Therapeutical - imagistic correlation regarding intracerebellar hematomas

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Abstract

Intracerebellar hematomas are single or multiple hematic collections localized on the cerebellar parenchyma, with an evolution similar to an intracranial expansive process.

If clinical examination opens the way to diagnose, the imagistics not only that can lead to an accurate diagnose in almost every case, but it also dictates the therapeutic strategy.Thus, our study is focused on establishing a link between imagistics and clinical presentation at the moment of patient's admission to hospital, patients with intracerebellar hematomas.

Our study comprised a number of 57 patients, with an age ranging from 32 to 82 years, all of them admitted either to neurology or neurosurgery sections of Clinic Emergency Hospital, "N. Oblu", Iasi, over a perioad of 7 years, it was retrospective, descriptive and longitudinal based on a selection of medical data taken from the medical history of the patients diagnosed with intracerebral hematoma. During our study the following aspects were taken into consideration: computed - tomograph imagistic aspects - hematoma's dimension, localization and associated complication -, cerebellar hematoma's treatment and progress, as well as patient's clinical presentation at the moment of admission, age, gender.

Keywords: intracerebellar hematoma, cerebellum stroke, posterior fossa syndrome, intraventricular hemorrhage, computed tomography, magnetic resonance imaging.

Introduction

Intracerebellar hematomas are single or multiple hematic collections localized on the cerebellar parenchyma, with an evolution similar to an intracranial expansive process.

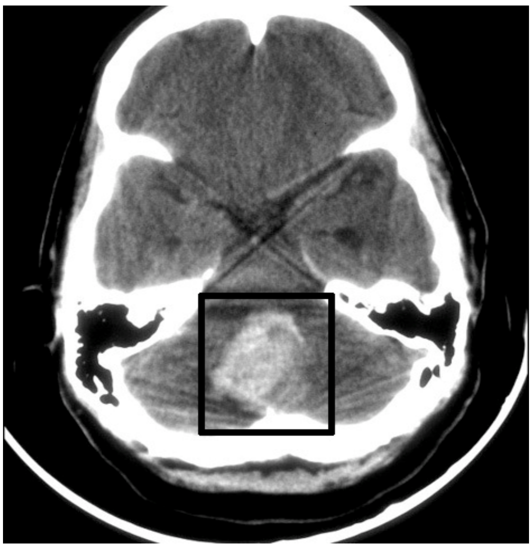

Figure 1 Intracerebellar hematoma – CT screening

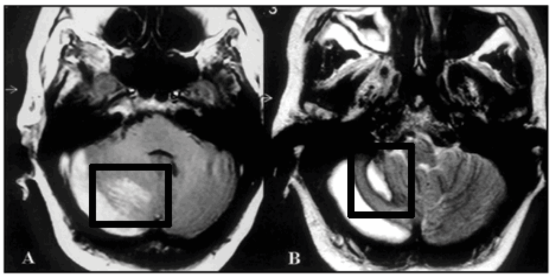

Figure 2 Intracerebellar hematoma – MRI screening

If clinical examination opens the way to diagnose, the imagistics not only that can lead to an accurate diagnose in almost every case, but it also dictates the therapeutic strategy.

Thus, our study is focused on establishing a link between imagistics and therapeutical behavior, within the context of clinical presentation at the moment of patient's admission to hospital, for patients with intracerebellar hematomas. Therapeutic indication represents a crucial moment in-between pain and healing, which in most of the cases will be a curative one, either through medical (the conservator approach), or surgical methods. Experience, along with results brought together in time, can lead to the expected results, in the absence of contingent complications. There are also anticipating factors that can adjust the therapeutic attitude towards one of those two treatment methods: medical or surgical.

Nowadays, we can't talk about achievements in intracerebellar hematomas field without efficient imagistic exploration methods (CT and MRI).

The following methods are used for intracerebellar hematomas imagistic diagnosis:

a) computed tomography;

b) magnetic resonance imaging;

c) angiography (only for certain cases).

A – Computed tomography (CT)

Axial computed tomography represents the elected diagnosis method for cerebellar hemorrhages, providing the possibility to discover them during the very first hours after admission.

