



Multidisciplinary Approach to the Management of Traumatic Epidural Hematoma: Pathophysiology, Treatment, and Outcomes

Afnan Mohammed Al Dosari¹, Eman Ibrahim Alshaikh Ali¹, Khwlah Abdulaziz Alswaied¹, Mohammed Naif Al Mutairi¹, Abdulkarim Shunayn Safi Alanazi¹, Fahad Husayyan Al Enazi¹, Nada Abdulrahman Amer Alajmi¹, Ali Abdullah Mohammed Alajlan¹, Ahmad Asri Awad Alanazi¹, Abdulrahman Ibrahim Abdullah Al Fahad¹, Ahmed Abdulkarim Sulaiman Alnughaymishi¹, Shalah Hmoud Al harbi, Ahmed suhaiman Alsharari¹, Nasser Ali Alhabib¹ Soliman Mohammed Alehaidib, Omar Obaid Alharbi¹, Hussein Mohammed alwadai, Adel lafi alharbi^{1*}

Abstract

Background: Epidural hematoma (EDH) is a life-threatening condition resulting from traumatic brain injury, often requiring prompt diagnosis and intervention to prevent irreversible neurological damage. Originating from arterial bleeding, EDH is characterized by the "lucid interval" phenomenon, emphasizing the need for vigilant clinical monitoring. Advances in imaging and a multidisciplinary approach have improved patient outcomes, yet challenges persist in timely management, particularly in patients with complicating factors such as anticoagulant use or advanced age. **Methods:** This review integrates recent findings on the pathophysiology, diagnosis, and management of EDH. A comprehensive literature search identified key studies on the contributions of emergency providers, pharmacists, and nurses to EDH care. Particular attention was given to the role of imaging modalities, pharmacological considerations, and post-operative monitoring in optimizing outcomes. **Results:** Emergency providers play a

critical role in stabilizing patients and determining the need for surgical intervention. Imaging Modalities, including CT and MRI, remain essential for diagnosis and assessing hematoma severity. Pharmacists contribute by managing anticoagulants and other medications, ensuring drug safety and preventing adverse interactions. Nurses are integral in continuous monitoring, early detection of complications, and patient education, enhancing recovery post-surgery. Multidisciplinary collaboration significantly reduces mortality and morbidity rates, particularly in high-risk populations such as the elderly or those on anticoagulation therapy. **Conclusion:** Timely recognition and intervention are paramount in the management of EDH. A coordinated effort between emergency providers, pharmacists, and nursing staff is essential to delivering effective care and improving outcomes. Future research should focus on refining management protocols, advancing imaging technologies, and exploring innovative therapeutic options to address unmet clinical needs EDH care.

Keywords: Epidural hematoma, traumatic brain injury, multidisciplinary care, pharmacological management, surgical intervention

Significance | Early recognition and coordinated multidisciplinary care improve outcomes for patients with traumatic epidural hematoma and prevent neurological deterioration.

*Correspondence. Hussein Mohammed alwadai, Adel lafi Alharbi, Ministry of National Guard Health Affairs, Prince Mutib Ibn Abdullah Ibn Abdulaziz Rd, Ar Rimayah, Riyadh 11426, Saudi Arabia.
E-mail:

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1. Introduction

An epidural hematoma (EDH) refers to a collection of blood between the dura mater and the inner surface of the skull. This

Author Affiliation.

¹ Ministry of National Guard Health Affairs, Prince Mutib Ibn Abdullah Ibn Abdulaziz Rd, Ar Rimayah, Riyadh 11426, Saudi Arabia.

