of intracerebral hemorrhage is caused by an abrupt rupture of cerebral blood vessels, which results in the creation of a hematoma, elevated intracranial pressure, and mechanical compression of the surrounding brain tissue. Tissue breakdown causes primary brain damage, while inflammatory reactions, edema formation, and interruption of cerebral perfusion induce secondary brain damage. A key factor in clinical decline and unfavorable results is the hematoma's growth in the initial hours following commencement. Neurological impairments, including hemiplegia, altered consciousness, headaches, vomiting, seizures, and in extreme cases, coma, frequently appear suddenly in patients.The treatment of intracerebral hemorrhage is still mostly supportive, with an emphasis on blood pressure control, intracranial pressure management, and prevention of further brain injury, despite advancements in neurocritical care. Surgical procedures including decompressive craniectomy and hematoma evacuation are taken into consideration in certain situations, but their usefulness is still debatable and greatly depends on the timing and patient selection. As a result, patient outcomes differ greatly, and determining mortality and neurological recovery predictors is crucial for directing clinical decision-making and prognostication.The results of intracerebral hemorrhage are influenced by a number of clinical, radiological, and laboratory variables. One of the most critical factors is age; older patients have much greater mortality rates because of decreased physiological reserve and more comorbidities. Another reliable indicator of outcome is the degree of consciousness at presentation, which is often measured using the Glasgow Coma Scale (GCS). Patients who have low GCS scores are more likely to die and have poor neurological rehabilitation. Larger hematomas especially those involving deep brain structures like the brainstem, thalamus, or basal ganglia are linked to worse outcomes. Hematoma volume and location are other important factors.Apart from these variables, hematoma growth over the first 24 hours has been found to be a significant predictor of death. The prognosis is considerably worsened by early neurological impairment brought on by continuous bleeding. Poor outcomes are further exacerbated by radiological abnormalities such as intraventricular hemorrhage extension, midline shift, and perihematomal edema. Clinical practice frequently uses clinical scoring systems, such the ICH score, to stratify risk and direct treatment choices. These systems were created to predict mortality based on these characteristics.Following intracerebral hemorrhage, neurological recovery is dependent on a number of interrelated factors, such as the severity of the initial injury, prompt medical care, and availability of rehabilitation facilities. Long-term neurological abnormalities such motor weakness, speech impairment, cognitive dysfunction, and functional reliance are frequently experienced by patients who make it through the acute period. It has been demonstrated that early rehabilitation—including speech, occupational, and physical therapy—improves quality of life and functional outcomes. However, many patients continue to rely on caretakers, and recovery is frequently not complete.The most important modifiable risk factor for intracerebral hemorrhage is still hypertension. Small penetrating artery rupture and vascular degeneration are caused by poorly managed blood pressure. Anticoagulant and antiplatelet medication, cerebral amyloid angiopathy, alcoholism, smoking, and the use of illegal drugs like cocaine are additional risk factors. Anticoagulant-associated

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intracerebral hemorrhage, which is frequently linked to larger hematomas and worse outcomes, has become more common in older individuals due to the increased usage of anticoagulants.The burden of intracerebral hemorrhage is especially significant in low- and middle-income nations, where fatality rates are higher due to poor rehabilitative services, delayed hospital presentation, and restricted access to specialized neurocritical care. Early detection of high-risk patients is essential in these situations to maximize resource allocation and enhance survival rates. Therefore, it is crucial for doctors managing these patients in emergency and critical care settings to comprehend predictors of mortality and neurological recovery.Due to variations in study populations, healthcare systems, and management practices, stated predictors of outcome continue to vary despite substantial research. The intricacy of the disease course in intracerebral hemorrhage is shown by the fact that some patients with identical clinical presentations may have quite varied outcomes. To better establish trustworthy prognostic signs that may be used in standard clinical practice, more study is therefore required.In patients with intracerebral hemorrhage, the current study attempts to assess the determinants of neurological recovery and mortality. This study aims to uncover important outcome variables that could help doctors with early risk classification, enhance treatment planning, and direct patient and family counseling by examining demographic, clinical, and radiological characteristics.

MATERIAL & MATHODS

In order to assess determinants of mortality and neurological recovery in patients with intracerebral hemorrhage (ICH), a descriptive observational study was carried out at Allied Hospital Faisalabad between August 2022 and August 2023. Patients of any gender who were 18 years of age or older and had a diagnosis of spontaneous intracerebral hemorrhage based on clinical presentation and verified by a brain computed tomography (CT) scan were included in the study.The study did not include patients with brain tumors, subarachnoid hemorrhage, severe intracerebral hemorrhage, or insufficient medical data. Non-probability consecutive sampling was used to enroll 150 patients who met the inclusion criteria.A structured proforma was used to gather data on demographic factors (age, gender), clinical parameters (blood pressure, Glasgow Coma Scale [GCS] level of consciousness at presentation, comorbidities like diabetes and hypertension), and radiological findings (hematoma location, hematoma volume, midline shift, and intraventricular extension). The ABC/2 method using CT scan imaging was used to calculate the hematoma volume.All patients were initially managed in accordance with normal neurocritical care procedures, which included supportive care in the emergency or intensive care unit, blood pressure control, and intracranial pressure management. When necessary, surgical interventions such as decompressive operations or hematoma evacuation were recorded.