The possibility to diagnose cerebellar hemorrhages in such a short time from the onset, has also changed the therapeutic attitude. Most authors agreed that a cerebellar hemorrhage promptly diagnosed can be cured using neurosurgical methods, especially because the results of surgical methods are far superior to those based on medical treatment.

CT screening highlightens:

1. The presence of a hyperdense mass on posterior fossa;

2. hematoma's localization on posterior cerebral fossa (medial - lateral hemispheric line);

3. Signs of cerebral stem, forth ventricle and quadrigeminal cistern compression;

4. Obstructive hydrocephaly.

Using CT screening, without any contrast substance, makes possible for the cerebellar hematomas diagnose to be established from the very beginning, even if their size is smaller than 2.5 cm. The presence of bloody effusion on cerebellar parenchyma can be explained by the presence of a spontaneous hyperdense mass (80-90 H.u.), which becomes visible right after the hemorrhagic accident occurrence. This is due to a high attenuation coefficient of protein (globulin) contained by the the hemoglobulin molecule, while the quantity of iron contributes to the total attenuation only in a 7-8%, calcium adding no contribution to the obtained density value.

There is a linear relation between the attenuation and patient's hemocrit at the moment of vascular accident occurrence.

In the first 24 hours, hemorrhage gets to a maximum attenuation level, while the clot formation and retraction takes place. In this stage the examination of the injury after injecting the intravenous contrast substance is unnecessary.

Hematoma revile itself as a well-defined, rounded or oval shaped, on the axial section, in very rare cases with an undetermined line, which shows us that in those situations the intraparenchymatous hematomas have a disected shape.

During the next hours after hematoma's onset, independently of the hemorrhage's causes at cerebellar tissue level a vasogenic edema will edge the injury area, complicating the mass effect on cerebellar and nearby structures, with a climax in the forth or fifth days, which will impose a surgical operation. Sometimes, when the hemorrhagic injury occur near ventricular cavity, mostly the forth ventricle, the images taken show a intraventricular bloody mass, with a variable volume. Ventricular flood can complicate the medical prognosis, as well as a mass effect characterized by a violent onset can lead to severe neurological complications. During the subacute phase, lasting from the end of the first week up until the end of a first month since hemorrhagic accident onset, repeated CT screening shows a continuous clot dissemination; density value, due to a progressive lysis, with a centripetal appearance, influencing clot's dissemination in size and density, along with an intensive drop of vasogenic edema, but in a lesser net limits. Introducing contrast substance will determine the presence of an annular contrast mesh, secondary to hematoencephalic barrier bursting.

During schelar stage or chronic phase an atrofic process bearing a cavitary – cavity encephalomalacia character can be observed – with a density similar to cephalorachidian liquid, which leads to abutting cortical channel enlargement and adjacent ventricular cavity dilatation.

Using intravenous contrast is necessary when a neoplasm, artherovenous malformation, aneurism is suspected to be responsible for hemorrhage occurrence.

The following criterion highlighted through CT screening are aimed for hydrocephaly diagnose:

˜ temporal horns (T.H.) are larger than 2 mm, so that sylvian fissure along with interhemispheric fissure and cerebral channels are not visible anymore;

˜ temporal horns size is equal to or larger than 2 mm, and F.H./I.D. account is higher than 0.5, where F.H. stands for the range of lateral ventricular frontal horn, and I.D. stands for the internal diameter from one panel to another, and at the same level.

More features:

˜ lateral ventricular ballooning;

˜ transependymal resorption (periventricular hypodensity);

˜ when the F.H./I.D. X 100% situates:

a) under 40% - normal;

b) between 40-50% - at the edge;

c) over 50% - hydrocephaly.

