Turk Neurosurg 34(4):618-623, 2024

Original Investigation

DOI: 10.5137/1019-5149.JTN.43250-22.4

Received: 22.12.2022
Accepted: 24.07.2023

Published Online: 13.06.2024

Surgical Technique for Draining a Concomitant Supra-and Infratentorial Epidural Hematomas

Alper TABANLI, Hakan YILMAZ

University of Health Sciences Izmir Bozyaka Education and Research Hospital, Department of Neurosurgery, Izmir, Türkiye

Corresponding author: Alper TABANLI ✉ alper_tabanli@hotmail.com

ABSTRACT

AIM: To assess clinical and radiological characteristics of simultaneous acute supra- and infratentorial epidural hematomas.

MATERIAL and METHODS: We retrospectively reviewed the clinical and radiological data of 18 patients with a concomitant acute supra- and infratentorial epidural hematoma, who were treated and followed up at our hospital.

RESULTS: The Glasgow Coma Score was 3–8 in four patients, was 9–12 in seven, and was 13–15 in seven patients. While the concomitant supra- and infratentorial hematoma did not cross the midline in 15 of the patients, it did in three of them. The dural venous sinus rupture was repaired in five of the patients. Functional healing was observed in 14 of the 18 patients. Two of the patients died during the postoperative period.

CONCLUSION: A simultaneous supra- and infratentorial epidural hematoma rarely occurs in neurosurgical practice. Mortality and morbidity rates are high if these are not addressed in time. The radiological images of patients should be evaluated carefully preoperatively. In patients with a concomitant infra- and supratentorial hematoma, transverse sinus damage, which is a surgical challenge, should be considered. Herein, we describe a surgical technique (supra- and infratentorial craniotomy leaving the bone bridge over the transverse sinus) for draining a concomitant supra- and infratentorial epidural hematoma; this technique is an effective surgical choice in select patients.

KEYWORDS: Epidural hematoma, Head trauma, Supratentorial, Infratentorial, Posterior fossa

INTRODUCTION

Epidural hematomas usually produce a compressive effect, causing an increase in the intracranial pressure. Hematomas, especially those located in the temporal region, are clinically noisy and are associated with high mortality and morbidity rates (4,7). Approximately 50% of the epidural hematomas occur due to bleeding from the arteria meningea media. Computed tomography (CT) of the brain obtained after the acute period of trauma has revealed late-onset epidural hematomas in approximately 8% of cases without initial hematomas (4,5). Epidural hematomas are seen in approximately 1.14%–5.8% of patients with a blunt head trauma. This incidence rises up to 19% in cadaveric studies.

A posterior fossa epidural hematoma (PFEDH) is less frequently observed than a hematoma in the supratentorial area. They constitute approximately 4%–12.9% of all epidural hematomas. PFEDH may not have any symptom or signal initially (6). It is challenging to predict the location and type of hematoma based on the development of clinical findings (3,15). By the time PFEDHs show up, it is too late for any effective treatment and the outcome is usually death (9-11). Simultaneous appearance of an acute supra- and infratentorial epidural hematoma is rare. We aimed to evaluate patients with concomitant supra- and infratentorial epidural hematomas, who underwent surgery at our hospital between 1999 and 2019.

MATERIAL and METHODS

We retrospectively evaluated 18 patients who were treated for acute concomitant supra- and infratentorial epidural hematomas between 1999 and 2019 at the Department of Neurosurgery, University of Health Sciences Izmir Bozyaka Educa-

Alper TABANLI : 0000-0002-2378-507X Hakan YILMAZ : 0000-0002-2180-1195

tion and Research Hospital. We retrospectively reviewed the participants' clinical and radiological data. In all patients with a head injury an emergency cranial and cervical vertebra CT was obtained and a systemic and neurological examination was performed. The following parameters were evaluated on CT: diameter-length of the epidural hematoma, fractures, hemorrhagic contusion (HC), subarachnoid hemorrhage (SAH), intraparenchymal hemorrhage (IPH), subdural hematoma (SDH), fourth ventricle compression, and shift effects. Patients with a supra- and infratentorial epidural hematoma, which required surgical intervention were rapidly evaluated and taken up for emergency surgery. Epidural hematomas in the first CT that were not at the surgical margin were re-evaluated with a 4th hour control CT.

The study was approved by Ethics Committee of the University of Health Sciences Izmir Bozyaka Education and Research Hospital (No: 27/10/2020-06).

