Case Series

Electrocardiographic Alterations in Patients with Acute Cerebral Hemorrhage: A Case Series and Implications for Critical Care Nursing

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Abstract

Introduction. Acute cerebral hemorrhages may be associated with secondary cardiovascular manifestations, including electrocardiographic abnormalities, even in the absence of pre-existing structural heart disease. In the intensive care setting, the early recognition of these abnormalities may have both clinical and nursing relevance.

Methods. A single-center observational case series was conducted at the Intensive Care Unit of the ARNAS "G. Brotzu" Hospital in Cagliari, Italy. Twenty-five patients admitted between July and October 2025 with a diagnosis of acute cerebral hemorrhage, including subarachnoid hemorrhage, intracerebral hemorrhage, and subdural hematoma, were included. ECG abnormalities observed during the first 5 days of hospitalization and their clinical and nursing significance were analyzed.

Results. Electrocardiographic abnormalities were observed in 15 of 25 patients (60.0%). Among patients with ECG abnormalities, 9 (60.0%) presented isolated QTc prolongation, 3 (20.0%) showed isolated T-wave abnormalities, and 3 (20.0%) exhibited both findings. No clinically significant ST-segment changes or rhythm disturbances were detected. Pupillary abnormalities and hypertension were observed in 36.0% and 32.0% of patients, respectively.

Conclusions. In this case series, ECG abnormalities, particularly QTc prolongation, were frequent in patients admitted to the intensive care unit for acute cerebral hemorrhage. When integrated with neurological and hemodynamic assessment, ECG monitoring may represent a useful tool for the early recognition of complications and for planning targeted nursing interventions in neurocritical patients.

Keywords: Acute Cerebral Hemorrhage, Electrocardiographic Abnormalities, QTc Prolongation, Neurocritical Care, Intensive Care Nursing, Nursing Assessment

Introduction

Acute intracranial hemorrhages—including intracerebral hemorrhage, subarachnoid hemorrhage, and subdural hematoma—represent neurological emergencies associated with high morbidity and mortality. Beyond the primary brain injury, these conditions can be associated with significant cardiovascular manifestations, including electrocardiographic (ECG) abnormalities, even in patients without preexisting heart disease. This association has been consistently described in the literature (Liu, Ding, Yan, et al., 2011; Liu, Ding, Zhang, et al., 2011; Takeuchi et al., 2015), and the most commonly reported ECG abnormalities include QTc interval prolongation, STsegment changes, T-wave inversion or flattening, the presence of prominent U waves, and the occurrence of both supraventricular and ventricular arrhythmias (Chatterjee, 2011; Frontera et al., 2008; Takeuchi et al., 2015; van den Bergh et al., 2004).

Pathophysiologically, these manifestations are primarily attributed to autonomic nervous system dysregulation induced by the acute brain injury. Sympathetic overactivation and massive catecholamine release can lead to myocardial electrical instability, repolarization abnormalities, and transient cardiac damage. Indeed, neurocardiological literature supports the existence of a tight brain-heart interaction in acute brain injuries, where the catecholamine surge represents a primary pathogenetic mechanism (Chen et al., 2017; Hasegawa et al., 2022; Mo et al., 2019; Salem et al., 2014).

In the intensive care unit (ICU) setting, the early recognition of ECG abnormalities has significant implications for patient care, as these anomalies may reflect neurological deterioration, precipitate hemodynamic instability, or require rapid clinical and instrumental reassessment. In this scenario, nurses play a fundamental role in continuous monitoring, rhythm interpretation, QTc measurement and reassessment, alarm management, and the timely communication of abnormalities to the multidisciplinary team. Practice standards for in-hospital electrocardiographic monitoring emphasize the importance of nursing competence in the early detection of arrhythmias, ischemia, and QT prolongation, while implementation studies have shown that targeted nursing education improves knowledge, quality of care, and patient outcomes (Drew et al., 2004; Funk et al., 2017; Sandau et al., 2017). From this perspective, integrating clinical monitoring with structured nursing care planning is also particularly relevant in patients with acute intracranial hemorrhage (Tambasco, 2018).