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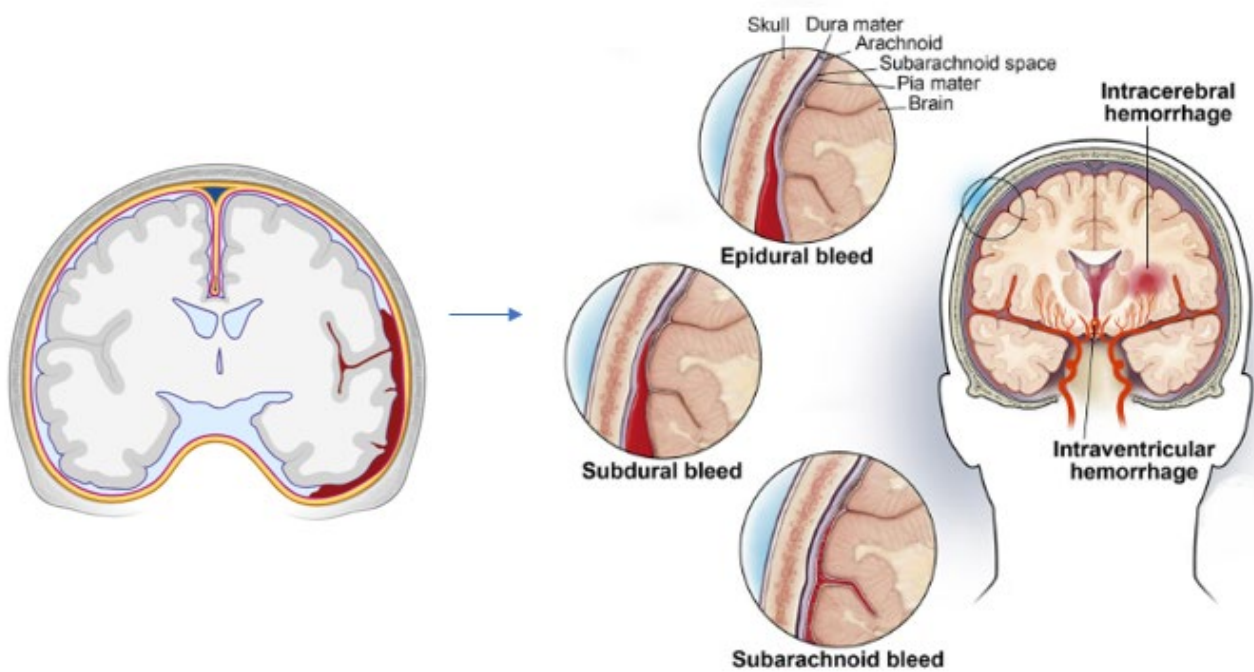


Figure 1. Mechanism of Traumatic Epidural Hematoma. Epidural hematoma (EDH) results from arterial bleeding, typically originating from a rupture of the middle meningeal artery, which lies between the inner table of the skull and the dura mater. The pathophysiology of EDH is closely tied to the anatomy of the cranial vault and its vasculature. The injury commonly arises from a high-energy impact to the head, causing a skull fracture that tears arterial or venous structures. The resulting hematoma expands rapidly, exerting pressure on the brain.

hematoma is typically confined by the lateral sutures, particularly along the coronal sutures, where the dura mater is firmly attached to the skull. EDH is a serious and potentially fatal condition requiring immediate medical intervention. Delayed recognition and treatment can result in severe complications, including brain damage or death, underscoring the critical need for timely diagnosis and rapid evacuation of the accumulated blood (Rosenthal et al., 2017). The life-threatening nature of EDH stems from its potential to exert progressive pressure on the brain, leading to herniation, ischemia, and neurological deficits (Babu et al., 2019).

Clinically, EDH often presents with a loss of consciousness followed by a lucid interval, after which neurological deterioration can occur rapidly. This progression highlights the importance of early diagnosis and management (Gutowski et al., 2018). Advanced imaging techniques, particularly computed tomography (CT) scans, play a pivotal role in confirming the diagnosis and determining the severity of the hematoma (Flaherty et al., 2018). Effective management typically requires a multidisciplinary approach involving neurosurgeons, emergency physicians, and critical care specialists to optimize patient outcomes (Bonow et al., 2018). Early surgical evacuation is associated with significantly improved prognoses, reducing the risk of irreversible neurological damage and mortality rates (Burjorjee et al., 2018).

The development of EDH is often attributed to traumatic and, less commonly, non-traumatic causes. Traumatic mechanisms account for the majority of cases and include head injuries resulting from motor vehicle collisions, physical assaults, and falls. These incidents typically involve younger individuals, particularly males, and are characterized by a significant impact to the head. The trauma disrupts blood vessels, most commonly the middle meningeal artery, leading to the accumulation of blood in the epidural space (Gutowski et al., 2018). Non-traumatic causes, while rarer, also play a role. These include conditions such as infections, abscesses, coagulopathies, hemorrhagic tumors, and vascular malformations like arteriovenous fistulas. Such conditions may predispose individuals to vascular damage or bleeding, complicating the clinical course of EDH (Babu et al., 2019).

Understanding these diverse etiologies is crucial for healthcare providers. For traumatic cases, rapid imaging and surgical intervention are often required, while non-traumatic cases necessitate a broader diagnostic approach to identify and manage the underlying condition. Early recognition and intervention are critical, particularly for non-traumatic EDH, as delayed management can result in worse outcomes (Tamburrelli et al., 2018).

2. Epidemiology

EDH accounts for approximately 2% of all head injuries and up to 15% of fatal head traumas (Chicote Álvarez et al., 2018). The

incidence is higher in males, especially adolescents and young adults, with a mean age of 20 to 30 years. The higher prevalence in younger populations is attributed to their increased exposure to high-energy traumas, such as sports-related injuries and vehicular accidents (Fernández-Abinader et al., 2017).

In contrast, EDH is less common in individuals over 50 to 60 years of age. This decline can be explained by age-related anatomical changes, including the dura mater's firm adhesion to the skull and decreased potential space for blood accumulation. Furthermore, reduced vascularity and elasticity of the dural membrane with advancing age decrease the likelihood of EDH formation (Chicote Álvarez et al., 2018). Despite its rarity in older populations, EDH can still occur, particularly in those with significant trauma or underlying vascular conditions. Recognizing these epidemiological patterns aids clinicians in assessing risk and prioritizing early diagnostic imaging and management (Jeong et al., 2016).

