

Acute Traumatic Epidural Hematoma with Significant Midline Shift Following a Helmetless Motorcycle Accident: A Case Report on Emergent Craniotomy and Favorable Neurological Recovery in a Young Adult

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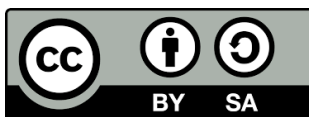
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Abstract

Traumatic epidural hematoma (EDH) is a neurosurgical emergency commonly observed in young men following high-energy head trauma, particularly motorcycle-related traffic accidents. Although EDH accounts for approximately 8% of traumatic brain injuries, timely surgical evacuation is associated with favorable neurological outcomes, whereas delayed diagnosis or treatment may result in rapid neurological deterioration and death. An 18-year-old male patient presented to the emergency department following a motorcycle crash without a helmet, with loss of consciousness, vomiting, and a laceration in the left supraorbital region. On admission, his Glasgow Coma Scale (GCS) score was 6 (E1V1M4), accompanied by anisocoria (pupillary diameters of 2 mm and 4 mm) and sluggish pupillary light responses. Noncontrast computed tomography (CT) of the head revealed a well-defined, biconvex hyperdense extra-axial collection in the left frontotemporoparietal region, associated with a 1.6-cm rightward midline shift, consistent with acute EDH. The patient underwent emergency craniotomy and hematoma evacuation. Postoperatively, his neurological status progressively improved, with the GCS score increasing from 6T to 15 within four days. He was subsequently extubated, transferred from the intensive care unit, and discharged home with a favorable neurological outcome. At outpatient follow-up, the surgical wound had healed well. This case illustrated the characteristic clinical and radiological features of acute traumatic EDH and emphasized the importance of rapid assessment, early neuroimaging, and timely surgical evacuation in preventing secondary brain injury. Despite the patient's initially low GCS score and substantial midline shift, favorable neurological recovery was achieved following emergency surgical intervention, consistent with evidence supporting early hematoma evacuation as a critical modifiable factor associated with improved survival and functional outcomes in patients with traumatic EDH.



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INTRODUCTION

(Montemurro et al., 2020) Traumatic brain injury (TBI) remains a leading cause of death and disability worldwide, with traumatic epidural hematoma (EDH) representing one of its most acute and time-sensitive manifestations. (Rahimi et al., 2022; (MR et al., 2006) EDH is characterized by the accumulation of blood between the inner surface of the skull and the dura mater, most commonly resulting from injury to the middle meningeal artery or its branches following a temporal or temporoparietal skull fracture, although venous and dural venous sinus bleeding may also contribute (DS & JG, 2016). Because the periosteal layer of

the dura mater can separate from the inner surface of the skull, particularly in regions between cranial sutures, arterial hemorrhage may rapidly expand within the epidural space. This process produces the characteristic biconvex, or lentiform, hyperdense extra-axial collection observed on computed tomography (CT), typically limited by cranial suture lines. (DS & JG, 2016) Pisciă et al., 2024) Clinically, EDH may present with a characteristic triphasic course involving an initial loss of consciousness following trauma, a transient period of apparent neurological recovery known as the "lucid interval," and subsequent neurological deterioration as the hematoma expands and intracranial pressure increases. However, this presentation is not universal, as the lucid interval has been reported in only 10–33% of cases. Many patients instead present with persistently impaired consciousness immediately following injury, as observed in the present case (JC, 2013; Irie et al., 2011; SS et al., 2024).

