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Original Article

CT grouping and microsurgical treatment strategies of hypertensive cerebellar hemorrhage

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Abstract: Purpose: This study investigated the CT grouping, surgical methods and clinical efficacy of hypertensive cerebellar hemorrhage patients. Methods: A retrospective analysis was conducted on the patients from 2006, 07 to 2013, 01 who were performed with CT grouping and whose surgical indications were confirmed. Surgical methods were selected according to the three danger signs of preoperative hypertensive cerebellar hemorrhage, and GOS Rating was used to determine the prognosis. Results: A total of 21 cases of cerebellar hemorrhage met the inclusion criteria, in which 10 cases were breaking into the ventricle, 6 cases were simple posterior fossa craniotomy, 2 cases were simple lateral external drainage, and 7 cases were posterior fossa craniotomy plus occipital horn ventricular drainage. Postoperative follow-up for 6 months, the GOS rating showed that 10 cases were undergoing good recovery, 6 cases had mild disability, 3 cases had severe disability, one case was vegetative, and one case were dead. The method of CT grouping according to the three danger signs of cerebellar hemorrhage to determine surgical indications and surgical approach is quite simple and practical, which can help guide clinical treatment and prognosis.

Keywords: CT grouping, microsurgical, hypertensive cerebellar hemorrhage

Introduction

Since the anatomical location of the cerebellum is adjacent to brain stem and fourth ventricle, cerebellar hemorrhage may lead to complications such as brainstem compression and hydrocephalus, foramen magnum herniation or hernia on tentorial notch etc., which directly endanger the lives of patients. This requires clinician's rapid diagnosis and accurate emergency treatment strategy. However, the currently used treatment regimen is controversial, and the surgical intervention indications are not clear. Cerebellar hemorrhage with brainstem compression, hydrocephalus or patients with supratentorial intraventricular hemorrhage are considered as the three danger signs of cerebellar hemorrhage by Wang, these three danger signs are closely related to the clinical signs, CT features and prognosis of the patients. From July 2006 to January 2013, we conducted CT grouping according to the three danger signs of cerebellar hemorrhage, and hereby determined the indications for surgery, surgical approaches and surgical methods to cure 21 cases of hypertensive patients of cerebellar hemorrhage, which are summarized below.

Materials and methods

General information

Inclusion criteria: 1) comply with the cerebral hemorrhage diagnostic criteria formulated by 1995 Fourth China Cerebrovascular Diseases Conference; 2) emergency or postoperative CTA or DSA exclude cerebral vascular malformations, aneurysms and other spontaneous bleeding; 3) the head CT examination confirmed to be cerebellar hemorrhage; 4) patients who had undergone surgical treatment.

Exclusion criteria: 1) patients are of deep coma, double pupil mydriasis and fixed, no spontaneous breathing when admitted to hospital; 2) patients with disturbances of blood coagulation; 3) patients with other organ dysfunction before surgery; 4) patients whose clinical information is incomplete or drop out of therapy and automatically discharged.

Table 1. GOS prognostic score

Level	Clinical manifestations
5	Good recovery, return to normal life despite the mild defect
4	Mild disability, disability but can live independently and can work under protection
3	Severe disability, sober, disability and needs to take care in daily living
2	Vegetative state, only minimal response exists (such as with the sleep/wake cycle, the eyes can be opened)
1	Death

Table 2. CT grouping, surgical procedures and GOS prognostic score of hypertensive cerebellar hemorrhage

CT grouping	Surgical approach	GOS score (number of cases)				
		5	4	3	2	1
A1	Cerebellar hematoma evacuation	4	3	1		0
A2	Lateral cerebral ventricle drainage	2	2			0
A3	Lateral cerebral ventricle drainage	2	1	1		0
B12 (Mild hydrocephalus)	Cerebellar hematoma evacuation	3	2	1	1	0
B12 (Severe hydrocephalus)	Occipital horn puncture ventricular drainage + Cerebellar hematoma evacuation	2		1		0
B13	Occipital horn puncture ventricular drainage + Cerebellar hematoma evacuation	2		1		0
B23	Lateral cerebral ventricle drainage	3	2	1		0
C123	Occipital horn puncture ventricular drainage + Cerebellar hematoma evacuation	3			1	1

CT grouping methods

Cerebellar hemorrhage CT grouping methods: cerebellar hemorrhage with 1 brainstem compression, 2 hydrocephalus, or with 3 patients with supratentorial intraventricular hemorrhage are called the three danger signs of cerebellar hemorrhage; according to three danger signs of cerebellar hemorrhage, they are divided into four types, A-type: only one danger sign; B-type: two danger signs; C-type: three kinds of all danger signs; D-type: none of the danger signs.

