Case Report
J Trauma Inj 2023;36(4):399-403
https://doi.org/10.20408/jti.2023.0073

Journal of Trauma and Injury JTI
pISSN 2799-4317 • eISSN 2287-1683

Surgical management of supratentorial and infratentorial epidural hematoma in Korea: three case reports

Su Young Yoon, MD[1], Junepill Seok, MD[1], Yook Kim, MD[2], Jin Suk Lee, MD[3], Jin Young Lee, MD[3], Mou Seop Lee, MD[4], Hong Rye Kim, MD[4]

[1]Department of Thoracic Surgery, Chungbuk National University Hospital, Cheongju, Korea
[2]Department of Radiology, Chungbuk National University Hospital, Cheongju, Korea
[3]Department of Trauma Surgery, Chungbuk National University Hospital, Cheongju, Korea
[4]Department of Neurosurgery, Chungbuk National University Hospital, Cheongju, Korea

Received: October 7, 2023
Revised: November 5, 2023
Accepted: November 10, 2023

Correspondence to
Hong Rye Kim, MD
Department of Neurosurgery,
Chungbuk National University Hospital,
776 1sunhwan-ro, Seowon-gu,
Cheongju 28644, Korea
Tel: +82-43-269-6677
Email: nshrmkim@gmail.com

Supratentorial and infratentorial epidural hematoma (SIEDH) is a rare but life-threatening complication following traumatic brain injury. However, the literature on SIEDH is sparse, consisting only of a few small series. Prompt diagnosis and the application of appropriate surgical techniques are crucial for the rapid and safe management of SIEDH. Herein, we present three cases of SIEDH treated at our institution, employing a range of surgical approaches.

Keywords: Hematoma; Epidural; Cranial; Craniotomy; Case reports

INTRODUCTION

Epidural hematoma (EDH) following head trauma is observed in only approximately 2% of all head injuries [1], yet it carries a high risk of mortality. The clinical presentations of EDH can vary widely in the acute stage. When EDH is diagnosed, an emergency craniotomy may be indicated, depending on the clinical and radiological findings. In cases of supratentorial and infratentorial EDH (SIEDH), which affects both the upper and lower tentorial cavities, even more urgent surgical evacuation may be required. The literature on SIEDH is sparse, with only a few small series published [2–4]. This case series represents one of the most recent articles to review and propose an intraoperative surgical technique. It details the treatment of three patients with acute SIEDH at our institution.

CASE REPORT

Case 1

A 24-year-old man was admitted to the emergency department presenting with cranial trauma following an episode of syncope and a subsequent fall backwards. He was drowsy upon arrival, with a Glasgow Coma Scale (GCS) score of 14, and reported experiencing a headache as well as nausea accompanied by vomiting. Physical examination revealed a contusion on the left occipital region of the scalp. A brain computed tomography (CT) scan showed an acute EDH in the left occipital area extending to the posterior fossa, with detachment of the left transverse sinus (Fig. 1A–C). The patient's headache and nausea were attributed to increased intracranial pressure resulting from the subdural hematoma.

The patient underwent surgery under general anesthesia, positioned laterally. We marked the incision and prepared the surgical site to perform a combined supratentorial craniotomy and suboccipital craniotomy, leaving a bone bridge over the transverse sinus to preserve the sinus (Fig. 2). A hockey stick–shaped scalp incision was made on the occiput, with the vertical limb positioned along the midline, and the upper extent was tailored based on the extent of the supratentorial EDH. A linear fracture was noted on the left parietal bone. The initial craniotomy was performed above the left transverse sinus to expose and evacuate the supratentorial hematoma. The posterior branch of the middle meningeal artery was identified as the source of the bleeding (Fig. 3A, B). Following the removal of the supratentorial EDH with the transverse sinus left intact, we gained access to the infratentorial EDH via the same supratentorial craniotomy (Fig. 4). In the posterior fossa, no active bleeding foci were found, allowing for the comfortable removal of the infratentorial EDH without necessitating a suboccipital craniotomy. The surgical site contained no residual EDH and did not require a dural tenting suture (Fig. 1D).