The objective of this case series is to describe the main ECG abnormalities observed in the early stages of the event among patients with acute intracranial hemorrhage admitted to the ICU, and to discuss their clinical and nursing

significance. Particular attention is given to the early recognition of complications and the planning of targeted nursing interventions for neurocritical patients.

Materials and Methods

Study Design

A single-center observational case series was conducted in the intensive care unit (ICU) to describe the electrocardiographic (ECG) abnormalities observed in patients with acute intracranial hemorrhage, and to further explore their potential clinical and nursing significance within the context of nursing monitoring.

Setting and Observation Period

The study was carried out at the ICU of the ARNAS "G. Brotzu" hospital (Cagliari, Italy). Patients admitted between July 9, 2025, and October 20, 2025, were included.

Participants

The sample comprised 25 patients diagnosed with acute intracranial hemorrhage—including cases of subarachnoid hemorrhage (SAH), subdural hematoma (SDH), and intracerebral hemorrhage (ICH)—admitted to the ICU during the observation period. Patients were considered eligible if their clinical, nursing, and electrocardiographic data from the initial phase of admission were available.

Clinical and Nursing Data Collection

To standardize the observation, data collection was limited to the first 5 days following the acute event, a timeframe deemed clinically relevant to document both early electrocardiographic abnormalities and primary nursing needs during the initial phase of hospitalization.

For each patient, key clinical and nursing data were collected, including:

- Essential demographic data;
- Type of intracranial hemorrhage;
- Neurological status, with particular reference to the Glasgow Coma Scale (GCS);
- Pupillary status;
- Hemodynamic parameters, including the presence of hypertension;
- Occurrence of clinical complications during hospitalization, including infections;
- Presence of ECG abnormalities.

Electrocardiographic Assessment

Electrocardiographic assessment was performed within the first 5 days of the acute event (corresponding to the most critical phase of autonomic activation and the highest incidence of ECG abnormalities reported in the literature). For descriptive purposes, the main ECG abnormalities of clinical interest in the neurocritical patient were considered, with particular focus on:

- QTc interval prolongation;
- T-wave abnormalities;
- ST-segment changes;
- Rhythm disturbances.

The observed abnormalities were subsequently classified by type in order to describe their distribution within the case series and to descriptively relate them to the patients' clinical conditions.

Nursing Assessment and Care Planning

Nursing assessment was conducted using Gordon's functional health patterns and NANDA-I nursing diagnoses (2024–2026 edition) specifically applicable to the case series, in order to identify the main compromised needs, primarily during the initial phase of admission, but also throughout the hospital stay. Based on this framework, corresponding nursing outcomes were identified according to the Nursing Outcomes Classification (NOC) and interventions according to the Nursing Interventions Classification (NIC), thereby defining a care plan consistent with the observed clinical conditions.

Data Analysis

Data were analyzed using descriptive

statistics. Categorical variables were reported as absolute frequencies and percentages. The analysis aimed to describe the clinical characteristics of the sample, the frequency of ECG abnormalities, the distribution of the main types of electrocardiographic anomalies, and their descriptive co-occurrence with specific clinical variables of interest, such as neurological status, pupillary abnormalities, hypertension, and infectious complications. Given the descriptive nature of the case series and the limited sample size, inferential analyses were not performed.

Ethical Considerations

The study was conducted in accordance with the principles of the Declaration of Helsinki and current regulations regarding observational research. The analyzed data were derived from routine clinical and nursing practice in the ICU; they were anonymized and analyzed in aggregate form. The entire data collection and management process was oriented toward protecting the confidentiality, dignity, and safety of the patients.

Results

The study sample comprised 25 patients admitted to the intensive care unit (ICU) with a diagnosis of acute intracranial hemorrhage. Of these, 14 were male (56.0%) and 11 were female (44.0%). The observed population consisted predominantly of adult and elderly subjects, with the exception of a single 14-year-old pediatric case.

Regarding neurological status during the initial phase of admission, 4 patients (16.0%) showed an improvement in their Glasgow Coma Scale (GCS) score, while the remaining 21 patients (84.0%) showed no improvement during the first 5 days of observation (Figure 1).

