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POST-TRAUMATIC TEMPORAL LOBE LESIONS

Surgical decision making based on CT scan findings

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ABSTRACT - *Background:* The indication for surgical treatment of post-traumatic parenchymal lesions in the temporal lobe remains controversial. *Objective:* We reviewd the tomographic parameters that might be useful in making surgical decisions. *Method:* The tomographic findings of 69 patients were analyzed in a retrospective manner considering: 1) the effects of the lesion (classified into 4 variables: midline shift, status of the cisterns, status of the ventricles, and status of the peripheral sulci); and 2) the characteristics of the lesion: anterior, posterior or anteroposterior location (as defined by a coronal plane tangent to the cerebral peduncles) and its mediolateral diameter. *Results:* When none or only one of the aforementioned variables was found to be altered, conservative treatment was instituted (22 out of 38 lesions). In two cases, all four variables were altered, and surgery was performed in both. Anterior, anteroposterior and posterior lesions measuring 21, 23 and 28 mm in diameter, respectively, had a 50% chance of surgical removal. *Conclusion:* Amongst the patients who underwent surgical intervention, the more anterior the location of the temporal lobe lesion, the smaller the diameter.

KEY WORDS: Brain injury, computerized tomography, head injury, temporal lobe.

Lesões traumáticas do lobo temporal: indicações cirúrgicas baseadas na tomografia computadorizada

RESUMO - *Introdução:* A indicação do tratamento cirúrgico das lesões parenquimatosas temporais de origem traumática é controversa. Analisaram-se os parâmetros tomográficos que poderiam ser úteis nesta decisão terapêutica. *Método:* Os achados tomográficos de 69 patientes foram analisados retrospectivamente em relação a: 1) efeitos das lesões (classificados em 4 variáveis: desvio de estruturas medianas, estado das cisternas, dos ventrículos e dos sulcos periféricos); e 2) características das lesões: localização anterior, posterior ou ântero-posterior (definida por um plano coronal tangente aos pedúnculos cerebrais) e diâmetro médio-lateral. *Resultados:* Quando nenhuma ou uma das variáveis acima mencionadas foi encontrada alterada, foi instituído o tratamento conservador (22 em 38 lesões). Em dois casos, as quatro variáveis estavam alteradas, sendo instituído o tratamento cirúrgico. Lesões anteriores, ântero-posteriores e posteriores medindo 21, 23 e 28 mm, respectivamente, tiveram 50% de chance de serem removidas. *Conclusão:* Nos casos operados, quanto mais anterior a lesão esteve no lobo temporal, menor foi seu diâmetro.

PALAVRAS-CHAVE: traumatismo crânio-encefálico, tomografia computadorizada, lobo temporal.

Temporal lobe lesions of traumatic origin (contusions, lacerations, hematomas) present a special clinical picture, considering the possibility of rapid and sometimes fatal neurological deterioration[1-5]. In these cases, therefore, the decision on whether or not to operate represents a common challenge to neurosurgeons.

Because of the variety of lesions that can be associated with craniocerebral trauma, the clinical presentation cannot always be attributed to any one lesion, and the state of consciousness cannot be used as the sole parameter for surgical decision. Thus, other variables must be considered when deciding the therapy to be instituted. Lesions in the temporal lobe can cause early brainstem compression, even before intracranial pressure (ICP) rises. For this reason, ICP monitoring is not a useful criterion for therapy. Thus, computerized tomographic (CT) scan findings become the most important parameters.

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The purpose of this study was to determine the tomographic parameters to be used when considering surgical management of post-traumatic parenchymal lesions located in the temporal lobe.

METHOD

All patients with head injury who were admitted to Hospital João XXIII of Belo Horizonte, Brazil, in the period between September 1, 1994 and November 30, 1995 were analyzed with regards to: 1) presence of temporal lobe lesion on CT scan; 2) craniocerebral trauma of any nature, excluding gunshot wounds to the head; 3) interval between injury and the first CT scan performed within 24 hours. In some cases, it was not possible to determine the exact time of the accident, since the patients had been found down at home or on the streets, without further information being available. The authors only made sure that the accident had occurred within the last 24 hours, and the cases in which such determination was not possible were excluded.

Based on these parameters, 69 patients were selected and had a protocol filled out.

The patients were followed during one month, since only the acute phase of these lesions was to be evaluated.

The clinical complications and the associated lesions were noted.