Epidemiologically, EDH occurs in approximately 8% of patients with TBI, with reported pooled incidences of 9.2% in high-income countries and 5.8% in low- and middle-income countries (LMICs). An estimated 3.1 million individuals worldwide require surgical intervention for traumatic EDH annually (Rahimi et al., 2022). Large multicenter investigations, including the Collaborative European NeuroTrauma Effectiveness Research in Traumatic Brain Injury (CENTER-TBI) study, have reported EDH on initial CT scans in approximately 11% of patients admitted with TBI and up to 16% of those with severe TBI. The median age of affected patients was within the fourth decade of life, although surgically treated patients tended to be younger. (Faried et al., 2017) Traumatic EDH disproportionately affects adolescents and young adult males, a pattern also observed in Indonesia and other Southeast Asian countries. A large single-center study conducted in Bandung, West Java, reported that motorcycle crashes accounted for nearly two-thirds of emergency department presentations involving head injuries, while more than 70% of patients with moderate-to-severe TBI were not wearing helmets at the time of injury. (AW & NUE, 2025; Cremonini et al., 2020) Similarly, a recent Indonesian registry-based investigation conducted in North Maluku, known as the NOMADEN study, reported that more than 90% of patients with motorcycle-related TBI were not wearing helmets. The study also identified admission Glasgow Coma Scale (GCS) scores and prolonged injury-to-admission intervals as independent predictors of in-hospital mortality, with delayed admission associated with an adjusted odds ratio exceeding 5 (Vastani et al., 2023). Collectively, these findings highlight traumatic EDH as an important public health concern associated with preventable road traffic injuries, particularly in LMICs, including Indonesia (JH et al., 2022).

The clinical significance of traumatic EDH lies in its potential for rapid neurological deterioration and death when diagnosis or treatment is delayed, contrasted with the favorable outcomes achievable through timely recognition and surgical evacuation (EH et al., 2025). Established surgical indications include an EDH volume greater than 30 cm³, regardless of the patient's GCS score. Surgical evacuation is also generally indicated for smaller hematomas when associated with a thickness exceeding 15 mm, a midline shift greater than 5 mm, or progressive neurological deterioration (Nakamura et al., 2023). Furthermore, patients presenting with coma (GCS score below 9) and anisocoria require surgical evacuation as soon as possible. Despite advances in neurosurgical management, mortality associated with traumatic EDH remains disproportionately high in LMICs compared with high-income countries, partly because of delays in prehospital transportation, access to diagnostic

neuroimaging, and definitive neurosurgical intervention. The present case report describes an 18-year-old man who sustained an acute left frontotemporoparietal EDH with substantial midline shift following a motorcycle crash without a helmet and subsequently achieved favorable neurological recovery after emergency craniotomy and hematoma evacuation. This case highlights the importance of early diagnosis, timely surgical intervention, and coordinated emergency neurosurgical management in optimizing clinical outcomes among patients with severe traumatic EDH (Yang et al., 2022).

Case Illustration

An 18-year-old man was brought to the emergency department after being found unconscious at the scene of a motorcycle traffic accident. He had been riding without a helmet. Witnesses reported an episode of vomiting after the incident, and a laceration was noted over the left supraorbital region. There was no history of a preceding lucid interval reported by bystanders; the patient remained unresponsive from the time of the accident to arrival at the hospital (Peng et al., 2022).

On initial assessment using the Advanced Trauma Life Support (ATLS) protocol, the airway was patent without gurgling or snoring, and a cervical collar was applied as a precaution. Breathing was irregular with a respiratory rate of 28 breaths per minute and oxygen saturation of 97% on room air; chest expansion was symmetrical and auscultation was unremarkable. Circulatory status was stable, with a strong pulse at 103 beats per minute, blood pressure of 107/87 mmHg, and capillary refill under two seconds. Neurological examination revealed anisocoria (2 mm on the right, 4 mm on the left) with a sluggish pupillary light reflex and a Glasgow Coma Scale (GCS) of E1V1M4, totaling 6 indicating severe traumatic brain injury. A $6 \times 0.5 \times 0.5$ cm laceration was identified over the left supraorbital region with mild eyelid edema; the remainder of the secondary survey, including pulmonary, cardiac, abdominal, and extremity examination, was unremarkable.

Initial laboratory evaluation obtained in the emergency department is summarized in Table 1. Findings were notable for a stress-pattern leukocytosis, consistent with the acute physiological response to trauma, while hemoglobin, hematocrit, platelet count, and random blood glucose remained within normal limits.

Table 1. Initial laboratory findings.