ECG abnormalities were observed in 15 out of 25 patients (60.0%) (Figure 2), whereas 10 patients (40.0%) presented no detectable electrocardiographic anomalies during the considered period. Among the 15 patients with ECG abnormalities, 9 (60.0%) presented exclusively with QTc interval prolongation, 3 (20.0%) showed exclusively T-wave abnormalities, and 3 (20.0%) exhibited both anomalies (Figure 3). No clinically significant ST-segment changes or rhythm disturbances were detected in the observed sample.

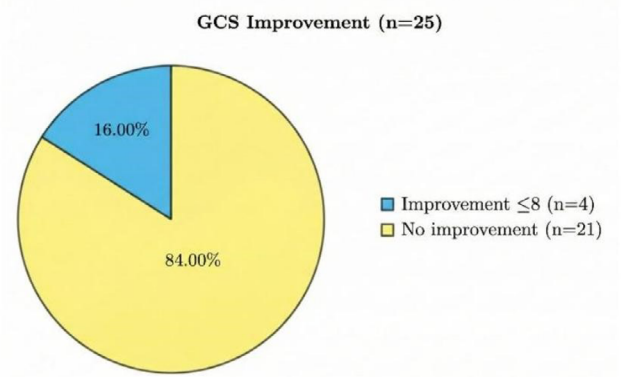

Figure 1. Glasgow Coma Scale improvement within the first 5 days of observation among patients with acute intracranial hemorrhage (n = 25).

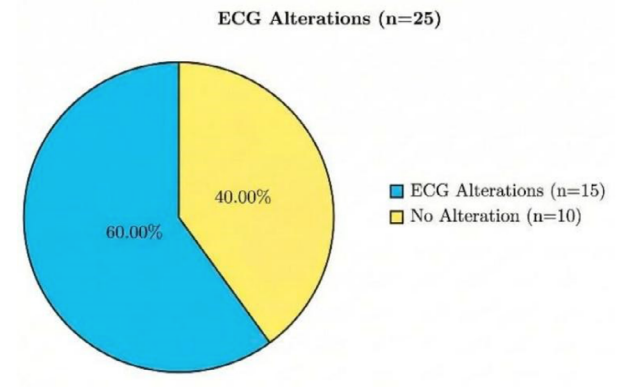

Figure 2. Prevalence of electrocardiographic abnormalities among patients with acute intracranial hemorrhage (n = 25).

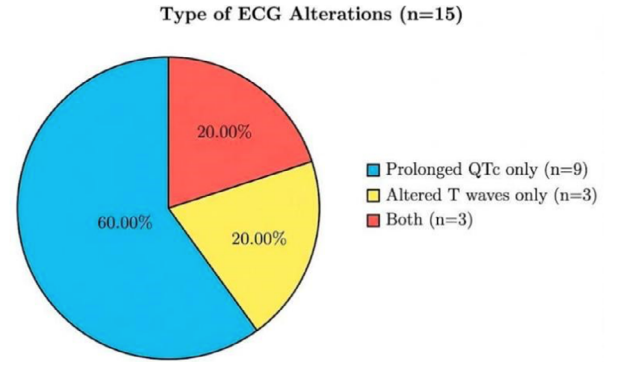

Figure 3. Distribution of electrocardiographic abnormalities among patients with abnormal ECG findings (n = 15).

Pupillary abnormalities were detected in

9 patients (36.0%). Among these, 6 patients (66.7%) concurrently presented with ECG abnormalities, whereas 3 (33.3%) showed no electrocardiographic anomalies (Figure 4).

