

Case Report



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Conflict of Interest

The authors have no financial conflicts of interest.

Exploring Rare Traumatic Injuries: A Miniseries of 4 Cases Discussing Epidural Hematomas Bridging the Infratentorial and Supratentorial Regions

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ABSTRACT

Supratentorial-infratentorial epidural hematomas (SIEH) are a rare occurrence following traumatic head injuries, representing only 2% of traumatic epidural hematomas. Given the unique anatomical characteristics of the infratentorial region, mainly its small size, surgical intervention is commonly undertaken to alleviate the pressure on the posterior fossa components. Consequently, there is ongoing debate surrounding the optimal surgical approaches. In this report, we present four cases of SIEH that were treated surgically. Furthermore, we conduct a comprehensive review of existing literature, encompassing clinical, radiological, and therapeutic aspects associated with this condition. SIEH are uncommon post-traumatic lesions that require urgent and individualized management on a case-by-case basis, as guided by multiplanar cerebral computed tomography scan findings. Preoperative planning is essential; however, intraoperative exploration and identification of transverse sinus and torcula lesions are crucial for optimal patient care. The surgical approach may be modified intraoperatively based on the nature and extent of these lesions. In all cases, prompt hematoma evacuation and meticulous hemostasis are the two primary objectives of this surgery.

Keywords: Hematoma; Transverse sinuses; Traumatology; Neurosurgery

INTRODUCTION

Supratentorial-infratentorial epidural hematomas (SIEH) are rare following traumatic head injuries, representing only 2% of traumatic epidural hematomas.¹⁾ Manifestations related to these lesions vary widely, and symptoms can arise anywhere within an acute to chronic timeframe.²⁾ Given the unique anatomical characteristics of the infratentorial region, primarily its small size, surgical intervention is commonly performed to alleviate pressure on the posterior fossa components. Consequently, there is an ongoing debate surrounding the optimal surgical approach.³⁾ In this report, we present four cases of SIEH that were treated

surgically. Furthermore, we comprehensively review the existing literature on the clinical, radiological, and therapeutic aspects associated with this condition.

CASE REPORT

We report four cases of SIEH that were surgically managed in the department of neurosurgery of the trauma and burns center of Ben Arous in Tunisia.

Case 1

A 61-year-old man with no prior medical history suffered a fall from a height of 3 meters, resulting in severe cranial and thoracic trauma. Following a lucid interval, he experienced a deterioration in his level of consciousness and developed right anisocoria. He was brought to the emergency department of our center 3 hours after the trauma. His Glasgow Coma Scale score was 6 out of 15, with right anisocoria. There was neither hemodynamic nor respiratory instability.

An emergency whole-body scan revealed a right parieto-occipitotemporal epidural hematoma measuring 40 mm in thickness that exerted a significant mass effect extending into the supratentorial region (**FIGURE 1**). There was also a right parieto-occipital fracture extending to the right petrous bone with bone displacement adjacent to the right transverse sinus (**FIGURE 2**). Emergency evacuation of the epidural hematoma was performed via right parieto-occipital craniotomy, with the lower limit of the craniotomy being the upper border of the right transverse sinus. Infratentorial bleeding was removed by suction from the craniotomy located above, as the sinus was removed by the hematoma.

During hematoma evacuation, significant venous bleeding occurred due to the removal of a bone fragment lodged within the right transverse sinus. Bleeding was managed by partially reconstructing the sinus, packing the sinus, and placing a dural suspension over an absorbable hemostat. A postoperative computed tomography (CT) scan demonstrated near-complete evacuation of the epidural hematoma and resolution of the mass effect (**FIGURE 3**).