3. Pathophysiology

The primary pathophysiological mechanism in EDH is arterial injury, with most cases resulting from bleeding in the middle meningeal artery (Figure 1). Venous bleeding, although less common, occurs in up to 10% of cases and typically involves lacerations of dural venous sinuses (Bonow et al., 2018). Anatomically, EDH is most frequently observed in the temporal region in adults, accounting for approximately 75% of cases. In children, however, EDH is more evenly distributed across the temporal, occipital, frontal, and posterior fossa regions, reflecting differences in cranial development and injury patterns (Kanematsu et al., 2018).

Radiographically, EDH can be classified into acute, subacute, and chronic phases based on progression. Acute EDH, occurring within 24 hours, is characterized by a swirl of un-clotted blood on imaging. Subacute EDH, observed between days 2 to 4, presents as a solid hematoma. Chronic EDH, which develops over 7 to 20 days, appears as a mixed or lucent lesion with possible contrast enhancement (Babu et al., 2019). These classifications provide a framework for guiding treatment decisions and predicting clinical outcomes.

4. Clinical Presentation

The hallmark clinical presentation of EDH includes an initial loss of consciousness following trauma, a transient lucid interval, and subsequent neurological deterioration. This classic progression is observed in approximately 14% to 21% of cases. However, not all patients experience a lucid interval; some remain unconscious or exhibit no loss of consciousness, underscoring the variability in clinical manifestations (Gutowski et al., 2018).

Neurological symptoms are largely dependent on the rate of hematoma expansion. Small EDH may remain asymptomatic, while

rapid hematoma growth can lead to signs of increased intracranial pressure, including ipsilateral pupil dilation, bradycardia, and irregular respiration. These symptoms, collectively termed the Cushing reflex, indicate impending brain herniation and the need for immediate surgical intervention (Flaherty et al., 2018).

Posterior fossa EDH, a rare variant comprising approximately 5% of all cases, presents unique challenges. Patients may remain conscious until late in the disease course, at which point they experience sudden decompensation characterized by apnea and coma. Such cases require high clinical suspicion and prompt imaging to prevent fatal outcomes (Basamh et al., 2016).

5. Significance of Early Intervention

The prognosis of EDH is closely tied to the timing of diagnosis and intervention. Surgical evacuation remains the cornerstone of treatment for most cases, with non-operative management reserved for select patients with small, stable hematomas (Burjorjee et al., 2018). Delays in intervention increase the risk of irreversible brain injury and death, particularly in patients with rapid hematoma expansion or posterior fossa involvement.

Advances in neuroimaging have significantly improved the early detection of EDH. Computed tomography (CT) remains the gold standard for diagnosis, providing rapid and detailed visualization of the hematoma and associated skull fractures (Bonow et al., 2018). Magnetic resonance imaging (MRI) may be used in certain cases to evaluate chronic hematomas or associated brain injuries (Flaherty et al., 2018).

Epidural hematomas represent a life-threatening condition with diverse etiologies and clinical presentations. Understanding the epidemiological and pathophysiological nuances of EDH is essential for accurate diagnosis and effective management. While most cases are caused by traumatic injuries, non-traumatic factors such as vascular malformations and coagulopathies must not be overlooked. Early recognition, facilitated by advances in imaging technology, and prompt surgical intervention remain critical in improving outcomes for patients with EDH.

6. Evaluation and Management of Epidural Hematoma (EDH)

6.1 Imaging Studies

Computed tomography (CT) scans remain the gold standard for diagnosing epidural hematomas (EDH). Laboratory tests, including international normalized ratio (INR), partial thromboplastin time (PTT), prothrombin time (PT), and liver function tests (LFTs), may also be conducted to assess bleeding risk or detect underlying coagulopathies (Flaherty et al., 2018).

6.2 CT Scan

CT scans are the most widely used imaging modality in emergency settings due to their accessibility and diagnostic accuracy. EDHs typically appear as a biconvex or lens-shaped hyperdense mass,

restricted by the attachment of the dura to cranial sutures, which prevents their extension across suture lines. Radiologists often calculate the volume of hematomas using the ABC/2 formula. Here, "A" represents the maximum hemorrhage diameter on the CT slice with the largest hemorrhagic area, "B" is the maximum diameter perpendicular to "A," and "C" is the number of slices containing the hematoma multiplied by slice thickness in centimeters.

