

Prognostic factors in intracranial epidural hematoma: lessons learned

Factores pronósticos en el hematoma epidural intracraneal: lecciones aprendidas

Carlos Umberto Pereira¹ 

Joilson Francisco de Souza Júnior² 

Ana Beatriz Pereira Bieritz Pinto³ 

Débora Moura da Paixão Oliveira⁴ 

Samuel Pedro Pereira Silveira⁵ 

ABSTRACT

Introduction: Intracranial epidural hematoma (IHE) is considered a neurosurgical emergency. Its knowledge has been increasingly highlighted in the literature. **Materials and Methods:** The present literature review, was performed through the PubMed/MEDLINE, Embase, and Google Scholar databases, published over 50 years. A total of 116 articles from 1975 to 2022 were selected for their relevance to the topic at hand. **Results:** The main factors influencing the prognosis of patients with IHE are: patient age, the time between injury and treatment, Glasgow Coma Scale (GCS) score ≤ 8 on admission or before surgery, presence of pupillary abnormalities/associated intracranial lesions. **Conclusion:** The prognosis is determined by several factors, the most important of which is the GCS grade at the time of admission, as discussed extensively in the literature. The functional outcome has been excellent when IEH is detected early and treated.

Keywords: epidural hematoma intracranial; head injury; treatment outcome; prognostic factors.

RESUMEN

Introducción: El hematoma epidural intracraneal (HEI) es considerado una urgencia neuroquirúrgica. Su conocimiento ha sido cada vez más destacado en la literatura. **Materiales y Métodos:** La presente revisión bibliográfica se llevó a cabo utilizando las bases de datos PubMed/MEDLINE, Em-base y Google Scholar, publicadas durante 50 años. Se seleccionaron un total de 116 artículos de 1975 a 2022 por su relevancia para el tema en cuestión. **Resultados:** Los principales factores que influyen en el pronóstico de los pacientes con EHI son: edad del paciente, tiempo entre la lesión y el tratamiento, puntuación en la escala de coma de Glasgow (GCS) ≤ 8 al ingreso o antes de la cirugía, presencia de anomalías pupilares/lesiones intracraneales asociadas. **Conclusión:** El pronóstico está determinado por varios factores, siendo el más importante el grado de la GCS al momento del ingreso, ampliamente discutido en la literatura. El resultado funcional ha sido excelente cuando la EHI se detecta a tiempo y se trata.

Palabras clave: hematoma epidural intracraneal; traumatismo craneoencefálico; resultado del tratamiento; factores pronósticos.

¹Neurosurgery. Hospital of Emergency of Sergipe, Aracaju, Sergipe, Brazil.

²Student of Medicine University Federal of Sergipe, Aracaju, Sergipe, Brazil.

³Student of Medicine School Bahiana, Salvador, Bahia, Brazil.

⁴Nurse. Vice-President Association Brazilian Nurse in Neurology and Neurosurgery, Aracaju, SE, Brasil.

⁵Student of Medicine Faculty Medicine Uberaba, Uberaba, MG, Brasil.

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1 INTRODUCTION

Intracranial epidural hematoma (IEH) is defined as a blood collection located between the dura mater and the internal bone plate of the skull^{1,2}. IEH occurs in 0.2% to 6% of patients admitted with traumatic brain injury (TBI) and in 9% to 12% of severe TBI^{1,3-9}. It corresponds to 20% of surgical interventions for intracranial hematomas of traumatic origin¹. Usually affects young male adults^{3,10-12}. The typical clinical picture is an initial loss of consciousness, followed by a return to a normal state of consciousness (lucid interval), followed by focal neurological signs associated with worsening of the state of consciousness.

IEH represents an extremely significant cause of morbidity and mortality in patients with moderate and severe TBI. Prognosis depends on trauma mechanism, age, volume, and location of hematoma, GCS score on admission, the presence of the lucid interval, pupillary abnormalities, motor response, interval between trauma and treatment, elevated intracranial pressure, and neuroimaging findings (associated intradural injury, hematoma volume, midline shift)^{3,13-37}. Prognosis can also be affected by geographical factors, based on the distance between the accident site and the reference hospital. The authors review the main prognostic factors in patients with IEH and discuss their findings.

2 LITERATURE SEARCH

We conducted a literature review based on a data survey found in the literature. The descriptors used in the medical subject headings (MeSH) and Descritores em Ciência da Saúde (DeSC) were: Epidural hematoma intracranial, head injury, treatment outcome, prognostic factors. A detailed literature search was performed in the PubMed/MEDLINE, Embase, and Google Scholar databases in December 2022, and the related bibliographic searches were published in the period between 1975 and 2022. A total of 116 articles from 1975 to 2022 were selected for their relevance to the topic at hand. Ethical approval and patient consent were not required as this is a systematic review based on published studies.

3 DISCUSSION

3.1 Lesson 1: Age

IEH mainly affects people in their second and third decades of life^{3,7,9,11,38-40}. It affects about 3% of patients under the age of two and 6% of patients over the age of 60^{8,38,40}. Due to anatomical and physiological variations, such as increased cranial malleability and elasticity, the middle meningeal artery accommodated in a shallow sulcus (allowing this artery to shift without being injured during trauma), increased adherence of the dura mater to the skull, and a less prominent cranial diploe (reducing the possibility of IEH development), IEH is less common in childhood⁴¹⁻⁴⁴.

According to some authors^{23,24}, patients over the age of 61 have a poor prognosis. They assert that older age results in less favorable functional recovery. An elderly patient may present with an atypical presentation and is frequently associated with focal neurological signs; thus, a computed tomography (CT) of the brain has been recommended early for diagnostic elucidation. The elderly patient typically has multiple comorbidities, and because of the use of anticoagulant drugs and the risk of falling, they have a reduced capacity to recover neurological functions⁴⁵.

Several authors have reported that age influences the poor prognosis^{4,27,39,46-52}. According to Onodera et al.⁵³, advanced age and GCS score at admission are predictors of poor prognosis in patients undergoing surgical treatment for IEH. Young adult patients had a better prognosis, according to Ayub et al.³³. Age had no effect on prognosis in Ali et al.⁵⁴ patient series.

3.2 Lesson 2: Localization

The location of the IEH is also significant because it influences the prognosis and directs the neurosurgeon's surgical approach⁵⁵. The preferred location is supratentorial in 90% of patients and infratentorial in 10%. It is unilateral in 95% of cases and bilateral in 5%^{40,56}.