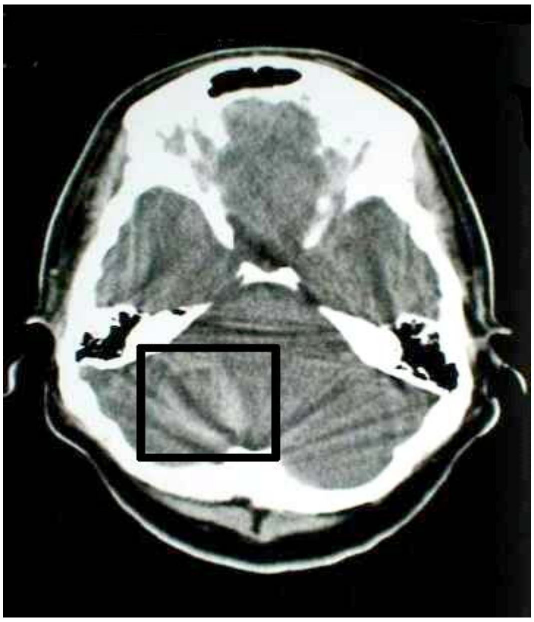

Figure 3 CT native screening – Posterior fossa hyperdense blood accumulation with compressive effect on the forth ventricle

Figure 4 CT native screening (axial/sagittal) – hydrocephaly aspect

B – Magnetic resonance (M.R.I.)

The well-known sensitivity of a M.R.I along with paramagnetic effect of hemoglobin degradation products are the perfect tool for establishing the hemorrhagic accident's age and etiology.

In physiologic conditions most of blood cells which form the hematoma have an initial content of oxygenated hemoglobin, coming from artery circulation. Iron is characterized by ferrous state (+2), while two oxygen molecules occupy these electrons, and so oxyhemoglobina becomes slightly hypointense compared to the white substance.

T1 and T2 signals depend on serum water concentration from the collected blood.

During the next hours after vascular accident occurred the process of deoxyhemoglobinization takes place due to hemoglobin desaturation. This process is facilitated by accumulation of some metabolic products in the bloody collection, as follows:

˜ lactic acid;
˜ carbon dioxide;
˜ hydrogen ions.

4 electrons become unsaturated due to oxygen dissociation, which transforms the compound into a paramagnetic one.

Deoxyhemoglin becomes isointense with a tendency towards hypointense compared to parenchyma at T1, and obviously balanced at T2. Deoxyhemoglobin oxidation process starts with day 3-5 after hemorrhagic accident occurrence.

The iron atom becomes converted from ferrous state (four unpaired electrons) to ferric state (five unpaired electrons).

Other changes occur in hemoglobin, which allows water protons to get close enough to unpaired electrons significantly reducing the relaxation time in T1 and T2.

The methemoglobin formation process is ireversible, and S1 occurs within 3 weeks time.

In practice, there can be seen a hyperintense signal in T1, while balanced images show a hypointense signal in T2. While degradation process follows its way, ferric ions are released, encouraging the process of hemosiderin and feritin formation.

Hemosiderin is an unsolvable protein contained by lysozyme and reactive macrophage. Feritin is a solvable protein, more visible in glial or macrophage cells, which is why T2 registers a significantly drop in signal intensity.

Vasogenic edema surrounding the hemorrhage reaches its maximum size and intensity during the fourth or the fifth day, with a progressive dropping over the next 3-4 weeks. Balanced images show a hypersignal in T2, while in T1 there can be evidentiated a hypo- intermediate signal.

C-Angiography

Vertebral angiography is recommended when there is a suspicion of arteriovenous malformation or a torn aneurysm.

Treatment principles in intracerebellar hematomas

The neuroimagistics development allowed for the reevaluation of intracerebellar hematomas, due to diagnosis possibilities and monitoring of patients with large hematomas but minimal simptomatology.

The initial therapeutic behavior aims at maintaining the vital signs as well as establishing the cerebral suffering degree through the estimation of consciousness and focal neurological signs, followed by providing the necessary cerebral oxygenation with the indication of orotracheal intubation and assisted ventilation in patients presenting the absence of consciousness and signs of cerebral trunck lesion.

A – Medical treatment

B - Surgical treatment

A – Medical treatment

Establishing a certain treatment option is based on 4 randomized studies focused on the efficiency of steroids, hemodilution and gligerol versus placebo treatment in intracerebral hemorrhages. None of these 4 studies revealed any efficiency regarding medical treatment in intracerebral hemorrhages.