Hypertension was present in 8 patients (32.0%); of these, 5 (62.5%) also exhibited ECG abnormalities, while 3 (37.5%) showed no tracing anomalies (Figure 5). During hospitalization, 5 patients (20.0%) developed infections. Although not directly related to the ECG findings, this latter variable represents a the

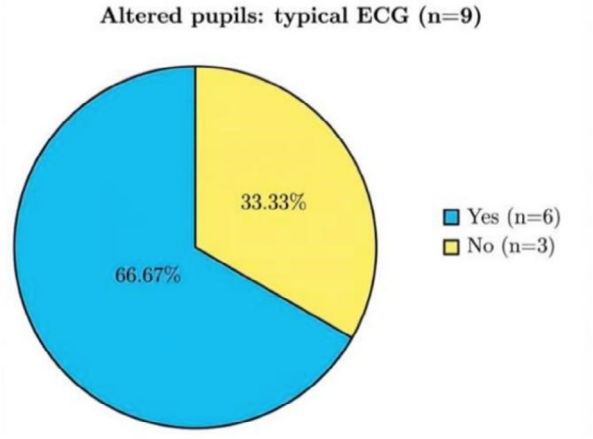

Figure 4. Presence of electrocardiographic abnormalities among patients with pupillary abnormalities (n = 9).

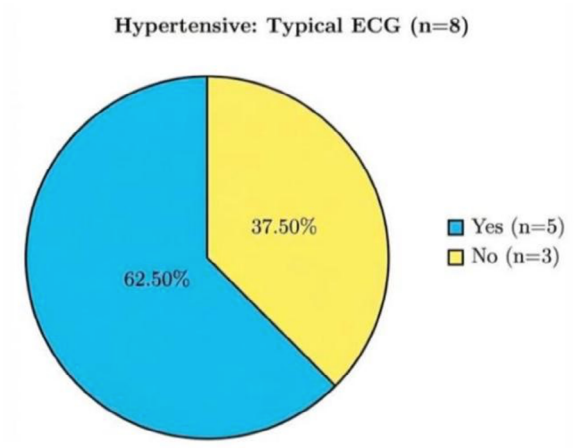

Figure 5. Presence of electrocardiographic abnormalities among patients with hypertension (n = 8).

Overall, in the observed sample, ECG abnormalities were present in 60.0% of patients admitted to the intensive care unit for acute intracranial hemorrhage, with QTc interval prolongation being the most prevalent among the detected anomalies.

The collected data are summarized in Table 1.

Table 1. Demographic, neurological, electrocardiographic, and clinical characteristics of the study population (n = 25).

Variable	n/N	%
Total patients included	25/25	100.0
Male	14/25	56.0
Female	11/25	44.0
GCS improvement within the first 5 days	4/25	16.0
No GCS improvement within the first 5 days	21/25	84.0
Presence of ECG abnormalities	15/25	60.0
Absence of ECG abnormalities	10/25	40.0
Isolated QTc prolongation	9/15	60.0
Isolated T-wave abnormalities	3/15	20.0
QTc prolongation + T-wave abnormalities	3/15	20.0
Pupillary abnormalities	9/25	36.0
With ECG abnormalities	6/9	66.7
Without ECG abnormalities	3/9	33.3
Hypertension	8/25	32.0
With ECG abnormalities	5/8	62.5
Without ECG abnormalities	3/8	37.5
In-hospital infections	5/25	20.0

Discussion

In the present case series, electrocardiographic (ECG) abnormalities were observed in 60.0% of patients admitted to the Intensive Care Unit (ICU) for acute cerebral hemorrhage, with a higher prevalence of QTc prolongation than isolated T-wave abnormalities. Although the sample size was limited, this finding is consistent with the literature describing a frequent association between acute brain injury and ECG abnormalities, likely mediated by brain-heart interaction mechanisms and autonomic dysregulation (Chen et al., 2017; Mo et al., 2019).

However, the main relevance of our findings lies not only in the presence of these ECG changes, but also in their interpretation within nursing care. In neurocritical patients, QTc prolongation and T-wave abnormalities should be considered together with neurological status, hemodynamic stability, respiratory function, and the overall risk of complications. In this context, continuous ECG monitoring represents an important tool for identifying clinical instability and guiding nursing surveillance in the critical care setting.