IEH is almost always found over the convexity of the cerebral hemisphere in the middle fossa, with the temporal and temporoparietal regions being the most common (70% of cases)^{2,3,6,9,10,26,32,39,40,42,52,54,57-59}. Approximately 10% of cases were found in the frontal region, 10% in the parieto-occipital region, and 10% in the posterior fossa, with the vertex and clivus being less common^{52,60}.

In cases of IEH located in the temporal region^{32,61,62}, a high mortality rate has been reported. Other authors^{39,40,42,63} have reported that temporoparietal location was associated with a high mortality rate.

3.3 Lesson 3: GCS score on admission

The clinical presentation depends on the size, location, and hematoma growth velocity, plus the presence or absence of associated intradural lesions. Some symptoms associated with IEH are headache, nausea, vomiting, seizures, and focal neurological deficit⁴⁴. Small-volume IEHs are usually asymptomatic. According to Haselsberger et al.⁶⁴ the prognosis depends on the GCS score and neurological status on admission. Several authors^{15,34,65,66} associated the presence of pupillary abnormalities and low GCS score on admission with a poor prognosis. Other authors^{1-4,15,19,27,28,30,31,39,67-70}, have suggested that the most important predictor of prognosis is the GCS score before the surgical procedure. Many authors reported that prognosis is influenced by both the score on admission and the volume of the hematoma^{21,27,71}. The literature has reported a high mortality rate in unconscious patients at the time of surgery^{27,34,40,42,57}. Mortality ranges from 1.3% to 71% in patients admitted to the emergency department in a comatose state⁶⁵. Considering patients with GCS score on admission between 13-15, 85% have a good outcome; GCS on admission between 9-12 (67%) and GCS score on admission between 3-8 (39%)¹¹.

3.4 Lesson 4: Presence of Lucid Interval

The classical evolution of loss of consciousness after trauma accompanied by complete recovery of consciousness (lucid interval), followed by mydriasis (homolateral to the hematoma), followed by uncal herniation and contralateral hemiparesis with a decrease in the consciousness level, occurs in 10% to 33% of cases^{3,5}. The lucid interval is initially associated with IEH, because of the anatomical particularities that allow the development of the hematoma without immediate clinical manifestations after the injury, due to the non-compression of adjacent structures. This clinical sign is not specific to IEH and may occur in other expanding mass lesions^{72,73}.

The lucid interval takes 1-24 hours¹ and is found in 2.4% to 58% of occurrences^{1-3,74,75}. It usually occurs in isolated and voluminous IEH that can be demonstrated by CT imaging with findings of active bleeding (swirl sign). Gutowski et al.⁷⁶ reports that in patients with IEH, the signs and symptoms progress rapidly, are often associated with alterations in the level of consciousness in a brief time interval after injury and do not present with the classic

“lucid interval” sign. Increasingly, a reduction in the incidence of the lucid interval has been demonstrated, due in part to the earlier use of brain CT in moderate and severe TBI cases. The presence of the lucid interval is not mandatory but is considered a significant parameter in terms of prognosis.

The prognosis is generally excellent if surgical intervention, when possible, is performed before the onset of clinical signs, in particular signs of uncal herniation. Therefore, every TBI with a history of loss of consciousness benefits from a CT scan. The IEH should be detected before the onset of changes in consciousness and focal neurological signs for a better patient prognosis^{39,77}.

3.5 Lesson 5: Presence of motor deficit

Patients with better motor function in the first clinical picture have better outcomes, and the absence of motor deficit is an important prognostic factor for these patients^{61,78}. According to Özkan et al.³⁰ the presence of pyramidal signs is an independent risk factor for poor prognosis.

3.6 Lesson 6: Presence of pupillary compromise

Pupillary reactivity to light plays an important role in the evaluation and helps the examiner localize the intracranial hematoma. Monitoring pupillary reactivity provides information about a secondary and continuing outcome (elevation of intracranial pressure), and the presence of mydriasis is a predictor of poor prognosis^{79,80}. Unilateral mydriasis (anisocoria) is identified in 6% to 44% of IEH cases^{2,3,19,57}. Other authors^{15,26,27,30,81} pointed out that the presence of pupillary alteration may confer a poor outcome on these patients.

Bilateral pupillary non-reactivity is associated with high mortality⁵⁰⁻⁶⁹. Dubey et al.¹⁵ reported that the presence of pupillary abnormalities associated with a low GCS score at admission is associated with a poor prognosis. For Cohen et al.¹⁴ mortality increases three times more in patients with anisocoria, and the prolonged presence of this sign for more than 70 minutes confers 100% mortality.

3.7 Lesson 7: Presence of associated comorbidities

The presence of arterial hypertension, bradycardia, and respiratory irregularities has been rare but is associated with significant mortality^{30,34}. Bradycardia associated with elevated blood pressure is directly related to increased intracranial pressure (ICP). According to Brazdzionis et al.⁸² the presence

of comorbidities such as obesity, diabetes mellitus, arterial hypertension, hyperlipidemia, illicit drug use, tabagism, cancer, psychiatric diseases, and chronic renal disease are involved in the poor prognosis of patients operated on for IEH.

Onodera et al.⁵³ demonstrated that there was no significant difference between the findings of vital signs, blood pressure, and body temperature between patients who had good and poor prognoses. According to Ayub et al.³³ the presence of associated injuries such as cervical spinal cord injury, chest trauma, and cerebral edema increase the mortality rate.

3.8 Lesson 8: CT findings: fracture trace, hematoma volume, swirl sign, midline shift, hematoma thickness, and presence of associated lesions

CT is essential to determine the location, volume, and thickness of the hematoma, in addition to the presence of a mass effect, deviation of midline structures, ventricular system and basal cisterns, and associated intracranial lesions, and helps to assist treatment decision-making^{1,2,21,59,71,83-86}. When CT is performed six hours post-injury, the patient is at high risk for complications from a developing hematoma^{10,16}. The incidence of skull fracture trace varies from 60% to 86.7% of cases^{1,7,9,11,15,17,26,38,71,87}. The absence of fracture trace on plain skull radiography does not exclude the presence of IEH⁸⁸. Fracture trace crossing the middle meningeal artery pathway or dural venous sinuses confers a tendency for hematoma expansion even after conservative treatment⁸⁹. Several authors have described that the presence of cranial fracture trace is associated with a worse prognosis^{42,90}.

CT findings that correlate with poor prognosis are superior hematoma volume (30-150 ml), midline deviation (>10-12 mm), presence of the “swirl sign” indicating active bleeding, and presence of isolated intracranial lesions. Several studies have shown that IEH volume is one of the main factors influencing prognosis^{15,22,27,39,40,44,70,71,91-93}. Supratentorial hematoma volume (> 30 ml) or in posterior fossa/ temporal region (> 25 ml) have immediate surgical indication.

