Ten Questions About Intracranial Epidural Hematoma. Lessons learned
Dez Questões Sobre Hematoma Epidural Intracraniano. Lições aprendidas

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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 masculino 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

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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 \(^8\).

Question 2: Age and sex

It affects more the second and third decades of life \(^1,^3,^5,^6,^14,^17\), occurring 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 \(^1-^4,^6,^8,^13,^25\). Its location is supratentorial in 90% and infratentorial in 10% of cases. In 95% of cases it is unilateral and 5% bilateral \(^1,^3,^25\). 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 \(^28,^30\).

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. Oertel et al. 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. The absence of a fracture line on the plain skull radiography does not exclude the presence of EH. 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. Several authors described that the presence of the fracture line is associated with a poor prognosis.

**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. 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. Important consideration must be made related to the time to repeat CT scans. According to Sullivan et al., 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. Pereira et al. 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. 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. 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), but with constant clinical observation and CT control. In case of neurological deterioration, immediate surgery is indicated. Bullock et al. demonstrated that a volume between 12-38 ml was convenient for conservative treatment. Chen et al. 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, 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.

Surgical treatment is indicated based on neurological status and cranial CT findings:
- Coma with anisocoria;
- Coma and worsening of neurological status in EH with volume > 25 ml;
- EH volume > 30 ml, even in the absence of symptoms;
- EH volume > 25 ml, located in the posterior fossa or temporal region;
- Midline deviation > 5 mm, with worsening of neurological status;
- 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. In cases of bleeding from venous sinuses, it is controlled using Gelfoam or Surgicel and head elevation in bed to avoid air embolism.

**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. The mortality of EH varies from 0 to 33%.

Stephanov 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. reported a drop in mortality from 29 to 8% in the last 35 years. According to Lee et al., 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. 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.


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