The patient was discharged 7 days after surgery without exhibiting any neurological deficits or symptoms. No instances of rebleeding occurred after discharge.

Case 2

A 50-year-old man sustained a headfirst backward fall from a height of 1.5 m. Upon admission, he presented with a stuporous mental state and a GCS score of 9. A brain CT scan revealed an acute SIEDH with separation of the transverse sinus from the skull (Fig. 5A–C). Sagittal and coronal CT images showed a relatively large volume of SIEDH, likely exerting pressure on the cerebellum and brainstem. This pressure would have contributed to increased intracranial pressure and a reduced level of consciousness.

The patient underwent surgery in the prone position. Given that the transverse sinus had already detached from the skull due to the substantial hematoma, the risk of iatrogenic sinus injury was minimal, even with a combined supratentorial and infratentorial craniotomy. We believed that this approach would not only reduce the duration of the craniotomy but also expedite the identification of the hemorrhage source and facilitate cessation of the bleeding. Consequently, we opted for a single supratentorial and infratentorial craniotomy traversing the sinus. Following a midline incision in the occipital scalp, we executed an occipital bone

Fig. 2. Incision and surgical marking indicates the hockey stick–shaped incision. The craniotomy, conducted above and below the transverse sinus (TS), left a thin strip of bone on the sinus.

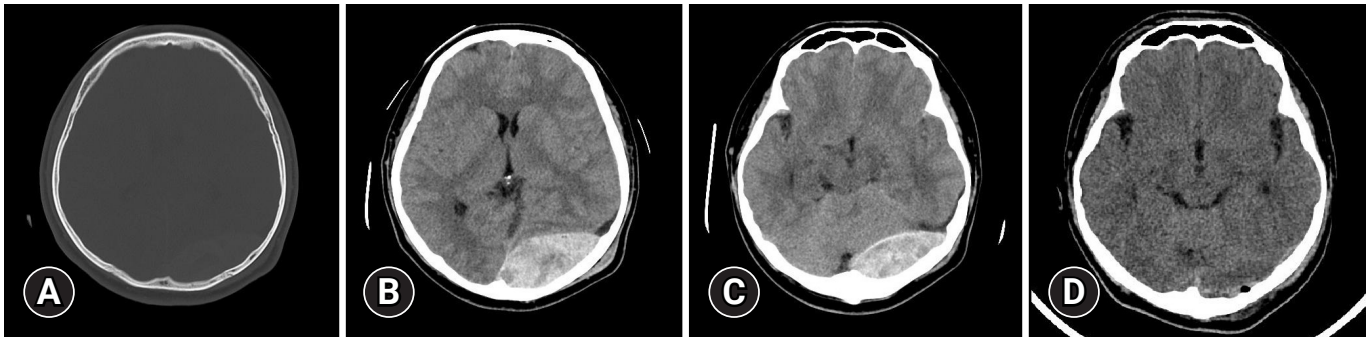

Fig. 1. Computed tomography (CT) scans of case 1. (A) Preoperative axial bone-setting CT reveals a linear fracture on the left parietal bone. (B) Preoperative axial CT scan displays the supratentorial portion of the left supratentorial and infratentorial extradural hematoma. (C) Preoperative axial CT scan shows the infratentorial portion of the left supratentorial and infratentorial extradural hematoma. (D) Postoperative axial CT scan reveals no residual epidural hematoma without the need for a dural tenting suture.