Surgical indications and strategies

Since the lesion is close to the brain stem, mostly there is no obvious sign before the deterioration of cerebellar hemorrhage, thus in order to prevent the occurrence of sudden hernia, it is widely believed that surgery is the only effective treatment. We determine the surgery indications according to the CT groups, the D-type we take conservative treatment and close observation without surgery temporarily, if the patient's condition changes, we will promptly review of head CT, while the remainders require surgical treatment; for the patients who have brain stem compression deformation, the craniotomy was taken under microscopic to remove the hematoma at suboccipital midline approach or beside midline approach; the one who has hydrocephalus or supratentorial intraventricular hemorrhage need to take external ventricular drainage; the patients without brainstem compression may not need craniotomy to remove the hematoma.

Hypertensive cerebellar hemorrhage CT grouping and surgical approach

A1: cerebellar hematoma evacuation at suboccipital midline or beside midline approach; B12 cerebellar hematoma evacuation at suboccipital midline or beside midline approach (mild hydrocephalus); A2, A3: lateral cerebral ventricle drainage; B12 (severe hydrocephalus), B13, C123: First occipital horn punctures ventricular drainage + craniotomy cerebellar hematoma evacuation at suboccipital midline or beside midline approach; approach craniotomy, according to intraoperative conditions to select posterior fossa decompression range. B23: lateral cerebral ventricle drainage. Cerebellar hematoma evacuations are all microsurgical operations under endotracheal intubation and general anesthesia.

Postoperative treatment

Patients are sent to ICU postoperative generally with optimal care and therapy, when their conditions are stable, they will be back to neurosurgery ward. "Three early" treatment is used for those who cannot wake up postoperative in a short period: early tracheotomy, early enteral nutrition, and early use of antacids to reduce postoperative complications. They will be periodic reviewed of CT and biochemical conventional, actively regulated of blood pressure to regulate the blood pressure into the baseline blood pressure within a week. In the recovery period, according to patient's situation, they can take early hyperbaric oxygen, acupuncture and other rehabilitation treatment to promote recovery of neurological function and reduce complications and to prevent recurrence.

Therapeutic evaluation

Follow-up for more than 3 months after operation, evaluate the clinical effectiveness with GOS prognostic score, shown in **Table 1**.

Results

Twenty-one cases of cerebellar hemorrhage met the inclusion criteria: 10 cases of breaking into the ventricle; all emergency surgery are taken within 24 h of relapse, wherein within 3 h of 15 cases; endotracheal intubation in prehospital and emergency center of 2 cases. Simple posterior fossa craniotomy of cerebellar hematoma evacuation 6 cases, simple lateral cerebral ventricle drainage 2 cases, posterior fossa craniotomy plus occipital horn ventricular drainage 7 cases. In second postoperative day review of head CT, 14 cases of hematoma evacuation > 95%, 5 cases of hematoma evacuation > 75%, 2 cases of hematoma evacuation > 50%; the average hospitalization days is 15.5 d. Postoperative bleeding is 0 cases. According to GOS rating: good recovery 10 cases, mild disability 6 cases, severe disability 3 cases, vegetative state 1 case, death 1 case, see **Table 2**.

A1: cerebellar hematoma evacuation at suboccipital midline or beside midline approach; B12 cerebellar hematoma evacuation at suboccipital midline or beside midline approach (mild hydrocephalus); A2, A3: lateral cerebral ventricle drainage; B12 (severe hydrocephalus), B13, C123: First occipital horn punctures ventricular drainage + craniotomy cerebellar hematoma evacuation at suboccipital midline or beside midline approach; approach craniotomy, according to intraoperative conditions to select posterior fossa decompression range. B23: lateral cerebral ventricle drainage.