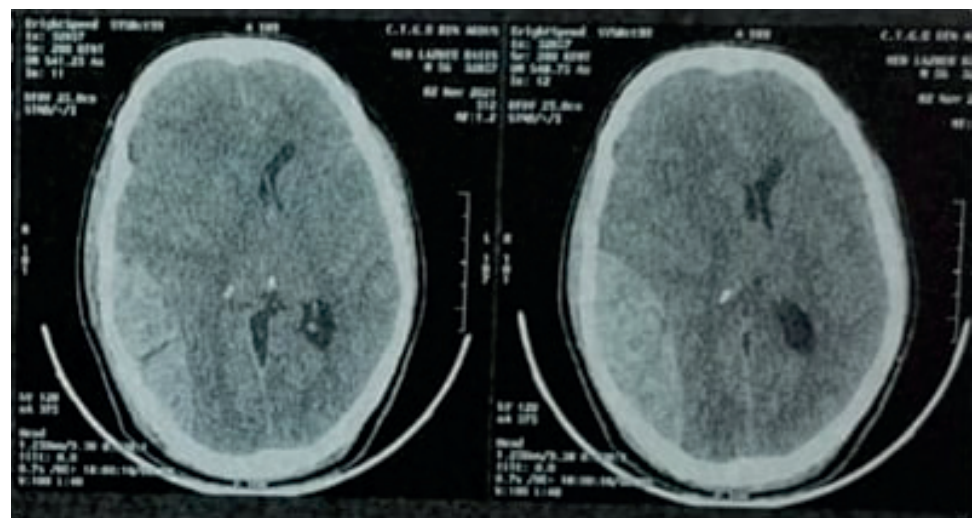


FIGURE 1. Axial section of a brain computed tomography scan showing a right supratentorial infratentorial epidural hematoma mainly located on the occipito-parietal region.

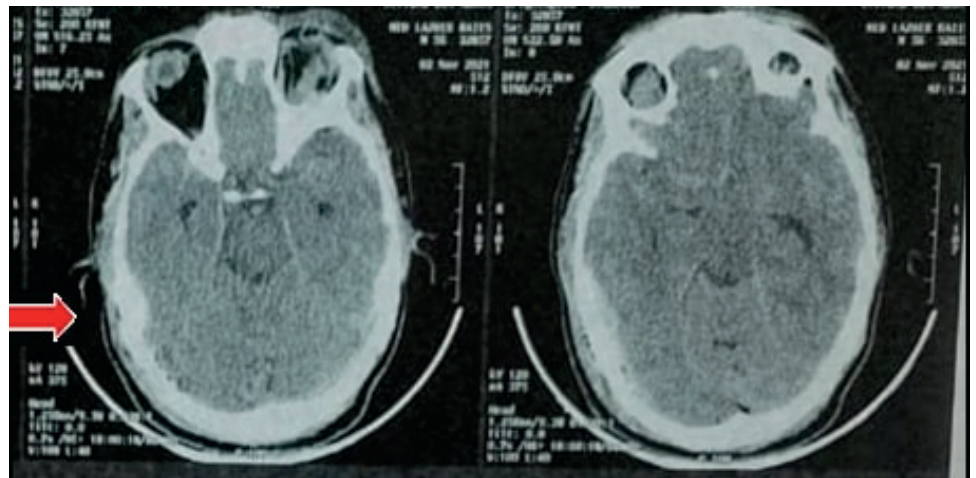


FIGURE 2. Axial section of a brain computed tomography scan showing an occipital fracture displacement regarding transverse sinus (red arrow).

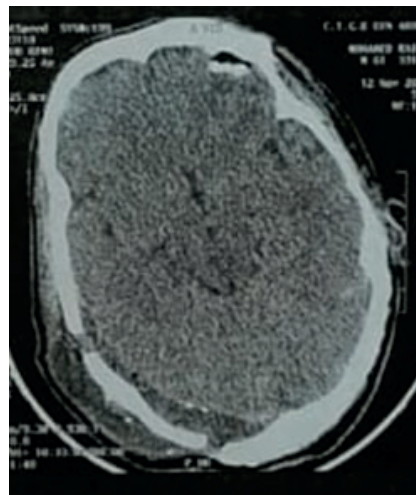


FIGURE 3. Axial section of a brain computed tomography scan immediately after surgical evacuation of the supratentorial infratentorial epidural hematoma.

During the postoperative period, the patient required a 15-day stay in the intensive care unit and received mechanical ventilation and antibiotics for the management of pneumonia. Subsequently, he recovered a perfect state of consciousness without any neurologic sequelae. Two years after the trauma, the patient is leading a normal life.

