Feasibility and safety of prophylactic tentorium cerebelli hiatus incision in surgery of glioma located in lateral fissure area

1 Introduction

During the growth of glioma located in lateral fissure area, glioma surrounds the lateral fissure area. Under normal conditions, glioma will infringe frontal lobe, insular lobe, basal ganglia, parietal lobe, etc. With complex anatomical structure, more blood vessels and abundant blood supply, this area provides good preconditions for the rapid growth of glioma which very easily surrounds blood vessels located in lateral fissure area and infiltrates into deep tissues. At the same time, ligation and traction of blood vessel during surgery very easily lead to intracerebral hematoma after surgery or vasospasm forms in the surgery area and then lead to ischemia, causing severe edema after surgery [1]. In order to effectively prevent edema caused by ischemia and hematoma after surgery and thereby minimize the occurrence rate of intracranial hypertension and cerebral hernia, it is necessary to conduct a second decompressive craniectomy to patient. During the surgery, the tentorium cerebelli hiatus is incised to facilitate the effective reduction of intracranial pressure [2]. This research carried out statistical analysis on the clinical data of 80 cases of patients with glioma located in lateral fissure area who received treatment from May 2012 to May 2015 in our hospital and discussed the feasibility and safety of prophylactic tentorium cerebelli hiatus incision in surgery of glioma located in lateral fissure area. Reporting is shown below.

2 Data and method

2.1 General data

80 patients with glioma located in lateral fissure area who received treatment from May 2012 to May 2015 in our hospital were randomly selected. All patients were examined by MRI and diagnosed with glioma before surgery, which
mainly infringed lateral fissure area and tentorium cerebelli hiatus wasn’t incised, with main manifestations of headache and aphasia etc. All patients received treatment for the first time and gave informed consent. Patients who received chemoradiotherapy treatment before surgery or had abnormal renal function or hypoproteinemia were excluded [3]. These patients were divided into two groups in accordance with their therapeutic methods, i.e. the research group (n=40) and control group (n=40). In the research group, 23 cases were male patients and 17 cases were female patients, who were between 25 and 79, with an average age of (44.73±10.24). The diameter of glioma was between 2 and 6 cm, with an average diameter of (4.61±1.02) cm. In the control group, 22 cases were male patients and 18 cases were female patients, who were between 26 and 80, with an average age of (45.65±10.63). The diameter of glioma was between 3 and 7 cm, with an average diameter of (5.12±1.26) cm. Comparative differences of general data of patients of two groups were not significant (P>0.05), so they were comparable.

Ethical approval: The research related to human use has been complied with all the relevant national regulations, institutional policies and in accordance the tenets of the Helsinki Declaration, and has been approved by the authors’ institutional review board or equivalent committee.

Informed consent: Informed consent has been obtained from all individuals included in this study.

2.2 Method

Head CT or MRI inspection shall be applied to clarify lesion position of patients of the two groups, and Treon navigation system shall also be made the best use of routine skin preparation shall be carried out 1 day before surgery and three-dimensional image shall be rebuilt to calibrate lesion and calculate the orientation and distance between operation position and lesion position at any plane. Therefore, the best surgical route is designed. After successful anesthesia, routine disinfection and draping are carried out and craniotomy approach is set on the frontotemporal extended pterion. Microscope is then led in and the approach is set in the sulcus. Ultrasound-assisted positioning is used during surgery to reveal and incise the hidden lesion. Due to the abundant blood supply in this surgery area, practical and effective protection is carried out for blood vessels located in lateral fissure area and vessels wrapped and surrounded by glioma are carefully distinguished and separated. If the glioma and basal ganglia blood vessels are too close, resection is not enforced at risk. After lesion has been removed, bleeding is sufficiently stopped under the microscope. Patients in the control group were not treated by prophylactic tentorium cerebelli hiatus incision while patients in the research group were treated by prophylactic tentorium cerebelli hiatus incision for about 1 cm to effectively relieve encephalodema after surgery and effectively prevent cerebral hernia. After bleeding is sufficiently stopped again, hemostatic cotton yarn is put on the surface of the wound and then repeatedly flushed. After errhysis is gone, the brain is closed and an intracranial pressure probe is implanted to monitor the intracranial pressure after surgery.

2.3 Treatment after surgery

After surgery, patients of the two groups were given routine treatment for glioma. In accordance with patients’ intracranial pressure and clinical symptoms, patients were given mannitol dehydration treatment to facilitate effective reduction of intracranial pressure. Infection was effectively prevented, the nerve was effectively nourished, and patients were treated with sodium valproate to effectively prevent epilepsy. At the same time, based on patients’ actual condition, reexamination was carried out for head CT or MRI inspection to have a clear knowledge of bleeding and edema in the surgery area as well as resection situation of lesion.