Increased blood pressure treatment

Studies have shown that the average blood pressure must be maintained at 130 mmHg in patients known to be hypertensive.

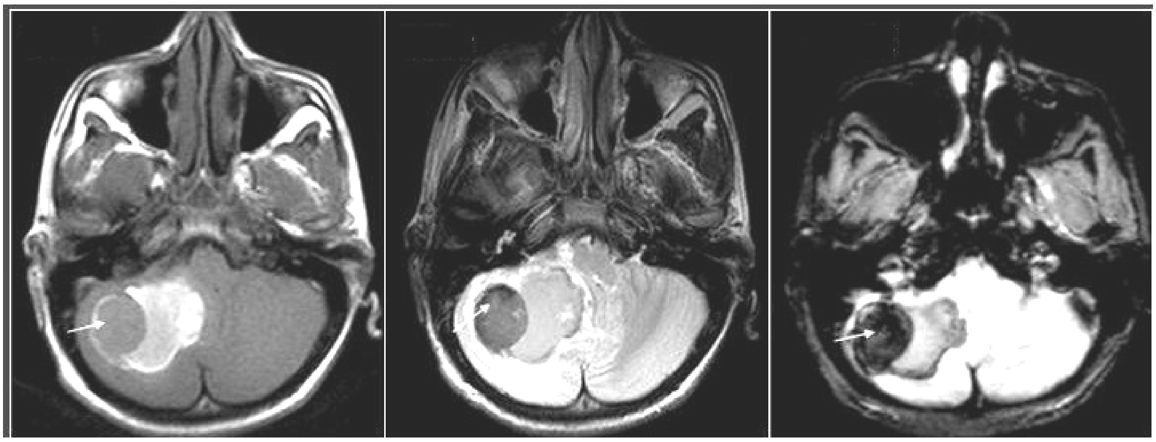

Figure 5 MRI exam – Intracerebellar hematoma evolution from subacute to chronic stage. Hematoma has a subacute consituent (medial) and a chronic constituent (pointer/lateral), with the chronic constituent both hypo-intense T1, and T2

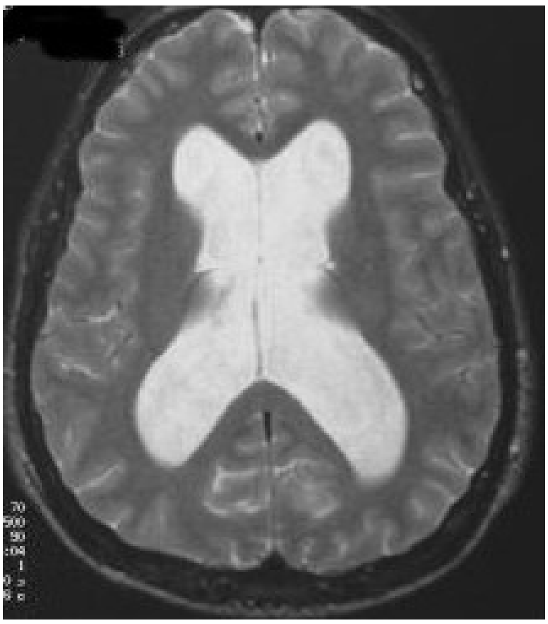

Figure 6 MRI exam – hydrocephaly appearance

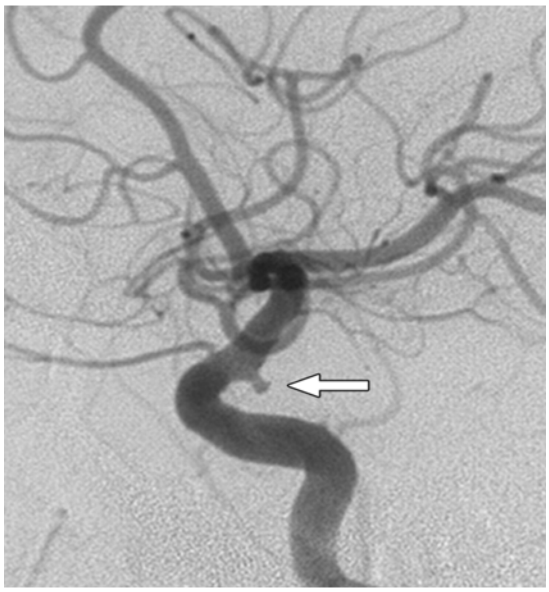

Figure 7 Vertebral angiography. Aneurysm of the right posterior cerebellar artery (pointer)

If blood pressure continues to be above 130 mmHg, it is recommended to administer beta-blockers.