Surgical Procedure

After general anesthesia was administered, the patient was positioned in the prone position with the head secured in a Mayfield holder. After appropriate preparation and draping, the midline and transverse sinuses were identified. Subsequently, an S-shaped incision was made. Thereafter, the skin flaps and muscle were retracted in a single layer. One-sided dual craniectomies (supra- and infratentorial) were performed using a high-speed drill for lesions that did not crossing the midline. A bone bridge over the transverse sinus was left in all cases to apply dural tenting sutures. First, the occipital bone flap was removed and the supratentorial portion of the epidural hematoma was evacuated. Subsequently, the infratentorial bone flap was removed and the epidural hematoma was evacuated. Bleeding from the sinus was stopped by applying compression with a gel foam and dural hitching. After achieving hemostasis with a bipolar cautery, the two bone flaps were repositioned and the scalp was sutured (Figure 1). A similar surgical technique was described by Aggarwal et al. in 2017 (1).

RESULTS

Of the 18 patients included in the study, 15 (83%) were males and 3 (17%) were females. The average age of the study participants was 31.1 years. All the patients underwent surgery for the simultaneous presence of supra- and infratentorial epidural hematomas. Of the 18 patients, nine were admitted following a fall from height, five following a traffic accident, and four following an assault. Local features of trauma were observed in all 18 patients. Fourteen patients complained of headache, 12 complained of vomiting, and three gave a history suggestive of ataxia. Eight patients were brought unconscious to the emergency room. Four patients had otorrhagia and two had anisocoria (Table I).

The neurologic examination was based on the main consciousness level. In addition, the cranial nerves were assessed. The patients were divided into three groups according to the Glasgow Coma Score (GCS) at the time of arrival to the hospital. Patients with a GCS of 3–8 were classified as Group I (n=4), those with a GCS of 9–12 were classified as Group II (n=7), and those with a GCS of ≥13 were classified as Group III (n=7) (Table II).

All patients were diagnosed with the aid of a cranial CT. The hematoma thickness varied between 13 mm and 22 mm (average, 14.7 mm). In 15 of the patients, the supra- and infratentorial hematomas did not cross the midline; however, the hematomas in the three other patients crossed the midline. Of the 18 patients, 12 had a linear fracture in the occipital bone and four patients had a depressed occipital bone fracture. In five of the patients, the fracture line crossed the transverse sinus. Of the 18 included patients, 11 had an SAH, seven had an IPH or HC, and four had an SDH. In both fractures types, fourth ventricular compression was observed due to the hematoma.

A fracture of the occipital bone was seen in 16 of the patients. Thus, an occipital and suboccipital craniectomy was performed, which helped in centering the transverse sinus. The bleeding originated from the venous sinus in five patients, and from the fractured occipital bone in nine patients. No distinctive focus of bleeding was identified in four patients. A craniotomy was performed with the help of a Kerrison rongeur while leaving the bone bridge over the transverse sinus to avoid damaging it. Transverse sinus rupture was observed in five patients. Among the patients with a transverse sinus