Case 2

A 13-year-old male adolescent with no prior medical history suffered from severe isolated cranial trauma following an assault with a blunt object, impacting the occipital region. He was brought to our emergency department while conscious. However, owing to rapid deterioration in his state of consciousness, he was intubated with a Glasgow Coma Scale score of 3 out of 15. Bilateral myosis of the pupils was noted. However, the patient had no hemodynamic or respiratory instability.

An emergency CT scan revealed a 15-mm thick epidural hematoma in the posterior fossa, exerting a mass effect on the fourth ventricle (**FIGURE 4**). The hematoma extended beyond

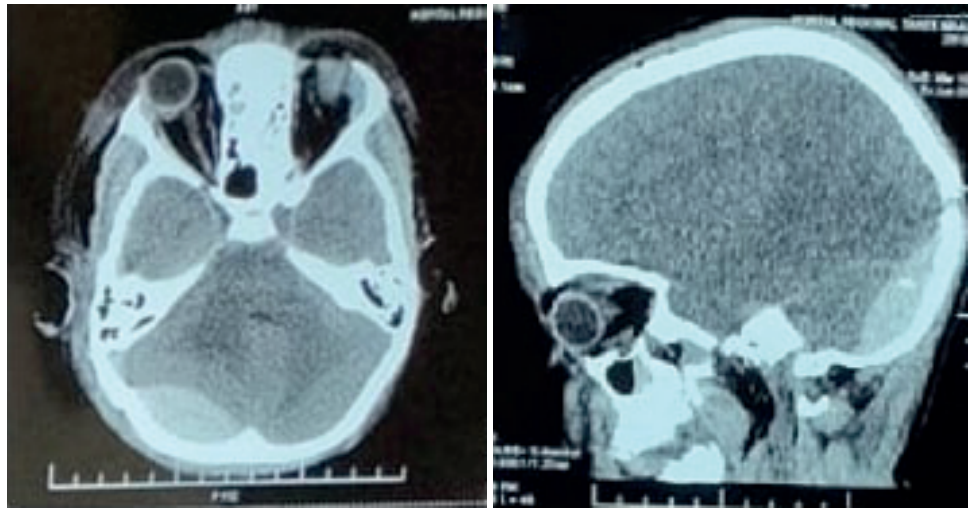


FIGURE 4. Axial brain computed tomography scan showing a right Supratentorial infratentorial epidural hematoma.

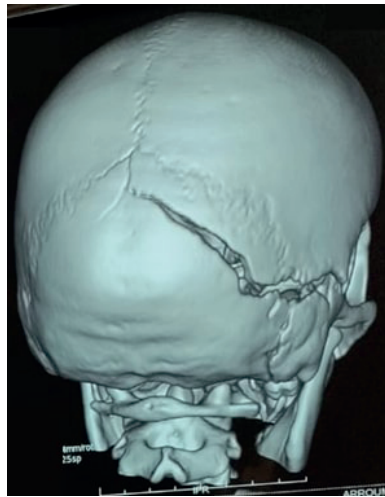


FIGURE 5. Three-dimensional-computed tomography scan reconstruction of skull showing a right linear occipitotemporal fracture.

the midline and into the supratentorial region. The right occipitotemporal linear fracture extended into the extralabyrinthine portion of the petrous bone (**FIGURE 5**).

The patient underwent emergency surgery to evacuate the hematoma. An extensive midline suboccipital craniectomy, extending more towards the right side, was urgently performed. This allowed near-complete evacuation of the hematoma, leaving a collar of coagulated blood along the path of the right transverse sinus and torcula. Because the bleeding located above the tentorium was minimal and noncompressive, we decided not to evacuate it to minimize manipulations over the sinus. Hemostasis was achieved using a dural suspension over an absorbable hemostat.

Postoperative imaging indicated nearly complete evacuation of the hematoma, with some residual blood collars along the path of the right transverse sinus and torcula and over the tentorium. The patient was successfully extubated on postoperative day three without any neurologic sequelae.