Parameter	Result	Reference Range (Male)	Unit
Hemoglobin	15.1	14.0 – 18.0	g/dL
Leukocytes	24,200	4,000 – 10,000	/ μ L
Hematocrit	44	40 – 54	%
Erythrocytes	5.2	4.4 – 5.9	$\times 10^6/\mu$ L
Platelets	287,000	150,000 – 450,000	/ μ L
Random blood glucose	168	< 200	mg/dL

Non-contrast computed tomography (CT) of the head was performed emergently (Figures 1–3). Axial images (Figure 1) demonstrated a well-circumscribed, convex, hyperdense extra-axial collection occupying the left fronto-temporo-parietal region. The lateral, third, and fourth ventricles appeared symmetrically narrowed, while the cortical sulci, sylvian fissures, and basal cisterns remained otherwise unremarkable. Bone-window images (Figure 2) confirmed the integrity of the visualized calvarium without an overt displaced fracture on the scanned sections. Three-dimensional volume-rendered reconstruction (Figure

3) was performed to further delineate the craniofacial skeletal anatomy prior to surgical planning. The most critical finding was a rightward midline shift of approximately 1.6 cm, indicative of significant mass effect. The formal radiological impression was acute epidural hematoma occupying the left fronto-temporo-parietal space, causing rightward midline shift findings diagnostic of a surgical EDH per established volumetric and midline-shift criteria.

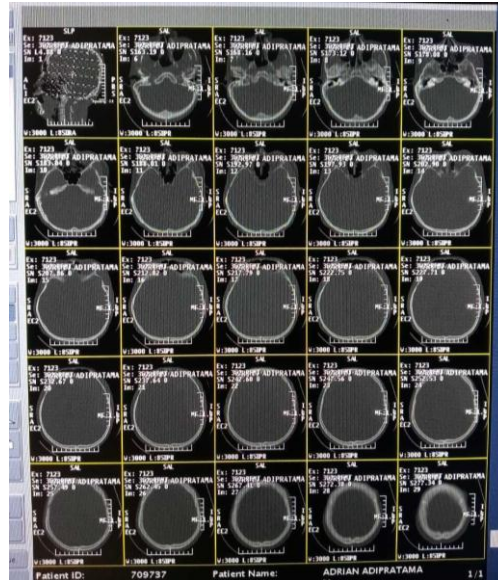


Figure 1. Axial CT (brain window): biconvex hyperdense left fronto-temporo-parietal EDH with midline shift.



Figure 2. Axial CT (bone window) to assess for calvarial fracture

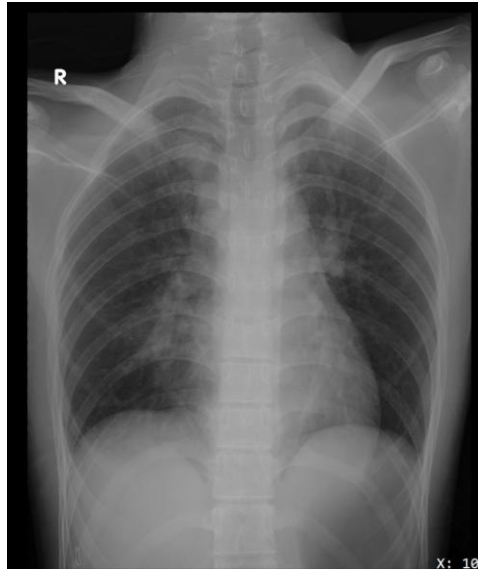


Figure 3. 3D volume-rendered CT reconstruction of the craniofacial skeleton for pre-operative planning

Diagnosis and Surgical Management

Based on the clinical presentation (GCS 6 with anisocoria) and radiological findings (EDH with 1.6 cm midline shift), the patient met established criteria for emergent surgical evacuation.² He was intubated for airway protection, a nasogastric tube and urinary catheter were placed, and intravenous fluid resuscitation with 0.9% saline was initiated alongside empiric ketorolac, omeprazole, and ceftriaxone. The patient was taken for emergency (cito) craniotomy for hematoma evacuation. Intraoperative findings confirmed a large, organized epidural clot occupying the left fronto-temporo-parietal epidural space (Figure 4), which was evacuated in its entirety with achievement of hemostasis and re-approximation of the dura to the inner calvarial table.



