Application of Urapidil Blood Pressure Regulation and Mechanical Ventilation Combined with Bone Window Craniotomy in the Treatment of Hypertensive Basal Ganglia Intracerebral Hemorrhage

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We attempts to study the application of urapidil blood pressure regulation and mechanical ventilation combined with bone window craniotomy in the treatment of hypertensive basal ganglia intracerebral hemorrhage. Retrospectively selected 98 patients with hypertensive basal ganglia intracerebral hemorrhage who underwent bone window craniotomy hematoma removal and decompression in our hospital from May 2018 to may 2021. Divided them into two groups with 49 cases in a single group. Treated control group with routine treatment combined with mechanical ventilation, after receiving the same treatment as control group, observation group received another urapidil for blood pressure regulation. Compared both groups in cerebral oxygen uptake rate, intracranial pressure, middle cerebral artery blood flow parameters, Glasgow Coma Scale score and 3 mo prognosis conditions. Compared with control group, the intracranial pressure in observation group was remarkably lower at 3 and 7 d after operation, the average velocity of middle cerebral artery at 7 d after operation was remarkably higher and the pulsatility index was remarkably lower than that in control group (p<0.05). 7 d after operation, both groups had higher Glasgow Coma Scale scores than before operation (p<0.05). Compared with control group, 7 d after operation, Glasgow Coma Scale score of observation group was significantly higher (p<0.05). 3 mo after operation, good recovery rate (24.49 %) and moderate disability rate (46.94 %) in observation group were higher than those in control group, but severe disability rate (12.24 %) and mortality rate (6.12 %) were lower than those in control group and the vegetative state rate (10.20 %) had no significant difference compared with control group (p>0.05). Urapidil blood pressure regulation and mechanical ventilation combined with bone window craniotomy in the treatment of hypertensive basal ganglia intracerebral hemorrhage can reduce cerebral oxygen uptake rate, regulate middle cerebral artery blood flow parameters and improve prognosis.

Key words: Urapidil, blood pressure, mechanical ventilation, hypertension, intracerebral hemorrhage

Cerebral hemorrhage is a common serious complication in patients with hypertension and it has the characteristics of high incidence rate, high mortality and high disability rate, hypertensive cerebral hemorrhage often occurs in basal ganglia. After the formation of intracranial hematoma, the patient has intracranial hypertension and in severe cases develops into brain herniation, which threatens lives[1]. In order to rapidly reduce intracranial pressure, bone window craniotomy is often used in clinic to treat hypertensive basal ganglia intracerebral hemorrhage, but the cerebral extraction of oxygen of patients cannot be improved in time and long-term high blood pressure is easy to cause hematoma recurrence. So it is necessary to adopt mechanical ventilation and smooth reduction treatment after surgery to improve patient prognosis[2].

Urapidil is an alpha 1 receptor blocker, which has a good central hypotensive effect and can reduce peripheral vascular resistance, has a peripheral hypotensive effect and is used in the control of various types of hypertension[3]. However, previous studies have mostly focused on the research on the effect of urapidil on lowering blood pressure and there are few reports on the effect of urapidil on the brain oxygen uptake rate of patients. This study investigated the effect of urapidil blood pressure regulation and mechanical ventilation combined with bone window craniotomy in the treatment of hypertensive basal ganglia intracerebral hemorrhage and its effects on oxygen uptake rate, intracranial

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pressure and cerebral blood flow parameters.

MATERIALS AND METHODS

General information:

Selected 98 patients with hypertensive basal ganglia intracerebral hemorrhage who underwent bone window craniotomy hematoma removal and decompression in our hospital from May 2018 to May 2021. Divided them into two groups according to the treatment scheme, with 49 cases in a single group. Treated control group with regular treatment combined with mechanical ventilation, 24 males and 25 females included, ages were from 32 to 75 y old, average were about (56.08±7.14) y old; time from onset to admission were from 0.5 h to 4 h, average were about (2.17±0.29) h; hematoma volume were from 50 ml to 80 ml, average were about (65.85±5.78) ml; average Glasgow Coma Scale (GCS) scores were about (7.14±0.96) points. After receiving the same treatment as control group, observation group received another urapidil for blood pressure regulation, 28 males and 21 females included, ages were from 31 to 75 y old, average were about (57.11±7.06) y old; time from onset to admission were from 0.5 h to 4 h, average were about (2.20±0.25) h; hematoma volume were from 50 ml to 80 ml, average were about (64.96±6.04) ml; average GCS scores were about (7.08±1.09) points. Comparison of both groups general information was not of significant difference ($p>0.05$).

