JBNC Brazilian Journal of Neurosurgery
Jornal Brasileiro de Neurocirurgia

Ten Questions About Intracranial Epidural Hematoma. Lessons learned

Dez Questões Sobre Hematoma Epidural Intracraniano. Lições aprendidas

Carlos Umberto Pereira[1]
Nicollas Nunes Rabelo[2]
Gabriela Ferreira Kalkman[3]
Rodrigo Antonio Rocha da Cruz Adry[4]
Debora Moura da Paixão Oliveira[5]

ABSTRACT

Introduction: *Intracranial epidural hematoma (EH) is considered a neurosurgical emergency. Its knowledgement has been increasingly prominent in literature.* ***Methods:*** *a literature review was performed on ten questions related to intracranial EH, such as age, sex, causes, location, imaging findings, neurological examination, lucid interval, hematoma size, treatment and prognosis.* ***Conclusion:*** *EH affects more young adult males. It does not cross the lines of cranial sutures. The lucid interval has been commonly described, however, it is not pathognomonic of EH, and may occur in other lesions of expanding mass. The computed tomography (CT) scan of the skull has been the exam of choice. The size influences prognosis and sequelae, when small and asymptomatic the treatment has been conservative and, if bulky, it requires surgical intervention. Early recognition and appropriate treatment for a good prognosis is of great importance.*

Keywords: *Cranial Epidural hematoma; Craniocerebral trauma; Treatment; Outcome*

RESUMO

Introdução: *O hematoma epidural (HE) intracraniano é considerado uma emergência neurocirúrgica. Seu conhecimento tem sido cada vez mais destacado na literatura.* ***Método:*** *Revisão na literatura sobre dez questões pertinentes ao HE intracraniano: idade, sexo, causas, localização, achados de imagem, exame neurológico, intervalo lúcido, tamanho do hematoma, tratamento e prognóstico.* ***Conclusão:*** *O HE acomete mais adultos jovens do sexo masculine e não cruza as linhas de suturas cranianas. O intervalo lúcido tem sido comumente descrito, porém, não é patognomônico de HE, podendo ocorrer em outras lesões de massa em expansão. Como exame de escolha, destaca-se a tomografia computadorizada de crânio. O tamanho tem relação com o prognóstico e sequelas, quando pequeno e assintomático, o tratamento tem sido conservador e, se volumoso, necessita de intervenção cirúrgica. O reconhecimento precoce e o tratamento adequado, para um bom prognóstico, são de suma importância.*

Palavras-chave: *Hematoma epidural; Trauma craniocerebral; Tratamento; Resultado*

[1]MD, PhD. Neurosurgeon at the HUSE Emergency Department. Preceptor of the Neurosurgery Service at FBHC. Aracaju, Sergipe.
[2]MD, Doctorate student FMUSP, Department of Neurosurgery, Faculty of Medicine, UniAtenas. Paracatu, Minas Gerais
[3]Medical Student at Federal University of Paraná. Curitiba, Paraná
[4]MD, PhD. Neurosurgeon. Salvador, Bahia
5PhD. Nurse. Vice President of the Brazilian Association of Nursing in Neurology and Neurosurgery. Aracaju, Sergipe

Received Apr 8, 2019
Corrected Jun 14, 2021
Accepted Jul 01, 2021

INTRODUCTION

Epidural hematoma (EH) is defined as a blood collection located between the dura and the inner bone plate of the skull, and occurs between 0.2 to 6% of patients hospitalized with traumatic brain injury (TBI) [1,2,3]. It usually affects young adult male patients [4,5,6]. The characteristic clinical picture is initial loss of consciousness, followed by a return to a normal state of consciousness (lucid interval), and by focal neurological signs associated with a worsening of the state of consciousness. Computed tomography (CT) examination is the initial accurate diagnostic tool for its identification [7,8]. Since this is a neurosurgical emergency, it is necessary an early diagnosis and adequate treatment. The objective of this work is to present the ten relevant questions to HE, thus presenting important clinical aspects such as its epidemiology, diagnosis and treatment.