Ideally, in order to evaluate which patient needs surgery, it is better to follow the lesion's natural course. However, this strategy is not ethical. For this reason, the authors decided to leave neurosurgeons and physicians involved in the management of the different cases to make their decisions based on their own judgements (clinical and or tomographic). The date of the surgical intervention, intraoperative findings and measurements were obtained from each surgeon's notes. The surgical complications and eventual re-interventions were recorded.

The CT scans were performed using CE 10.000 and CE 12.000 CGR units with a 256 x 256 or 512 x 512 matrix, with 10 mm thick axial slices. The CT scanning sequence was as follows: the first scan was performed on admission, the second one at 12 to 20 hours, and the third one at 21 to 36 hours after admission. The fourth and fifth examinations were performed at 6 or 7 days and at 30 days, respectively. Patients who were admitted after hour 12 and those who were operated upon on the day of admission not always had all three initial CT scans. Patients were scanned again on the day following surgery. Some patients had a very unstable clinical condition, for which reason the risk posed by transport to the radiology sector exceeded the benefits of scanning. In these circumstances, not all planned CT scans could be done. Whenever warranted by a medical situation (neurological deterioration for example), CT scans were performed outside the scheduled hours/days.

All CT scans were analyzed by the same observer. The measurements were taken using a caliper and then converted using the scale of each photograph. The unit was recorded in millimeters. Measurements were taken of the largest diameter of the hyperdense component of the lesions, along its anteroposterior and mediolateral axes. The craniocaudal diameter was not recorded, due to the risk of partial volume effect in the upper and lower slices containing each lesion. The volumes of the lesions were not measured either, in view of the wide variation in their morphology and continuity. The displacement of midline structures (septum pellucidum, third ventricle, and pineal body) was measured and recorded in millimeters. The basal (pentagonal and ambient) cisterns were considered present when they showed normal morphologic characteristics; absent, when they were totally occupied by cerebral tissue; and compressed when in an intermediate situation. When the tomographic slice did not allow a precise evaluation of the cisterns, these were recorded as not visualized. The peripheral sulci were considered normal, globally widened, or ipsilaterally or diffusely effaced. The ventricles were considered normal, uni- or bilaterally small, or with contralateral hydrocephalus. The presence of associated lesions was noted, as well as their location, whether homolateral or contralateral. In the case of extra-axial hematomas, the largest thickness was measured. Hypodense images were interpreted as associated edema and necrosis. Petechial, intraventricular or subarachnoid hemorrhages, intracranial air, and fractures were noted.

The dimensions of the hyperdense component were compared on the CT scans performed within the first 36 hours. The CT scan that showed the largest diameter was used for the analysis.

The clinical and tomographic evolution, as well as the need for surgical drainage were compared.

In order to establish the tomographic parameters that would be important for surgical decision making in the temporal lobe lesions, the variables were, retrospetively, evaluated and divided in two categories: 1) Position of the midline structures and status of the cerebrospinal fluid (CSF)-filled spaces and 2) Position and mediolateral diameter of the hemorrhagic component.

Position of the midline structures and status of the CSF-filled spaces – Four variables were considered significant: 1) shifts in the septum pellucidum, third ventricle and/or pineal body equal to or greater than 5 mm; 2) compressed or collapsed pentagonal and/or ambient cisterns; 3) ipsilaterally or diffusely effaced peripheral sulci; 4) uni - or bilaterally reduced lateral ventricles.

Midline shift and alteration of the CSF-filled spaces are known to be influenced by the presence of other intracranial lesions associated with those in the temporal lobe. Thus, only 36 patients (harboring 38 lesions) were placed in a category in which the other intracranial

alterations were of little importance (small contusions, laminar hematomas, small intraventricular or subarachnoid hemorrhages, intracranial air or diffuse axonal injury).

Position and mediolateral diameter of the hemorrhagic component – With regards to location, the lesions in the temporal lobe were categorized as anterior or posterior if located anteriorly or posteriorly to a coronal plane tangent to the cerebral peduncles. In order to evaluate the tomographic features of the hemorrhage as a criterion for surgical treatment, the examinations of 69 patients harboring a total of 75 lesions were analyzed.

In this study, emphasis was placed on the mediolateral diameter, since it follows the same direction as that in which displacement occurs. The anteroposterior and the superoinferior diameters were considered as being less important.

The results obtained were analyzed using the qui-square test, Fisher's exact test, and the logistic regression method.