The use of Gordon's Functional Health Patterns and NANDA-I nursing diagnoses allowed these

clinical findings to be incorporated into a structured assessment of care needs. In addition, the integration of NOC (Nursing Outcomes Classification) and NIC (Nursing Interventions Classification) made it possible to translate clinical data into a targeted care plan. This plan focuses on neurological and hemodynamic monitoring, management of reversible predisposing factors, pharmacological review, and prevention of respiratory complications and immobility-related problems.

The relationship between assessment, nursing diagnoses, and interventions is summarized in Table 2 (Tambasco, 2018). These findings reinforce the pivotal role of the ICU nurse in the early recognition and clinical and nursing interpretation of ECG abnormalities. Recent guidelines on hospital-based ECG monitoring also emphasize the importance of nursing competencies in the prompt detection of QT interval changes and in the safe management of critically ill patients (Sandau et al., 2017).

Limitations

The present study has several limitations that must be considered when interpreting the results. The small sample size and the single-center observational design limit the generalizability of the findings. Furthermore, the observed ECG abnormalities may have been influenced by confounding factors such as pharmacological therapy, electrolyte imbalances, hemodynamic fluctuations, and pre-existing cardiovascular comorbidities. Finally, the clinical heterogeneity of the study population and the limited observational window, restricted to the initial phase of ICU admission, preclude the evaluation of the long-term evolution of the observed findings. Despite these constraints, this study retains its descriptive and exploratory value, providing useful insights for future research involving larger cohorts in multicenter settings.

Conclusions

In this case series, ECG abnormalities—particularly QTc prolongation and T-wave alterations— were frequently observed in patients admitted to the ICU for acute cerebral hemorrhage.

Table 2. NANDA-I nursing diagnoses, corresponding Nursing Outcomes Classification (NOC) outcomes, and Nursing Interventions Classification (NIC) interventions for patients with acute intracranial hemorrhage.

NANDA-I Nursing Diagnosis (Code)	Main NOC Outcomes	Main NIC Interventions
Risk for ineffective cerebral tissue perfusion (00201)	Neurological stability; absence of GCS deterioration; headache controlled	Blood pressure control according to target; neutral head positioning; prevention of hypoxia and hypercapnia; serial neurological monitoring
Impaired	Effective ventilation; adequate respiratory rate and depth; stable O_2 saturation; absence of accessory muscle use	Airway management; ventilatory/mechanical support when indicated; head-of-bed elevation at 30–45°; arterial blood gas and SpO_2 monitoring
Impaired gas exchange (00030)	Adequate oxygenation (PaO_2/SpO_2); normocapnia; absence of cyanosis or dyspnea at rest	Oxygen therapy or ventilation as prescribed; promotion of effective coughing when possible; secretion management and suctioning if needed
Ineffective airway clearance (00031)	Patent airways; reduced or manageable secretions; vesicular breath sounds on auscultation	Bronchial hygiene; adequate hydration; bronchial suctioning when indicated
Risk for aspiration (00039)	Absence of aspiration episodes; safe swallowing; tolerance to nutrition	Dysphagia assessment; nasogastric tube placement or enteral nutrition when indicated; modified food consistency
Impaired physical mobility (00085)	Preserved muscle tone and strength; absence of complications related to immobility. immobilityrelated complications	Caregiver education; early mobilization; pressure injury prevention

Acknowledging the limitations of a small, single-center cohort, these findings confirm the clinical relevance of continuous electrocardiographic monitoring during the early stages of an acute neurological event.

From a nursing care perspective, ECG data should not be evaluated in isolation but rather integrated with the patient's neurological status,

hemodynamic stability, respiratory function, and overall risk of complications. In this context, the ICU nurse plays a pivotal role in the early recognition of ECG abnormalities, continuous clinical and instrumental surveillance, and the prompt initiation of targeted interventions. The integration of nursing assessment, NANDA-I diagnoses, NOC outcomes, and NIC interventions allows clinical and instrumental findings to be translated into a structured care plan aimed at ensuring the safety of the neurocritical patient.

Therefore, the study results suggest that ECG monitoring, when incorporated into a comprehensive nursing assessment, represents a valuable tool for the early detection of complications and the planning of targeted nursing interventions in patients with acute cerebral hemorrhage.

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