METHODS

This systematic review was based on the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA), searching in the Pubmed and Scielo databases, and neurosurgery books, using the following descriptors: "Cranial Epidural Hematoma", "Craniocerebral trauma" and "treatment outcome". The inclusion criteria were studies with a time frame between 1975 and 2016, with individuals of any given age group, diagnosed with intracranial epidural hematoma, observational studies and original case reports published in English. Studies not developed in humans, with no abstract in the databases, and letters to the editor were excluded. Duplicate studies were removed, resulting in a total of 58 articles that met the inclusion criteria taking into account their citations and their respective impacts.

DISCUSSION

Question 1: Epidemiology and Incidence

EH corresponds to 0.2% to 6% of all TBI and 9% to 12% of severe TBI [2,5,9,10,11,12,13,14]. As for the evolution, they can be acute (58%), subacute (31%) or chronic (11%) [15,16]. It corresponds to 20% of surgical interventions for traumatic intracranial hematomas [9].

Question 2: Age and sex

It affects more the second and third decades of life [1,3,5,6,14,17], occuring in approximately 3% of patients under the age of two years and less than 6% in patients over 60 years of age [1,2,3]. EH is uncommon in childhood due to anatomical and physiological peculiarities in this age group, such as greater cranial malleability and elasticity, the middle meningeal artery groove is shallow. During trauma, this artery displaces without suffering injury, greater adherence of the dura mater to the skull and a less prominent cranial diploe reduces the possibility of developing EH [18-21]. It affects the male gender in the proportion of 3 to 5 male to 1 female patients [4,6,9,13,14,22-24].

Question 3: Causes and Locations

In 70-90% of cases are due to traffic accidents and accidental falls [1-4,6,9,13,25]. Its location is supratentorial in 90% and infratentorial in 10% of cases. In 95% of cases it is unilateral and 5% bilateral [3,26]. The EH is almost always located on the convexity of the cerebral hemisphere in the middle fossa, therefore, its temporal and temporal parietal location is more common in 70% of the cases [4,14,27,28,29]. Approximately 10% of the cases are in the frontal region, 10% in the parieto-occipital region and 10% in the posterior fossa, and less common in the vertex and clivus [29,30].

Question 4: Neurological condition

The clinical presentation depends on the size and location of the hematoma, the speed of growth of the hematoma and the presence or absence of associated intradural lesions. Some symptoms associated with EH are headache, nausea and vomiting, seizures and focal neurological deficit [21]. Pyramid syndrome and anisocoria are valuable signs of EH location, occurring in 20 to 45% of the cases [3,17,19,20]. Unilateral mydriasis (anisocoria) is identified in 6 to 44% of cases. When its volume is small, it is usually asymptomatic. If bulky, the HE presents a high incidence of coma state [3].

Question 5: Lucid range

The classic evolution of loss of consciousness after trauma

accompanied by complete recovery of consciousness (lucid interval), followed by mydriasis ipsilateral to the hematoma, which is secondary to uncus herniation and contralateral hemiparesis with decreased level of consciousness, occurs between 10 to 33 % of cases [5,11]. Oertel et al. [31] reported the presence of the lucid interval in 58% of cases. A reduction has been increasingly demonstrated in the incidence of the lucid interval, partially due to the increasingly earlier use of cranial CT in cases of moderate and severe TBI.

Question 6: Simple skull radiography

The incidence of the cranial fracture line varies from 60% to 86.7% of the cases [1,6,13,14,20,25,27,32]. The absence of a fracture line on the plain skull radiography does not exclude the presence of EH [33]. A fracture line crossing the path of the middle meningeal artery or of the dural venous sinuses presents a high incidence of increase in the size of the hematoma even after expectant management [22]. Several authors described that the presence of the fracture line is associated with a poor prognosis [19,34].

Question 7: Computed tomography findings

CT scan is the method of choice for diagnosis: it demonstrates an extra-axial, biconvex or lentiform lesion, hyperdense, usually located in the temporal fossa [7,8,35]. In some situations, it presents deviation of the midline structures and intradural lesions associations. EH does not usually cross suture lines. In the hyperacute form of EH, the "swirl sign" can be seen on CT scans, which is a hypodense spiral area within the hematoma, which means active arterial bleeding and indicates the need for immediate surgery to drain the hematoma [36]. Important consideration must be made related to the time to repeat CT [4]. According to Sullivan et al. [37], the increase of volume in EH occurs in 23% of cases and the average time for this increase to occur is 8 hours after trauma and this would be the time for a new CT exam.