Discussion

Cerebellar hemorrhage refers to bleeding within the cerebellum parenchymal; there is usually a direct relationship with hypertension. Hypertensive cerebellar hemorrhage accounts for about 10 percent of cerebral parenchymal hemorrhage. Since the anatomical location of cerebellar hemorrhage is adjacent to brain stem and ventricular system, may lead to complications which can directly endanger the lives of patients such as brainstem compression and hydrocephalus, foramen magnum herniation or hernia on tentorial notch etc., this requires clinician's rapid diagnosis and accurate emergency treatment strategy. However, the currently using treatment regimen is controversial, and the surgical intervention indications are not clear. Early suboccipital decompression surgery can save lives, but some bleeding can be cured by conservative treatment or ventricular drainage treatment, that the potential risk of surgery is unnecessary, and the effect of hematoma evacuation remains controversial [1].

Surgical treatment can save the lives of serious patients and promote recovery of neurological function, and the surgery should be performed within 6-24 h after the onset. The deterioration of patient's state of consciousness is often used as indications for surgery, but the clinical disease decrease may be the process leading to sudden death in a very short period of time. Therefore, the evaluation of surgical indications simply according to state of consciousness may loose the good timing of surgery for some patients with better conscious when admitted to hospital. In the past some authors choose the treatment according to the amount of supratentorial bleeding, however, due to the special anatomical location of cerebellum, hematoma also cannot be ignored. For example, hematoma is located outside the cerebellar hemispheres, although is large even greater than 10 ml, it won't be necessarily affect the ventricular system significantly, but the clinical manifestations may not be serious; While if the hematoma is in the vermis and near

the fourth ventricle, even small one can easily break into the fourth ventricle, or compress of the fourth ventricle and lead to deformation and shift, causing obstructive hydrocephalus and a sharp increase in intracranial pressure with life-threatening, thus fatality rate is higher.

Hemorrhage location (neutral and hemis-phere) is very important in determining the symptoms and clinical course, it may be more important than the size of the absolute prognostic hematoma; the development of intraventricular compression and obstructive hydrocephalus may lead to increased intracranial pressure and decreased cerebral perfusion pressure [2]. Therefore, the evaluation of surgical indications cannot be based solely on the state of consciousness or the amount hematoma. Clinical manifestations of cerebellar hemorrhage are not only the symptoms and signs of damaged cerebellum itself; it may also occur brainstem compression and breaking into the ventricle and a series of changes, therefore, the clinical manifestations depend on the site of bleeding, brain stem compression and ventricular system, which are the clinical features of cerebellar hemorrhage. Cerebellar hemorrhage with brainstem compression, hydrocephalus or patients with supratentorial intraventricular hemorrhage are called the three danger signs of cerebellar hemorrhage by Wang [1] in order to assess the disease that even there is no danger signs and the situation is not serious, meanwhile the three crisis means the most serious disease, that the three danger signs are closely related to clinical signs, CT features and prognosis of patients. Therefore, in view of the danger signs, establish surgical indications with promptly surgical intervention to prevent the pathophysiological process after cerebellar hemorrhage, thereby improve the prognosis.

According to CT grouping, there is at least one of the danger signs of hypertensive cerebellar hemorrhage, that there are indications for surgery; the one with indications for surgery should take microsurgical treatment as early as possible to relieve the danger signs, so as to help improve the curative effect. Therefore, we conduct CT grouping and determine surgical indications, surgical approach on this basis according to cerebellar hemorrhage three kinds of danger signs, the D-type we take conservative treatment and close observation without surgery temporarily but ready for Preoperative preparation, if the patient's condition changes, we will promptly review of head CT, and wary of the possibility of fatal re-expansion of cerebellar hematoma [1]; remainders require surgical treatment to early release of the danger signs of cerebellar hemorrhage, the patients without brainstem compression do not need craniotomy to remove the hematoma; the patients with hydrocephalus or supratentorial intraventricular hemorrhage need the ventricular drainage to drain cerebrospinal fluid and to relieve intracranial pressure, while drainage of intraventricular hemorrhage. Such as typical case 1, CT grouping: B23 (supratentorial intraventricular hemorrhage with hydrocephalus, no brainstem compression), select lateral external drainage surgery to drain cerebrospinal fluid and to relieve intracranial pressure, while drainage of intraventricular hemorrhage, since no compression in brain stem, no need craniotomy to remove the hematoma.