Case 3

A 33-year-old man with no prior medical history was brought to our center for the management of polytrauma following a fall down the stairs. On arrival, the patient was unconscious, with a Glasgow Coma Scale score of 9 out of 15. The pupils were in an intermediate position, with a reflective response. A cerebral CT scan revealed a right-lateralized epidural hematoma in the posterior fossa extending into the supratentorial region (**FIGURE 6**). This was associated with a right cerebellar lobar contusion measuring 3 cm, which collectively caused the obstruction of the fourth ventricle and upstream hydrocephalus.

Analysis of the bone window revealed a non-displaced, simple lateralized right occipital fracture extending towards the homolateral occipital condyle. Additionally, bifrontal and left temporal contusions and diffuse sulcal subarachnoid hemorrhages were observed. Our surgical approach involved initial placement of an external ventricular drain, followed by evacuation of the epidural hematoma and right cerebellar contusectomy. This was achieved through extensive suboccipital craniectomy, with the upper border of the craniectomy corresponding to the lower limit of the torcula. A collar of coagulated blood on the torcula was preserved. Bleeding of slight thickness above the tentorium was appreciated. Effective hemostasis was achieved.

Watertight closure was performed using an enlargement duroplasty after coagulation of the cerebellar tonsils. An epidural suction drain was placed before closing the various tissue layers. During the postoperative period, the patient was managed in the intensive care unit, where he remained intubated for 2 weeks. Subsequently, he progressively recovered a perfect state of consciousness. He was discharged on the 41st postoperative day with no sequelae.

Case 4

A 65-year-old homeless man was brought to our emergency department following a road traffic accident. He was a pedestrian struck by a car, which resulted in polytrauma with cerebral, thoracic, and pelvic components. Upon arrival, he was intubated, ventilated, sedated, and assessed with a Glasgow Coma Scale score of 3 out of 15. His pupils were constricted (myosis). He had no hemodynamic or respiratory instabilities.

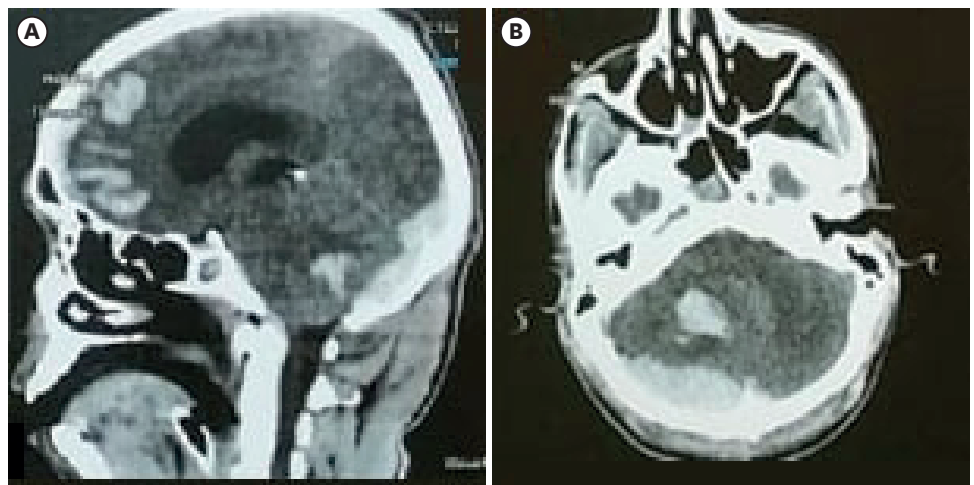


FIGURE 6. Initial CT scan (case 3). Sagittal (A) and axial (B) sections of a brain computed tomography scan showing multiple post-traumatic intracranial lesions including a supratentorial infratentorial epidural hematoma, right cerebellar and frontal contusions. The lesions developing within the posterior fossa were responsible for an upward hydrocephalus.