RESULTS

Position of the midline structures and status of the CSF-filled spaces - Table 1 compares the state of consciousness, according to the Glasgow Coma scale, between the patients who underwent surgery and those who did not. In these 36 patients, a lesion in the temporal lobe was the principal CT scan abnormality. Other lesions, when present, were small. Among the operated patients, a moderate to severe clinical picture dominated (7/8). Sixty four percent of the patients in the group that received conservative treatment showed minor alterations of the state of consciousness.

Table 2 shows the number of altered variables and their relationship with the treatment instituted. It was observed that in the absence or presence of only one of such parameters, all cases were managed conservatively. When two or three of these variables were altered, there was no significant difference with respect to the final treatment. The two cases that showed alterations in all four parameters (the only cases with midline shifts greater than 5 mm) were sent to surgery.

Position and mediolateral diameter of the hemorrhagic component – Tables 3 to 5 refer to the 69 patients with a total of 75 CT scan abnormalities. These were categorized as anterior, posterior or anteroposterior lesions, in accordance with their location in the temporal lobe. The mediolateral diameter of each lesion was related to the treatment chosen.

Table 3 shows the 26 lesions located anteriorly.

Table 1. State of consciousness as related to treatment chosen.

G.C.S Surgery	3 - 8	9 - 12	13 - 15	Total
Yes	2	5	1	8
No	3	7	18	28
Total	5	12	19	36

G.C.S, Glasgow coma scale.

Table 2. Number of altered variables on CT scan as related to treatment chosen.

Variables Surgery	None	One	Two	Three	Four	Total
Yes	0	0	1	5	2	8
No	15	7	2	6	0	30
Total	15	7	3	11	2	38

Variables: 1) mideline shift greater than 5 mm; 2) compressed or collapsed cisterns; 3) affaced sulci; 4) reduced lateral ventricles.

Table 3. Correlation between the mediolateral diameter and the treatment of anterior lesions.

Diameter Surgery	< 19 mm	20-24 mm	25-29 mm	> 30 mm	Total
Yes	1	3	2	1	7
No	17	2	0	0	19
Total	18	5	2	1	26

Table 4. Correlation between the mediolateral diameter and the treatment of posterior lesions.

Diameter Surgery	< 19 mm	20-24 mm	25-29 mm	> 30 mm	Total
Yes	0	1	1	5	7
No	18	8	2	1	29
Total	18	9	3	6	36

Table 5. Correlation between the mediolateral diameter and the treatment of anteroposterior lesions.

Diameter Surgery	< 19 mm	20-24 mm	25-29 mm	> 30 mm	Total
Yes	1	0	1	6	8
No	3	2	0	0	5
Total	4	2	1	6	13

In one out of the 18 lesions measuring less than 19 mm in diameter, the treatment of choice was surgical. The presence of brain swelling and ipsilateral frontal contusion justified the intervention. Out of the five patients with lesions between 20 and 24 mm in diameter, two were treated conservatively and made a complete recovery. The other three underwent surgery. All three patients with lesions larger than 25 mm were treated with surgery.

Graph 1 shows the logistic regression curve for the correlation between the mediolateral diameter and the treatment of anterior lesions (p = 0.00003). It can be observed that a 21-mm lesion has a 50% chance of being operated on.

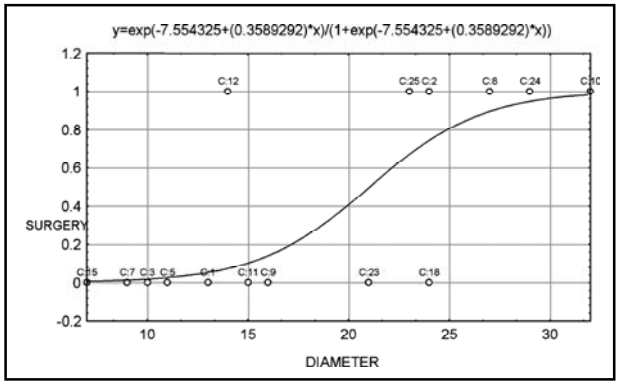
The lesions with a posterior location are shown in Table 4. One out of 27 patients with lesions measuring 24 mm or less (23.8 mm was the exact value) went to surgery. None of the patients who received conservative treatment died from complications due to the lobar lesion. Three patients had CT images between 25 and 29 mm in diameter and were treated in different ways. The only one who was operated on had a GCS score of 6 and died of pulmonary infection. The other two had GCS scores of 11 and 14 and made a good recovery. Six patients had lesions larger than 30 mm in diameter. Of these, the only one who was not operated on died before being taken to the operating room.