Figure 4. Intraoperative view of the large organized epidural hematoma prior to evacuation

Immediately after surgery, the patient was electively kept intubated and sedated (fentanyl and propofol infusions) and transferred to the intensive care unit with the head of bed elevated to 30 degrees. Broad-spectrum antibiotic coverage (meropenem) was continued together with analgesia, gastric protection, and hemostatic support (vitamin K and tranexamic

acid), with serial monitoring of GCS and vital signs. The post-operative neurological trajectory, summarized in Table 2, showed steady and progressive improvement.

Table 2. Post-operative Glasgow Coma Scale (GCS) trajectory.

Timepoint	GCS	Clinical Status / Key Management
Admission (pre-operative)	E1V1M4 = 6	Anisocoria 2/4 mm; intubated; emergency craniotomy performed
POD 0 (post-operative, sedated)	E1M1Vett	Under sedation/analgesia on mechanical ventilation
POD 1	E2M5Vt = 7T	Sedation ongoing; drain in place
POD 2	E3M5Vt = 8T	Sedation stopped; spontaneous eye opening and motor response
POD 3 (extubation)	E4M6Vt = 15 (post-extubation)	Extubated; feeding trial initiated
POD 3 (later)	E4M6V5 = 15	Fully alert; surgical site pain; drain removed
POD 4	E4M6V5 = 15	Transferred to general ward; would care; discharge planning
Outpatient follow-up (day 12)	E4M6V5 = 15	No headache, vomiting, or seizures; sutures removed; wound clean

Sedation was discontinued on post-operative day (POD) 1, and the patient demonstrated spontaneous eye opening and localizing motor response by POD 2. He was successfully extubated on POD 3, tolerated an oral feeding trial, and achieved a full GCS of 15 later that same day, at which point the surgical drain was removed. By POD 4, the patient was fully alert and oriented, was transitioned to a high-protein diet, and was transferred from intensive care to a general ward in preparation for discharge. He was discharged home on oral cefixime, omeprazole, and analgesics.

At outpatient follow-up on day 12 after injury, the patient reported complete resolution of headache, vomiting, and had experienced no seizure activity. Neurological examination was entirely normal (GCS 15, no focal deficit), and the surgical wound had healed well without evidence of infection or dehiscence (Figure 5), permitting removal of the remaining sutures.



Figure 5. Surgical wound ((a) superior view; (b) lateral view, periauricular region) at outpatient follow-up, sutures in situ

METHOD

This study was conducted as a descriptive clinical case report documenting the clinical presentation, diagnostic evaluation, emergency management, surgical intervention, and short-term neurological outcomes of a young adult with acute traumatic epidural hematoma following a motorcycle accident. Clinical data were obtained from emergency department assessments, inpatient medical records, radiological examinations, operative findings, postoperative monitoring, and outpatient follow-up.

The initial assessment followed Advanced Trauma Life Support (ATLS) principles, including evaluation of the airway, breathing, circulation, neurological status, and a secondary survey. Neurological status was assessed using the Glasgow Coma Scale (GCS), pupillary size and symmetry, and pupillary light responses. Vital signs and associated injuries were also documented. The patient presented with a GCS score of 6 and anisocoria, indicating severe traumatic brain injury and necessitating urgent neurosurgical evaluation.

Initial laboratory investigations included a complete blood count and random blood glucose measurement. Neuroimaging was performed using noncontrast computed tomography (CT) of the head with brain and bone window reconstructions. Three-dimensional volume-rendered reconstruction was also performed to evaluate craniofacial skeletal anatomy and assist with preoperative planning. Radiological assessment focused on hematoma location and morphology, associated cranial injuries, ventricular and basal cistern compression, and the degree of midline shift. CT imaging revealed a biconvex hyperdense extra-axial collection in the left frontotemporoparietal region, accompanied by approximately 1.6 cm of rightward midline shift.