If the average blood pressure drops under 90 mmHg pressor agents are needed. In hypotension and bradycardia cases the administration of 0.5-1 mg atropine is recommended.

Intracranial hypertension treatment

The main goal in intracranial hypertension treatment is to maintain values under 20 mmHg and the cerebral perfusion pressure above 70 mmHg.

These parameters are obtained through:

-keeping the head above the cord;

-osmotherapy through administration of 1g/kgc Manitol;

-hyperventilation through keeping the PCO2 values between 30-35 mmHg, when intracranial pressure measurement is possible;

-invasive intracranial pressure motorization in patients with consciousness modification (Glasgow scale <9). Intracranial pressure can be obtained through insertion of intraventricular or intraparenchymal devices.

-If normal intracranial pressure cannot be maintained by using the methods mentioned above, hypnotic coma (propofol, benzodiazepines) and finally barbiturate coma will be induced.

Maintaining normovolemia

Administration of isotonic saline solutions for hydric balance correction.

Comitial crisis prevention

Administration of sodium valproate (Depakine) 10 - 30 mg/kgc.

Maintaining normothermia

Administration of antithermic medication (acetaminofen), wrapping or administration of neuroleptic medication.

This medical treatment is used for all patients with intracerebellar hemorrhage, and as a unique therapeutic option for the next group of patients:

a. patients with 14 on the Glasgow scale. Some authors take into consideration>9 on the Glasgow scale, with 30 - 40 mm hematomas, where no hydrocephaly is present. If the neurological state is getting worse, those patients will be reevaluated for surgical treatment options.

b. comatose patients with large intracerebellar hematomas and central localization.

B. Surgical treatment

Surgical treatment options are:

1. suboccipital craniectomy – in patients with hematomas > 3, but not >4 cm;
2. ventriculostomy – in patients with hemorrhage and hydrocephaly;
3. stereotactic fibrinolysis of hematomas.

Surgical indications are given by:

a. patients with hemorrhage >3, characterized by neurological deterioration;

b. patients with cerebellar hemorrhages and signs of cerebral trunk compression.

External ventricular drainage indications are given by patients with hydrocephaly caused by intraventricular hemorrhage.

Evolution and therapeutic reevaluation in patients with cerebellar hematomas

Consciousness and vital function monitoring is necessary in patients diagnosed with intracerebellar hematomas. When these deteriorate emergency surgical intervention should be taken into consideration.

Medical prognosis in patients with intracerebellar hematomas depends on the size, location and clinical presentation of each patient at the moment of admission.

1. patients with hematomas >4 cm localized on vermis and with absent cerebral trunk reflexes receive a negative prognosis and have no surgical indication.
2. the medical evolution in patients with favorable clinical presentation must be monitored depending on clinical parameters and CT, the following criteria, which could lead to a possible deterioration, must be taken into consideration:

- blood pressure above 200 mmHg when the patient was admitted;
- punctiform eyeball and corneal and oculocephalic reflex modification;
- hematoma extention to cerebellar vermis;
- hematomas larger than 3 cm;
- cerebral trunk compression;
- intraventricular hemorrhage;
- vermis herniadue to tentorial incisura;
- acute hydrocephaly.

Material and methods

Our studies were conducted in the Neurosurgery Wards of Clinical Emergency Hospital ”Prof Dr Nicolae Oblu”, Iasi, Romania, during a seven year period, between 2002 and 2009.

Our study was retrospective, descriptive and longitudinal, based on a selection of medical data taken from the medical history of patients diagnosed with intracerebellar hematoma.

This study was conducted on 57 patients, 26 males (45.61%) and 31 females (54.39%), their age ranging from 32 to 82, admitted to the neurosurgery ward for a period of over 7 years, diagnosed with bleeding in the posterior fossa.