Graph 2 shows the logistic regression curve for the correlation between the mediolateral diameter and the treatment of posterior lesions (p = 0.00001). It can be noted that a lesion approximately 28 mm in diameter has a 50% chance of being operated on.

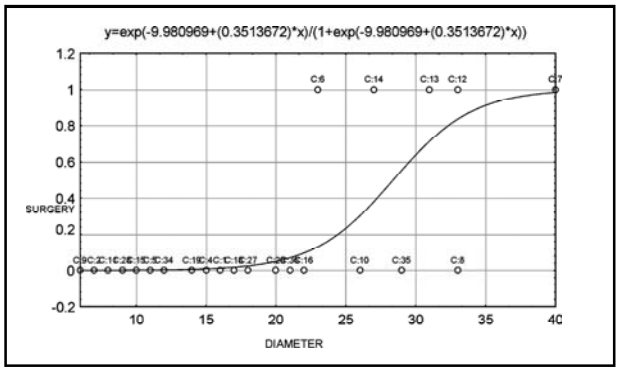
Thirteen lesions involved the anterior and posterior portions of the temporal lobe (Table 5). Out of six patients whose lesions measured 24 mm or less, only one was operated on because of a concomitant subdural hematoma. The seven patients with lesions measuring 25 mm and over were treated with surgery.

Graph 3 shows the logistic regression curve for the correlation between the mediolateral diameter and the treatment of anteroposterior lesions (p = 0.00157). It can be seen that a lesion measuring 23 mm had a 50% chance of going to surgery.

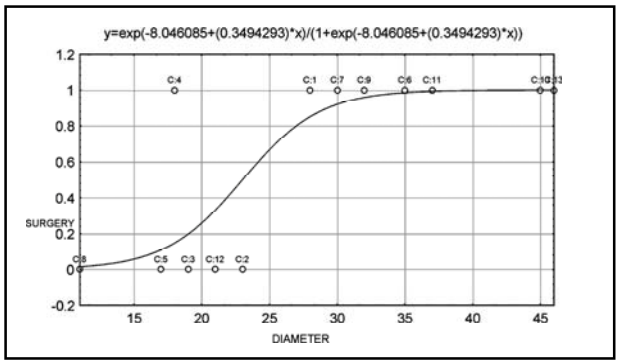
Rate of mortality in traumatic lesions in the temporal lobe – Seven patients did not return after one month. Therefore, 62 patients were analyzed for outcome. Of these, 19 (32.2%) died. Nine were operated on and 10 received conservative treatment. Thus, the rate of mortality among the patients who were operated on was 50%, and among those who were managed conservatively, 22.7%.



Graph 1. Logistic regression for correlation between the mediolateral diameter and the treatment of anterior lesions.



Graph 2. Logistic regression for correlation between the mediolateral diameter and the treatment of posterior lesions.



Graph 3. Logistic regression for correlation between the mediolateral diameter and the treatment of anteroposterior lesions.

DISCUSSION

Position of the midline structures and status of the CSF-filled spaces

Shift of midline structures – According to Ropper[6], an acute supratentorial expanding lesion will

cause stupor if horizontal shift of the pineal body is greater than 6 mm or if there is a shift of the septum pellucidum greater than 10 mm. Gailbraith and Teasdale[7] detected no difference in midline shift between the patients who were operated on and those who received conservative treatment. Sadhu et al.[8] and Tabaddor et al.[9] found no correlation between midline shift and ICP status. On the other hand, Marshall et al.[10] observed that a midline shift greater than 15 mm heralds a subsequent deterioration of the neurologic condition, even if the patient is clinically well. Eisenberg et al.[11] found that the greater the shift of the septum pellucidum, the higher the risk of death.

These analyses based on CT scanning, however, are not specific for temporal lobe lesions. In this series, only two of the 36 patients with isolated lesions in the temporal lobe had midline shifts greater than 5 mm. Both underwent surgery. On the other hand, six patients showing small or no midline shift were subjected to surgical treatment. Thus, this variable alone apparently did not seem useful as a criterion for the surgical decision.

