Decompressive Craniectomy (DC) - Comparative Study of 30-Day Mortality in Surgeries of Severe Brain Trauma with Subdural Hematoma, with and without DC

Craniectomia descompressiva (CD): estudo comparativo da mortalidade em 30 dias das cirurgias para traumatismo craniano grave com hematoma subdural, com e sem CD

Lucas Eduardo Bonadio[1] Luis Renato Garcez Mello[1] Leandro Jose Haas[1] Vitor Hugo Tamiosso Boer[1] Celso Itiberê Carvalho Bernardes[1] Danielle De Lara[1] Filipe Laurindo Cabral[2] Gabriel Hoher Peres[2] Stephanie Lindner[2]

[1] Neurosurgeon, Department of Neurosurgery, Instituto Catarinense de Neurologia e Neurocirurgia, Hospital Santa Isabel, Blumenau, SC, Brazil
[2] Department of Neurosurgery, Hospital Santa Isabel, Blumenau, SC, Brazil

Address for correspondence Lucas Eduardo Bonadio, MD, Instituto Catarinense de Neurologia e Neurocirurgia, R. Mal. Floriano Peixoto, 300, Centro, Blumenau, Santa Catarina, Brazil 89010-500 (e-mail: lucasbonadio@hotmail.com).

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Abstract

Objective Compare 30 days mortality of patients harboring acute subdural hematomas in two series, one treated only by wide aspiration of hematoma and other with aspiration followed by decompressive craniectomy.

Methods Comparing retrospectively two series of ASD with and without DC. Involved 81 TBI patients with acute subdural hematoma and GCS $\leq$ 8 (Jan 2000 to Nov 2014) arranged into two groups. Group 1 - 58 cases underwent to DC. Group 2 - 23 patients underwent only hematoma aspiration.

Results Group 1 showed 44.8% mortality directly due to brain lesion within 30 days. The most frequent associated lesion were contusion in 37.2%. Group 2 the mortality within 30 days was 47.8%. The majority of deaths (82%) resulted from uncontrollable brain swelling, midline shift was present in 94.7% of patients.

Conclusion High admission GCS and age less than 50 remain better outcome predictor in 30 days survival for patients undergoing surgery of traumatic ASDH.

Keywords
- decompressive craniectomy
- acute subdural hematoma
- mortality

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Resumo

Objetivo Comparar a mortalidade em 30 dias de pacientes que sofreram hematoma subdural agudo em duas séries, uma tratada por aspiração do hematoma e outro por aspiração seguida de craniectomia descompressiva.

Métodos Comparar retrospectivamente duas séries de HSD com e sem CD. Envolveu 81 pacientes com TCE com hematoma subdural agudo e GCS $\leq$ 8 (Jan 2000 a Nov 2014) em dois grupos. Grupo 1–58 casos tratados submetidos a CD. Grupo 2–23 pacientes submetidos a drenagem do hematoma somente.

Resultados Grupo 1 apresentou 44,8% de mortalidade diretamente devido a lesão cerebral dentro de 30 dias. A mais comum lesão associada era contusão em 37,2%. Grupo 2 a mortalidade dentro de 30 dias foi 47,8%. A maioria dos óbitos (82) resultou de edema cerebral incontrolável, desvio de linha média estava presente em 94,7% dos pacientes.

Conclusão Alto GCS de admissão e idade menor que 50 anos permanecem melhores preditores de desfecho na mortalidade em 30 dias para paciente submetidas a cirurgia de hematoma subdural agudo.

Palavras-chave
- craniectomia descompressiva
- hematoma subdural agudo
- mortalidade

Introduction

Despite current advances, the mortality rate by severe traumatic brain injury (TBI) is still $\sim$ 30% after six months without reasonable improvement of morbidity. Aggressive measures have been advised for controlling those bias, like bilateral decompressive craniectomy, wherein decompressive hemicraniectomy is the most popular procedure in the database about TBI.[1–3]

An increasing number of reports on the prognosis for TBI after decompressive craniectomy have been published, focusing on several intracranial lesion long-term outcomes. The most important mass injury in TBIs is subdural hematoma, generally accompanied by ipsilateral swelling, midline shift and thickness of hematoma. The indication of hematoma drainage with or without decompressive craniectomy (DC) is a challenge that has not yet been definitively established.[4–6]

The enthusiasm for DC has been motivated by the results of a recent multicenter prospective randomized trial of early decompressive craniectomy in patients with severe traumatic brain injury (DECRA) study, which showed a more unfavorable outcome following DC. The results cannot be extrapolated to patients with focal or mass lesions. Decompressive Craniectomy should not be considered a risk-free procedure due to complication rates of up to 50%. In this article, we report a comparative 30-day mortality of patients harboring acute subdural hematomas (ASHs) in two series, one treated only by wide aspiration of the hematoma, and the other with aspiration followed by DC.[6–12]

Material and Methods

The study involved 81 TBI patients with ASHs who were admitted to Hospital Santa Isabel between January 2000 and November 2014. All patients were assessed according to age, gender, Glasgow Coma Scale (GCS) score at admission, associated systemic injury (hypoxia and hypotension), pupillary reactivity, midline shift; associated intracranial injuries; and timing for DC and Glasgow Outcome Scale (GOS) score.