https://doi.org/10.20408/jti.2023.0073

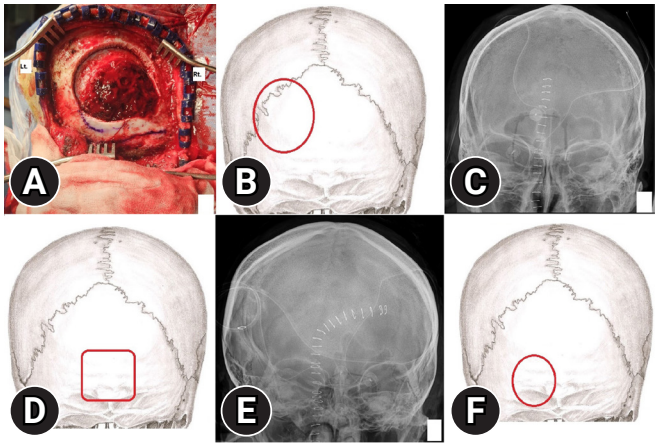

Fig. 3. Images of (A, B) case 1, (C, D) case 2, and (E, F) case 3. (A) Operative image of supratentorial craniotomy over the hematoma. (B) Pictorial depiction of the craniotomy above the left transverse sinus. (C) Skull x-ray and (D) pictorial depiction of the central supratentorial and infratentorial craniotomy, conducted across the sinus. (E) Skull x-ray and (F) pictorial depiction of the left supratentorial and infratentorial craniotomy, conducted across the sinus.

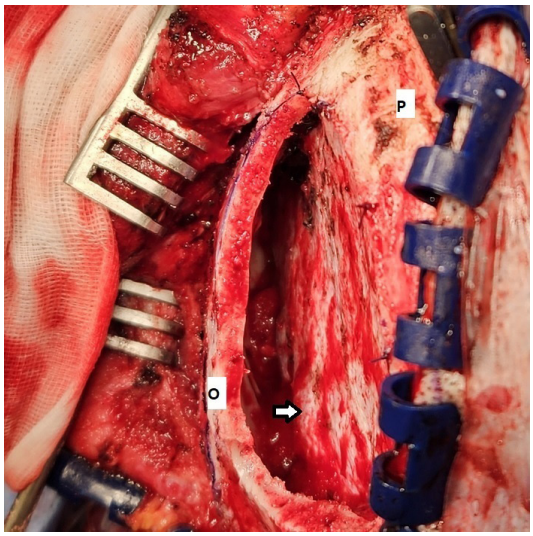

Fig. 4. Operative image of evacuation of the infratentorial epidural hematoma via supratentorial craniotomy. Postoperative axial computed tomography indicated no residual supratentorial and infratentorial extradural hematoma. The arrow indicates the transverse sinus. O, occipital bone; P, parietal bone.

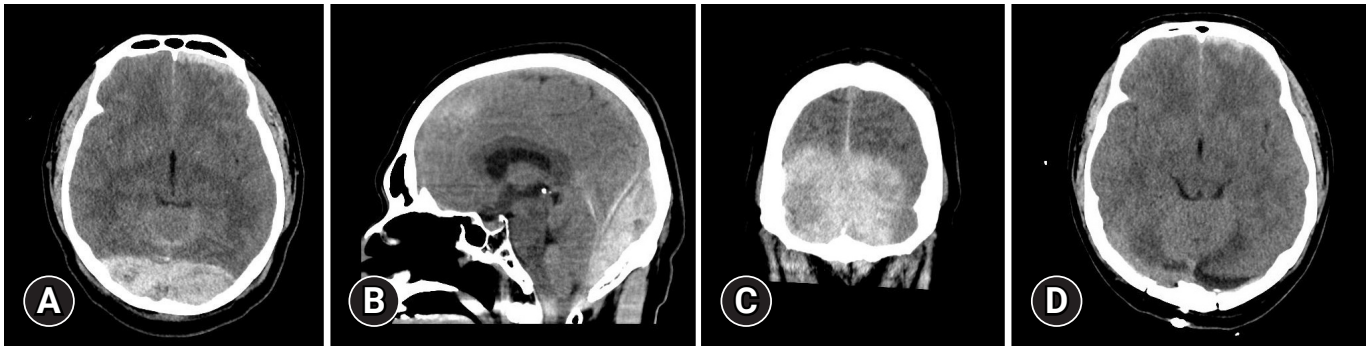

Fig. 5. Computed tomography (CT) scans of case 2. Preoperative (A) axial, (B) sagittal, and (C) coronal CT scans indicate massive supratentorial and infratentorial epidural hematoma and detachment of the transverse sinus due to supratentorial and infratentorial extradural hematoma. (D) Postoperative axial CT scan reveals no residual epidural hematoma.

craniotomy (Fig. 3C, D). Upon the complete evacuation of the SIEDH, the occipital sinus was identified as the source of the bleeding, and hemostasis was achieved.