Typical cases 1, patient, surname Wang, male, 61 years old, preoperative CT: cerebellar hemorrhage and broken into the fourth ventricle, the left lateral ventricle angle seen blood with severe supratentorial hydrocephalus (third ventricle, lateral ventricle expansion), no significant pressure on the brain stem, CT grouping: B23, selected lateral cerebral ventricle drainage surgery (**Figure 1**). The CT of 7th day after operation: cerebellar hematoma basically absorbed, the fourth ventricle, the left lateral ventricle angle blood disappeared, supratentorial hydrocephalus eased. GOS rating: good recovery; GOS: 5, see **Figure 2**.

The one who has brain stem compression deformation, suboccipital midline approach or beside midline approach microsurgical craniotomy hematoma evacuation to release brainstem compression; if the one is concomitant hydrocephalus or supratentorial intraventricular hemorrhage, he needs first ventricular drainage to alleviate intracranial pressure, then the intracranial hematoma evacuation. Such as typical case 2 CT grouping: C123 (supratentorial intraventricular hemorrhage + hydrocephalus + brainstem compression), first select the prone position bilateral lateral occipital horn external drainage to release of cerebrospinal fluid and to alleviate intracranial pressure, and then conduct the suboccipital midline approach microsurgical craniotomy hematoma evacuation + Posterior fossa decompression.

Figure 1. Pre operative CT scan. Representative pre-operative CT scan of a patient in it showing a posterior fossa haemorrhage with associated hydrocephalus and blood in the ventricles.

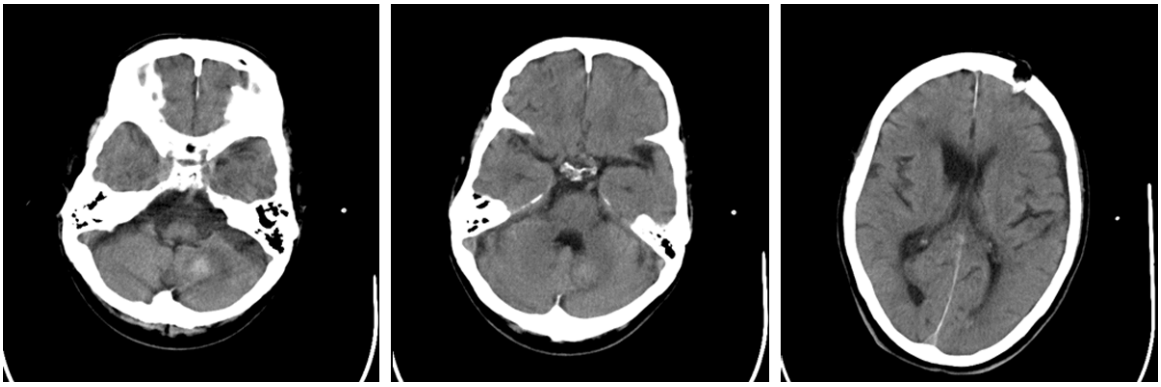

Figure 2. Post operative CT scan. Post operative CT scan of the patient depicted in it. Scan done seven days after surgery showing resolving hydrocephalus and the absence of intraventricular blood and posterior fossa hemorrhage.

Typical case 2, name: surname Lei; gender: female; 68 years old. Moderate coma when admitted to hospital, GCS score is 5, the right pupil is dilated and both pupils do not react to light. Cerebellar hemispheres and vermis hematoma cause obvious brainstem compression, fourth ventricle compression, lateral ventricle, third ventricle and fourth ventricle hemorrhage, supratentorial severe hydrocephalus, CT grouping: C123 (supratentorial intraventricular hemorrhage + hydrocephalus + brainstem compression) see **Figure 3**, select the prone position bilateral lateral occipital horn external drainage + suboccipital midline approach microsurgical craniotomy hematoma evacuation + Posterior fossa decompression. GOS rating: severe disability; GOS: 3, see **Figure 4**.