The women’s average age was significantly larger than the men’s (66.84 ± 7.19 compared to 62.31 ± 11.04, p=0.03), with the case frequency of patients under 50 year of age being significantly larger in men (4 cases - 15.39% compared to 0% for women, p= 0.01). The most frequent cases involved men 60 years old and older.

The following aspects were taken into consideration:

- CT screening regarding the hematoma’s dimension, localization and associated complications;
- angiography (only for certain cases);
- cerebellar hematoma's treatment: medical, surgical, external ventricular drainage;
- post-treatment evolution (cured, better, no improvement, worse, deceased).

The study also tracked the influence of the patient’s clinical presentation at the moment of admission (coma, posterior fossa syndrome, intracranial hypertension syndrome), age and gender in relation with the efficiency of the treatment and how the patient’s condition evolved.

CT screening

Based on the CT screening, the following items were tracked:

1. The size of the hematoma: the cerebellar hematomas were split into 2 categories, mainly hematomas with a diameter larger than 3 cm (figure 8) and hematomas with a diameter smaller than 3 cm (Figure 9). 44 patients presented cerebellar hematomas with a diameter larger than 3 cm, while the remaining 13 patients presented a cerebellar hematoma with a diameter smaller than 3 cm.

2. Localization: vermian cerebellar hematomas (Figure 9) and hemispheric intracerebellar hematomas (Figure 10);

3. Complications: mass effect on the fourth ventricle was encountered in 17 cases (Figure 10), ventricular flood was encountered in 15 cases (Figure 11), and hydrocephaly was encountered in 10 cases and subarachnoid hemorrhage (Figure 12).

Figure 8 Native CT scan. Cerebellar hematoma with a diameter larger than 3 cm localized on the left hemisphere

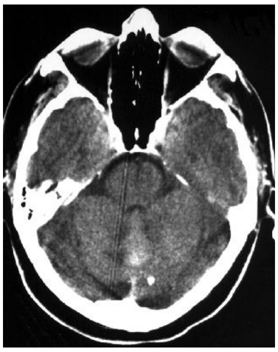

Figure 9 Native CT scan. Vermian cerebellar hematoma with a diameter smaller than 3 cm (vermis localized intracerebellar hematoma)

Figure 10 Native CT scan. Cerebellar hematoma with a diameter larger than 3 cm, with mass effect on the fourth ventricle, localized on the right hemisphere

Figure 11 Native CT scan. Cerebellar hematoma with a diameter smaller than 3 cm and ventricular flood on the fourth ventricle, localized on the fourth ventricle

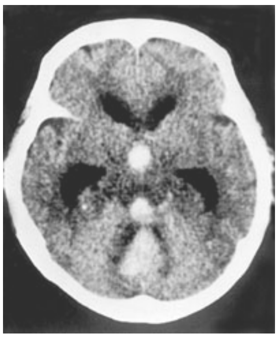

Figure 12 Native CT scan. Ventricular flood and hydrocephaly

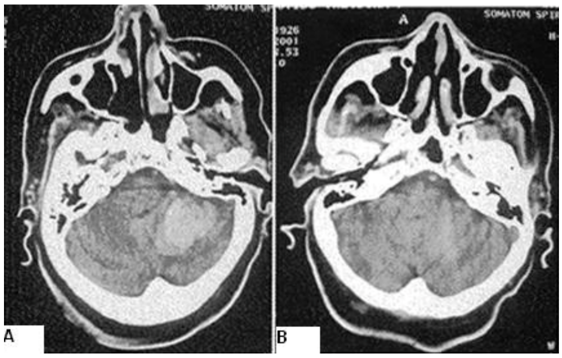

Figure 13 Cerebellar hematoma. A. CT representation on the day of onset. B. Cerebellar hematoma resorption after medical treatment

