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Basal Ganglia Traumatic Hematoma: Case Series and Literature Review

Hematoma traumático em gânglios da base: Série de casos e revisão da literatura

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Abstract

Introduction Basal ganglia traumatic hematoma (BGTH) is rare, occurring in 3% of closed traumatic brain injuries, and it is associated with a poor prognosis. In the present paper, the authors present a series of 16 BGTH cases, describing their causes, treatment, and results.

Patients and Methods Thisis a retrospective study of 16 patients diagnosed with BGTH, associated with a literature review in the PubMed, ScienceDirect, and Google Scholar databases, using the terms *craniocerebral trauma* AND *basal ganglia* and *basal ganglia* AND *hematoma* AND *trauma*. Articles published in the period from 1986 to 2019 were selected, resulting in a total of 19 articles that met the inclusion criteria taking into account their citations and their respective impacts.

Results Sixteen patients were studied. They were all male, with an average age of 21 years and 5 months. The main cause of BGTH was traffic accident (12). The mean score in the Glasgow coma scale at admission was 8. All patients underwent a computed tomography (CT) scan of the skull. The putamen was the most affected structure (5). Thirteen patients underwent conservative treatment, and three drained the associated intracranial hematoma. Nine patients died, and seven, and four had neurological sequel.

Conclusions The neurosurgeon's knowledge of GBTH, including diagnosis and clinical surgical management, is extremely important, as this type of lesion is associated with a poor prognosis.

Keywords
- basal ganglia
- craniocerebral trauma
- neuroimaging
- traumatic cerebral hemorrhage

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Resumo

Introdução O hematoma traumático dos gânglios da base (HTGB) é raro, ocorrendo em 3% dos traumatismos cranioencefálicos fechados, estando associado a mau prognóstico. Neste artigo, os autores apresentam uma série de 16 casos de HTGB, descrevendo suas causas, tratamento e resultados.

Pacientes e métodos Estudo retrospectivo de 16 pacientes com diagnóstico de HTGB, associado a uma revisão de literatura nas bases de dados PubMed, ScienceDirect e Google Scholar, utilizando os termos: "Craniocerebral Trauma" AND "Basal Ganglia" and "Basal Ganglia" AND "Hematoma" AND "Trauma." Foram selecionados artigos com período de 1986 a 2019, resultando em um total de 19 artigos que atenderam aos critérios de inclusão levando em consideração suas citações e seus respectivos impactos.

Resultados Dos 16 pacientes foram estudados, todos do sexo masculino e com idade média de 21 anos e 5 meses. A principal causa de HTGB foi acidente de trânsito (12). A pontuação média na escala de coma de Glasgow na admissão foi de 8. Todos foram submetidos a uma tomografia computadorizada do crânio. Putamen foi o mais afetado (5). Treze pacientes foram submetidos a tratamento conservador e três apresentaram o hematoma intracraniano associado. Nove pacientes morreram e sete, e quatro tiveram sequelas neurológicas.

Conclusões O conhecimento dos neurocirurgiões sobre HTGB, diagnóstico e manejo clínico cirúrgico é de extrema importância, pois está associado a um mau prognóstico.

Palavras-chave
- gânglios da base
- hemorragia traumática cerebral
- neuroimagem
- trauma craniocerebral

Introduction

Basal ganglia traumatic hematoma (BGTH) is characterized by being in the basal ganglia (caudate nucleus, putamen and globus pallidus) or in adjacent structures, such as the thalamus and the internal capsule.[1,2] The basal ganglia hematoma often occurs spontaneously in hypertensive patients, and it is rarely caused by trauma; it is associated with a poor prognosis[3] and severe injuries.[4] Basal ganglia traumatic hematomas represent 3.2% in closed traumatic brain injuries (TBIs).[5] It often occurs in high-speed trauma, and falls from heights are one of the causes of pediatric BGTH.[6] Basal ganglia (BG) hematomas $>$ 2 cm are considered large,[7,8] and those with diameter $<$ 2 cm can be considered a hemorrhage due to cerebral contusion,[9] associated as part of the spectrum present in diffuse axonal injury (DAI).[5] Basal ganglia deep cerebral contusion and brain gray matter deep region are classified as intermediary contusion, characteristic of DAI.[10] Basal ganglia traumatic hematoma patients have a high incidence of coagulating disorders, DAI, contusion, intraventricular hemorrhage, and extra axial hematomas.[1]

The authors present a series of 16 BGTH cases, describing its causes, treatment, and results.

Patients and Methods

This is a retrospective study of 16 patients diagnosed with basal BGTH, aged 16 to 44 years, admitted to Hospital de Urgência de Sergipe (Aracaju, SE, Brazil), in the period from 2009 to 2013. The following aspects were analyzed: age, gender, injury laterality, injured basal ganglia, imaging tests, treatment, and prognosis.