According to Singh et al.²⁵, a large IEH (> 80 ml) is associated with a poor prognosis. Voluminous IEH causes a large mass effect demonstrated by midline deviation and brainstem compression, causing significant deterioration of the neurological status and leading the patient to a poor prognosis^{4,33,35,39,92}. Pereira et al.⁹¹ reported no relationship between hematoma volume and

patient age and stated that hematoma volume is independent of the presence of associated intracranial injury. These authors found a relationship between the volume of the hematoma and its location, the smallest volume being located at the temporal region, also observed by Ersahin et al.⁶¹ who associated large IEH in this region with high mortality.

Rivas et al. 40 associated the volume of the hematoma with the severity of deviation of midline structures in comatose patients preoperatively, and consequently with a poor prognosis. Other authors 2,21 reported that surgical outcomes were considered better when the hematoma volume was less than 30 ml, compared to those with a volume > 30 ml.

According to Özkan et al.³⁰, hematoma volume and the presence of pyramidal signs were considered independent risk factors for mortality in patients with IEH. The comatose state is more associated with the presence of voluminous IEH⁴⁰. Badhe and Bhamre² associated hematoma volume and GCS score on admission as the most important factors in prognosis. For Wang et al.⁹³ Voluminous IEH causes internal cerebral herniation within 3-24 hours after injury, inducing a persistent suppression of cerebral blood flow and venous drainage, resulting in massive cerebral infarction and cerebral edema.

In the hyperacute form of IEH the “swirl sign” can be seen on the CT scan, which is a hypodense spiral area within the hematoma, representing active arterial hemorrhage and indicating the need for immediate surgery for cerebral decompression. The presence of this sign is associated with a poor prognosis^{34,94}.

A midline deviation > 5 mm with worsening of the neurological condition has a very poor prognosis. Other authors report that the main factor influencing the therapeutic decision is the presence of deviation of midline structures at CT^{1,15,17,20,26,30,39,40,76,95}. IEH thickness greater than 1.5 cm has shown an unfavorable evolution^{1,14,15,26,27,30,40}.

Several authors^{1,29,96} report that between 10% and 55% of cases of IEH are associated with other intracranial lesions, which leads to a high number of “atypical” clinical presentations that cause a mortality rate of 20% to 50% of cases. Other authors have described that the presence of associated intracranial lesions is common in patients with IEH and is associated with a poor prognosis^{17,27,39,40,53,76}. In cases with associated intracranial lesions, conservative treatment

is contraindicated^{27,97}. According to Kvarnes and Trumphy⁶, the presence of intracranial lesions is associated with a two to four times higher mortality compared to those without other intracranial lesions. The presence of brain swelling and diffuse axonal lesions associated with IEH is associated with a poor prognosis^{33,98}. It has been in the literature has reported that patients with low GCS scores of associated lesions (brain contusion) increase mortality^{11,19,29,57}.

3.9 Lesson 9: Late initiation of treatment

The patient outcome tends to be unfavorable when associated with the delay between injury and surgical decompression^{23,24,54,99,100,101,102}. Several authors associate comatose state and delay in surgery as important factors in prognosis^{3,17,30,34,39,100,103}. Other authors found no relationship between the time taken for surgery and the prognosis^{28,104}. For Gnani et al.¹⁰⁵ the delay in definitive treatment leads to cerebral ischemic complications due to prolonged compression and cerebral herniation.

Ayub et al.³³ observed that young patients who underwent surgery and were operated on early and with absent or minimal associated intracranial injury, recover better than those patients in whom surgery was performed late. Ayogu et al.²⁸ reported that patients operated on within six hours of the presentation showed no significant improvement in outcome when compared to those operated on more than six hours from the presentation. Neurological conditions preoperatively and the interval between trauma and surgery are important factors in prognosis^{99,100}.

One of the contributing factors to the delay in performing surgery is the delayed transportation from the accident site to the referral hospital^{99,100}. According to Ramazam et al.¹⁰⁶, the delay between transportation from the injury site and the hospital and the presence of bilateral IEH are associated with poor prognosis. Kattak et al.⁵⁹ reported that mortality is reduced when a diagnosis is made early and treatment indicated immediately. Beketi et al.¹⁰⁷ reported that delayed treatment and a low GCS score on admission confer a poor prognosis. Ayub et al.³³ reported that the time between injury and surgery and the volume of the hematoma are important factors affecting prognosis. In the study by Ozkan et al.³⁰ the mortality of patients undergoing surgery within 6 hours of injury was 23.5%, reducing to 18.5% when operated on within the first 6 hours of trauma.

Important considerations should be made regarding the timing of repeat CT, especially in cases of conservative treatment. According to Sullivan et al.¹⁰⁸ the increase in IEH volume occurs in 23% of

cases and the average time for this increase to occur is 8 hours after trauma, which would be the time to perform a new CT. The IEH may increase in volume between 6-8 hours after the injury²¹.

3.10 Lesson 10: Treatment

IEH is classified as a neurosurgical emergency^{1,4,9,71,109}. The therapeutic decision and timing of treatment should be individualized based on the patient's age, hematoma size, location, and neurological status^{18,110}. Multiple associated comorbidities, associated intracranial lesion, cerebral ischemia, antithrombotic treatment, and elderly patient, influences surgical treatment prognosis²⁵. According to Cheung et al.¹¹, the surgical outcome of IEH is also affected by important factors such as the presence of anisocoria, the time between the injury and surgery, the hematoma volume, and the GCS score at admission.

Conservative treatment has been recommended in patients with a preserved level of consciousness, no focal neurological deficit, no associated intracranial injury, and IEH of small volume (<30 ml), thickness (<15 mm), and midline deviation (<5 mm), constant clinical observation, and the ability to perform control CT^{10,15}. In the event of neurological deterioration, immediate surgery is advised. Other authors^{10,111} refer to conservative treatment when the thickness is greater than 20 mm. Bullock et al.²⁶ demonstrated that a volume ranging from 12-38 ml was suitable for conservative treatment. According to Chen et al.¹¹², hematomas greater than 30 ml in volume, thickness greater than 15 mm, and midline deviation greater than 5 mm are strong indications for surgical drainage. There is also disagreement regarding IEH of the posterior fossa; several authors recommend surgical treatment in all cases due to the possibility of significant mass effect in a small space⁹⁵. According to Wong¹¹³, IEH located in the posterior fossa with a volume less than 10 ml, thickness less than 15 mm, midline deviation less than 5 mm, and the absence of another intracranial hematoma has an excellent outcome when conservative treatment is used.