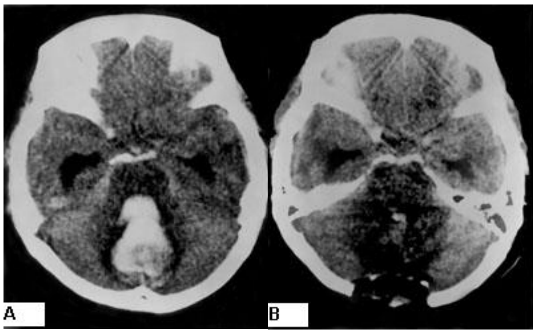

Figure 14 Cerebellar hematoma. A. Pre-surgery image. B. Post-surgery image

Cerebellar hematoma's treatment and progress:

Methods of treatment:

a) Surgical – 27 cases;

b) Medical – 25 cases;

c) External ventricular drainage – 5 cases.

The favorite surgical method was suboccipital craniectomy with the evacuation of the cerebellar hematoma.

Post-surgery progress was evaluated according to the admission clinical presentation and the complications diagnosed through CT screening.

Results and discussions

In 8 cases (14.03%) the localization (of the cerebellar hematoma) was on the middle, vermian line, with a higher frequency in men 23.08% compared to 6.45% for female patients), and on one side of the cerebellar hemisphere, in 49 cases, with a higher frequency in women (93.55% compared to 76.92% for male patients).

In 44 cases (77.19%) the size of the hematoma was smaller than 3 cm, while in 13 cases (22.81%) the size of the hematoma was larger than 3 cm, with no significant difference according to the sex of the patient.

Regarding medical complications, 15 cases (26.32%) presented no medical complications, while 42 cases (73.6%) presented the following medical complications: 10 cases (17.54%) presented intracranial hypertension, 15 cases (26.32%) presented ventricular flood and 17 (29.82%) cases presented mass effect. The type and the frequency of the complications were not significantly differentiated according to age.

27 cases (47.37%) benefited from medical treatment, 25 (43.86%) cases benefited from surgical evacuation, and 5 (8.77%) cases needed external drainage, with no significant differences based on the sex of the patient.

After receiving treatment positive progress was noticed in 56.14% of cases (2 cases were cured – 3.51% and 30 cases got better – 52.63%), no progress was noticed in 2 cases (3.51%) while no positive progress was noticed in 23 cases (11 cases got worse – 19.3% and 12 cases deceased – 21.05%). The post-treatment progress showed no significant differences based on the sex of the patient.

Throughout our study we also noticed that patients diagnosed with intracranial hypertension and coma at the time of the admission developed hematomas with a diameter larger than 3 cm, while those patients with posterior fossa syndrome presented a greater frequency of cerebellar hematomas with a diameter smaller than 3 cm. These facts also bear little or no statistical relevance.

Regarding patients with posterior fossa syndrome at the time of admission, a decreased frequency of medical complications was noticed (38.89%), compared to patients with intracranial hypertension at the time of admission (14.29%). Regarding comatose admitted patients, we noticed a greater frequency of ventricular flood (38.89%), compared to patients with posterior fossa syndrome (11.11%). The frequency of mass effect was significantly greater with patients with intracranial hypertension at the time of admission (42.86%), compared to patients diagnosed with coma at the time of admission (11.11%). Mass effect occurrences were noticed significantly less often in the case of patients with posterior fossa syndrome (33.33%). Hydrocephaly was more frequent in men's case than in women's case (26.92% compared to 9.68%), while female patients presented a greater frequency of ventricular flood (35.48% compared to 15.38% in men's case).

Medical treatment was mainly given to patients with intracranial hypertension (71.43%) and posterior fossa syndrome (55.56%) compared to patients diagnosed with coma (11.11%). Surgical evacuation was used generally for patients with coma at the time of admission, compared to those with posterior fossa syndrome (33.33%) and intracranial hypertension (28.57%). At the same time, external drainage was usually needed for patients with coma (16.67%) compared to patients with intracranial hypertension (0%) and posterior fossa syndrome (11.11%).

Both cured cases were noticed for patients diagnosed with intracranial hypertension at the time of admission, while the frequency of patients who got better was significantly greater for diagnoses of posterior fossa syndrome (77.78%), compared to diagnoses of coma (38.89%) and intracranial hypertension (42.86%).