At discharge and, if available, at follow-up, neurological recovery was evaluated using the Modified Rankin Scale (mRS). The results were divided into three categories: mortality (mRS 6), poor recovery (mRS 3–5), and satisfactory recovery (mRS 0–2).Version 26 of the Statistical Package for Social Sciences (SPSS) was used to analyze the data. While categorical variables were shown as percentages and frequencies, quantitative variables were reported as mean ± standard deviation. Using the chi-square test and logistic regression analysis, the relationship between predictors (age, GCS score, hematoma volume, location, and intraventricular extension) and outcomes (mortality and neurological recovery) was evaluated. Statistical significance was defined as a p-value of less than 0.05. Patients or attendants gave their informed consent before being included in the study, and Allied Hospital Faisalabad's institutional review board granted ethical approval. Throughout the study period, ethical standards and confidentiality were rigorously upheld.

RESULT

This study, which was carried out at Allied Hospital Faisalabad between August 2022 and August 2023, involved 150 patients with intracerebral hemorrhage (ICH). Patients were primarily male (58%), with a mean age of 61.4 ± 13.2 years. With 72% of cases, hypertension was the most prevalent risk factor, followed by diabetes mellitus (38%) and anticoagulant use (22%). 44% of patients had a Glasgow Coma Scale (GCS) score of less than 8 at presentation, 36% had scores between 9 and 12, and 20% had mild impairment with GCS scores between 13 and 15. The basal ganglia (46%), lobar (28%), thalamic (16%), and brainstem or cerebellar regions (10%) were the most frequently bleeding sites. 34% of patients had intraventricular extension, and 40% had midline shift.

Table 1: Baseline Characteristics of ICH Patients (n = 150)

Variable	Frequency	Percentage
Mean age (years)	61.4 ± 13.2	—
Male	87	58%
Female	63	42%
Hypertension	108	72%
Diabetes mellitus	57	38%
Anticoagulant use	33	22%

Table 2: Clinical and Radiological Features

Parameter	Frequency	Percentage
GCS ≤ 8	66	44%
GCS 9–12	54	36%
GCS 13–15	30	20%
Basal ganglia bleed	69	46%
Lobar hemorrhage	42	28%
Thalamic hemorrhage	24	16%
Brainstem/cerebellar	15	10%
Intraventricular extension	51	34%
Midline shift	60	40%

Table 3: Outcomes of ICH Patients

Outcome	Frequency	Percentage
Survival	99	66%
Mortality	51	34%
Good recovery (mRS 0–2)	63	42%
Poor outcome (mRS 3–5)	36	24%

DISCUSSION

The present study was intended to investigate the determinants of mortality and neurological recovery in patients of spontaneous intracerebral haemorrhage (ICH) admitted in Allied Hospital Faisalabad. Results indicated that despite the advancements in neurocritical care, intracerebral haemorrhage remains linked with significant mortality and poor functional result. Low GCS at presentation, big hematoma volume, intraventricular extension, midline shift, and deep brain involvement were substantially linked with higher mortality and poor neurological recovery. In contrast, patients with higher GCS scores, lower hematoma sizes, and no ventricular extension had considerably better functional prognosis. These results highlight the necessity of early clinical and radiological evaluation to identify high risk individuals who require aggressive care.The mortality rate of 34% found in the present study is consistent to the results of previous international investigations. Mortality after spontaneous intracerebral haemorrhage is between 30% and 50% [7,8]. Stroke therapy has improved, yet ICH is one of the most fatal cerebrovascular illnesses because of rapid hematoma growth, increased intracranial pressure, and subsequent brain injury. Similar fatality rates have been observed in multicenter stroke registries, which underscore the deadly nature of this illness and the need for early detection and care[7].One of the strongest predictors of mortality in this study was the Glasgow Coma Scale (GCS) score at admission. Almost half of the patients had a GCS score of ≤8 and these patients had considerably worse neurological outcomes and mortality . These findings are in line with Hemphill et al. who found admission GCS to be one of the key components of the ICH Score,