Additional CT features can provide critical insights. Low-density areas or the "swirl sign" may indicate active bleeding, often warranting surgical intervention (Burjorjee et al., 2018). Close attention is essential when EDH coexists with hemorrhagic or contused brain tissue, as these cases can present more subtle imaging findings. Factors such as severe anemia or hypotension may obscure diagnostic accuracy by causing low-density or diminished extravasation. Moreover, in cases of venous bleeding, slower blood accumulation can complicate interpretation, particularly if the scan is performed soon after trauma (Gutowski et al., 2018).

6.3 Magnetic Resonance Imaging (MRI)

MRI offers superior sensitivity compared to CT scans, especially for detecting vertex EDH. It is recommended for cases with strong clinical suspicion of EDH but negative initial CT results. For spinal EDH, MRI is the preferred modality due to its high-resolution capabilities (Kanematsu et al., 2018).

6.4 Angiography

In cases involving vertex EDHs, angiography may be warranted to investigate potential dural arteriovenous (AV) fistulas originating from the middle meningeal artery. Angiographic evaluation ensures a comprehensive assessment of these lesions (Tamburrelli et al., 2018).

7. Treatment and Management

Epidural hematoma is a neurosurgical emergency requiring prompt intervention to mitigate risks of neurological deterioration and mortality from hematoma expansion and herniation. Early surgical evacuation within 1–2 hours of presentation significantly improves outcomes (Bhorkar et al., 2018; Basamh et al., 2016).

7.1 Initial Stabilization

The immediate priority is stabilizing the patient by addressing the airway, breathing, and circulation (ABCs). Once stabilized, patients with acute EDH are evaluated for surgical intervention. Surgery is indicated if the hematoma exceeds 30 mL, regardless of the Glasgow Coma Scale (GCS) score, or if the GCS score is less than 9 with pupillary abnormalities such as anisocoria (Rosenthal et al., 2017).

7.2 Operative Management

Craniotomy and hematoma evacuation are the gold-standard treatments for acute symptomatic EDH. In resource-limited settings, burr hole evacuation (trephination) may serve as a life-

saving alternative, though craniotomy remains preferred for complete evacuation and improved outcomes (Jeong et al., 2016).

7.3 Non-Operative Management

Conservative management may be an option for select patients with mild symptoms and specific criteria: hematoma volume <30 mL, clot diameter <15 mm, midline shift <5 mm, and GCS >8 without focal neurological deficits. These patients require close monitoring, including repeated neurological examinations and follow-up imaging within 6–8 hours to detect potential hematoma expansion or clinical deterioration (Bonow et al., 2018).

8. Differential Diagnosis

EDH shares overlapping clinical features with several conditions, necessitating a thorough differential diagnosis. Key conditions include intracranial abscess, intracranial mass, seizure, and transient ischemic attack (TIA):

Intracranial Abscess: Presents with fever, headache, and focal deficits. Imaging can differentiate abscesses, which exhibit ring-enhancing lesions, from EDH (Fernández-Abinader et al., 2017).

Intracranial Masses: Symptoms such as headache and altered consciousness may mimic EDH, but imaging often reveals a distinct appearance of tumors compared to EDHs' biconvex shape (Chicote Álvarez et al., 2018).

Seizures: Postictal confusion and altered consciousness can overlap with EDH presentation but typically lack structural changes seen on imaging.

Transient Ischemic Attack (TIA): Characterized by transient neurological deficits that resolve without hemorrhagic findings on imaging (Aguilar & Brott, 2011).

Accurate diagnosis relies on a combination of detailed clinical history, neurological examination, and advanced imaging techniques like CT or MRI (Khairat & Waseem, 2023).

The evaluation and management of EDH demand a multidisciplinary approach involving imaging studies, prompt diagnosis, and decisive treatment. While CT scans are the primary diagnostic tool, MRI and angiography provide additional sensitivity and specificity in complex cases. Treatment primarily involves surgical evacuation, though conservative management may be suitable for a select subset of patients. Early recognition and timely intervention remain pivotal in optimizing patient outcomes and reducing morbidity and mortality associated with EDH.

9. Prognosis

The prognosis for patients with isolated epidural hematomas (EDHs) is generally favorable when the condition is promptly diagnosed and surgically managed. However, delays in diagnosis and treatment significantly increase morbidity and mortality rates (Khairat & Waseem, 2023). EDHs caused by arterial bleeding tend to develop rapidly, allowing quicker detection, whereas those

resulting from dural sinus tears often evolve more slowly, leading to delayed clinical recognition and intervention (Gutowski et al., 2018). The volume of the EDH is a critical determinant of prognosis; for example, hematomas exceeding 50 cm³ before evacuation are associated with poorer neurological outcomes and higher mortality rates (Basamh et al., 2016).

Several factors influence prognosis, including patient age, the time elapsed between injury and treatment, the presence of a coma or lucid interval, pupillary abnormalities, and the Glasgow Coma Scale (GCS) or motor score at presentation (Jeong et al., 2016). Radiological findings also provide essential prognostic information. These include the hematoma's volume, midline shift, signs of active bleeding, and the presence of associated intra-dural lesions such as contusions or diffuse brain swelling (Flaherty et al., 2018).