According to Chen et al.¹¹², supratentorial IEH with a volume greater than 30 mL, a thickness greater than 15 mm, and a midline deviation greater than 5 mm necessitates immediate surgical intervention. Early diagnosis followed by surgical treatment should be taken into consideration in some cases, according to Choi et al.¹¹⁰; in their series, 50% of the patients had positive surgical outcomes. Patients with a low GCS score, pupillary abnormalities, a bulky hematoma, and a large deviation of midline structures, according to Hamilton and Wallace¹¹⁴, require immediate surgical intervention.

3.11 Lesson 11: Mortality

The mortality rate for IEH ranges from 0% to 33%^{9-11,27,32,40,56,90,95,103,112,115}. According to Sthephanov¹⁰³, pre-CT mortality ranged from 16% to 52%, while post-CT mortality ranged from 8% to 14%. This author concluded that the most important factor in reducing mortality was prompt transport of the patient to a neurosurgical referral center. Jones et al.¹¹⁶ reported that mortality has decreased from 29% to 8% in the last 35 years. According to Lee et al.²⁷, before the use of CT in emergency departments, mortality ranged between 40 and 80%, but after the use of CT became routine, mortality dropped to 9%. Other authors^{1,6,32} have shown that late diagnosis and the presence of associated intradural lesions are major contributors to high morbidity and mortality.

4 CONCLUSIONS

IEH is a common pathology in patients with moderate to severe TBI and is considered a neurosurgical emergency. Its symptoms are variable. The CT scan is the preferred method of diagnosis. The prognosis is determined by several factors, the most important of which is the GCS grade at the time of admission, as discussed extensively in the literature. Preoperative GCS score, the presence of anisocoria, the volume of hematoma, and the presence of associated intracranial lesions all have a significant impact on surgical outcomes. A good outcome is associated with isolated IEH, hematoma volume less than 60 ml, GCS score greater than 8, absence of anisocoria, and surgical intervention within six hours of trauma. The functional outcome has been excellent when IEH is detected early and treated.

The main prognostic factors of patients with IEH should be investigated further to better determine the elements that contribute to a favorable outcome, reducing morbidity and mortality in these patients.

REFERENCES

1. Alliez JR, Hilal N, Kaya JM, Leone M, Reynier Y, Alliez B. Hématomes intracrâniens extra-duraux: À propôs de 100 cases

récents. *Neurochirurgie*. 2005;51(5):464-70. [http://doi.org/10.1016/S0028-3770\(05\)83504-0](http://doi.org/10.1016/S0028-3770(05)83504-0). PMID:16327679.

2. Badhe VR, Bhamre S. Clinical evaluation and management outcome of extradural hematoma. *MVP J Med Sci*. 2018;5(1):49-54. <http://doi.org/10.18311/mvpjms/2018/v5/i1/11006>.

3. Bricolo AP, Pasut LM. Extradural haematoma: toward zero mortality. *Neurosurgery*. 1984;14(1):8-12. <http://doi.org/10.1227/00006123-198401000-00003>. PMID:6694798.

4. Jeong YH, Oh JW, Cho S. Clinical outcome of acute epidural hematoma in Korea: Preliminar report of 285 cases registered in the Korean Trauma Data Bank System. *Korean J Neurotrauma*. 2016;12(2):47-54. <http://doi.org/10.13004/kjnt.2016.12.2.47>. PMID:27857907.

5. Kalkan E, Cander B, Gul M, Girisgin S, Karabagli H, Sahin B. Prediction of prognosis in patients with epidural hematoma by a new stereological method. *Tohoku J Exp Med*. 2007;211(3):235-42. <http://doi.org/10.1620/tjem.211.235>. PMID:17347548.

6. Kvarnes TL, Trumphy JH. Extradural hematoma: report of 132 cases. *Acta Neurochir (Wien)*. 1978;41(1-3):223-31. <http://doi.org/10.1007/BF01809151>. PMID:665332.

7. Ndoumbe A, Ekeme MVP, Jemea B, Simeu C, Takongmo S. Epidemiological analysis of surgically treated acute traumatic epidural hematoma. *Open J Modern Neurosurg*. 2016;6(1):89-97. <http://doi.org/10.4236/ojmn.2016.63016>.

8. Phonprasert C, Suwanwela C, Hongsaprabhas C, Prichayud P, O'Charoen S. Extradural hematoma: analysis of 138 cases. *J Trauma*. 1980;20(8):679-83. <http://doi.org/10.1097/00005373-198008000-00008>. PMID:7401209.

9. Thiam AB, Mudekerez PS, Ndooye N, et al. Hématome extradural. Étude épidémiologique a propos de 35 cas. *J Neurochirurgie*. 2013;18(1):13-20.

10. Bercionoglu H, Ersahin Y, Demirçivi E, Yurt I, Dönertras K, Tektas T. Nonoperative treatment of acute extradural hematomas: analysis of 80 cases. *J Trauma*. 1996;41(4):696-8. <http://doi.org/10.1097/00005373-199610000-00016>. PMID:8858030.

11. Cheung PS, Lam JM, Yeung JH, Graham CA, Rainer TH. Outcome of traumatic extradural haematoma in Hong Kong. *Injury*. 2007;38(1):76-80. <http://doi.org/10.1016/j.injury.2006.08.059>. PMID:17097656.

12. Noman K, Raihan MZ, Chowdhury EH, Ashadullah ATM, Sarkar MH, Hassain SS. Surgical management of traumatic extradural haematoma: experience with 610 patients and prospective analysis. *Indian J Neurotrauma*. 2008;5(2):75-9. [http://doi.org/10.1016/S0973-0508\(08\)80004-4](http://doi.org/10.1016/S0973-0508(08)80004-4).

13. Andrioli GC, Zuccarello M, Trinica G, Fiore D. Extradural hematomas in elderly. A statistical analysis of 58 cases. *Adv Neurosurg* 1984; 18-23.. http://doi.org/10.1007/978-3-642-69360-1_38.

14. Cohen JE, Montero A, Israel ZH. Prognosis and clinical relevance of anisocoria-craniotomy latency for epidural haematoma in comatose patients. *J Trauma*. 1996;41(1):120-2. <http://doi.org/10.1097/00005373-199607000-00019>. PMID:8676403.