The literature review was performed according to the preferred reporting items for systematic reviews and meta-analyses (PRISMA) statement. The inclusion criteria were studies and case reports with a time frame between 1986 and 2019, with individuals of any determined age group, diagnosed with BGTH. Studies not developed in humans, published in databases with no abstract, systematic reviews, and letters to the editor, were excluded.

The literature review was performed in July 12, 2020 using the following databases: PubMed, ScienceDirect, and Google Scholar, using the terms *craniocerebral trauma* AND *basal ganglia* and *basal ganglia* AND *hematoma* AND *trauma*. Duplicate studies were removed, resulting in a total of 19 articles that met the inclusion criteria taking into account their citations and their respective impacts.

Results

In the present case series, all patients were male, with a mean age of 21 years and 5 months. The main causes of BGTH were traffic accident (12) and accidental fall (3) (►**Table 1**). The mean Glasgow coma scale (GCS) score on admission was 8. All patients underwent a computed tomography (CT) test, showing that the main affected nuclei were the putamen (5), the caudate nucleus (4), and the internal capsule (4) (►**Figures 1–9**). In the analysis of the laterality of the lesion, in five patients the lesion was located on the right side, in five it was on the left side, and in six, there were lesions on both sides (►**Table 2**).

Table 1 Clinical-epidemiological characteristics of 16 BGTH patients

Clinical-epidemiological characteristics (n = 16)		
Characteristics	**No.**	**Percentage**
Sex		
Male	16	100%
Female	0	0.00%
Causes		
Traffic accident	12	75.00%
Accident fall	3	18.75%
Physical aggression	1	6.25%
Treatment		
Surgical	3	18.75%
Conservative	13	81.25%
Results		
Good general condition	3	18.75%
Neurological sequelae	4	25.00%
Death	9	56.25%

Fig. 2 Non-contrast skull computed tomography showing bilateral basal ganglia hematoma.

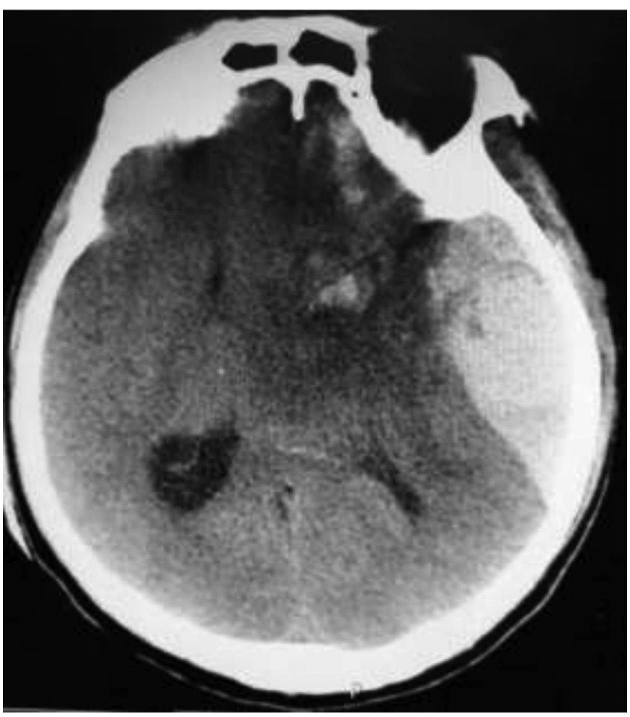

Fig. 1 Skull computed tomography without contrast showing acute epidural hematoma in the left temporoparietal region and frontal contusion hematoma in left basal ganglia.

Fig. 3 Non-contrast skull computed tomography showing hemorrhage in the right lateral ventricle associated with left basal ganglia hematoma.

Fig. 4 Non-contrast skull computed tomography showing right parietal hematoma, left temporal contusion and left basal ganglia hematoma.

Fig. 6 Computed tomography of the skull without contrast with large right basal ganglia hematoma and compression of the right lateral ventricle, with deviation of the midline structures.