The relationship between CT grouping and prognosis: according to **Table 2**: the relationship between CT grouping and prognosis, the crisis prognosis of type one is good, the second is worse, and the third is the worst. Although Wang's called the above mentioned two kinds of symptom and supratentorial hematocele three dangerous symptoms of cerebellar hemorrhage, and suggested that the death possibility is 100% if three symptoms seen at the same time, whereas, the CT type of this case is C123 (with three symptoms at the same time). There is only 1 case of death and death rate is 33.3% due to timely operation. Therefore, clinical manifestations rang of Cerebellar hemorrhage from a similar range of ischemic brain death to catastrophic neurological decline; symptoms are subject to seriousness of bleeding and cerebral edema and position. Posterior fossa is a chamber which has almost no extra space to accommodate, hematoma and its associated swelling can cause obstructive hydrocephalus, brainstem compression, in severe cases, lead to early death. Intraventricular hemorrhage or hematoma extending to the midline brings a poor prognosis [2].

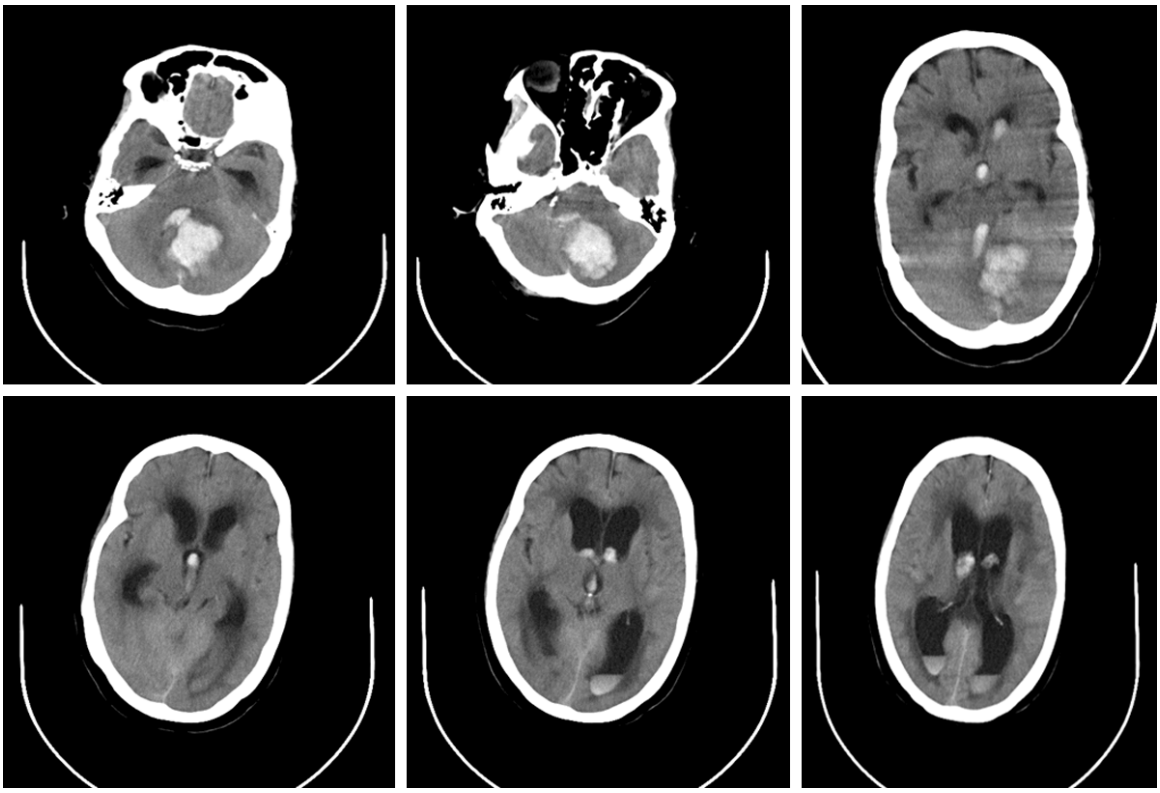

Figure 3. Pre operative CT scan. Representative pre-operative CT scan of a patient in it. showing a posterior fossa haemorrhage with associated hydrocephalus and blood in the ventricles.