15. Dubey A, Pillai SV, Sastry KVR. Does volume of extradural hematoma influence management strategy outcome? *Neurol India*. 2004;52(4):443-5. PMID:15626829.
16. Heinzelmann M, Platz A, Imhof HG. Outcome after acute extradural haematoma, influence of additional injuries and neurological complications in the ICU. *Injury*. 1996;27(5):345-9. [http://doi.org/10.1016/0020-1383\(95\)00223-5](http://doi.org/10.1016/0020-1383(95)00223-5). PMID:8763290.
17. Jamjoom A. The influence of concomitant intradural pathology on the presentation and outcome of patients with acute traumatic extradural haematoma. *Acta Neurochir (Wien)*. 1992;115(3-4):86-9. <http://doi.org/10.1007/BF01406363>. PMID:1605089.
18. Korinth M, Weinziert M, Gilsbach JM. Treatment options in traumatic epidural hematomas. *Unfallchirurg*. 2002;105(3):224-30. <http://doi.org/10.1007/s001130100316>. PMID:11995217.
19. Kudah C, Uzan M, Hanci M. Statistical analysis of the factors affecting the outcome of extradural haematomas: 115 cases. *Acta Neurochir (Wien)*. 1994;131(3-4):206-6. <http://doi.org/10.1007/BF01808613>. PMID:7754821.
20. Paterniti S, Fiore P, Macri E, et al. Extradural haematoma. Report of 37 consecutive cases with survival. *Acta Neurochir (Wien)*. 1994;131(2):207-10. <http://doi.org/10.1007/BF01808614>. PMID:7754822.
21. Servadei F, Vergoni G, Staffa G, et al. Extradural haematomas: how many deaths can be avoided? Protocol for early detection on haematoma in minor head injury. *Acta Neurochir (Wien)*. 1995;1(133):50-5. <http://doi.org/10.1007/BF01404947>. PMID:8561036.
22. Servadei F. Prognostic factors in severely head injured adult patients with epidural hematomas. *Acta Neurochir (Wien)*. 1997;139(4):273-8. <http://doi.org/10.1007/BF01808821>. PMID:9202765.
23. Kiboi JG, Nganga HK, Kitunguu PK, Mbuthia JM. Factors influencing the outcomes in extradural hematomas patients. *Ann Afr Surg*. 2015;12(1):14-8.
24. Kiboi JG, Kitunguu PK, Angwenyi P, Mbuthia F, Sagina LS. Predictors of functional recovery in African patients with traumatic intracranial hematomas. *World Neurosurg*. 2011;75(5-6):586-91. <http://doi.org/10.1016/j.wneu.2010.05.041>. PMID:21704911.
25. Singh R, Sahu A, Singh K, Prasad RS, Pandey N. Clinical, operative, and outcome analysis of giant extradural hematoma: a retrospective study in tertiary care center. *Surg Neurol Int*. 2020;11:236. http://doi.org/10.25259/SNI_128_2020. PMID:32874739.
26. Bullock MR, Chesnut R, Ghajar J, Gordon D, Hartel R, Newell DW. Surgical management of acute epidural hematoma. *Neurosurgery*. 2006;58:S2-15. <http://doi.org/10.1097/00006123-200603001-00006>.
27. Lee EJ, Hung YC, Wang LC, Chung KC, Chen HH. Factors influencing the functional outcome of patients with acute epidural haematomas: analysis of 200 patients undergoing surgery. *J Trauma*. 1998;45(5):946-52. <http://doi.org/10.1097/00005373-199811000-00017>. PMID:9820707.
28. Ayogu OM, Onobun DE, Igbokwe KK, Chizin CU, Morfi O, Ibeneme S. Factors affecting the outcome of traumatic brain injured patients with acute epidural haematoma in National Hospital, Abuja. *J West Afr Coll Surg*. 2021;11(1):1-4. http://doi.org/10.4103/jwas.jwas_16_22. PMID:35873877.
29. Emejulu JK, Uche EO, Nwankwo EU. The challenges of managing acute extradural hematoma in a Nigerian neurosurgical center – Still a long way to go. *World Neurosurg*. 2014;82(6):969-73. <http://doi.org/10.1016/j.wneu.2014.09.002>. PMID:25204718.
30. Özkan Ü, Kemaloglu S, Özates M, Güzel A, That M. Analyzing extradural haematomas: a retrospective clinical investigation. *Dicle Med J*. 2007;34(1):14-9.
31. Hassan N, Azam F, Ahmad S, Usman M. extradural hematoma surgical outcome using Glasgow Coma scale in a tertiary care hospital of Khyber Pakhtunkhwa. *J Postgrad Med Inst*. 2019;33(2):155-9.
32. Husain M, Ojha BK, Chandra A, et al. Contralateral motor deficit in extradural hematoma: analysis of 35 patients. *Indian J Neurotrauma*. 2007;4(1):41-4. [http://doi.org/10.1016/S0973-0508\(07\)80010-4](http://doi.org/10.1016/S0973-0508(07)80010-4).
33. Ayub S, Ali M, Ilyas M. Acute extradural hematoma: factors affecting the outcome. *J Postgraduate Med Inst JPMI*. 2005;19(2):208-11.
34. Yurt I, Bezircioglu H, Ersahim Y, Demirçivi F, Kahraman M, Tektas S. Extradural hematoma: Analysis of 190 cases. *Turkish Neurosurgery* 1996; 6(1): 63-67.
35. Budzar H. Acute extradural hematoma analysis factors influencing the outcome of patients undergoing surgery in coma. *J Coll Physicians Surg Pak*. 1999;9:511-4.
36. Navdeep SS, Vikas R, Yashbir D, Grewall SS. Factors predicting outcome in patients with severe head injury: multivariate analysis. *Indian J Neurotrauma*. 2012;9(1):45-8. <http://doi.org/10.1016/j.ijnt.2012.04.009>.
37. Narayan RK, Greenberg RP, Milles JD, Enas GG. Improved confidence of outcome prediction in severe head injury. *J Neurosurg*. 1981;54(6):751-62. <http://doi.org/10.3171/jns.1981.54.6.0751>. PMID:7241184.
38. Baykanner K, Alp H, Çeviker N, Keskil S, Seçkin Z. Observation of 95 patients with extradural hematoma and review of the literature. *Surg Neurol*. 1988;30(5):339-41. [http://doi.org/10.1016/0090-3019\(88\)90195-4](http://doi.org/10.1016/0090-3019(88)90195-4). PMID:3055383.
39. Lobato RD, Rivas JJ, Cordobes F, et al. Acute epidural hematoma: an analysis of factors influencing the outcome of patients undergoing surgery in coma. *J Neurosurg*. 1988;68(1):48-57. <http://doi.org/10.3171/jns.1988.68.1.0048>. PMID:3335912.
40. Rivas JJ, Lobato RD, Saraiba R, Cordobes F, Cabrera A, Gómez P. Extradural hematoma: analysis of factors influencing the courses of 161 patients. *Neurosurgery*. 1988;23(1):44-51. <http://doi.org/10.1227/00006123-198807000-00010>. PMID:3173664.
41. Bejjani GK, Donahue DJ, Rusin J, Broemeling LD. Radiological and clinical criteria for the management of epidural hematomas in children. *Pediatr Neurosurg* 1996;25(6):302-8. <http://doi.org/10.1159/000121144>.
42. Cook RJ, Dorsch NWC, Fearnside MR, Chaseling R. Outcome prediction in extradural hematomas. *Acta Neurochir (Wien)*. 1988;95(3-4):90-4. <http://doi.org/10.1007/BF01790766>. PMID:3228007.
43. Jamjoom A, Cummins B, Jamjoom ZA. Clinical characteristics of traumatic extradural hematoma: a comparison between children and