The decision to perform emergency surgery was based on the patient's severe neurological impairment, anisocoria, and radiological evidence of substantial intracranial mass effect. Emergency craniotomy and epidural hematoma evacuation were performed, followed by intraoperative hemostasis and dural reapproximation. Surgical findings and immediate postoperative management were documented in the patient's medical records.

Postoperative monitoring included serial assessments of neurological status, GCS scores, vital signs, respiratory support requirements, and clinical recovery in the intensive care unit and general ward. Neurological assessments were performed at admission and throughout the postoperative period. Sedation was gradually discontinued, and the patient's readiness for extubation, oral intake, transfer from intensive care, and hospital discharge was evaluated. Neurological recovery was assessed based on improvements in consciousness, restoration of a GCS score of 15, absence of focal neurological deficits, and overall clinical stability.

Short-term neurological outcomes were assessed during outpatient follow-up on day 12 after injury. The evaluation included assessments of consciousness, headache, vomiting, seizures, focal neurological deficits, and surgical wound healing. At follow-up, the patient had a GCS score of 15, exhibited no focal neurological deficits, and reported no recurrent headaches, vomiting, or seizures. The surgical wound demonstrated satisfactory healing.

RESULTS AND DISCUSSION

Acute EDH arises most commonly from arterial hemorrhage following a temporal or temporoparietal skull fracture that lacerates the middle meningeal artery or one of its

branches, although venous and dural sinus sources account for a meaningful minority of cases, particularly in the young, in whom the dura is less firmly adherent to the inner table and can be stripped away relatively easily by an expanding hematoma. This anatomical property explains both the characteristic biconvex, lens-shaped morphology of EDH on CT because the hematoma is contained by the tight dural attachments at suture lines and the disproportionate vulnerability of adolescents and young adults, whose thinner, more pliable calvaria and less adherent dura predispose to this pattern of injury following relatively lower-energy trauma than would be required in older adults. The classically taught "lucid interval" an initial loss of consciousness followed by transient recovery and subsequent rapid deterioration as the hematoma expands beyond the compensatory capacity of arteriovenous shunting within the epidural space is a useful diagnostic heuristic but is in fact present in only a minority of patients, reported in 10% to 33% of series. In the present case, no lucid interval was observed; the patient remained persistently unconscious (GCS 6) from the time of injury to hospital arrival, a presentation that is equally, if not more, consistent with the literature and should not be regarded as atypical or as evidence against the diagnosis of EDH.

The decision-making pathway followed in this case mirrors the internationally accepted Brain Trauma Foundation guidelines for the surgical management of acute EDH, which recommend evacuation of any EDH exceeding 30 cm³ irrespective of GCS, and of smaller lesions when accompanied by more than 15 mm thickness, more than 5 mm midline shift, or clinical/neurological deterioration. These same guidelines strongly recommend that patients presenting in coma (GCS < 9) with anisocoria undergo evacuation "as soon as possible," reflecting the well-established relationship between operative delay and mortality: comatose patients with EDH who undergo surgery have an overall mortality around 28%, a figure that falls sharply when intervention precedes the onset of coma. Our patient presented with a GCS of 6, anisocoria, and a midline shift of 1.6 cm (16 mm) findings that unequivocally satisfied surgical criteria and craniotomy was performed on an emergent (cito) basis without delay, a management decision directly concordant with guideline recommendations. This is consistent with early surgical evacuation as a key determinant of outcome in this condition (RM et al., 2019).

The neurological trajectory observed here recovery from GCS 6 to GCS 15 over approximately three post-operative days compares favorably with outcome data reported in the literature. In the CENTER-TBI cohort, acute surgery was performed in only 21% of patients with EDH overall, but in 81% of those with EDH volume ≥ 30 cm³, underscoring that volumetric and midline-shift criteria reliably identify the subgroup of patients, such as the one described here, for whom operative management confers the greatest benefit.⁷ A global systematic review and meta-analysis similarly found that, despite an operative mortality of approximately 8–9%, favorable outcomes are achievable in the majority of surgically treated patients, and that traumatic EDH unlike many other severe TBI lesion subtypes carries a favorable prognosis when access to timely neurosurgical care is available. (Marhold et al., 2023) reported that excellent long-term outcomes are achievable in patients with isolated EDH managed surgically, whereas outcomes are less favorable, when EDH coexists with additional intracranial injuries such as contusion or subdural hemorrhage a comorbid pattern that was absent on this patient's imaging.