Question 8: Hematoma size

Several studies have shown that EH volume is one of the main factors influencing prognosis [21,24]. Pereira et al. [24] did not find a relationship between the hematoma volume and the age of the patient, and also that the hematoma volume is independent of the associated intracranial lesions. These authors found a relationship between the hematoma volume and its location, with the smallest volume being in the temporal region.

Question 9: Treatment

EH is considered a neurosurgical emergency [10,14,38]. The decision and timing of EH treatment can be individual for each case, depending on the patient's age, size of the hematoma, location and neurological status of the patient [39]. Expectant management has been indicated in patients with preserved level of consciousness, without focal neurological deficit, absence of associated intracranial lesion and CT in six hours or more after the trauma demonstrating EH of small volume (less than 30 ml, thickness less than 15 mm and midline deviation less than 5 mm) [4,32], but with constant clinical observation and CT control. In case of neurological deterioration, immediate surgery is indicated. Bullock et al. [27] demonstrated that a volume between 12-38 ml was convenient for conservative treatment. Chen et al. [40] suggest that hematoma greater than 30 ml, with a thickness greater than 15 mm and midline deviation greater than 5 mm is an indication for surgical drainage. There is still disagreement in the protocol regarding EH of the posterior fossa. However, surgical treatment has been indicated in all cases, due to the possibility of a considerable mass effect in a small space. According to Wong [41], EH located in the posterior fossa with volume less than 10 ml, thickness less than 15 mm, midline deviation less than 5 mm and absence of other intracranial hematoma has an excellent result when submitted to conservative treatment. In cases associated with intracranial lesions, it indicates greater trauma severity and contraindicates conservative treatment [42,43].

Surgical treatment is indicated based on neurological status and cranial CT findings:

a. Coma with anisocoria;

b. Coma and worsening of neurological status in EH with volume > 25ml;

c. EH volume > 30 ml, even in the absence of symptoms;

d. EH volume > 25 ml, located in the posterior fossa or temporal region;

e. Midline deviation > 5 mm, with worsening of neurological status;

f. Increased volume of the hematoma.

Surgical treatment is performed through osteoplastic craniotomy, above the site of the hematoma, and coagulation of the lacerated vessel is often considered necessary, with suturing of the dura mater at the edges of the craniotomy and in the center of the bone flap to prevent its recurrence [44,45,46]. In cases of bleeding from venous sinuses, it is controlled using Gelfoam or Surgicel and head elevation in bed to avoid air embolism [27,47].

Question 10: Prognosis

EH is an important cause of morbidity and mortality in patients with TBI. Factors that have a great influence on the prognosis are age, low Glasgow Coma Scale score on admission, associated intradural lesion, time between trauma and onset of symptoms, size and location of the hematoma [5,20,26,39,48-54]. The mortality of EH varies from 0 to 33% [3,4,7,14,26,34,43,55]. Stephanov [56] demonstrated that in the pre-CT era, mortality ranged from 16 to 52% and in the post-CT era, it ranged from 8 to 14%. This author concluded that rapid patient transport to a neurosurgical referral center was the most important factor to reduce the mortality. Jones et al. [57] reported a drop in mortality from 29 to 8% in the last 35 years. According to Lee et al. [43], before the introduction of CT in emergency units, mortality was between 40 and 80% and after the routine use of CT, mortality was reduced to 9%. Shahid et al. [58] observed that young patients, who underwent surgery and performed early and with no or minimal associated intracranial lesion, recovered better than those patients who underwent surgery later. Other authors have shown that the absence of early diagnosis and the presence of associated intradural lesions are factors that contribute most to high morbidity and mortality [9,12,28].

CONCLUSIONS

We can conclude that occurence was between 0.2 to 6% of all traumatic brain injuries, male individuals are the most affected, and the most common age group is the second and third decades of life. As main causes there are traffic accidents, accidental falls and assaults. The most common location is supratentorial, and the temporal and temporoparietal locations are the most frequent. While clinical presentation depends on size, location and presence of associated intradural lesions. The exam of election is CT scan. EH is considered a neurosurgical emergency, and factors as the patient's age, low Glasgow Coma Scale score on admission, size, volume and the presence of associated intracranial lesions have a great influence on the prognosis.