- adults. *Neurosurg Rev.* 1994;17(4):277-81. <http://doi.org/10.1007/BF00306818>. PMID:7753416.
44. Pereira CU, Santos EAS, Cavalcante S, Serra MV, Pascotto D, Fontoura EAF. Hematoma extradural intracraniano. *J Bras Neurocir.* 2005;16(1):25-34. <http://doi.org/10.22290/jbnc.v16i1.509>.
 45. Lima MG, Barros MB, Cesar CL, Goldbaum M, Carandina L, Ciconelli RM. Health related quality of life among the elderly: a population-based study using SF-36 survey. *Cad Saude Publica.* 2009;25(10):2159-67. <http://doi.org/10.1590/S0102-311X2009001000007>. PMID:19851616.
 46. Taussky P, Widmer HR, Takala J, Fandino J. Outcome after acute traumatic subdural and epidural haematoma in Switzerland. A single-centre experience. *Swiss Med Wkly.* 2008;138(19-20):281-5. PMID:18491241.
 47. Mazza C, Pascualin A, Feriotti G, Da Piab R. Traumatic extradural hematomas in children: experience with 62 cases. *Acta Neurochir (Wien).* 1982;65(1-2):67-80. <http://doi.org/10.1007/BF01405443>. PMID:7136879.
 48. Zuccarello M, Fiore DL, Trincvía G. Extradural hematoma: statistical analysis of 413 cases. In: Villani R, Papo I, Geovanelli M, Garni SM, Tomei G, editors. *Advances in neurotraumatology*. Amsterdam: Excerpta Medica; 1983. p. 238-41.
 49. Bir SC, Maiti TK, Ambekar S, Nanda A. Incidence, hospital costs and in-hospital mortality rates of epidural hematoma in the United States. *Clin Neurol Neurosurg.* 2015;138:99-103. <http://doi.org/10.1016/j.clineuro.2015.07.021>. PMID:26318360.
 50. Scotter J, Hendrickson S, Marcus HJ, Wilson MH. Prognosis of patients with bilateral fixed dilated pupils secondary to traumatic extradural or subdural haematoma who undergo surgery: a systematic review and meta-analysis. *Emerg Med J.* 2015;32(8):654-9. <http://doi.org/10.1136/emermed-2014-204260>. PMID:25385844.
 51. Islam MJ, Saha SK, Elahy ME, islam KMT, Ahamed SV. Factors influencing the outcome of patients with acute extradural hematomas undergoing surgery. *Blangladesh J Med Sci.* 2011;10(2):111-20.
 52. Reale F, Delfini R, Mencantini G. Epidural hematomas. *J Neurosurg Sci.* 1984;28(1):9-16. PMID:6470802.
 53. Onodera K, Kamida T, Kimura T, et al. Identification of prognostic factors in surgically treated patients with acute epidural hematoma. *Asian J Neurosurg.* 2020;15(3):532-6. http://doi.org/10.4103/ajns.AJNS_129_20. PMID:33145203.
 54. Ali MF, Khan AA, Imran M, Zulfigar F, Valdin MM, Ashraf J. Traumatic extradural hematoma: factors affecting the surgical outcome. *J Dow Univ Health Sci.* 2016;10(1):9-13. <http://doi.org/10.36570/jduhs.2016.1.497>.
 55. Prajapati DV, Shah NJ. Outcome of traumatic extradural hematoma (EDH) using Glasgow Outcome Scale (GOS). *Int Surg J.* 2018;5(10):3327-34. <http://doi.org/10.18203/2349-2902.isj20184083>.
 56. Dharkar SR, Bhargava N. Bilateral epidural hematoma. *Acta Neurochir (Wien).* 1991;110(1-2):29-32. <http://doi.org/10.1007/BF01402044>. PMID:1882715.
 57. Babu ML, Bhasin SK, Kumar A. extradural hematoma: an experience of 300 cases. *JK Science.* 2005;7:205-7.
 58. Chowdhury NK, Raihan MZ, Choudhury FH, Ashadullah ATM, Sarkar MH, Hossain SS. Surgical management of traumatic extradural hematoma: experiences with 610 patients and prospective analysis. *Indian J Neurotrauma.* 2008;5(1):75-9.
 59. Khattak AU, Iftikhar-UL-Haq M, Azam F. Frequency of extradural hematoma in patients with head injury. *Pak J Neurol Surg.* 2012;16(2):83-5.
 60. Kumar J, Prakash A, Harsh V, Kumar A. Vertex extradural hematoma: a diagnostic dilemma. *Asian J Neurosurg.* 2017;12(4):718-20. <http://doi.org/10.4103/1793-5482.215758>. PMID:29114292.
 61. Ersahin Y, Mutluer S, Guzalbag E. Extradural haematoma: analysis of 146 cases. *Childs Nerv Syst.* 1993;9(2):96-9. <http://doi.org/10.1007/BF00305316>. PMID:8319240.
 62. Cordobes F, Lobato RD, Rivas JJ, et al. Observation on 82 patients with extradural hematoma. *J Neurosurg.* 1981;54(2):179-86. <http://doi.org/10.3171/jns.1981.54.2.0179>. PMID:7452331.
 63. Sakai H, Takagi H, Ohtaka H, Tanabe T, Ohwada T, Yada K. Serial changes in acute extradural hematoma size and associated changes in level of consciousness and intracranial pressure. *J Neurosurg.* 1988;68(4):566-70. <http://doi.org/10.3171/jns.1988.68.4.0566>. PMID:3351584.
 64. Haselsberg K, Pucher R, Auer L. Prognosis after acute subdural or epidural haemorrhage. *Acta Neurochir (Wien).* 1988;90(3-4):111-6. <http://doi.org/10.1007/BF01560563>. PMID:3354356.
 65. Seelig JM, Marshall LF, Toutant SM, et al. Traumatic acute epidural hematoma: unrecognized high lethality in comatose patients. *Neurosurgery.* 1984;15(5):617-20. <http://doi.org/10.1227/00006123-198411000-00001>. PMID:6504278.
 66. Hoffmann M, Lefering R, Rueger JM, et al. Pupil evaluation in addition to Glasgow Coma Scale components in prediction of traumatic brain injury and mortality. *Br J Surg.* 2012;99(Suppl 1):122-30. <http://doi.org/10.1002/bjs.7707>. PMID:22441866.
 67. Howlader RA, Sarker AC, Das S, Islam M, Sadhukhan UK, Yasmin L. Surgical outcome of extradural hematoma patients in relation to preoperative neurological status. *Open J Modern Neurosurg.* 2021;11(4):223-33. <http://doi.org/10.4236/ojmn.2021.114026>.
 68. Hamid NA, Mian JM. Factors affecting mortality in extradural hematomas. *Pak J Neurol.* 1998;4(1):30-4.
 69. Gurer B, Kertmen H, Yilmaz ER, Dolgun H, Hasturk AE, Sekerci Z. The surgical outcome of traumatic extradural hematomas causing brain herniation. *Turk Neurosurg.* 2017;27(1):37-52. PMID:27593740.
 70. Ruff LM, Mendelow AD, Lecky FE. Improving mortality after extradural haematoma in England and Wales. *Br J Neurosurg.* 2013;27(1):19-23. <http://doi.org/10.3109/02688697.2012.709555>. PMID:22909250.
 71. Mushtaq RL, Khaleeg S, Zaman KU. Association of outcome of traumatic extradural hematoma with Glasgow Coma Scale and hematoma size. *Ann Pak Inst Med Sci.* 2010;6(3):133-8.