The frequency of cases that worsened after receiving medical treatment was greater with coma patients (22.22%), and even greater with those diagnosed with intracranial hypertension (28.57%) at the moment of admission compared to posterior fossa syndrome (5.56%).

Death occurred mainly in patients with coma at the time of admission (38.89%), compared to those who presented posterior fossa syndrome (11.11%) and intracranial hypertension (14.29%).

The incidence of cases that got better was notably greater with patients who received medical treatment (66.67%), compared to those who received surgical evacuation (40%). At the same time, death occurred more frequently amongst patients with surgical evacuation (40%), compared to those who received medical treatment (3.7%).

Positive post-treatment progress was noticed in female patients' cases, with a greater incidence of cured cases or cases that got better compared to that of men's (64.51% in comparison to 46.15% with men), while the number of deceased was significantly larger with male patients (34.62% in comparison to 9.68% with women). The patients' progress was not considerably differentiated according to the localization of the hematoma. Greater chances of improvement were noticed with patients with a hematomas smaller than 3 cm in diameter, while with hematomas larger than 3 cm in diameter the risk of getting worse or death was significantly increased. Death occurrence frequency was larger with intracranial hypertension patients (50%) in comparison to those with no medical complications (6.67%), or mass effect (5.88%). Also, death occurrence frequency was greater with patients diagnosed with ventricular flood (33.33%), compared to patients with no medical complications (6.67%) or mass effect (5.88%).

Taking into account the following elements:

- a larger number of male patients presented posterior fossa syndrome at the moment of admission, rather than female patients;

- with male patients the frequency of intracranial hypertension was greater than with female patients;

- the post-treatment progress was more responsive in women's case, with a frequency of cured or improved patients larger than with male patients, while de incidence of deceased patients was significant greater among men, we can assert that with male patients we noticed an increased risk of delayed diagnose, the development of medical complications along with decreased treatment efficiency.

The clinical presentation at the time of admission (particularly for comatose patients) has an important influence on the progress of the patient, due to the following aspects:

- the frequency of hematomas with a diameter larger than 3 cm was greater among patients with intracranial hypertension and coma;

- the frequency of ventricular flood was significantly larger among patients diagnosed with coma at the moment of admission;

- the mass effect occurrence was significantly greater among patients with intracranial hypertension at the moment of admission;

- no improvement was noticed among comatose patients;

- the frequency of cases that got worse was greater among patients with coma and intracranial hypertension at the moment of admission.

Hematomas with a diameter larger than 3 cm led to an increased occurrence of ingravescence and death, while the chances of a positive progress were noticed with patients with hematomas smaller than 3 cm.

Associated medical complications (mainly intracranial hypertension and ventricular flood) can influence the patients' progress and at the same time, contributes to a significant death occurrence increase.

The method of treatment we opted for showed us that the frequency of improved medical conditions was greater among patients who received medical treatment, while death occurred more commonly among patients who needed surgery.

Conclusions

1.Taking into account the fact that coma and posterior fossa syndrome had a higher frequency in male patients, we can assess that males present medical prognostic factor;

2.The factors that could lead to a negative medical outcome are the patient's neurologic condition at the moment of admission, respectively coma, a hematoma with a diameter larger than 3 cm, ventricular flood and mass effect on the fourth ventricle;

3.Imagistic examination's importance is indisputable for diagnose and deciding on medical/surgical therapeutic attitude, the establishment of precise medical indications being imposible without performant imagistic explorations. Performant imagistic explorations are used both to eliminate some additional symptomatology responsible for a resambling symptomatology and for accurate injury localization. As far as our study is concerned, the most important imagistic method is by far computed-tomographic screening, due to its complet and precise provided information.

4.Therapeutic behavior is characterized by a traditional treatment prescribed for conscious patients with posterior fossa syndrome or intracranial hypertension syndrome and for comatose patients;

5.Radical surgical treatment, surgical evacuation of the hematoma through suboccipital craniectomy, will be applied to patients with cerebellar hematomas larger than 3 cm whose clinic condition gets worse;

6.Palliative surgical treatment, external ventricular drainage, is recommended for patients initially diagnosed with hydrocephaly, but whose medical condition gets worse.

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