This case also reflects the broader epidemiological context of motorcycle-related TBI in Indonesia. The patient's demographic profilean adolescent male, helmetless, involved in a motorcycle crashcorresponds to the population most affected in Indonesian series. In Bandung, West Java, the same province in which this case occurred, a study by (Faried et al., 2017) found that motorcycle crashes accounted for 62.8% of all emergency department head-injury presentations, and that 71.2% of patients with moderate-to-severe TBI had not been wearing a helmet, with an associated overall mortality of 29.2% in that subgroup. More recent Indonesian data from the NOMADEN study similarly demonstrated that over 90% of motorcycle-related TBI patients presented without helmet protection, and identified injury-to-admission time as an independent, strongly weighted predictor of in-hospital mortality (adjusted odds ratio 5.44), alongside admission GCS. These findings collectively reinforce why the present patient's outcome should not be viewed in isolation: his survival with excellent neurological recovery was contingent not only upon appropriate in-hospital surgical decision-making but also upon a comparatively short pre-hospital interval and rapid access to CT imaging and neurosurgical capacityresources that are unevenly available across Indonesia and other low- and middle-income settings (Kourouklari et al., 2022). In these settings, the operative mortality for EDH, while still favorable relative to other TBI subtypes, remains measurably higher than in high-income countries due to systemic delays rather than differences in disease severity.

Several limitations merit acknowledgment. As with any single case report, the findings described here cannot be generalized to the broader population of patients with traumatic EDH, and the excellent outcome observed may in part reflect favorable individual factorsincluding the patient's young age, the absence of concomitant intracranial injury, and a comparatively short interval between injury and definitive surgical carethat are not uniformly present in all patients with this diagnosis. Longer-term neuropsychological and functional outcome data beyond the immediate post-operative and short-interval outpatient follow-up period were not available for this report.

CONCLUSION

Acute traumatic epidural hematoma (EDH) remains a life-threatening neurosurgical emergency with the potential for favorable neurological outcomes when promptly diagnosed and appropriately managed. This case demonstrated that a patient presenting with severe impairment of consciousness (Glasgow Coma Scale [GCS] score of 6) and substantial intracranial mass effect could achieve favorable neurological recovery following timely emergency craniotomy and hematoma evacuation, consistent with established surgical indications based on hematoma characteristics, midline shift, and neurological status. The association between motorcycle-related head trauma, helmet nonuse, and traumatic EDH highlighted in this case and the broader Indonesian literature underscores the importance of strengthening road safety enforcement, promoting consistent helmet use, and improving access to rapid trauma referral and emergency neurosurgical services. These measures are essential for reducing preventable morbidity and mortality associated with traumatic brain injuries among young adults.

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CONFLICT OF INTEREST

The authors declare that this study was conducted without any commercial or financial relationships that could be interpreted as a potential conflict of interest.

AUTHORS' CONTRIBUTIONS

Suhada Akmal Al Kausar: research conceptualization, methodology design, experiment execution, data collection, data analysis, manuscript drafting, and manuscript revision. Ilham Rizky Ernawan: research supervision, validation of research results, provision of scientific input, and manuscript review and revision. All authors have read and approved the final version of the manuscript.

STATEMENT ON THE USE OF GENERATIVE ARTIFICIAL INTELLIGENCE

The authors declare that generative artificial intelligence (AI) was used in the preparation of this manuscript to help improve linguistic clarity, correct grammar, and refine the writing structure. Generative AI was not used to generate, manipulate, or analyze research data. The entire content of the manuscript has been reviewed and verified by the author(s). The author(s) are fully responsible for the accuracy, integrity, and final content of the manuscript.

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