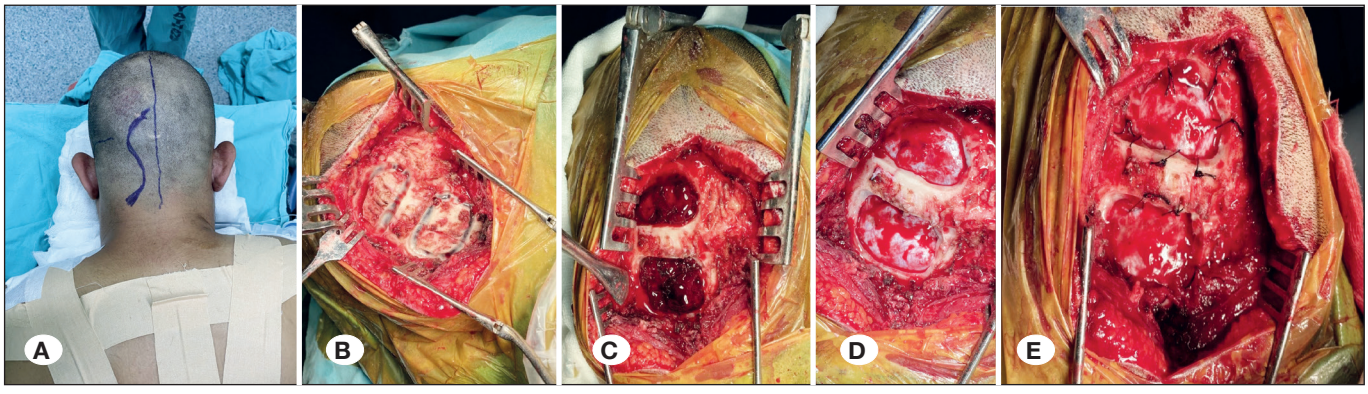

Figure 1: A) Skin incision. **B)** Occipital and suboccipital craniotomy with preservation of the bone above the sinus. **C)** Supra- and infratentorial epidural hematoma. **D)** Evacuation of the epidural hematoma. **E)** Suspension sutures of the dura.

injury, three had a GCS of 3–8 and two had a GCS of 9–12. All venous sinus injuries were successfully repaired. Two of the patients with a sinus injury died during the postoperative period. None of the 13 patients without a transverse sinus injury died. There was a significant difference between the groups according to the transverse sinus injury (p=0.026). The GCS was significantly lower in patients with a transverse sinus injury than in those without a transverse sinus injury. The transverse sinus was not injured in Group III; however, it was observed in two patients in Group II and three in Group I. Thus, the mortality rate was higher in patients with a sinus injury than in those with a sinus injury. No statistically significant difference was found between the groups and the mortality rates (p=0.680). This may be due to only some patients dying.

Table I: Clinical and Radiographic Features of Patients

Case	Age/ Sex	Mechanism	Clinical manifestations besided local trauma findings	Initial CT findings on admission	Bleeding source
1	M / 24	Traffic accident	case 1: headache, vomiting	Fr, CS	Transverse sinus
2	M / 22	Fall	case 2: otorrhagia, vomiting	Fr, SAH	Fractured bone
3	M / 30	Assault	case 3: headache, vomiting	Fr, SAH	Fractured bone
4	M / 41	Traffic accident	case 4: headache	SDH, HC	Unidentified
5	F / 25	Assault	case 5: headache, vomiting	Fr, SAH	Fractured bone
6	M / 25	Fall	case 6: otorrhagia	CS, SAH, IPH	Transverse sinus
7	M / 22	Traffic accident	case 7: headache, vomiting	Fr, SDH, SAH	Fractured bone
8	F / 35	Traffic accident	case 8: Headache, vomiting	HC	Unidentified
9	M / 40	Fall	case 9: Otorrhagia, vomiting, anisocoria	CS, SDH, SAH, IPH, V	Transverse sinus
10	M / 52	Fall	case 10: headache, vomiting	Fr, HC	Unidentified
11	M / 50	Traffic accident	case 11: headache, vomiting	Fr, HC	Unidentified
12	M / 18	Fall	case 12: headache, vomiting	Fr	Fractured bone
13	M / 34	Fall	case 13: Otorrhagia, anisocoria	CS, SDH, SAH, IPH, V	Transverse sinus
14	F / 38	Fall	case 14: headache, vomiting	Fr, SAH	Fractured bone
15	M / 33	Assault	case 15: headache	Fr, HC	Fractured bone
16	M / 32	Fall	case 16: headache	Fr, SAH	Fractured bone
17	M / 19	Assault	case 17: vomiting	CS, SAH	Transverse sinus
18	M / 20	Fall	case 18: headache, vomiting	Fr, SAH	Fractured bone

Fr: *Fracture of the occipital bone,* ***CS:*** *Fracture cross the transverse sinus,* ***SDH:*** *Subdural hematoma,* ***SAH:*** *Subarachnoid hematoma,* ***IPH:*** *Intraparenchymal hematoma,* ***HC:*** *Hemorrhagic contusion,* ***V:*** *Compression and/or displacement of the fourth ventricle.*

Table II: Mortality and Functional Recovery Rates According to the GCS Scores on Admission

	Number of patients	Alive	Exitus	MO (%)	FR (%)	Transvers sinus injury (+)	Transvers sinus injury (-)
Group I	4	3	1	25	75	3	1
Group II	7	6	1	14	85	2	5
Group III	7	7	-	-	100	-	7
Total	18	16	2	16,6	83,3	5	13

FR: *Functional recovery,* ***MO:*** *Mortality,* ***GCS:*** *Glasgow Coma Scale.*

Two of the patients who were referred to our hospital with a GCS of 3–8, died during the postoperative period. The other patients were discharged from the hospital and re-evaluated according using the Glasgow Outcome Scale (GOS). The healing according to the GOS and the moderate disabilities were accepted as functional recovery.