9.1 Postoperative Intracranial Pressure (ICP)

Postoperative intracranial pressure (ICP) is a critical indicator of prognosis. Elevated ICP post-surgery is associated with poorer outcomes, as it signifies ongoing cerebral stress or secondary brain injury (Gutowski et al., 2018). Poor prognostic markers include a low GCS score at the time of presentation, unreactive pupils, advanced age, and delays in surgical intervention. Imaging findings such as hematoma volumes between 30 and 150 mL, midline shifts exceeding 10 to 12 mm, or a "swirl sign" indicating active bleeding are linked to less favorable outcomes (Bonow et al., 2018). The presence of concurrent lesions, such as subarachnoid hemorrhages or diffuse cerebral edema, further compounds the risk of adverse outcomes (Tamburrelli et al., 2018).

9.2 Complications

Epidural hematomas can lead to severe complications, particularly if the bleeding is substantial or the condition is not promptly treated. A significant complication is the mass effect, where accumulating blood exerts pressure on the brain, causing compression and damage to surrounding neural structures. This increases ICP, potentially leading to dangerous neurological sequelae (Rosenthal et al., 2017). If untreated, the rising ICP can result in herniation, a life-threatening condition where the brain shifts abnormally, often compressing critical structures like the brainstem (Babu et al., 2019).

Seizures are another common complication of EDHs, often resulting from irritation of brain tissue by the hematoma. These seizures can arise as a direct consequence of the hematoma or secondary to other complications, such as elevated ICP. Seizure occurrence complicates clinical management, requiring careful monitoring and often necessitating anticonvulsant therapy (Fernández-Abinader et al., 2017).

If left untreated or diagnosed late, EDH-related complications can lead to permanent neurological impairment or death. Early recognition of symptoms, appropriate imaging, and prompt

surgical evacuation are crucial to mitigating these risks (Bhorkar et al., 2018).

9.3 Consultations

The management of EDHs requires immediate consultations with appropriate medical specialists to ensure optimal patient outcomes. Neurosurgical and trauma teams should be involved as soon as an EDH is suspected, given the time-sensitive nature of the condition. Trauma surgeons are responsible for stabilizing the patient, focusing on airway, breathing, and circulation (ABCs), while neurosurgeons determine the need for surgical intervention, such as craniotomy or burr hole evacuation (Basamh et al., 2016).

Timely neurosurgical consultation is particularly crucial, as the success of treatment often hinges on rapid evacuation of the hematoma. For instance, delays in treatment significantly increase the risk of irreversible neurological damage or death (Jeong et al., 2016). Neurosurgeons also provide guidance on postoperative care, such as monitoring ICP and addressing complications like seizures or infections.

In cases with associated injuries or secondary complications, consultations with other specialists may be necessary. For example, neurologists may be involved in managing seizures, while critical care teams can assist in monitoring and managing ICP or other systemic complications. A multidisciplinary approach ensures comprehensive care, reduces the risk of long-term disability, and improves overall prognosis (Aguilar & Brott, 2011).

The prognosis for EDH is highly dependent on early recognition, timely surgical intervention, and effective postoperative care. While isolated EDHs generally have favorable outcomes, delays in diagnosis or treatment can lead to severe complications, including elevated ICP, seizures, herniation, and death. Collaboration among trauma surgeons, neurosurgeons, and other specialists is critical for optimizing patient outcomes. Early imaging, accurate diagnosis, and prompt surgical evacuation remain the cornerstones of successful EDH management, highlighting the importance of a coordinated and multidisciplinary approach.

10. Other Issues

Epidural hematoma (EDH) is a medical emergency that necessitates prompt diagnosis and intervention to minimize morbidity and mortality. A key clinical hallmark of EDH is a history of head trauma followed by transient loss of consciousness, often accompanied by a lucid interval. During this lucid interval, the patient temporarily regains consciousness before deteriorating again. While this phenomenon is frequently associated with EDH, it is not pathognomonic and can also occur in conditions such as subdural hematomas or brain tumors. Therefore, although a lucid interval may heighten suspicion for EDH, it should not be relied upon as the sole diagnostic indicator.

Patients with smaller EDHs may remain asymptomatic for a significant period, complicating timely clinical assessment. Additionally, EDH is often linked with skull fractures but can also occur without any bony injury. One radiological feature that aids in diagnosis is that the hematoma does not typically cross suture lines due to the adherence of the dura to the cranial sutures. The urgency for surgical intervention is influenced by hematoma volume, the degree of midline shift, and signs of active bleeding, all of which are critical considerations in acute cases. When identified and treated expeditiously, the prognosis for EDH patients is generally favorable, with many achieving excellent functional recovery.