72. Ganz JC. The lucid interval associated with epidural bleeding: evolving understanding. *J Neurosurg.* 2013;118(4):739-45. <http://doi.org/10.3171/2012.12.JNS121264>. PMID:23330993.
73. Khairat A, Waseem M. Epidural hematoma. In: StartPearls. Treasure Island (FL). StartPearls Publishing; 2019. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/30085524>. Accessed: 20/4/2025.
74. Keet PC. Extradural hematoma. An Analysis of two 8 years series at Groote Schuur Hospital. *S Afr Med J.* 1984;66(24):913-6. PMID:6505903.
75. Orteler M, Kelly DF, Arthur MC. Progressive haemorrhage after head trauma: predictors and consequences of the evolving injury. *J Neurosurg.* 2002;97(6):1484-5.
76. Gutowski P, Meier U, Rhode V, Lenicke J, von der Brelie C. Clinical outcome of epidural hematoma treated surgically in the era of modern resuscitation and trauma care. *World Neurosurg.* 2018;118:e166-74. <http://doi.org/10.1016/j.wneu.2018.06.147>. PMID:29959068.
77. Rockswold GL, Leonaid PR, Nagib MG. Analysis of management in thirty-three closed head injury patients who "talked and deteriorated". *Neurosurgery.* 1987;21(1):51-5. <http://doi.org/10.1227/00006123-198707000-00010>. PMID:3614604.
78. Faheem M, Jaiswal M, Ojha BK, Chandra A, Singh SK, Srivastava C. Traumatic pediatric extradural hematoma: an institutional study of 228 patients in tertiary care center. *Pediatr Neurosurg.* 2019;54(4):237-44. <http://doi.org/10.1159/000501043>. PMID:31288223.
79. Jahns FP, Miroz JP, Messerer M, et al. Quantitative pupillometry for the monitoring of intracranial hypertension in patients with severe traumatic brain injury. *Crit Care* 2019;23(1):155. <http://doi.org/10.1186/s13054-019-2436-3>. PMID: 31046817.
80. Volpi PC, Robba C, Rota M, Vargiolu A, Citerio G. Trajectories of early secondary insults correlate to outcomes of traumatic brain injury: results from a large, single center, observational study. *BMC Emerg Med.* 2018;18(1):52. <http://doi.org/10.1186/s12873-018-0197-y>. PMID:30518336.
81. Khan MB, Riaz M, Javed G, Hashimi FA, Sananllar M, Ahmed SI. Surgical management of traumatic extradural hematoma in children: experiences and analysis from 24 consecutively treated outcomes in a developing Country. *Surg Neurol Int.* 2013;4(1):103-9. <http://doi.org/10.4103/2152-7806.116425>. PMID:24032078.
82. Brazdzionis J, Patchana T, Savia P, et al. Medical comorbidities associated with outcomes in patients with traumatic epidural hematomas. *Cureus.* 2021;13(6):e15514. <http://doi.org/10.7759/cureus.15514>. PMID:34277158.
83. Aurangzeb A, Ahmed E, Maqbool S, et al. Burr hole evacuation of extradural hematoma in mass trauma. A life saving and time saving procedure: Our experience in the Earthquake of 2005. *Turk Neurosurg.* 2016;26(2):205-8. PMID:26956813.
84. Erickson K, Hakasson S. Computed tomography of epidural hematomas. Association with intracranial lesions and clinical correlation. *Acta Radiol Diagn (Stockh).* 1981;22(5):513-9. <http://doi.org/10.1177/028418518102200501>. PMID:7331863.
85. Tataranu L, Ciubotaru V, Paunescu D, Spataru A, Radoi M. Extradural hematoma – is surgery always mandatory? *Rev Med Leg.* 2014;22(1):45-50. <http://doi.org/10.4323/rjlm.2014.45>.
86. Zimmerman RA, Bilaniuk LT. Computed tomographic staging of traumatic epidural bleeding. *Radiology.* 1982;144(4):809-12. <http://doi.org/10.1148/radiology.144.4.7111729>. PMID:7111729.
87. Rossi J Jr, Andrade AF, Yeng LC, et al. Epidural hematoma: A prospective analysis of morbidity and mortality in 173 patients. *Braz Neurosurg.* 2015;34(1):20-4. <http://doi.org/10.1055/s-0035-1547391>.
88. Ullman JS. Epidural hemorrhage. *Med Journal.* 2002;3(1):1-8.
89. Knuckey NW, Gelbard S, Epstein MH. The management of "asymptomatic" epidural hematomas. *J Neurosurg.* 1989;70(3):392-6. <http://doi.org/10.3171/jns.1989.70.3.0392>. PMID:2915245.
90. Heiskanen O, IEH skanen O. Epidural hematoma. *Surg Neurol.* 1975;4(1):23-6. PMID:1166398.
91. Pereira CU, Silva EASS, Dias LAA. Hematoma extradural intracraniano: correlação entre o volume do hematoma com a localização e idade do paciente. *J Bras Neurocir.* 2004;15(1):59-66.
92. Pang D, Iorton JA, Kerron JM, Wilberger JE, Vries JK. Nonsurgical management of extradural hematoma in children. *J Neurosurg.* 1983;59(6):958-71. <http://doi.org/10.3171/jns.1983.59.6.0958>. PMID:6631518.
93. Wang WH, Hu LS, Lin H, et al. Risk factors for post-traumatic massive cerebral infarction secondary to space-occupying epidural hematoma. *J Neurotrauma.* 2014;31(16):1444-50. <http://doi.org/10.1089/neu.2013.3142>. PMID:24773559.
94. Pereira CU, Santos LPA. "Sinal do redemoinho" em hematoma extradural hiperagudo. *Braz Neurosurg.* 2013;32(3):207-10. <http://doi.org/10.1055/s-0038-1626016>.
95. Grevsten S, Pelletieri L. Surgical decision in the treatment of extradural haematoma. *Acta Chir Scand.* 1982;148(2):97-102. PMID:7148320.
96. Khalid SM, Raihan MZ, Chowdhury FH, Ashadullah AT, Sarkar MH, Hossain SS. Surgical management of traumatic extradural hematoma: experiences of 610 patients and prospective analysis. *Indian J Neurotrauma.* 2008;5(1):75-9. [http://doi.org/10.1016/S0973-0508\(08\)80004-4](http://doi.org/10.1016/S0973-0508(08)80004-4).
97. Cuccinello C, Martellotta N, Nigro D, Citro E. Conservative management of extradural haematomas. *Acta Neurochir (Wien).* 1993;120(1-2):47-52. <http://doi.org/10.1007/BF02001469>. PMID:8434517.
98. Adams JH, Murray LS. Diffuse axonal injury due to non-missile in humans an analysis of 45 cases. *Ann Neurol.* 1982;12(6):557-63. <http://doi.org/10.1002/ana.410120610>. PMID:7159059.
99. Rochat P, Johannesen HH, Poulsgard L, Bogesky L. Sequentially evolved bilateral extradural hematoma. *Clin Neurol Neurosurg.* 2002;105(1):39-41. [http://doi.org/10.1016/S0303-8467\(02\)00099-9](http://doi.org/10.1016/S0303-8467(02)00099-9). PMID:12445923.
100. Ali M, Filza F, Khan T. Outcome assessment of acute extradural hematoma. *Pak J Neurol Surg.* 2003;7(1):22-8.