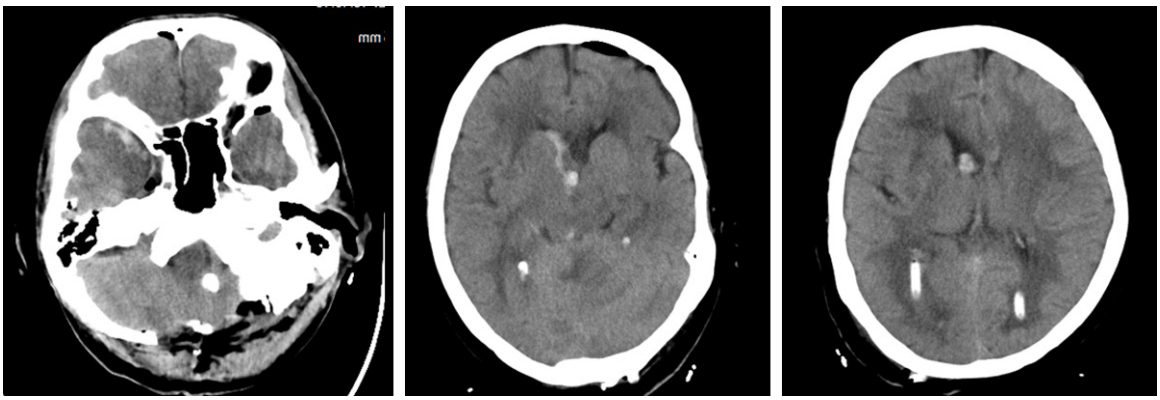

Figure 4. Post operative CT scan. Post operative CT scan of the patient depicted in it. Scan done two days after surgery showing resolving hydrocephalus and a significant reduction in the intra- ventricular blood and the absence of posterior fossa Haemorrhage.

Whereas, timely and proper operation may bring better prognosis [3]. Of course, cerebellar hemorrhage appeared not only due to single prognostic factor, such as operation skill, operation time, the treatment during operation, and early proper treatment are among the effect factors. Cerebral hemorrhage microsurgical techniques: Enlarged ventricles in patients with ventricular drainage first, slow release, so as not to appear on the tentorium hernia. When opening the meninge, high blood pressure if found inside, make small incision at dura in the nearest place of cortex and hematoma according to the imaging data, puncture the swollen part and suck out parts of hematoma so as to ease the pressure. Apart from it, avoiding that

sudden opening dura causes the pressure of Posterior fossa plummet and result in entorial hernia. Do not rush to the deep in the process to remove the hematoma; the surface hematoma should be carefully sucked out first. Hematoma can be easily removed when the bulging hematoma comes out from the inside itself due to poor pressure inside cerebral. Coagulation device power should be small, especially remove the hematoma in the vermis, avoiding heat burns the bottom nerve of the fourth ventricle. Posterior fossa decompression should be fully made because postoperative cerebellar edema generally is heavier and it must have considerable reserve space. Dura must be expanded to reduce repair, which can reduce subcutaneous fluid, intracranial infection. If the hematoma ruptured into the ventricle, blood clots can be sucked out or wash out at the ruptured place from the forth ventricle under microscope.

Shortcomings: The method used in this study is a retrospective study, and the samples are not as many as enough. Therefor a long-term clinical practice is still needed to further explore CT typing and microsurgical treatment strategies of hypertensive cerebellar hemorrhage.

Conclusion

According to three dangerous signs of cerebellar hemorrhage to determine surgical indications and surgical approach by CT grouping methods is simple and practical, and can help guide clinical treatment and prognosis.

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Disclosure of conflict of interest

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