REFERENCES

1. Baykaner K, Alp H, Ceviker N, Keskil S, Seçkin Z. Observation of 95 patients with extradural hematoma and review of the literature. Surg Neurol. 1988;30(5):339-41. doi: 10.1016/0090-3019(88)90195-4.

2. Phonprasert C, Suwanwela C, Hongsaprabhas C, Prichayudh P, O'Charoen S. Extradural hematoma: analysis of 138 cases. J Trauma. 1980;20(8):679-83.

3. Rivas JJ, Lobato RD, Sarabia R, Cordobés F, Cabrera A, Gomez P. Extradural hematoma: analysis of factors influencing the courses of 161 patients. Neurosurgery. 1988;23(1):44-51. doi: 10.1227/00006123-198807000-00010.

4. Bezircioğlu H, Erşahin Y, Demirçivi F, Yurt I, Dönertaş K, Tektaş S. Nonoperative treatment of acute extradural hematomas: analysis of 80 cases. J Trauma. 1996;41(4):696-8. doi: 10.1097/00005373-199610000-00016.

5. Bricolo AP, Pasut LM. Extradural hematoma: toward zero mortality. A prospective study. Neurosurgery. 1984;14(1):8-12. doi: 10.1227/00006123-198401000-00003.

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

7. Ericson K, Håkansson S. Computed tomography of epidural hematomas. Association with intracranial lesions and clinical correlation. Acta Radiol Diagn (Stockh). 1981;22(5):513-9. doi: 10.1177/028418518102200501.

8. Tataranu L, Ciubotaru V, Paunescu O, Spatariu A, Radoi M. Extradural hematoma – is surgery always mandatori? Rom J Legal Med 2014; 22(1): 45-50.

9. Alliez JR, Hilal N, Kaya JM, Leone M, Reynier Y, Alliez B. Hématomes intracrâniens extra-duraux: À proprós de100 cases récents. Neurochirurgie 2005; 51: 464-470. Doi: 10.1016/S0028-3770(05)83504-0.

10. Jeong YH, Oh JW, Cho S; Korean Trauma Data Bank System Committee. Clinical Outcome of Acute Epidural Hematoma in Korea: Preliminary Report of 285 Cases Registered in the Korean Trauma Data Bank System. Korean J Neurotrauma. 2016;12(2):47-54. doi: 10.13004/kjnt.2016.12.2.47.

11. 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. doi: 10.1620/tjem.211.235.

12. Kvarnes TL, Trumpy JH. Extradural haematoma. Report of 132 cases. Acta Neurochir (Wien). 1978;41(1-3):223-31. doi: 10.1007/BF01809151.

13. Ndoumbe A, Ekene MVP, Jema B, Simeu C, Tokongmo S. Epidemiological analysis of surgically treated acute traumatic epidural hematoma. Open J Modern Neurosurg 2016; 6(1): 89-97. Doi: 10.4236/ojmn.2016.63016.

14. Thiam AB, Mudekeza PS, Ndoye N, et al. Hématome extra-dural. Étude épidémiologique a propos du 35 cas. J. Neurochirurgie 2013; 18(1): 13-20.

15. Sharma R, Verma SK, Sinha S. Chronic extradural hematomas: An illustrative case report and review of literature. Indian J Neurosurg 2016; 5(3): 163-171. Doi: 10.1055/s-0036-1588038.

16. Zimmerman RA, Bilaniuk LT. Computed tomographic staging of traumatic epidural bleeding. Radiology. 1982;144(4):809-12. doi: 10.1148/radiology.144.4.7111729.

17. 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. doi: 10.3171/jns.1988.68.1.0048.

18. 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. doi: 10.1159/000121144.

19. Cook RJ, Dorsch NW, Fearnside MR, Chaseling R. Outcome prediction in extradural haematomas. Acta Neurochir (Wien). 1988;95(3-4):90-4. doi: 10.1007/BF01790766.

20. 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. doi: 10.1007/BF01406363.