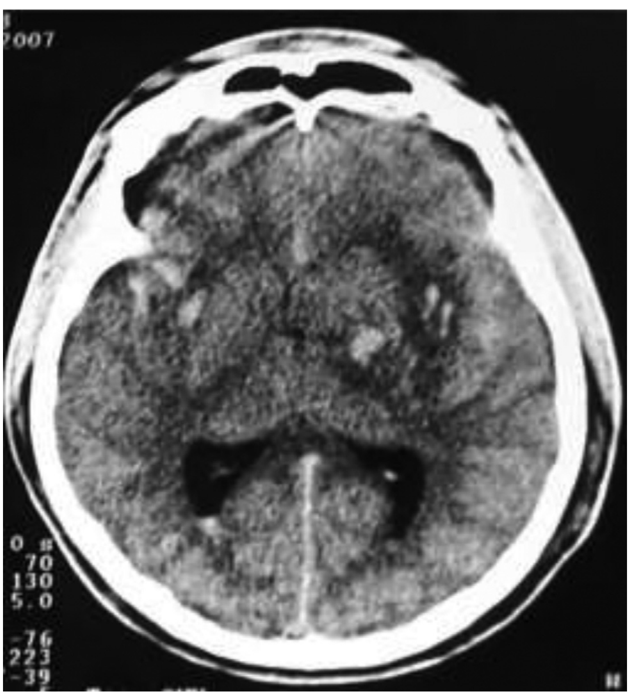

Fig. 5 Non-contrast skull computed tomography showing bilateral lesion in basal ganglia.

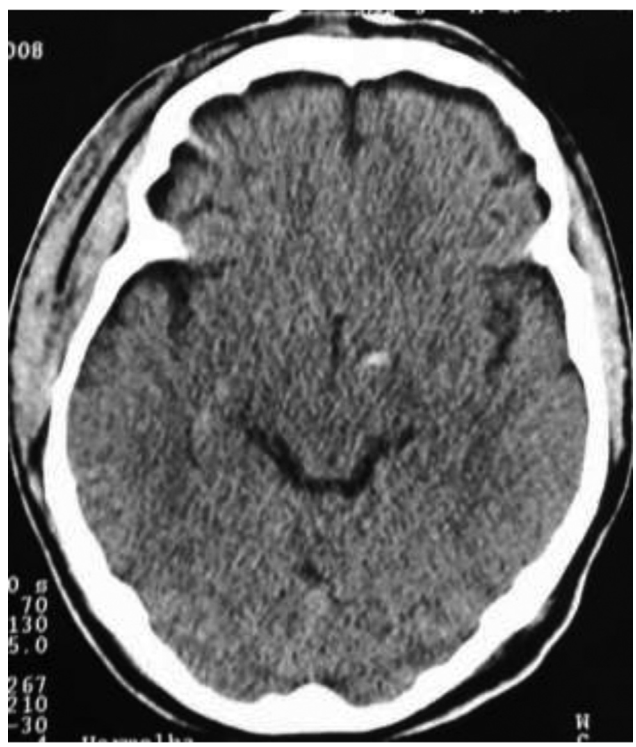

Fig. 7 Computed tomography of the skull without contrast with hematoma in left basal ganglia.

Thirteen patients underwent conservative treatment and three underwent intracranial hematomas drainage—two epidural hematomas (EDH), and one subdural hematoma (SDH). Seven patients survived, four had neurological sequelae, and nine patients died.

Discussion

Epidemiology

Basal ganglia TBIs in closed cranial lesions represent 3%,[1,6,8] and, when found in autopsies, they represent 10%.[3] In a study

Fig. 8 Non-contrast skull computed tomography showing left acute frontoparietal subdural hematoma, intraventricular hemorrhage, deviation of the midline structures and right basal ganglia hematoma.

Fig. 9 Non-contrast skull computed tomography showing intraventricular hemorrhage, subarachnoid hemorrhage, massive left basal ganglia hematoma.

Moe et al., it was demonstrated that when associated with DAI affecting unilateral and bilateral BG, they represent 18% and 2%, respectively,[11] being extremely rare in the pediatric population.[9] Chung et al.,[4] in a study with 309 pediatric TBI patients, showed that all BG lesions were unilateral and represented only 2.5%.

Table 2 Skull computed tomography of 16 BGTH patients

Characteristics of skull computed tomography (n = 16)		
Characteristics	**No.**	**Percetage**
Lateralization		
Right	5	31.25%
Left	5	31.25%
Bilateral	6	37.5%
Associated injuries		
Subdural hematoma	3	18.75%
Epidural hematoma	2	12.25%
Cerebral contusion	5	31.25%
Diffuse axonal injury	4	25.00%
Basal ganglia hematoma location		
Putamen	5	31.25%
Caudado nucleus	4	25.00%
Internal capsule	4	25.00%
Globus pallidus	2	12.25%
Thalamus	1	6.25%

Basal ganglia traumatic hematoma is often small, uni or bilateral, located in the internal capsule and lenticular nucleus (putamen and globus pallidus),[2] which may occur in the thalamus and caudate nucleus,[12] and it may be accompanied by cranial fracture, brain stem lesions, subarachnoid hematoma,[3] EDH, and SDH.[8] When the hematoma occurs due to spontaneous hemorrhage, it is unilateral and commonly located in the internal capsule and thalamus.[2] Jayakumar et al.,[13] in a study with 22 patients, showed the following location distribution of BGTH: 41% in the putamen, 23% in the caudate nucleus, 23% in the internal capsule, and 13% in the thalamus, with the highest mortality associated with the first structure.