2.4 Observation indexes

Observation and statistics shall be carried out for patients of the two groups, in intracranial pressure after surgery, dosage of mannitol and number of cases that need second surgery to have a clear knowledge of the situation after surgery.

2.5 Statistical analysis

\( \bar{x} \pm s \) is used to represent measurement data, t-test and chi-square test are used to count data, and SPSS20.0 software is used to carry out statistical analysis on the above data. The inspection level \( \alpha = 0.05 \).
3 Results

3.1 Comparison of general situation between patients of the two groups

Difference in gender, age and diameter of glioma between patients of the two groups was not significant (P>0.05). See Table 1 for details.

3.2 Comparison of resection situation of lesion between patients of the two groups

In the research group, there are 26 patients undergoing total resection of glioma and 14 patients undergoing subtotal resection of glioma, with resection rates of 65.00% (26/40) and 35.00% (14/40) respectively. In the control group, there are 27 patients undergoing total resection of glioma and 13 patients undergoing subtotal resection of glioma, with resection rates of 67.50% (27/40) and 32.50% (13/40) respectively. Difference in total resection rate and subtotal resection rate of glioma between patients of the research group and those of the control group was not significant (P>0.05). See Table 2 for details.

3.3 Comparison of intracranial pressure, hospital stay, times of using mannitol, acute renal function damage and second surgery between patients of the two groups

The intracranial pressure of patients in the research group was significantly lower than that of the control group (P<0.05), their hospital stay was significantly shorter than that of the control group (P<0.05), times of using mannitol were significantly less frequent than those of the control group (P<0.05), but the differences of acute renal function damage and second surgery occurrence rate 0, 0, 7.50% (3/40) and 5.00% (2/40) between patients of the two groups were not significant (P>0.05). See Table 3 for details.

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Table 1: Comparison of general situation between patients of the two groups

| Group          | Case number | Gender | Average age (years old) | Average diameter of glioma (cm) |
|----------------|-------------|--------|-------------------------|---------------------------------|
| Research Group | 40          | Male   | 44.73±10.24             | 4.61±1.02                       |
| Control Group  | 40          | Female | 45.65±10.63             | 5.12±1.26                       |

Note: Compared with the control group, *P<0.05

Table 2: Comparison of resection situation of lesion between patients of the two groups (Case/%)

| Group          | Case number | Total resection of glioma | Subtotal resection of glioma |
|----------------|-------------|---------------------------|------------------------------|
| Research Group | 40          | 26(65.00)                 | 14(35.00)                    |
| Control Group  | 40          | 27(67.50)                 | 13(32.50)                    |

Note: Compared with the control group, *P<0.05

Table 3: Comparison of intracranial pressure, hospital stay, times of using mannitol, acute renal function damage and second surgery between patients of the two groups

| Group          | Case number | Intracranial pressure (mmHg) | Hospital stay (times) | Times of using mannitol (times) | Acute renal function damage | Second surgery |
|----------------|-------------|------------------------------|----------------------|--------------------------------|-----------------------------|----------------|
| Research Group | 40          | 11.03±2.82*                  | 10.96±1.49*          | 28.84±4.08*                    | 0(0)                        | 0(0)           |
| Control Group  | 40          | 16.35±3.69                  | 12.40±1.65           | 37.26±4.63                     | 3(7.50)                     | 2(5.00)        |

Note: Compared with the control group, *P<0.05
4 Discussion

The clinical symptoms of glioma located in lateral fissure area are not typical enough. Most patients were diagnosed with glioma located in lateral fissure when they went to hospital to receive physical examination after relevant neurological symptoms and signs appeared. Frontal lobe type and mixed type are the primary lesion parts of glioma located in lateral fissure area. Due to the special anatomical structure in the operation area of glioma located in lateral fissure area and the rich distribution of peripheral blood vessels, it is very hard to avoid vascular injury and stop bleeding when resecting the glioma in the operative process. The consequence is irreversible if any artery or vein is damaged, because it will trigger bleeding in the operation area or ischemic infarction, deepening the harm to post-operation effects in a direct way. In the process of operation, cerebrospinal fluid shall be released as much as possible at the very beginning and the distribution of blood vessels around the glioma shall be distinguished carefully so that favorable conditions can be provided for the operation [4].