21. Pereira CU, Santos EAS, Cavalcante S, Serra MV, Pascotto D, Fontoura EAF. Hematoma extradural intracraniano. J Bras Neurocir 2005; 16(1): 25-34. 10.22290/jbnc.v16i1.509.

22. Knuckey NW, Gelbard S, Epstein MH. The management of "asymptomatic" epidural hematomas. A prospective study. J Neurosurg. 1989;70(3):392-6. doi: 10.3171/jns.1989.70.3.0392.

23. Khaled CN, Raihan MZ, Chowdhury FH, Ashadullah ATM, SarkarMH, Hossain SS. Surgical management of traumatic extradural haematoma: Experiences with 610 patients and prospective analysis. Indian J Neurotrauma 2008;5(2):75-79. Doi: 10.1016/S0973-0508(08)80004-4.

24. Pereira CU, Silva EAS, Dias LAA. Hematoma extradural intracraniano. Correlação entre o volume do hematoma com a localização e idade do paciente. J Bras Neurocirurg 2004;15(1):59-66. Doi: 10.22290/jbnc.v15i2.481.

25. Rossi Jr J, Andrade AF, Yeng LC, et al. Epidural hematoma: A prospective analysis ofmorbidity and mortality in 173 patients. Arq Bras Neurocir. 2015;34(01):020-024 DOI: 10.1055/s-0035-1547391.

26. Dharker SR, Bhargava N. Bilateral epidural haematoma. Acta Neurochir (Wien). 1991;110(1-2):29-32. doi: 10.1007/BF01402044.

27. Bullock MR, Chesnut R, Ghajar J, et al. Surgical management of acute epidural hematomas. Neurosurgery. 2006;58(3 Suppl):S7-15.

28. Husain M, Ojha BK, Chandra AM, et al. Contralateral motor deficit in extradural hematoma: Analysis of 35 patients. Indian Journal of Neurotrauma 2007; 04(01): 41-44 doi: 10.1016/S0973-0508(07)80010-4.

29. Reale F, Delfini R, Mencattini G. Epidural hematomas. J Neurosurg Sci. 1984;28(1):9-16.

30. Kumar J, Prakash A, Harsh V, Kumar A. Vertex Extradural Hematoma: A Diagnostic Dilemma. Asian J Neurosurg. 2017;12(4):718-720. doi: 10.4103/1793-5482.215758.

31. Oertel M, Kelly DF, McArthur D, et al. Progressive hemorrhage after head trauma: predictors and consequences of the evolving injury. J Neurosurg. 2002;96(1):109-16. doi: 10.3171/jns.2002.96.1.0109.

32. Dubey A, Pillai SV, Kolluri SV. Does volume of extradural hematoma influence management strategy and outcome? Neurol India. 2004;52(4):443-5.

33. Ullman JS. Epidural hematomas. Atualizado em Abr 13, 2016. Disponível em: https://emedicine.medscape.com/article/248840-overview.

34. Heiskanen O. Epidural hematoma. Surg Neurol. 1975;4(1):23-6.

35. 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. doi: 10.5137/1019-5149.JTN.7345-12.0.

36. Pereira CU, Santos LPA. "Sinal do redemoinho" em hematoma extradural hiperagudo. Arq Bras Neurocir 2013; 32(3): 207-210.

37. 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.

38. Rehman L, Khattak A, Naseer A, Mushtaq. Outcome of acute traumatic extradural hematoma. J Coll Physicians Surg Pak. 2008;18(12):759-62.

39. Korinth M, Weinzierl M, Gilsbach JM. Behandlungsmöglichkeiten bei traumatischen Epiduralhämatomen [Treatment options in traumatic epidural hematomas]. Unfallchirurg. 2002;105(3):224-30. doi: 10.1007/s001130100316.

40. Chen TY, Wong CW, Chang CN, et al. The Expectant Treatment of "Asymptomatic" Supratentorial Epidural Hematomas. Neurosurgery. 1993;32(2):176–179. Doi: 10.1227/00006123-199302000-00004.

41. Wong CW. The CT criteria for conservative treatment--but under close clinical observation--of posterior fossa epidural haematomas. Acta Neurochir (Wien). 1994;126(2-4):124-7. doi: 10.1007/BF01476421.