The patients were divided into three groups according to their GCS, and the mortality and functional recovery rates were calculated for each group. The mortality rate in Groups I and II was 24% and 14%, respectively. The functional recovery rate in Groups I and II was 75%, and 85%, respectively. In Group III, there was no mortality and functional recovery was seen in all the patients (Table II).

Three of the patients who were simultaneously operated for supra- and infratentorial epidural hematomas presented enclosed with their pre- and postoperative images (Figures 2–4).

DISCUSSION

Epidural hematomas are a complication of serious head injuries. It significantly affects the mortality and morbidity rates. Epidural hematomas located both supra- and infratentorially are rare. It arises as a result of a transverse sinus injury or bleeding from the fractured bone. In such patients a fracture line is seen passing through the transverse sinus. In such cases, clinical and radiological follow-up would be life-saving (9).

Patients with supra- and infratentorial epidural hematomas generally have a history of an occipital region trauma, a headache, vomiting, loss of consciousness, pain on neck contraction, and mastoid ecchymosis (also called “battle sign”) (8). The clinical manifestations of supratentorial epidural hematomas are headache, nausea, vomiting, amnesia, and loss of consciousness. The clinical manifestations of infratentorial epidural hematomas are neck pain, cranial nerve palsy, and

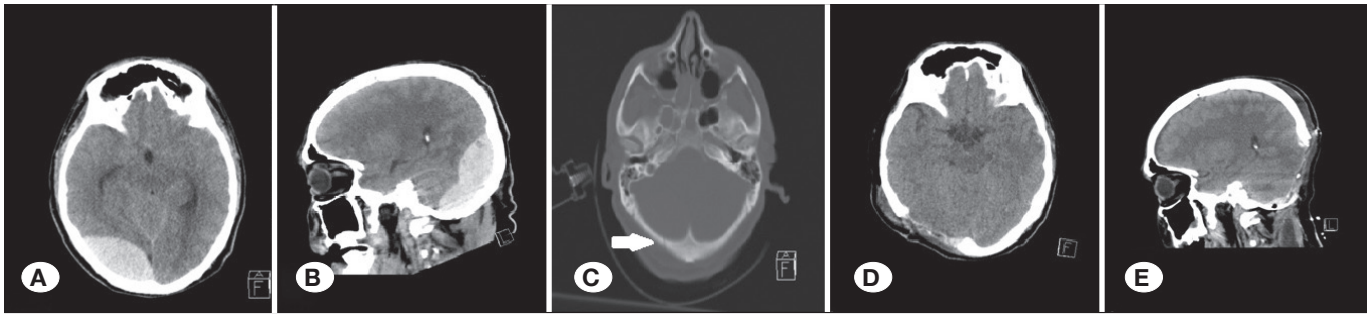

Figure 2: Preoperative CT of case 5 **A)** axial CT scan revealed epidural hematoma **B)** sagittal CT scan revealed supra-and infratentorial epidural hematoma **C)** linear skull fracture **D)** postoperative axial CT scan revealed occipital craniectomy **E)** postoperative sagittal CT scan revealed evacuation of epidural hematoma.

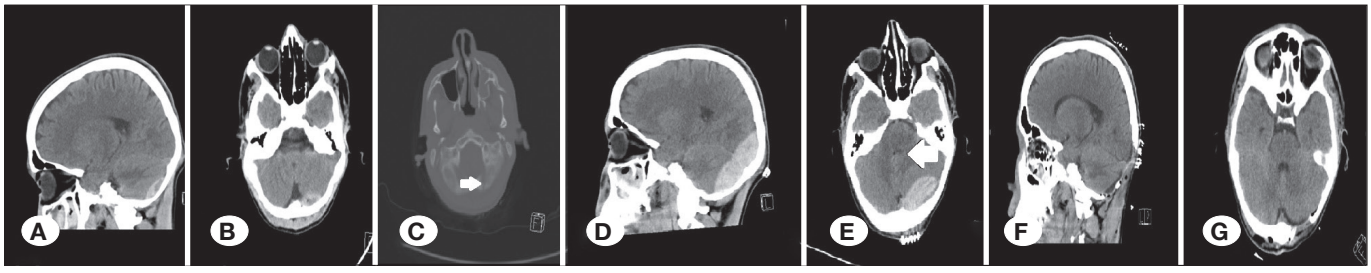

Figure 3: Preoperative CT of case 13 **A-B)** sagittal and axial CT scan revealed epidural hematoma not requiring surgery **C)** linear skull fracture **D-E)** fourth hour control sagittal and axial CT scan revealed epidural hematoma requiring surgery **F-G)** postoperative sagittal and axial CT scan revealed evacuation of epidural hematoma.