Inclusion criteria: Meet the standard of diagnostic criteria of hypertensive intracerebral hemorrhage were[4], clearly diagnosed as hypertensive basal ganglia intracerebral hemorrhage by head Computed Tomography (CT), undergo emergency craniotomy for hematoma removal and decompression treatment; age ≥18 y old, age ≤75 y old and data integrity.

Exclusion criteria: Previous cerebral hemorrhage; accompanied by mental illness; accompanied by thoracic and abdominal organ damage and important organ failure; allergic to study drug and pregnant women and other special groups.

Methods:

Patients in control group remained in bed, closely monitored their vital signs, fasted for 24~48 h after operation and then placed gastric tube. Adopted antihypertensive drugs to stably control blood pressure, ease brain edema to reduce intracranial pressure, monitor coagulation function, maintain nutrition water electrolyte balance. Actively prevent and treat complications such as infection, stress ulcer and lower extremity deep venous thrombosis. Adopt Biphasic Positive Airway Pressure (BIPAP) ventilation mode, positive end-expiratory pressure 25 cm H_2O, tidal volume 8-12 ml/kg, respiratory rate 12-18 times/min, inhalation-expiration ratio 1:2. Maintain blood oxygen saturation >97 %.

Observation group adopted urapidil (Takeda Austria GmbH, size: 5 ml:25 mg, Import Drug Registration Certificate No.: h20160363) to regulate blood pressure based on control group. Add 100 mg urapidil into 0.9 % sodium chloride injection, dilute to 50 ml and continue micropump injection. At the beginning, set pumping speed at 10 mg/h and adjusted it according to the patient's systolic blood pressure every 10 min until the blood pressure is well controlled (systolic blood pressure is maintained at about 140 mmHg) and then maintained the pumping.

Observation indicators and detection methods:

Compared both groups on cerebral oxygen uptake rate, intracranial pressure, blood flow parameters of middle cerebral artery, GCS scores and 3 mo prognosis.

Adopted Glasgow Outcome Scale (GOS)[5] to evaluate prognosis: 5 points means it has no impact on normal life, good recovery; 4 points means it can complete most of the daily work, moderate disability; 3 points means it is unable to take care of itself but clear consciousness, severe disability; 2 points means it is unable to take care of itself, persistent vegetative state and 1 points means death. Before operation and 6 h, 24 h, 48 h and 72 h after operation, adopt blood gas analysis to detect Internal Carotid Bulb Blood Oxygen Content ($CjvO_2$) and Radial Artery Blood Oxygen Content (CaO_2), cerebral oxygen uptake rate=Cardiac Output (Q)×(CaO_2-$CjvO_2$)/Q×CaO_2.

3 d and 7 d before and after surgery adopted ultrasonic to exam middle cerebral artery blood flow parameters (average flow rate, pulsatility index) of both groups. Testing equipment: Transcranial Doppler ultrasound system from Germany DWL Company, pulse probe frequency: 2 MHz. Adopted Chongqing Mingxi noninvasive intracranial pressure monitor to test intracranial pressure. Place grounding electrode at the center of the eyebrow, reference electrode at the forehead hairline or 2 cm away from grounding electrode, left and right scalp electrodes at the left and right occipital lobe respectively. First, use 75 % alcohol to clean the scalp where the electrode is installed and then apply supersaturated saline. Detect the impedance of left and right signals and reference electrodes to the ground, and

all three impedance values shall be less than 20 Hz. Put a flash mask on the patient, after starting the test, enter the file to save the test results.

Statistical analysis:

Adopted Statistical Package for the Social Sciences (SPSS) 19.0 software to analyze data. Used ($\bar{x}\pm s$) to indicate enumeration data with normal distribution and compared by t-test, expressed enumeration data by n, Percent (%) and compared by χ^2 test. $p<0.05$ was considered statistically significant.

RESULTS AND DISCUSSION

Before surgery, compared both groups on cerebral oxygen uptake rates, it possessed no statistical significance ($p>0.05$). At 6 h, 24 h, 48 h and 72 h after surgery, cerebral oxygen uptake rates of both groups decreased compared with before surgery ($p<0.05$). Observation group had lower cerebral oxygen uptake rates than control group ($p<0.05$) as shown in Table 1.