10.1 Enhancing Healthcare Team Outcomes

The management of EDH is a collaborative effort requiring a well-coordinated interprofessional team, including emergency physicians, radiologists, neurosurgeons, intensivists, trauma teams, and nursing staff. Each member contributes to timely diagnosis, stabilization, and treatment, which is crucial given that undiagnosed or delayed EDH can lead to mortality rates exceeding 15% (Rosenthal et al., 2017). Rapid recognition and treatment of EDH are vital for patient survival, especially in high-risk cases, such as bilateral or posterior fossa EDHs, which carry a heightened risk of mortality.

The patient's level of consciousness at presentation remains the most critical prognostic indicator. A proactive approach to prevention, including public health initiatives, education on head trauma risks, and advocacy for protective gear, can significantly reduce the incidence of EDH. For example, promoting the use of helmets during sports and in hazardous workplaces has been shown to prevent many head injuries, reducing the burden on healthcare systems (Chicote Álvarez et al., 2018).

Public awareness campaigns emphasizing the importance of timely medical attention after head trauma can also improve outcomes by ensuring early diagnosis and treatment.

11. Roles of Emergency Providers, Pharmacists, and Nurses

11.1 Role of Emergency Providers

Emergency physicians are pivotal in the early recognition and management of EDH. Upon a patient's presentation with head trauma, these physicians conduct a thorough history and physical examination to identify potential signs of EDH, such as transient loss of consciousness, lucid intervals, or neurological deficits. They must remain vigilant, as symptoms can range from subtle mental status changes to overt focal deficits.

Emergency providers are also responsible for ordering and interpreting diagnostic imaging, with a non-contrast CT scan being the gold standard for detecting EDH. Timely imaging is crucial because delays can lead to catastrophic outcomes (Bhorkar et al., 2018). Once a diagnosis is established, emergency providers

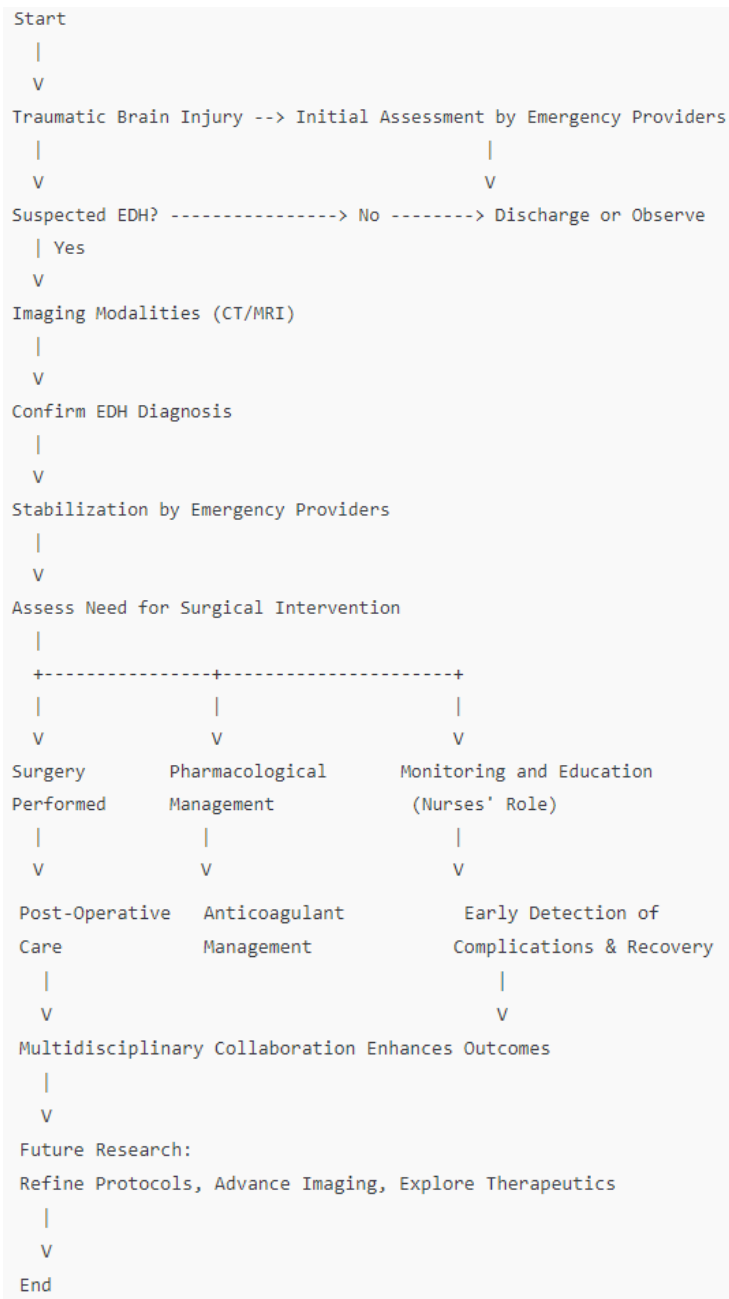


Figure 2. Coordinated multidisciplinary for patients with traumatic epidural hematoma management.

coordinate with neurosurgical teams to determine the need for surgical intervention.