42. Cucciniello B, Martellotta N, Nigro D, Citro E. Conservative management of extradural haematomas. Acta neurochir. 1993;120:47–52. Doi: 10.1007/BF02001469.

43. Lee EJ, Hung YC, Wang LC, Chung KC, Chen HH. Factors influencing the functional outcome of patients with acute epidural

hematomas: analysis of 200 patients undergoing surgery. J Trauma. 1998;45(5):946-52. doi: 10.1097/00005373-199811000-00017.

44. Zhao J, Liu Z, Liu Y, et al. [Effect of epidural drainage and dural tenting suture on epidural hematoma in 145 cases of craniotomy]. Zhong Nan Da Xue Xue Bao Yi Xue Ban. 2010;35(3):273-6. doi: 10.3969/j.issn.1672-7347.2010.03.014.

45. Gunasena P, Bandara L, Jayaratne C, Thilakaratne M. Evaluation of risk of developing EDH associated with large craniectomy closure without hitching the dura. Accepted abstracts from the International Brain Injury Association's Eighth World Congress on Brain Injury. Brain Injury 2010;24(3):129. Doi: 10.3109/02699051003648227.

46. Przepiórka Ł, Kunert P, Żyłkowski J, et al. Necessity of dural tenting sutures in modern neurosurgery: protocol for a systematic review. BMJ Open. 2019 Feb 19;9(2):e027904. doi: 10.1136/bmjopen-2018-027904.

47. Grevsten S, Pellettieri L. Surgical decision in the treatment of extradural haematoma. Acta Chir Scand. 1982;148(2):97-102.

48. Andrioli GC, Zuccarello M, Trinica G, Fiore D. Extradural Hematomas in Elderly. A Statistical Analysis of 58 Cases. In: Piotrowski W, Brock M, Klinger M. (eds). CNS Metastases Neurosurgery in the Aged. Advances in Neurosurgery, vol 12. Springer, Berlin, Heidelberg. 1984. Doi: 10.1007/978-3-642-69360-1_38.

49. Cohen JE, Montero A, Israel ZH. Prognosis and clinical relevance of anisocoria-craniotomy latency for epidural hematoma in comatose patients. J Trauma. 1996;41(1):120-2. doi: 10.1097/00005373-199607000-00019.

50. 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. doi: 10.1016/0020-1383(95)00223-5.

51. Kuday 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):203-6. doi: 10.1007/BF01808613.

52. Paterniti S, Fiore P, Macrì E, et al. Extradural haematoma. Report of 37 consecutive cases with survival. Acta Neurochir (Wien). 1994;131(3-4):207-10. doi: 10.1007/BF01808614.

53. Servadei F, Vergoni G, Staffa G, et al. Extradural haematomas: How many deaths can be avoided?. Acta neurochir. 1995;133:50–55. Doi: 10.1007/BF01404947.

54. Servadei F. Prognostic factors in severely head injured adult patients with epidural haematoma's. Acta Neurochir (Wien). 1997;139(4):273-8. doi: 10.1007/BF01808821.

55. Soon WC, Marcus H, Wilson M. Traumatic acute extradural haematoma - Indications for surgery revisited. Br J Neurosurg. 2016;30(2):233-4. doi: 10.3109/02688697.2015.1119237.

56. Stephanov S. Post-operative mortality in acute extradural haematoma. Br J Neurosurg. 1993;7(5):461-3. doi: 10.3109/02688699308995067.

57. Jones NR, Molloy CJ, Kloeden CN, North JB, Simpson DA. Extradural haematoma: trends in outcome over 35 years. Br J Neurosurg. 1993;7(5):465-71. doi: 10.3109/02688699308995068.

58. Shahid A, Mumtaz A, Muahammad I. acute extradural haematoma: Factors affecting the outcome. J Postgraduate Med Inst 2005;19(2):208-211.

CORRESPONDING AUTHOR

Carlos Umberto Pereira, MD, PhD
Av. Augusto Maynard, 245/404
Aracaju, Sergipe
E-mail: umberto@infonet.com.br

Conflict of interests: *nothing to disclose*
Funding: *nothing to disclose*