Before surgery, compared both groups on middle cerebral artery blood flow parameters and intracranial pressure, it possessed no statistical significance ($p>0.05$). 3 d and 7 d after surgery, mean flow velocity of middle cerebral artery of both groups enhanced but intracranial pressure and middle cerebral artery pulsatility index decreased compared with before surgery ($p<0.05$). Observation group had lower intracranial pressure at 3 d and 7 d after surgery than control group ($p<0.05$). Compared middle cerebral artery blood flow parameters after surgery of observation group with control group, the difference possessed no statistical significance ($p<0.05$). 7 d after surgery, observation group remarkably had higher mean flow velocity of middle cerebral artery and lower pulsatility index than control group ($p<0.05$) as shown in Table 2.

Before surgery, compared both groups on GCS scores, it possessed no statistical significance ($p>0.05$). 7 d after surgery, GCS scores of both groups enhanced compared with before surgery ($p<0.05$), observation group had higher GCS scores than control group ($p<0.05$) as shown in Table 3.

3 mo after surgery, observation group had higher good recovery rate (24.49 %) and moderate disability rate (46.94 %) than (8.16 %) and (22.45 %) of control group respectively, but lower severe disability rate (12.24 %) and death rate (6.12 %) than (28.57 %) and (22.45 %) of control group respectively, compared persistent vegetative state (10.20 %) of observation group with (18.37 %) of control group, the divergence possessed no statistical significance ($p>0.05$) as shown in Table 4.

Hypertensive basal ganglia intracerebral hemorrhage has a large amount of bleeding, which can cause the increase of intracranial pressure in a short time, emergency bone window craniotomy is needed to quickly reduce intracranial pressure and block the occurrence of cerebral hernia[6]. However, the location of basal ganglia hemorrhage is deep and surgical removal of hematoma is easy to lead to postoperative side injury. Restoring cerebral oxygen uptake rate as soon as possible after operation is conducive to protecting neurological function and improving the prognosis of patients. Mechanical ventilation can improve patients' ventilation function, form alveolar and airway pressure difference, reduce energy consumption in the process of breathing and maintain oxygen supply to brain tissue[7]. Liu *et al*.[8] adopted mechanical ventilation to treat severe craniocerebral injury and found that it was helpful to improve the oxygen supply of brain tissue and reduce the neurological deficit.

Hypertension is an independent risk factor for cerebral hemorrhage in basal ganglia. Therefore, blood pressure should be actively controlled after bone window craniotomy to prevent rebleeding. However, during antihypertensive treatment, we should steadily reduce blood pressure to prevent the risk caused by sudden drop of blood pressure[9]. Urapidil has both central and peripheral antihypertensive effects. It has advantages in the treatment of hypertensive crisis, severe, extremely severe hypertension and refractory hypertension. Clinically, it is mainly used for perioperative blood pressure control[10]. Jin adopted urapidil combined with ganglioside to treat hypertensive intracerebral hemorrhage and found that it can better control blood pressure and improve the prognosis of patients[11].

This study found that compared with patients with routine treatment combined with mechanical ventilation, those with urapidil blood pressure regulation combined with mechanical ventilation combined with bone window craniotomy 7 d after operation had higher GCS scores. At 3 mo after operation, good recovery rate and moderate disability rate were higher, severe disability rate and mortality rate were lower and the vegetative state rate was similar under the two treatment schemes. These results suggest that urapidil blood pressure regulation and mechanical ventilation combined with bone window craniotomy in the treatment of hypertensive basal ganglia intracerebral hemorrhage can improve the prognosis, reduce mortality and reduce the degree of disability. This is because urapidil can block peripheral blood vessels alpha receptor, excite the central system 5-hydroxytryptamine IA receptor, and achieve the dual antihypertensive effect of peripheral and central[12]. This can relieve the pathogenic factors of intracerebral hemorrhage, not only prevent rebleeding, but also improve hemodynamics, inhibit platelet aggregation, reduce the risk of cerebral thrombosis after intracerebral hemorrhage and improve the prognosis of patients[13].

Cerebral oxygen uptake rate is an index reflecting the functional state of brain cells and oxygen utilization ability. Space occupying injury caused by intracerebral hemorrhage and surgical trauma can reduce cerebral oxygen uptake rate, affect the oxygen supply of brain tissue and then cause neurological deficit[14]. This study found that cerebral oxygen uptake rate in both groups at 6 h, 24 h, 48 h and 72 h after operation was lower than that before operation, suggesting that the operation had an adverse effect on brain cells function and oxygen utilization ability. Compared with those treated with routine treatment combined with mechanical ventilation, those treated with urapidil blood pressure regulation combined with mechanical ventilation combined with bone window craniotomy had significantly higher cerebral oxygen uptake rate at 6 h, 24 h, 48 h and 72 h after operation, it suggested that urapidil blood pressure regulation and mechanical ventilation combined with bone window craniotomy in the treatment of hypertensive basal ganglia intracerebral hemorrhage can improve cerebral oxygen uptake rate and help the brain tissue restore sufficient oxygen supply. It has relationship with urapidil blocking the postsynaptic membrane alpha 1 receptor[15].