The patients were divided into two groups. Group 1 consisted of 58 cases treated between January 2007 and November 2014 with DC, and group 2 consisted of 23 patients treated between January 2000 and December 2006 who underwent only hematoma aspiration by a wide craniotomy followed by eventual dural expansion and reposition of bone. The patient selection criteria for the study were presence of subdural hematoma, and a GCS score of 8 or below, regarded as "severe head injury," evaluated after the primary resuscitation at the emergency service.

Comparisons between both groups were made using the Chi-square test. Differences were considered significant when $p < 0.05$.

Results

Group 1 involved 58 patients, with a mean age of 40.9 (13–77 years.); 81% of them were male. A total of 82.6% of these patients presented at admission a midline shift of more than 5 mm. Mortality directly due to brain lesion within 30 days was 44.8% (26 cases). Three patients died of lung infection after 30 days. Fourteen patients had 2 reacting pupils just before the craniotomy (24.1%). Anisocoria with only 1 reacting pupil was found in 33 cases (56.8%), and both pupils were not reacting in 11 patients (18.9%). A computed tomography CT scan showed that the most frequent associated lesions were contusion (37.2%), brain swelling (17.6%) and multiple lesion (7.8%); however, 33,3% showed no associated injury.

Group 2 comprised 23 patients, 19 male and 4 female, with a mean age of 44 years (16–74 years). A pupillary examination identified 5 patients with 2 reacting pupils, 16 with 1 reacting pupil, and 2 with 2 non-reacting pupils. Before craniotomy, the mean GCS score was 5. Every patient underwent emergency wide craniotomy within 24 hours, with aspiration of the ASH and cortical veins hemostasis,

without DC. A preoperative CT scan found a contusion-associated hemorrhage in 40.9%, epidural hemorrhage in 9%, and brain swelling in 18.1% of patients. The mortality within 30 days was 47.8% (11 patients). The majority of deaths (82%) resulted from uncontrollable brain swelling and high increased intracranial pressure (ICP), which occurred in 1 patient with 2 reactive pupils, in 2 patients with 2 non-reacting pupils, and in the other 8 patients with only 1 reacting pupil. Midline shift was present in 94.7% of the samples, of which 15 patients presented associated cerebral lesions, causing 10 deaths, mainly due to high intracranial pressure caused by swelling and contusion (►**Table 1**).

Discussion

Decompressive craniectomy has been performed since the early 19th century by neurosurgeons. Different types of bone decompression have been attempted with variations in the location and size of bone removal, depending on the cause of the ICP.[13–15]

Ransohoff and Benjamin, in 1971, gave an account of their experience with the management of an ASH demanding surgery for the preservation of life within the first 24 hours after injury. They mentioned a very high mortality for this type of head injury, which, in their own department, had previously reached 75%. Very few patients were restored to normal life. Death had resulted from brain-stem compression, torsion, and secondary hemorrhage, but, at necropsy, few had shown what had been regarded as primary brain-stem lesions.[5,13,16]

The main question is: does every patient need decompressive craniectomy? Can we accurately predict who will need it? Decompressive craniectomy is not a procedure free of major complications, which include subdural effusions, hydrocephalus and syndrome of the trephined.[11,17–21]

Surgical evacuation by craniotomy is often considered in patients with an ASH thicker than 5 mm (as measured with an axial CT scan), who exhibit neurologic signs such as lethargy, change in mental status, or a focal neurologic deficit. Bullock et al reported that "an acute subdural hematoma with a thickness greater than 10 mm, or a midline shift greater than 5 mm on CT scan, should be surgically evacuated, regardless of the patient's Glasgow Coma Scale (GCS) score."[6,9,18]

Ongoing clinical trials on the use of decompressive craniectomy after TBI may clarify many aspects of the clinical application of this technique. However, some important pathophysiological issues, that is, the timing of DC, its effect on brain edema formation, and the role of secondary brain damage must be taken into consideration.[8,22–24]

Comparing with other studies, the prevalence of sex and mean age remains the same, as well as the etiology of trauma. The presence of a non-reacting pupillary abnormality was prevalent in both groups what makes similar groups on admission in relation to severity.[2,3,10,25]

Unilateral fronto-temporo-parietal hemicraniectomy was performed in 55 patients of Group 1 within 24 hours after the head trauma, and 3 patients were treated with delayed surgery. Two of them died, one from swelling and one from lung infection after a long time of hospitalization (27 days).