The patient was discharged 9 days after surgery. A postoperative brain CT scan revealed no residual hematoma (Fig. 5D).

Case 3

A 19-year-old woman experienced cranial trauma caused by an electric scooter accident. Initially, the patient presented with a good GCS score of 15, and neurological examination revealed no deficits. The first brain CT scan demonstrated a thin subdural hematoma in the left temporal convexity, with no evidence of EDH (Fig. 6A). However, within an hour, the patient's mental status deteriorated to a deep drowsy state, with her GCS score decreasing to 12. A subsequent brain CT scan disclosed an acute left sided SIEDH (Fig. 6B, C). Presumably, following the lucid interval associated with EDH, the volume of the SIEDH increased rapidly, leading to a swift decline in the patient's level of consciousness.

The patient underwent surgery in the prone position. An incision was made in the left occipital scalp, followed by a left supratentorial and infratentorial craniotomy to expose and evacuate

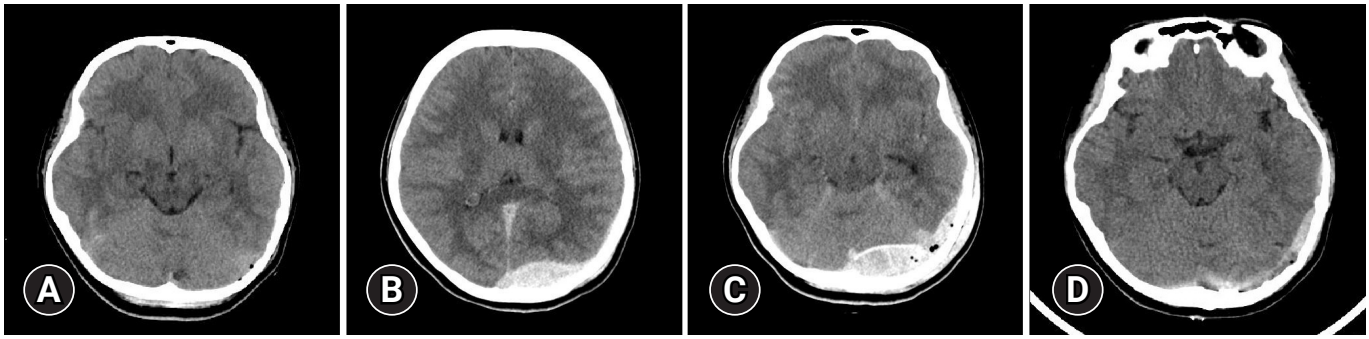

Fig. 6. Computed tomography (CT) scans of case 3. (A) Initial axial CT scan demonstrates a thin layer of subdural hematoma in the left temporal convexity without epidural hematoma. (B) Follow-up CT scan shows the supratentorial portion of an acute left supratentorial and infratentorial extradural hematoma. (C) Follow-up CT scan indicates the infratentorial portion of an acute left supratentorial and infratentorial extradural hematoma, along with increased subdural hematoma in the left temporal convexity. (D) Postoperative axial CT scan reveals no complications.

the hematoma (Fig. 3E, F). The craniotomy was performed on the left side, corresponding to the area where the hematoma was most pronounced. A left occipital linear fracture was identified that had not been detected on the CT scan, and the left transverse sinus was pinpointed as the source of the bleeding. Following complete removal of the SIEDH, adequate hemostasis was achieved. The patient's neurological deficits had completely resolved by the day following surgery.

Ethics statement

Written informed consents for publication of the research details and clinical images were obtained from the patients.

DISCUSSION

The simultaneous presence of EDH in both the upper and lower tentorial compartments is an uncommon occurrence and lacks characteristic clinical symptoms compared to infratentorial EDH. Clinical manifestations of supratentorial EDH may include headache, nausea, vomiting, hemiparesis, and unconsciousness. Conversely, infratentorial EDH can present as neck pain, cranial nerve palsy, and cerebellar dysfunction [5]. However, the lack of clinical signs does not preclude the diagnosis [6].