Initial stabilization of the patient is another critical responsibility. This includes managing the airway, breathing, and circulation (ABCs), ensuring hemodynamic stability, and addressing increased intracranial pressure. Signs of potential brain herniation, such as unequal or nonreactive pupils, warrant immediate action. Stabilizing the patient for transfer to an intensive care unit (ICU) or operating room is essential for optimizing outcomes.

11.2 Role of Pharmacists

Pharmacists play a supportive yet crucial role in managing EDH, particularly in cases involving anticoagulation therapy or coagulopathy. They assess the patient's medication history to identify anticoagulants or antiplatelet agents that may exacerbate bleeding risks (Burjorjee et al., 2018). In collaboration with the medical team, pharmacists recommend reversal agents, such as prothrombin complex concentrate or vitamin K, to mitigate bleeding.

Postoperatively, pharmacists assist in pain management, seizure prophylaxis, and the prevention of complications like infections. Their expertise ensures that medication regimens are optimized for efficacy and safety, reducing the risk of adverse drug interactions or side effects.

11.3 Role of Nurses

Nurses are integral to the continuous monitoring and care of EDH patients, both pre- and postoperatively. In the emergency setting, nurses assist with triage, monitor vital signs, and observe for signs of neurological deterioration, such as altered mental status or pupillary changes. They play a critical role in recognizing subtle changes that may indicate worsening intracranial pressure.

In the ICU, nurses ensure proper management of intracranial pressure monitoring devices, administer medications, and provide care tailored to the patient's needs. They also educate families about the patient's condition, treatment plan, and potential outcomes. Their contributions to patient care extend beyond clinical duties, encompassing emotional and psychological support for both patients and their families.

11.4 Interprofessional Collaboration and Outcomes

Effective collaboration among emergency providers, pharmacists, nurses, and other healthcare professionals is essential for the successful management of EDH. Each team member's contributions complement the others, creating a robust system of care that ensures rapid diagnosis, stabilization, and treatment. This coordinated approach minimizes delays in intervention, reducing the risk of complications and mortality.

Proactive measures, such as public education and preventive strategies, further enhance outcomes. By fostering a culture of safety and awareness, healthcare professionals can help mitigate the risks

associated with head trauma, ultimately reducing the incidence and severity of EDH cases.

11.5 Role of Pharmacists

Pharmacists play a crucial supporting role in managing epidural hematoma (EDH), particularly regarding medication management, drug interactions, and providing essential drug-related information. Their contributions complement those of emergency providers and nurses in optimizing patient outcomes. Upon the patient's presentation in the emergency department, pharmacists collaborate closely with the trauma and emergency teams to ensure that all medications are appropriately administered to prevent complications related to the condition and its treatment.

One of the critical roles of pharmacists is managing pain, which is a common issue for patients with EDH. Effective pain management is essential, as uncontrolled pain can exacerbate stress responses, potentially increasing intracranial pressure (Rosenthal et al., 2017). Pharmacists are responsible for recommending suitable analgesics, including opioid and non-opioid options, tailored to the patient's specific condition and pain levels. Furthermore, they must exercise caution with sedatives, which could worsen intracranial pressure or impair the neurological assessments necessary for monitoring the patient's condition.

Pharmacists also play an essential role in preventing or managing complications related to anticoagulation. Some EDH patients may require anticoagulation therapy or reversal agents if they have overdosed on anticoagulants. Pharmacists must ensure that coagulation profiles are monitored closely, collaborating with the neurosurgical team to adjust treatment as necessary (Kanematsu et al., 2018). They also review the patient's existing medications, such as antiplatelet agents or anticoagulants, to avoid contraindications with new treatments introduced during EDH management.

In high-pressure emergency situations, pharmacists are pivotal in educating healthcare teams about appropriate drug options and optimal intervention timing. They ensure the accuracy and appropriateness of prescribed medications, minimizing the risk of adverse drug interactions that could hinder recovery (Tamburrelli et al., 2018). This collaborative effort is critical in stabilizing the patient and preparing them for potential surgical intervention or long-term care.

11.6 Role of Nursing Staff

Nursing staff, particularly those in emergency departments, intensive care units (ICUs), and neurosurgical units, are vital in the comprehensive care of patients with EDH. Nurses are responsible for the initial assessment, stabilization, and ongoing monitoring of the patient, playing a crucial role in the early detection of changes in neurological status.

In the emergency department, nurses are tasked with collecting and documenting the patient's vital signs, including blood pressure, heart rate, respiratory rate, and oxygen saturation. These

measurements are essential for detecting early signs of neurological deterioration, such as Cushing's triad, which signals increasing intracranial pressure and impending herniation (Fernández-Abinader et al., 2017). Nurses must be highly vigilant in identifying subtle or overt changes in neurological status, including alterations in pupil size, reactivity, and mental status, and promptly report these to the attending physician or neurosurgical team.