There are many blood vessels and an extensive distribution of blood flow in the lateral fissure area. Generally speaking, gliomas are in serious infiltrative growth and close to the key functional zone, which increases the operative difficulty. Excessive pursuit of the resection of the glioma will increase the intensity of invading blood vessels and important nerve structures, resulting in vasospasm or bleeding and damage to neurological function after the surgery. Therefore, in the surgery process, important neural mechanisms and blood vessels such as the front and back parts of the internal capsule the medial insular lobe, M2 and three branches in middle cerebral artery and some important draining veins should be protected well, otherwise, large areas of encephaledema will trigger contralateral hemiplegia when neural mechanisms and blood vessels are damaged [5]. Under the action of encephaledema, the elevation of intracranial pressure will further trigger cerebral hernia, which is extremely harmful to the functional recovery after surgery and may easily cause the death of the patient at the same time. If the speech center which is near the lateral fissure area is not correctly operated in the surgery, aphasia is easily induced [6]. Due to the special anatomical structure of the glioma in the lateral fissure area, tentorium cerebelli should be incised pointedly to facilitate the effective reduction of the intracranial pressure and to effectively avoid the cerebral hernia arising from the bleeding or infarction in the operation area after surgery [7]. But because the tentorium cerebelli and oculomotor nerve and trochlear nerve tend to be too close, emphasis should be attached to avoiding damage to oculomotor nerve and trochlear nerve during the surgery. When incising the tentorium cerebelli which is near the middle cranial fossa, the oculomotor nerve, in the deep part of the tentorium cerebelli, shall be protected effectively. The trochlear nerve is beneath the tentorium cerebelli, and when incising the tentorium cerebelli, the petrous bone shall be kept away. In the process of incising the tentorium cerebelli and tearing the arachnoid, the tempoku sinus is easily damaged and triggers bleeding so that hemostasis is also important to avoid the formation of hematomas effectively after surgery [8]. Meanwhile, ultrasound and electrophysiological monitoring equipment should be put into during surgery to facilitate the clear understanding of the field of the glioma blood supply, to significantly improve the total resection rate of the glioma, to effectively protect blood vessels and other key functional zones and to minimize the damage.

Usually, if the patient has a larger glioma in a deep location, in the process of resecting the glioma, to resect the glioma completely, it is inevitable to burn and injure the draining veins, stretch and damage the surrounding brain tissue during the operation and, at the same time in the early period of postoperation, dilate the cerebral vascular and lead to the hypoxic-ischemic injury to the surrounding brain tissue, all of which will raise the intracranial pressure and worsen the encephaledema. Thus in the operation, the clinician should attach more importance to these factors and deal with them in a foreseeable way. In the operation process of treating the severe cerebral trauma complicated by cerebral hernia, the incisura of tentorium cerebelli should be incised to provide a good precondition for the restoration of cerebral hernia through facilitating the enlargement of the orificium hernialis [9]. The results show that difference in total resection rate and subtotal resection rate of glioma between patients of the research group and those of the control group was not significant (P>0.05); intracranial pressure of patients in the research group was significantly lower than that of the control group (P<0.05), their hospital stay was significantly shorter than that of the control group (P<0.05), times of using mannitol were significantly fewer than those of the control group (P<0.05), but the differences of acute renal function damage and second surgery occurrence rate between patients of the two groups were not significant (P>0.05). This fully shows that although fundamentally avoiding the occurrence of encephaledema is impossible,
prophylactic tentorium cerebelli hiatus incision is simple and safe, and can significantly lower the intracranial pressure. The rising of intracranial pressure and the lack of balanced pressure between cerebral areas can also cause the cerebral hernia, especially when the stereoplasm structure divides the adjacent cerebral areas, like cerebral falx or tentorium cerebelli. Through incising the tentorium cerebelli, the change of the structure in encephalocele will bring about the change of equilibrium relationship of pressure, which will better disperse the intracranial pressure of patients when the edema happens and reduce the incidence rate of cerebral hernia to the minimum extent without any function injury to patients. It will be ensured in a practical and effective way that relatively sufficient space is left in the operation area after surgery when the occurrence of bleeding or infarction leads to the severe cerebral edema, and then the intracranial pressure will be effectively reduced and the cerebral hernia caused by high intracranial pressure will be effectively avoided [10].

In short, in the process of treating the glioma located in lateral fissure area in which the lesion tends to the temporal lobe, because of its special anatomical structure, the clinician should resect the glioma as much as possible on the basis of ensuring that the functional areas won’t be injured in a practical and effective way. In this process, the glioma has higher rate of stretching or injuring the blood vessel than tumor in other parts, which to the utmost extent increases the incidence rate of bleeding or infarction in the operation area after surgery. In order to effectively avoid the harmful effect of this situation on patients, prophylactic tentorium cerebelli hiatus incision, on one hand, can effectively reduce the harmful effect of postoperative complications on patients and provide good preconditions for patients to help them to recover from postoperative edema; on the other hand, can also help to shorten the hospital stay and reduce the hospitalization expense to the minimum extent. To sum up, prophylactic tentorium cerebelli hiatus incision in surgery of glioma located in lateral fissure area can effectively reduce patients’ intracranial pressure, shorten patients’ hospital stay and reduce patients’ times of using mannitol without increasing the rate of patients’ acute renal function damage and second surgery. It’s safe, effective and worth clinical promotion.

Conflict of interest statement: Authors state no conflict of interest

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