Status of the suprasellar and ambient cisterns – During herniation of the uncus and parahippocampal gyrus, the suprasellar cistern is initially occupied, followed by collapse of the ambient cistern[12,13]. Based on this information, some authors have attempted to establish a prognostic method in patients with craniocerebral trauma. In the studies of Van Dongen et al.[14] and Toutant et al.[15], collapse of the basal cisterns was associated with a worse prognosis, particularly in the patients with a more severe neurological condition. According to Eisenberg et al.[11], the risk of death was three times greater in patients with collapsed cisterns than in those with normal cisterns. These authors also observed that abnormal mesencephalic cisterns were associated with higher ICP. However, Sadhu et al.[8] found no correlation between obliteration of the cisterns and ICP.

In this study, only one out of the eight patients who were operated on had patent cisterns. On the other hand, in seven out of the 30 lesions treated conservatively, the cisterns were compressed. Therefore, the status of the cisterns did not appear to be a good parameter on which to base the surgical decision.

Status of the peripheral sulci – In their study, Sadhu et al.[8] found no correlation between the status of the peripheral sulci and ICP. In this series, all patients who were operated on had effaced sulci, at least on the side of the lesion. On the other hand, such abnormality was seen in 12 out of the 30 lesions that did not go for surgery. Therefore, the status of the peripheral sulci alone was not considered a reliable indication for surgery.

Status of the lateral ventricles – Tabaddor et al.[9] reported the abnormally small size of the ventricles as being associated with ICP elevation. However, Eisenberg et al.[11] did not obtain the same result. Sadhu et al.[8], on the other hand, observed that dilatation of the inferior horn contralateral to an expanding lesion correlated with an average ICP above 30 mmHg.

In this study, all patients who were operated on had small ventricles. However, nine of the 30 cases that were treated conservatively also had reduced ventricles. Thus, this parameter did not seem to be a useful criterion for surgical treatment, either.

When all four variables were analyzed together, treatment of the patients in our series was conservative in all cases in which no abnormalities were present or only one variable was altered. However, when all variables were altered, surgery was always indicated. In those cases in which two or three variables were altered, the types of treatment were evenly divided between surgery and conservative management.

Position and mediolateral diameter of the hemorrhagic component – A review of the literature showed a wide variation in the measurement of intraparenchymal lesions. Tabaddor et al.[9] classified these lesions as being of grade 1 if less than 5 mm, of grade 2 if between 5 and 10 mm, of grade 3 if between 10 and 20 mm, and of grade 4 if larger than 20 mm in diameter. Fukamachi et al.[20,21] defined these lesions as small when between 1 and 3 cm, of average size when between 3 and 5 cm, and as large when over 5 cm in diameter. To Soloniuk et al.[22], hematomas were lesions greater than 2 cm in diameter. Yamaki et al.[23] thought that only intracerebral hematomas larger than 3 cm in diameter were of clinical significance, whereas Baratham and Dennyson.[24] considered as important only lesions larger than 4 cm. D'Avella et al.[25] reached the consensus that surgery should be recommended for all patients with intracerebellar clots larger than 3 cm. Eisenberg et al.[11], in their multicentric study, preferred to measure the volume of the lesions, and considered as significant only those larger than 15 ml.

While on one hand, there are discrepancies in the classification of lesions with regards to size, on the other hand the utilization of such parameter as a criterion for surgical treatment is even more difficult. McLaurin and McBride17 treated surgically the lesions between 10 and 75 ml in volume. For the lesions in the temporoparietal region, Aldrich.[26] recommended drainage if their volume was 20 ml, whereas Andrews et al.[27] suggested that such procedure should be considered for lesions above 30 ml.

When the size of the lesion was related to the t reatment chosen, a tendency toward surgical management of smaller lesions in the anterior region, as compared with the posterior region, was observed. The notch of the tentorium cerebelli is more closed and has an oblique curvature in its posterior portion, whereas in its anterior region it is more open and horizontal[12,28]. It is possible that these anatomic characteristics offer a greater obstacle to herniation of the parahippocampal gyrus in its posterior portion, hence the greater tolerance in the diameter of the lesions located in that region.

In conclusion, based on the cases evaluated in this series, some guidelines can apparently be stated: (1) isolatedly, shift of the midline structures and the status of the basal cisterns, peripheral sulci or ventricles are not useful as management criteria; (2) when shift or compression of the CSF-filled spaces is mild or absent, all patients can be safelly treated conservatively; (3) anterior, anteroposterior and posterior lesions measuring, respectively, 21, 23 and 28 mm or greather in diameter should be operated, specially, if two or more paramethers evaluating the position of the midline structures and the status of the CSF-filled spaces are alterated.

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