Medication management is another critical aspect of nursing care. Nurses administer prescribed analgesics, sedatives, and anticoagulants, ensuring proper dosing and closely monitoring for side effects. For instance, they may need to administer reversal agents in cases of anticoagulation-related complications, which requires careful attention to avoid excessive sedation or bleeding risks (Chicote Álvarez et al., 2018).

Patient education and family support are also integral components of nursing care. Nurses communicate with patients and their families, explaining the condition, expected outcomes, and the importance of timely intervention following head trauma. Providing clear information and reassurance can significantly reduce anxiety for both the patient and their family.

In the ICU, nurses continue to monitor the patient's neurological status closely after surgical intervention. They assess for signs of infection, seizures, or respiratory complications, manage airways, and ensure that the patient remains stable during the critical recovery period (Gutowski et al., 2018). ICU nurses are also instrumental in initiating early rehabilitation interventions, which are crucial for improving functional recovery in patients with severe neurological injuries.

11.7 Interdisciplinary Collaboration

The successful management of EDH relies on a multidisciplinary approach involving emergency providers, pharmacists, and nursing staff (Figure 2). Emergency providers take the lead in rapid diagnosis, stabilization, and initial treatment, while pharmacists ensure the appropriate use of medications and prevent drug-related complications. Nurses provide continuous patient monitoring, administer care, and support both patients and their families throughout the recovery process.

Effective communication and collaboration among these healthcare professionals are essential for improving patient outcomes. By working together seamlessly, the team can reduce the morbidity and mortality associated with EDH, ensuring that patients receive the highest standard of care.

12. Perspective

Epidural hematoma (EDH) represents a critical intersection of trauma, neurology, and critical care, demanding a well-coordinated, multidisciplinary approach to management. The nature of EDH, rooted in arterial bleeding often triggered by head trauma, highlights the urgency required in assessment and

intervention. Emergency providers act as the initial gatekeepers, employing their expertise to stabilize patients and facilitate rapid diagnostic imaging, which remains the cornerstone of EDH identification and severity assessment.

The collaborative involvement of pharmacists brings an indispensable layer of precision to patient care. Their ability to manage complex pharmacological regimens, particularly in patients with pre-existing conditions such as anticoagulant use, ensures the minimization of drug-related complications. Pharmacists also provide critical insights into the timing and appropriateness of sedation and analgesia, which are vital for patient stability during imaging and procedures. This expertise becomes even more crucial in situations where rapid intervention is needed to reverse anticoagulation or mitigate bleeding risks.

Nurses, as the linchpin of continuous care, provide vigilant monitoring of patients during all stages of treatment. Their role extends beyond the clinical, encompassing patient and family education about the condition, the recovery process, and the expectations for rehabilitation. Nurses' ability to detect subtle changes in neurological function, such as early signs of increased intracranial pressure, underscores their pivotal role in the care continuum. This proactive vigilance can often mean the difference between recovery and irreversible damage.

The "lucid interval" phenomenon unique to EDH poses both a diagnostic challenge and an opportunity for timely intervention. This brief period of regained consciousness following trauma often masks the severity of the underlying condition, requiring all members of the healthcare team to remain highly alert. With the advent of modern imaging techniques such as CT and MRI, diagnosis has become more precise, but the window for intervention remains narrow, underscoring the importance of swift, coordinated action among healthcare professionals.

13. Conclusion

The management of epidural hematoma exemplifies the necessity of a synchronized, multidisciplinary approach in modern medicine. Early recognition and rapid intervention are paramount to prevent severe neurological damage and improve patient outcomes. Emergency physicians play a pivotal role in diagnosing and stabilizing patients, while pharmacists ensure that pharmacological treatments are safe, effective, and tailored to the individual patient's needs. Nurses, with their constant bedside presence, are essential for monitoring and addressing complications, as well as providing education and emotional support to patients and their families.

The integration of expertise from these disciplines ensures that the complexities of EDH, from initial presentation to post-surgical recovery, are addressed comprehensively. This collaborative effort not only reduces mortality rates but also facilitates improved functional recovery and quality of life for patients. Advances in

diagnostic imaging and pharmacological interventions have enhanced the care landscape, but the cornerstone of success remains a timely, coordinated response by a skilled healthcare team. Ultimately, the management of EDH underscores the importance of multidisciplinary collaboration in critical care settings. By leveraging their collective expertise, healthcare professionals can mitigate the risks associated with this life-threatening condition and provide patients with the best possible outcomes. In the realm of emergency medicine, EDH serves as a reminder of the profound impact of teamwork and the shared commitment to saving lives.

Author contributions

All authors made equal contributions to the study design, statistical analysis, and drafting of the manuscript. The corresponding author, along with the co-authors, reviewed and approved the final version of the article prior to submission to this journal.

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