We still found that compared with patients with routine treatment combined with mechanical ventilation, patients treated with urapidil blood pressure regulation and mechanical ventilation combined with bone window craniotomy had remarkable lower intracranial pressure at 3 d and 7 d after surgery, higher mean flow velocity of middle cerebral artery at 7 d after surgery and lower pulsatility index. It suggested that urapidil blood pressure regulation and mechanical ventilation combined with bone window craniotomy in the treatment of hypertensive basal ganglia intracerebral hemorrhage can reduce intracranial pressure and regulate the blood flow parameters of middle cerebral artery. Urapidil's vasodilatory effect can increase the blood perfusion of brain tissue, promote the absorption of brain edema and inflammatory exudate, thereby reduce intracranial pressure[16].

In summary, urapidil blood pressure regulation and mechanical ventilation combined with bone window craniotomy in the treatment of hypertensive basal ganglia intracerebral hemorrhage can improve cerebral oxygen uptake rate, regulate middle cerebral artery blood flow parameters and improve prognosis.

TABLE 1: COMPARISON OF CEREBRAL OXYGEN UPTAKE RATES BETWEEN AND WITHIN GROUPS (x̄±s)

Group	Cases	Cerebral oxygen uptake rate (%)				
		Before surgery	6 h after surgery	24 h after surgery	48 h after surgery	72 h after surgery
Control group	49	34.58±3.26	30.21±2.58*	29.82±3.26*	30.58±3.27*	28.96±2.91*
Observation group	49	35.01±3.17	26.86±2.41*	25.12±2.43*	22.74±2.54*	20.36±2.47*
t		0.662	6.642	8.091	13.254	15.772
p		0.510	0.000	0.000	0.000	0.000

Note: Compared with this group before surgery, *p<0.05

TABLE 2: COMPARISON OF MIDDLE CEREBRAL ARTERY BLOOD FLOW PARAMETERS AND INTRACRANIAL PRESSURE BETWEEN AND WITHIN GROUPS (x̄±s)

Parameter	Time	Control group (n=49)	Observation group (n=49)	t	p
Intracranial pressure (mmHg)	Before surgery	35.14±3.26	34.97±3.31	0.256	0.798
	3 d after surgery	23.45±2.78*	19.02±2.86*	7.775	0.000
	7 d after surgery	17.12±2.14*	14.21±2.02*	6.922	0.000
Middle cerebral artery blood flow parameters					
Mean flow velocity (cm/s)	Before surgery	38.25±4.12	38.07±4.46	0.208	0.836
	3 d after surgery	63.52±4.58*	62.89±5.01*	0.650	0.517
	7 d after surgery	65.23±5.17*	72.25±4.62*	7.087	0.000
Pulsatility index	Before surgery	1.52±0.14	1.51±0.18	0.307	0.760
	3 d after surgery	1.03±0.12*	0.99±0.11*	1.720	0.089
	7 d after surgery	0.94±0.11*	0.82±0.14*	4.718	0.000

Note: Compared with this group before surgery, *p<0.05

TABLE 3: COMPARISON OF GCS SCORES BETWEEN AND WITHIN GROUPS (x̄±s)

Group	Cases	GCS scores (point)	
		Before surgery	7 d after surgery
Control group	49	7.14±0.56	8.58±1.02*
Observation group	49	7.08±1.59	9.94±1.11*
t		0.249	6.315
p		0.804	0.000

Note: Compared with this group before surgery, *p<0.05; GCS: Glasgow Coma Scale

TABLE 4: COMPARISON OF PROGNOSIS BETWEEN GROUPS [n (%)]

Group	Cases	Good recovery rate	Moderate disability rate	Severe disability rate	Persistent vegetative state	Death
Control group	49	4 (8.16)	11 (22.45)	14 (28.57)	9 (18.37)	11 (22.45)
Observation group	49	12 (24.49)	23 (46.94)	6 (12.24)	5 (10.20)	3 (6.12)
t		4.781	6.485	4.021	1.333	5.333
p		0.029	0.011	0.045	0.248	0.021

Acknowledgement:

This work was supported by Wenling Science and Technology Plan Project (Grant number: 2018C310014)

Conflicts of interest:

The authors declared no conflicts of interest.

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This article was originally published in a special issue, "New Advancements in Biomedical and Pharmaceutical Sciences" Indian J Pharm Sci 2022:84(2)Spl Issue "74-78"