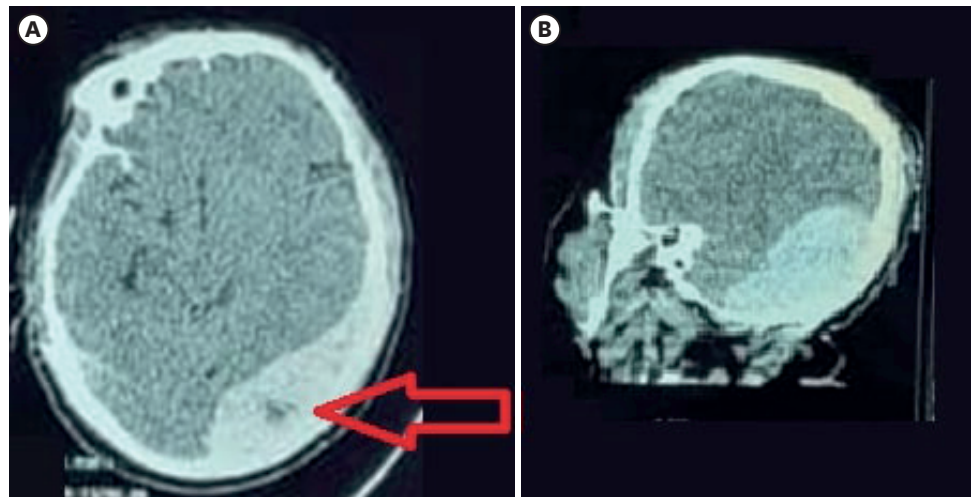


FIGURE 7. Initial CT scan (case 4). Axial (A) and Sagittal (B) sections of a brain computed tomography scan showing a left Supratentorial infratentorial Epidural hematoma. The red arrow on (A) shows the “swirl sign”.

An urgent whole-body CT scan revealed left-sided acute SIEH with a significant mass effect on the left occipital lobe and left cerebellar hemisphere (**FIGURE 7**). The hematoma contained hypodense areas suggestive of a “swirl sign.” Additionally, the CT scan showed extensive lung contusions and a complex pelvic fracture.

The patient was immediately transferred to the operating room. A paramedian occipitocervical incision was made, and the epidural hematoma was evacuated through a more extensive left suboccipital craniectomy and a left occipital craniotomy, with preservation of a “bony bridge” over the left transverse sinus. Intraoperative inspection revealed significant sinus detachment without apparent dural injury. Hemostasis was achieved by suspending the dura on both sides of the left occipital bony ridge. Closure was performed using two aspirating epidural drains, one under the suboccipital area (supratentorial) and the other on the left occipital side (infratentorial).

After surgery, the patient was transferred to the intensive care unit. Twelve hours after the surgery, he presented with sudden cardiorespiratory arrest, most probably related to a massive pulmonary embolism, leading to death.

DISCUSSION

SIEH is a unique consequence of brain trauma and comprises 2% of all epidural hematomas. Upon reviewing the available literature, it became apparent that this condition has only been documented in isolated cases or small case series because of its rarity.^{6,9,10)}

In most cases, the underlying pathophysiological mechanisms contributing to the development of SIEH are similar to those of post-traumatic epidural hematoma in the posterior fossa. Injury to the transverse sinus and/or torcula, significant extensive detachment, and extended bone fractures are the most common causes.^{4,6)}

The clinical presentation is nonspecific, as most patients present with headaches and vomiting after head trauma. According to Nasi et al.⁹⁾, only 20% of patients present with a Glasgow

Coma Scale score < 8. In our series, two patients (cases 1 and 2) exhibited rapid deterioration of consciousness shortly after a lucid interval. The third patient had an initial Glasgow Coma Scale score of 9, which was probably related to multiple frontotemporal contusions.