Infratentorial EDH is typically associated with fracture of the occipital bone [2,4,5,7]. Such fractures may be detected during surgery even if they were not identified on preoperative x-rays or CT scans. Nasi et al. [3] described the sources of bleeding in SIEDH as follows: venous bleeding from bone fractures with diploic bleeding accounts for 50%, injury to the transverse/ sigmoid sinus for 22%, oozing from meningeal venous vessels for 8%, and detachment of the transverse sinus without wall injury for 6%, with the remaining cases being of unknown cause. Due to the venous origin of the bleeding, the clinical manifestations of SIEDH may evolve gradually. However, once the hematoma reaches a critical size, rapid deterioration due to acute brain stem compression can occur, which may be life-threatening.

Surgery is the primary treatment for SIEDH. The surgical approach for the removal of SIEDH has been extensively documented in the literature. Several authors have recommended a combined supratentorial and suboccipital craniotomy, preserving a bone bridge over the transverse sinus to provide an anchor for dural tenting sutures [3–5]. An alternative method involves accessing the posterior fossa EDH via a supratentorial craniotomy, using suction to navigate between the sinus and the cranium, as demonstrated in our first case [2]. From our experience, this latter technique is safe and can be executed more rapidly in instances where the transverse sinus is intact. Furthermore, we observed that even in the absence of dural tenting sutures, no residual EDH was left at the surgical site, nor was there any subsequent rebleeding. In situations like our second and third cases, where the SIEDH is predominantly located in the supratentorial space or the bilateral transverse sinuses are substantially separated from the skull due to the size of the SIEDH, the hematoma can be removed easily, safely, and swiftly through a single, extensive supratentorial and infratentorial craniotomy (Fig. 3). Ultimately, the challenge in SIEDH surgery lies in balancing the need to avoid iatrogenic injury to the transverse sinus, creating space for dural tentorium sutures to prevent residual EDH, and reducing intracranial pressure by promptly removing the hematoma. Drawing from our experience with a series of cases, we propose the following surgical guidelines for SIEDH:

(1) If the volume of SIEDH is relatively small and the patient has not developed increased intracranial pressure (IICP), it is appropriate to perform a combined supratentorial and

https://doi.org/10.20408/jti.2023.0073

suboccipital craniotomy while preserving a bony bridge over the transverse sinus.
(2) If the SIEDH is massive and necessitates rapid decompression due to IICP, performing a single large supratentorial and infratentorial craniotomy is advantageous.
(3) When performing a single large supratentorial and infratentorial craniotomy, the extent of the craniotomy should not exceed the area of the transverse sinus separated by the hematoma, in order to prevent iatrogenic injury to the sinus.
(4) When conducting a single large supratentorial and infratentorial craniotomy, it is considered safe to position the central part of the craniotomy at the site where the hematoma is thickest.

In cases involving a large SIEDH, surgeons must exercise extreme caution to avoid damaging the sinus. Proactively organizing blood transfusions during the surgical preparation phase can be immensely beneficial in the event of an emergency. While some researchers advocate for conservative management of small, noncompressive hematomas, it is crucial to ensure meticulous clinical and radiological monitoring [4].

The reported overall mortality rate for SIEDH is approximately 4%, with 92% of patients experiencing a favorable prognosis following surgical intervention [3]. Timely diagnosis and the application of appropriate surgical methods are crucial for the swift and secure management of SIEDH [8]. Additionally, it is important to recognize that larger SIEDH cases are often correlated with substantial blood loss.

ARTICLE INFORMATION

Author contributions

Conceptualization: SYY; Formal analysis: HRK; Methodology: all authors; Project administration: all authors; Visualization: HRK; Writing–original draft: all authors; Writing–review & editing: all authors. All authors read and approved the final manuscript.

Conflicts of interest

The authors have no conflicts of interest to declare.

Funding

The authors received no financial support for this study.

Data availability

Data sharing is not applicable as no new data were created or analyzed in this study.

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