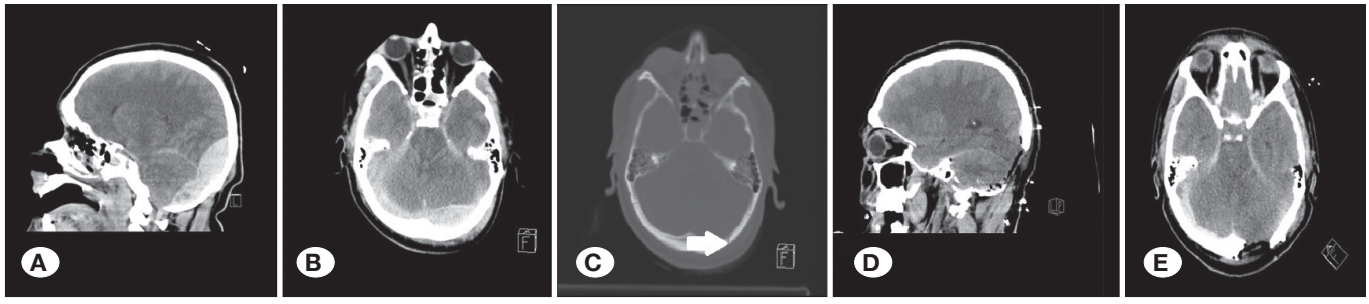

Figure 4: Preoperative CT of case 16 **A-B)** sagittal and axial CT scan revealed epidural hematoma **C)** Linear skull fracture **D-E)** Postoperative sagittal and axial CT scan revealed evacuation of epidural hematoma.

cerebellar dysfunction. The main complaint in our patients was a headache. The other associated findings were nausea and vomiting (2).

Impairment of consciousness varied depending on the severity of the hematoma, its location, and how rapidly it formed. Moreover, traumatic lesions such as a concomitant cerebral contusion, intracerebral hematoma, SAH, and SDH were also considered as other causes that could affect the level of consciousness. PFEDHs are rare, and almost all of them are associated with a history of trauma (14,16). The existence of infratentorial hematoma can result in quick clinical deterioration and sudden death (14). The complications may be more fatal in infratentorial hematoma than in those with supratentorial hematomas. This type of epidural hematoma often occurs in association with an occipital bone fracture, a lambdoid suture separation, or damage to a vein or sinus (13). In occipital bone fractures, especially when bone over the transverse sinus is fractured, the patient needs to be closely followed. The bleeding originated from the transverse sinus in five our patients and from the fractured bone in nine patient. No distinctive bleeding focus was identified in four patient.

Venous return disorders are seen in patients with transverse sinus compressions. The patients present with symptoms of intracranial hypertension and can rapidly develop cerebellar herniation. In both the patients who died, the intracranial pressure had been high intraoperatively and the brain parenchyma had an edematous contusion. In such patients, surgery to decompress the transverse sinus and fourth ventricle and to decrease the intracranial pressure should be performed at the earliest. Patients who undergo early surgical treatment heal without sequelae (12).

Larger craniotomies are required to drain concomitant supra- and infratentorial epidural hematomas. Solmaz et al. suggested that identifying the hematoma boundaries, fracture site, transverse sinus location, and the site of transverse sinus tear if it exists by performing a suboccipital craniectomy (15). In our case series, two craniotomies were performed while retaining a bone bridge over the transverse sinus. In five of the patients, bleeding occurred due to transverse sinus damage; furthermore, the dura hinged to the bone left behind after the craniectomy at frequent intervals. In the remaining 9 patients, the fracture line was monitored as the cause of bleeding. Preserving the integrity of the dura mater after the craniotomy is important. The epidural hematomas dissect the sinus and dura mater together. In one patient, due to frequent hinging of the dura mater, the transverse sinus was passed, causing blood leakage. The bleeding was controlled using a bipolar cautery and surgicel.