Taylor et al[8] concluded that in children treated with a combination of very early DC (within 24 hours) and conventional medical management, it is more likely that ICP will be reduced, and fewer episodes of intracranial hypertension will occur, causing a better functional outcome and quality of life than the conventional management alone ($p = 0.046$).[8] Similar results were achieved by Akyuz,[2] who performed an early bilateral DC, as soon as possible, and obtained a decreased mortality rate and an improved favorable outcome.[26–29]

Primary DC is usually performed during the evacuation of an ASH, either because the brain is swollen, or because of the high risk of worsening of the brain swelling during the postoperative period. In a study conducted by Hartings et al[30], ASH represents the most frequently operated type of mass lesion in the acute phase of TBI; an ASH was evacuated in 26 (87%) out of 30 patients undergoing surgery for early evacuation of a mass lesion.[31–33]

Table 1 Baseline characteristics of 81 patients with acute subdural hematoma

Parameter	Group 1*($N = 58$)	Group 2*($N = 23$)
Sex		
Male	81 (47)	82 (19)
Female	19 (11)	17 (4)
	Mean age	
Age	40.9 (13–77)	44 (16–74)
Glasgow Coma Scale score at admission		
3–5	41 (24)	54.5 (12)
6–8	55 (32)	45.5 (10)
Mechanism of head injury		
Traffic accident	55 (32)	
Fall accident	39 (23)	
Others	3.4 (2)	
Pupil reactivity		
Both reacting	24 (14)	21 (5)
1 reacting	56 (33)	69 (16)
Both non-reacting	18 (11)	8 (2)
Glasgow Outcome Scale score within 30 days		
1	44.8 (26)	48 (11)
2	3.4 (2)	9.5 (2)
3	18.9 (11)	4.7 (1)
4	25 (15)	19 (4)
5	6.8 (4)	19 (4)
Midline shift		
$>$ 5 mm	82.6 (49)	94.7 (18)
$<$ 5 mm	17.4 (9)	5.2 (1)
Cause of mortality		
Brain swelling	100 (26)	82 (9)
Total	**100**	**100**

Note: *Values are the number of patients expressed in percentages.

In the present study, we could not find statistically significant differences in the mortality of both groups by Mann-Whitney test ($p = 0.966$). If the Glasgow Outcome Scale is included as comparative variable remains without statistical difference in 30 day analysis ($p = 0.615$). Extensive brain damage associated with an ASH is the main cause of death, like the contusion and swelling associated in 54.8% of cases. Even though mortality is similar in both groups, we need to seek harmonic clinical and surgical managements.

As evidenced by an IMPACT study, the prognosis in patients with mass lesions was better for patients with an epidural hematoma against the poor prognosis with an ASH, or partial obliteration of the basal cisterns or midline shift (> 5 mm).[7] Who makes the decisions about the approach in relation to this mass lesion (ASDH) a hard task to be choose in the early hours of admission.

The mortality of patients younger than 50 years was 38%, while for those older than 50 was 57%. Moreover, the GCS score at admission presented an important relationship with mortality. A GCS score lower than 6 was associated with 67% mortality, while 7 and 8 caused a 25% death rate. As shown by Akyuz et al, the age and GCS score are major factors influencing DC effectiveness. It is generally assumed that the outcome of patients younger than 50 years or with an initial GCS score of 6 or more is significantly better than that of older patients or those with an initial GCS score lower than 6.[2,25,26]

Ischemic brain damage affects outcome morbidity adversely, and the difficulty in preventing ischemic damage in cases with marked brain shift leads to poor outcomes in patients with ASHs.[16,22,23]

This study has several potential limitations. It was a retrospective review of preexisting data, and it suffers from the inherent limitations of such studies. Specifically, data collection through chart and imaging reviews is less complete and accurate than in a prospective study.

Conclusion

It is already known that urgent craniectomy with evacuation of the hematoma decreased mortality from 75% to 30% on severe TBI, but in ASH the mortality is still high. The evidence for the benefit of decompressive craniectomy was studied by comparing retrospectively two series of ASH, with and without DC. Based on our results, no apparent benefit could be attributed to DC in diminishing 30-day mortality. Therefore, a high GCS score at admission and age lower than 50 remain better outcome predictors for 30-day survival for patients undergoing surgery for a traumatic ASH.

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