Narrowness of the posterior fossa and the rapidly increasing expansile volume of the hematoma, often due to venous lesions, can account for the swift deterioration of a patient's neurological state, thus worsening the overall prognosis.^{11,12)} Moreover, an increase in hematoma size causes obliteration of the perimesencephalic cistern and compression of the fourth ventricle, ultimately leading to sudden death.^{2,10)}

The radiological diagnosis of SIEH, primarily based on cerebral CT scans, is straightforward. A multiplanar cerebral CT scan with bone and parenchymal windows is necessary to study SIEH characteristics. Sagittal sections are particularly crucial for analyzing the extent of supratentorial and infratentorial hematomas. The bone window often reveals significant bone lesions that must be considered during surgical planning. This assessment is indispensable for detecting bone fragments that may be embedded in the sinus wall and for the planification of craniotomy boundaries. In the second case in our series, 3D reconstruction with a bone window allowed planning of an occipital craniotomy, taking advantage of the simple occipital fracture line.^{3,5,6,9,12)}

Surgical planning for SIEH should be wisely considered before surgery, relying on radiological elements, mainly the extent of the hematoma, its relationship with the sinuses, and the nature of bone lesions.⁶⁾

There is no consensus on the treatment approach for SIEH.^{1,6,9)} Some authors consider performing a wide craniotomy to allow the evacuation of both supratentorial and infratentorial hematomas, considering that the venous sinuses are most frequently cleaved, minimizing the risk of lesions during craniotomy.¹⁾ Other authors recommend performing two separate craniotomies separated by a bony bridge, which allows for the protection of the sagittal sinus and a suspension of the dura mater beneath it.⁸⁾ Finally, some reports consider the predominance of bleeding over or under the tentorium to perform a craniotomy where the hematoma is thicker and attempt to evacuate the rest of the hematoma through the same corridor.¹²⁾

In our series, the first patient underwent parietal craniotomy, with the lower limit being the upper edge of the transverse sinus. We chose to expose only the supratentorial portion of the hematoma, which accounts for more than 90% of the total volume. Bone window analysis revealed a transverse sinus injury. However, intraoperatively, the extent of the sinus lesions was much greater than anticipated, leading to intraoperative hemorrhagic shock. Full-thickness exposure of the transverse sinus may have yielded a better outcome. However, it would have sacrificed the benefit of dural suspension with hemostatic agents, which is crucial for effective bleeding control. In our experience, preserving a bone collar on the sinus wall to utilize a dural suspension as a hemostatic measure, akin to a permanent tamponade, is preferred. This method requires rapid identification of the type of sinus lesion and is applicable only to SIEH cases with predominantly supratentorial volumes and minimal sinus lesions that do not require complete sinus exposure.⁸⁾

In the second and third cases in our series, extended occipital craniectomy facilitated the evacuation of nearly the entire hematoma, leaving a bone strip along the course of the transverse sinus and torcula. Surgical planning involved bilateral craniotomy, preserving a

bone strip over the transverse sinus course to ensure hemostasis through dural suspension on both sides of the sinus in cases of active bleeding. However, intraoperative exploration in both cases revealed that the transverse sinus wall was covered with coagulated blood, which spontaneously ensured hemostasis. Given the absence of significant blood volume, a decision was made to respect the supratentorial compartment, reinforcing spontaneous sinus hemostasis with hemostatic material.

Although the SIEH was approached through the infratentorial compartment in the two abovementioned cases, initial planning involving both supratentorial and infratentorial bone flaps is a technique primarily described in the literature for vertex epidural hematomas. Several authors prefer to retain a bone strip over the superior sagittal sinus to benefit from the bilateral dural suspension for enduring tamponade.^{3,5) Aggarwal et al.¹⁾ reported the superiority of this technique for bilateral SIEH, particularly with regard to bleeding control. In our experience, we believe that the volume of the hematoma on both sides of the transverse sinus is the primary indication for a bicraniotomy approach for SIEH (case 4). More importantly, this approach is preferred if clinical and radiological findings indicate active bleeding and a fast expansion of the hematoma such as the classical “swirl sign”.⁷⁾}

CONCLUSION

SIEH is an uncommon post-traumatic lesion that requires urgent and individualized management on a case-by-case basis, guided by multiplanar cerebral CT findings. Preoperative planning is essential; however, intraoperative exploration and identification of transverse sinus and torcula lesions are crucial for optimal patient care. The surgical approach may be modified intraoperatively based on the nature and extent of the lesions. In all cases, prompt hematoma evacuation and meticulous hemostasis are the two primary objectives of this surgery.

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