CONCLUSION

Concomitant supra- and infratentorial epidural hematomas are rarely encountered in neurosurgical practice. However, their presence requires an emergency surgical decompression. In case the bone is fractured where the transverse sinus crosses, the transverse sinus is most likely damaged and needs to be repaired. Retaining a bone bridge at the transverse sinus and draining the hematomas via two craniotomies is an effective surgical choice in select patients.

AUTHORSHIP CONTRIBUTION

Study conception and design: AT, HY
Data collection: AT, HY
Analysis and interpretation of results: AT, HY
Draft manuscript preparation: AT, HY
Critical revision of the article: AT, HY
Other (study supervision, fundings, materials, etc...): AT, HY
All authors (AT, HY) reviewed the results and approved the final version of the manuscript.

REFERENCES

1. Aggarwal A, Salunke P, Futane S, Sodhi HBJ: Bilateral posterior fossa and temporo-occipital extra-dural hematomas: A simple novel technique. Asian J Neuro 12:253, 2017. https://doi.org/10.4103/1793-5482.150008
2. Aji YK, Apriawan T, Bajamal AH: Traumatic supra- and infratentorial extradural hematoma: Case series and literature review. Asian J Neurosurg 13:453-457, 2018. https://doi.org/10.4103/ajns.AJNS_282_16
3. Asanin B: Traumatic epidural hematomas in posterior cranial fossa. Acta Clin Croat 48:27-30, 2009
4. Borovich B, Braun J, Guilburd JN, Zaaroor M, Michich M, Levy L, Lemberger A, Grushkiewicz I, Feinsod M, Schächter I: Delayed onset of traumatic extradural hematoma. J Neurosurg 63:30-34, 1985. https://doi.org/10.3171/jns.1985.63.1.0030
5. Bor-Seng-Shu E, Aguiar PH, de Almeida Leme RJ: Epidural hematomas of the posterior cranial fossa. Neurosurg Focus 16:ECP1, 2004. https://doi.org/10.3171/foc.2004.16.2.10
6. Bozbuga M, Izgi N, Polat G: Posterior fossa epidural hematomas: Observations on a series of 73 cases. Neurosurg Rev 22:34-40, 1999. https://doi.org/10.1007/s101430050006
7. Bricolo A, Pasut LM: Extradural hematoma: Toward zero mortality. Neurosurgery 14:8-12, 1984. https://doi.org/10.1097/00006123-198401000-00002
8. Ersahin Y, Mutluer S: Posterior fossa extradural hematomas in children. Pediatr Neurosurg 19:31-33, 1993. https://doi.org/10.1159/000120697
9. Is M, Can A, Akgul MH: Chronic supra- and infratentorial epidural hematoma. Case report. Turk Neurosurg 16:212-213, 2006
10. Karasu A, Sabanci PA, Izgi N: Traumatic epidural hematomas of the posterior cranial fossa. Surg Neurol 69:247-251, 2008. https://doi.org/10.1016/j.surneu.2007.02.024
11. Khwaja HA, Hormbrey PJ: Posterior cranial fossa venous extradural haematoma: An uncommon form of intracranial injury. Emerg Med J 18:496-497, 2001. https://doi.org/10.1136/emj.18.6.496
12. Poon W, Rehman S, Poon C, Li A: Traumatic extradural hematoma of delayed onset is not a rarity. Neurosurgery 30:681-686, 1992. https://doi.org/10.1227/00006123-199205000-00005
13. Puech B, Puech PF, Dhellemmes P, Pellerin P, Lepoutre F, Tichy G: Did Mozart have a chronic extradural hematoma. Injury 20:327-330, 1989. https://doi.org/10.1016/0020-1383(89)90004-1

14. Rivas JJ, Lobato RD, Sarabia R, Cordobes F, Cabrera A, Gomez P: Extradural hematoma: An analysis of factors influencing the course of 161 patients. Neurosurg 23:44-51, 1988. https://doi.org/10.1227/00006123-198807000-00010
15. Solmaz I, Civelek E, Dinc C, Secer H Ibrahim, Temiz Caglar, Gonul E: Supra- and infratentorial acute epidural haematoma: A case report. J Nervous Sys Surg 2:161-163, 2009
16. Vlcek E, Druga R, Smahel Z, Bigoni L, Velemínská J: The skull of Wolfgang Amadeus Mozart predicates of his death. Acta Chir Plast 48:133-140, 2006