and a substantial predictor of short-term mortality[9]. The GCS score is inversely proportional to the severity of the neurological injury, intracranial pressure, and cerebral perfusion and is associated with a bad prognosis.Hematoma volume was also significantly correlated with mortality and neurological improvement. Patients with higher hematoma volumes had considerably poorer outcomes than those with smaller haemorrhages. Similarly, hematoma size has been observed to correlate directly with mortality in previous research as larger haemorrhages induce more destruction of tissue, mass effect, cerebral oedema, and increased intracranial pressure[10,11]. Thus, early measurement of hematoma volume by computed tomography remains an important component of prognostic evaluation and treatment planning.Presence of intraventricular haemorrhage extension was another key predictor of poor outcome in the current investigation. Ventricular extension was observed in almost one third of patients and was related with considerably increased mortality and poorer neurological rehabilitation. Steiner et al. found similar findings, showing that intraventricular extension increases the risk for hydrocephalus, ventricular blockage and secondary neurological impairment[12]. Thus, early diagnosis of ventricular involvement is critical to allow for rapid neurosurgical consultation and adequate cerebrospinal fluid diversion, as necessary.The anatomical site of haemorrhage was also of significance to the patient outcomes. Brainstem and deep cerebral haemorrhages were linked with significantly worse neurological recovery compared with lobar haemorrhages. Bleeding into the brainstem often destroys important autonomic centres for respiration and cardiovascular regulation and therefore has a very high mortality. Similarly, haemorrhages in the basal ganglia and thalamus often result in significant motor impairments due to involvement of corticospinal circuits and deep brain nuclei[10]. Similar findings have been described in other neurocritical care studies evaluating functional outcomes following spontaneous intracerebral haemorrhage[13].Hypertension was shown to be the most common underlying risk factor seen in over three-quarters of the study sample. This finding is in line with the well documented observation that persistent hypertension is the most important modifiable risk factor for spontaneous intracerebral haemorrhage worldwide[14]. Longstanding hypertension leads to lipohyalinosis, microaneurysm development and degeneration of small penetrating arteries rendering the patient susceptible to sudden rupture of vessels. These findings underscore the necessity of community-based preventative methods and regular clinical follow-up to regulate blood pressure effectively and lower risk of hemorrhagic stroke.The present study also indicated considerably improved neurological recovery in patients with higher GCS scores, smaller hematoma volume and no intraventricular extension. The Modified Rankin Scale revealed good functional recovery in almost half of the survivors. Early multimodal rehabilitation combining physiotherapy, occupational therapy and speech therapy has also been demonstrated to dramatically improve functional independence and quality of life after intracerebral haemorrhage[15]. These findings emphasise the significance of incorporating rehabilitation services within comprehensive stroke care programmes.The results of this investigation have substantial clinical consequences. Early identification of patients with low GCS scores, large hematoma volumes, ventricular extension, or brainstem involvement may facilitate timely admission to specialised neurocritical care units, earlier neurosurgical intervention, and more accurate prognostic counselling for patients and their families. Clinical scoring systems such as the ICH Score remain useful tools to include these predictive variables into the routine of clinical decision making and should be used in conjunction with extensive radiological assessment[9].Several constraints need to be acknowledged. The findings may be limited in terms of generalizability due to the study being conducted in a single tertiary care hospital with a limited sample size. Long-term neurological prognosis after hospital release was not routinely available. Serial examination of hematoma growth was not undertaken. Moreover, no sophisticated neuroimaging biomarkers and laboratory parameters were assessed. Future prospective studies from many centres and with larger populations of patients with longer follow-up are needed to confirm these findings and to develop more comprehensive prognostic models for patients with intracerebral haemorrhage.

CONCLUSION

According to the study's findings, intracerebral hemorrhage is linked to a high death rate and substantial long-term neurological impairment, especially in older hypertensive individuals. The results from patients treated at Allied Hospital Faisalabad showed that a number of clinical and radiological parameters are important predictors of neurological recovery as well as mortality.Strong indicators of poor outcomes and higher mortality were found to include low Glasgow Coma Scale (GCS) score at presentation, big hematoma volume, intraventricular extension, midline shift, and deep brain involvement (particularly brainstem and basal ganglia hemorrhages). Patients with lower hematoma volumes, minimal ventricular involvement, and higher GCS scores, on the other hand, demonstrated noticeably superior neurological recovery and survival rates.For prompt risk categorization, the study emphasizes the significance of early evaluation and quick neuroimaging in all suspected cases of intracerebral hemorrhage. Clinicians can make quick decisions about intensive care admission, surgical intervention, and family counseling by identifying high-risk patients early.In general, a multidisciplinary strategy involving emergency treatment, neurocritical monitoring, and rehabilitation services is necessary for the successful management of intracerebral hemorrhage. Improving early intervention techniques and fortifying stroke care infrastructures can greatly increase these patients' chances of survival and functional outcomes.

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