101. Sakas DE, Bullock MR, Teasdale GM. One-year outcome following craniotomy for traumatic hematoma in patients with fixed dilated pupils. *J Neurosurg.* 1995;82(6):961-5. <http://doi.org/10.3171/jns.1995.82.6.0961>. PMID:7760198.
102. Rosyidi RM, Priyanto B, Al Fauzi A, Sutiono AB. Toward zero mortality in acute epidural hematoma: a review in 286 cases problems and challenges in the developing country. *Interdiscip Neurosurg.* 2019;17(1):12-8. <http://doi.org/10.1016/j.inat.2019.01.021>.
103. Stephanov S. Posoperative mortality in acute extradural hematoma. *Br J Neurosurg.* 1993;7(5):461-3. <http://doi.org/10.3109/02688699308995067>. PMID:8267884.
104. Nnadi MO, Bankole BO, Fente B. Outcome of surgically treated traumatic extradural hematoma. *J Adv Med Med Res.* 2012;12(1):1-9.
105. Gnani E, Nadum M, Bano A, Irshad S, Zaidi GI, Khaleequz-Zaman M. Road traffic accident as a major contribution to neurosurgical mortality in adults. *J Coll Physicians Surg Pak.* 2003;13(3):143-5. PMID:12689531.
106. Ramazan A, Wani A, Malik AH, Kirnani A, Wani MA. Acute bilateral extradural hematomas. *Neurol India.* 2002;50(2):217-9. PMID:12134196.
107. Beketi KA, James EY, Gnadi-Pion F, et al. Hématomes extraduraux chez l'adulte au Togo. *Eur Scan J.* 2018;14(6):229-36.
108. Sullivan TP, Jarvik JG, Cohen WA. Follow-up of conservatively managed epidural hematomas: implications for timing of repeat CT. *AJNR Am J Neuroradiol.* 1999;20(1):107-13. PMID:9974064.
109. Rehman L, Khattak A, Naseer A, Mushtaq A. Outcome of acute traumatic extradural hematoma. *J Coll Physicians Surg Pak.* 2008;18(12):759-62. PMID:19032889.
110. Choi DH, Jeong TS, Kim WK, KNTDB INVESTIGATORS. Clinical outcome of patients diagnosed traumatic intracranial epidural hematoma with severe brain injury (Glasgow Coma Scale < 8) who undergo surgery: A report from the Korean Neuro-Trauma Data Bank System. *Korean J Neurotrauma.* 2022;18(2):153-60. <http://doi.org/10.13004/kjnt.2022.18.e62>. PMID:36381437.
111. Sangiovanni G, Pugliese R, Campagne G, Silvani V, Infredo L, Brambilla GI. Spontaneous healing of acute epidural hematomas (EDHs): a study of 35 patients. *Med Sci Res.* 1996;24:631-3.
112. Chen TY, Wong CW, Chang CN, et al. The expectant treatment of "asymptomatic" supratentorial epidural hematomas. *Neurosurgery.* 1993;32(2):176-9, discussion 179. <http://doi.org/10.1227/00006123-199302000-00004>. PMID:8437654.
113. Wong CW. The CT criteria for conservative treatment – but under close clinical observation of posterior fossa epidural hematomas. *Acta Neurochir (Wien).* 1994;126(2-4):124-7. <http://doi.org/10.1007/BF01476421>. PMID:8042543.
114. Hamilton M, Wallace C. Nonoperative management of acute epidural hematoma diagnosed by CT: The Neuroradiologist's role. *AJNR Neuroradiology.* 1992;13(3):853-9, discussion 860-2. PMID:1590183.
115. Soon WC, Marcus H, Wilson M. Traumatic acute extradural haematoma – Indications for surgery revisited. *Br J Neurosurg.* 2016;30(2):233-4. <http://doi.org/10.3109/02688697.2015.1119237>. PMID:26742836.
116. Jones NR, Molly CJ, Kloeden CN, North JB, Simpson DA. Extradural hematoma: trends in outcome over 35 years. *Br J Neurosurg.* 1993;7(5):465-71. <http://doi.org/10.3109/02688699308995068>. PMID:8267885.

CORRESPONDING AUTHOR

Carlos Umberto Pereira
E-mail: umberto@infonet.com.br

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Institution: Neurosurgery Service, Sergipe Emergency Hospital – HUSE, Aracaju (SE), Brasil.