In the present study, 10 lesions were located unilaterally and 6 bilaterally. The affected nuclei were the putamen (5), caudate nucleus (4), internal capsule (4), globus pallidus (2), and thalamus (1). The associated injuries were SDH (3), EDH (2), brain contusion (5), and DAI (4).

Physiopathology

It is believed that BGTH occurs due to shear forces.[5] When there is a high-energy impact on the vertex, in the frontal or in the occipital lobe and directed to the tentory,[3,14] with extension and consequent rupture of the vessels due to shear forces[2,11,15] resulting in hemorrhages in the BG,[3] both the striking and counter-striking movements can develop this mechanical action.[16] The vessels associated with this phenomenon are the anterior choroidal artery and the striated lenticular perforating arteries,[5,7,8] with the latter being associated with pediatric BGTH. The middle cerebral artery

(MCA) is associated with bleeding and infarction of the basal ganglia and the thalamus.[17] As the skull of children is elastic, the shear forces occur mildly in them compared with adults.[6]

Bilateral lesions in the BG are associated with a low value on the GCS score due to the connection of these structures to the ascending reticular activating system (ARDS).[11] The measure of remaining awake after TBI is related to bilateral atrophy of the globus pallidus and putamen.[10]

Symptomatology

As the BG are the union of several parts of the brain's gray matter, the symptoms manifest depending on the BG involved. When the internal capsule has a hematoma, the associated symptom is motor deficit. Extrapyramidal symptoms appear when the substantia nigra is damaged. Visual deficits and language and sensory disorders are associated with the lateral geniculate bodies and the thalamus. When the ARDS has a hematoma, the patient is unconscious.[7]

In their study, Moe et al.[11] demonstrated that patients with bilateral BG lesions and absence of other intracranial lesions present low level of awareness at the accident site or at hospital admission. Colquhoun et al.,[5] in a study conducted with 26 patients, showed the presence of a lucid interval in nine patients, and the presence of focal neurological deficit was associated with unilateral hematoma in the BG.

Diagnosis

The diagnosis is made through imaging exams. Computed tomography and magnetic resonance imaging (MRI) show a hematoma with localization in the BG, associated with a skull fracture,[13] and intraventricular and subarachnoid hematomas.[5] Diffuse axonal injury can be found in the imaging exams, being frequently associated with a low GCS score.[2] Computed tomography can present a diffuse lesion of the cerebral white matter, present in one third of patients with BGTH, often associated with increased intracranial pressure and a poor prognosis.[18]

Treatment

The treatment of BGTH follows the protocol of intracranial hematomas, considering the neurological status, mass effect, and high intracranial pressure.[5] Management can be achieved through conservative treatment, surgical drainage of the hematoma, aspiration of the hematoma guided by ultrasound or stereotactic CT.[1,2] Surgical drainage is recommended for hematomas with a volume greater than 25 ml, especially when associated with increased intracranial pressure.[7,14] In the present study, 13 patients were treated conservatively and 3 surgically, aiming at draining bruises associated with BGTH lesions, two EDH and one SDH.

Complications

The poor prognosis of patients with BGTH[4] is related to the global characteristic of this brain lesion,[13] associated with the presence of intracranial hypertension,[5] presenting a poorer prognosis rate higher than other traumatic intracranial hemorrhage types.[9] The factors associated with poor prognosis are age $>$ 60 years, DAI, large volume hematoma, extra-axial hematomas, abnormal pupillary and motor responses, severe TBI[14,16] and late hematoma increase.[2]

Zakharova et al.,[19] in a study with 278 patients, demonstrated that lesions located in the BG have a prognosis of adverse outcomes such as vegetative state, severe neurological deficit, and death. The high incidence of BG hematomas during autopsies demonstrates the clinical course of death.[7,8] Mortality in pediatric patients varies between 14 and 33%.[6]

In the present case series, seven patients survived, three were in a good general condition, and four had neurological sequelae such as dysphasia, motor deficit, convulsive crises, and involuntary movements, and nine patients died.

Conclusion

Neurosurgeons' knowledge of BGTH is extremely important, including the symptoms related to the affected areas, the diagnosis, and clinical or surgical management, since this type of lesion is associated with a poor prognosis.

Conflict of Interests
The authors have no conflict of interests to disclose.

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