

Effects of Endovascular Interventional Therapy at Different Stages on Blood Pressure and Cerebral Blood Flow Perfusion in Patients with Ruptured Hunt-Hess High-Grade Intracranial Aneurysms

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Abstract: Objective To investigate the effects of endovascular interventional therapy at different stages on blood pressure and cerebral blood flow perfusion in patients with ruptured Hunt-Hess high-grade intracranial aneurysms. **Methods** The clinical data of 137 patients with ruptured Hunt-Hess high-grade intracranial aneurysms admitted to the hospital from January 2022 to January 2024 were retrospectively analyzed. Patients were grouped according to the timing of endovascular intervention. Patients treated within 48 hours of onset were included in the observation group (n=75), while those treated between 48 and 96 hours after onset were assigned to the control group (n=62). The changes of blood pressure during operation and compared to preoperative values were analyzed in the two groups, postoperative cerebral blood flow perfusion [Cerebral blood flow (CBF), cerebral blood volume (CBV), time to peak (TTP), and mean transit time (MTT)]. The incidence of complications within 6 months after surgery was compared between the two groups. **Results** Intraoperative hemodynamic stability in the observation group were lower than those in the control group (P<0.05). Postoperative CBF and CBV were higher than before operation in both groups. And TTP and MTT were shorter than before surgery (P<0.05). However, there was no statistically significant differences between groups (P>0.05). The incidence of complications in the observation group was lower than that in the control group (P<0.05). **Conclusion** The earlier vascular interventional treatment is performed, the more conducive to stabilizing intraoperative blood pressure and reducing the risk of postoperative complications in patients with Hunt-Hess high-grade ruptured intracranial aneurysms.

Keywords: Hunt-Hess high-grade; Ruptured Intracranial Aneurysm; Blood Pressure; Cerebral Blood Flow Perfusion.

1. Introduction

Ruptured intracranial aneurysm is an extremely serious cerebrovascular disease. Among them, patients with Hunt-Hess high-grade are particularly critical, and their mortality and disability rates have remained high [1]. Endovascular interventional therapy is currently one of the important treatment methods for ruptured intracranial aneurysms. The choice of treatment timing has always been a hot topic and controversial focus in clinical research. The mechanism of the effect of different treatment windows on cerebral perfusion recovery is also very complex. Ultra-early interventional therapy may have advantages in restoring cerebral blood perfusion in a timely manner. Early intervention treatment also has the view that treatment after the condition is relatively stable can better assess the patient's overall condition and develop a more optimal treatment plan [2]. The

purpose of this study is to conduct an in-depth study of the effects of endovascular intervention at different periods on blood pressure and cerebral blood flow perfusion in patients with ruptured Hunt-Hess high-grade intracranial aneurysms. It is reported as follows.

2. Data and Methods

2.1. Clinical Data

The clinical data of 137 patients with ruptured Hunt-Hess high-grade intracranial aneurysms admitted to the hospital from January 2022 to January 2024 were retrospectively analyzed. Patients were grouped according to the timing of endovascular intervention. Patients treated within 48 hours of onset were included in the observation group (n=75), while those treated between 48 and 96 hours after onset were assigned to the control group (n=62). The two groups of patients were comparable (P>0.05), as shown in Table 1.

Table 1. Comparison of general data of patients in the two groups [$\bar{x} \pm s$, n (%)]

Group	Average Age (years)	Gender		Tumor Diameter (cm)	Hunt-Hess Classification	
		Male	Female		III	IV
Observation Group(n=75)	51.69±9.45	41(54.67)	34(45.33)	3.48±0.53	36(48.00)	39(52.00)
Control Group(n=62)	52.51±9.32	39(62.90)	23(37.10)	3.55±0.59	29(46.77)	33(53.23)
t/χ^2	0.509	0.948		0.731	0.020	
P	0.612	0.330		0.466	0.886	

2.2. Inclusion and Exclusion Criteria:

Inclusion criteria: 1) One or more intracranial aneurysms were diagnosed with bleeding due to rupture of the aneurysm [3]. 2) Hunt-Hess high grade. 3) Age > 18 years old.

Exclusion criteria: 1) History of interventional treatment. 2) The condition cannot be controlled by interventional therapy and requires craniotomy or is converted to craniotomy for other reasons. 3) Abnormal coagulation function. 4) Complicated intracranial malignant tumor. 5) Pregnancy or lactation. 6) Missing clinical data.

2.3. Methods

All patients underwent standardized endovascular interventional treatment procedures. The patient was placed in a supine position, routinely disinfected and draped, and under general anesthesia. Seldinger technique was used to identify the lesion through femoral artery puncture angiography. A 6F arterial sheath was placed through the right femoral artery, and the 6F guiding catheter was guided by a guide wire to the appropriate position in the internal carotid artery or vertebral artery of the affected side. Guided by the road map. Place the tip of the microcatheter into the aneurysm lumen, and according to the size, shape and neck width of the aneurysm. Select appropriate Guglielmi detachable coils for embolization until the aneurysm was completely occluded, and angiography showed that the parent artery was patent.

2.4. Observation Indicators

1) Intraoperative blood pressure changes: Analyze the

changes of intra-operative blood pressure in two groups of patients. 2) Cerebral blood flow perfusion: CT perfusion imaging (CTP) was used to measure cerebral blood flow perfusion parameters before and 7 days after surgery. Including cerebral blood flow (CBF), cerebral blood volume (CBV), time to peak (TTP) and mean transit time (MTT). 3) Incidence of complications: Complications such as hydrocephalus, rebleeding and intracranial infection were recorded within 6 months after operation.

2.5. Statistical Analysis

The above data were analyzed by SPSS25.0. The quantitative data of this study all conform to normal distribution, expressed as ($\bar{x} \pm s$). Independent sample t-test was performed between the two groups, and paired t-test was performed within each group. The counting data were tested using χ^2 test, and the data were expressed as n (%). $P < 0.05$ was considered as the difference was statistically significant.

3. Results

3.1. Comparison of Intraoperative Hemodynamic Stability Between the Two Groups of Patients

Intraoperative systolic and diastolic blood pressure differences in the observation group were lower than those in the control group ($P < 0.05$), as shown in Table 2.

Table 2. Comparison of intraoperative hemodynamic stability between the two groups ($\bar{x} \pm s$, mmHg)

Group	Systolic Pressure Gradient	Diastolic Pressure Difference
Observation Group($n=75$)	24.49 $\pm$ 5.64	20.46 $\pm$ 3.91
Control Group($n=62$)	33.68 $\pm$ 7.15	23.09 $\pm$ 3.83
<i>t</i>	8.409	3.955
<i>P</i>	<0.001	<0.001

3.2. Comparison of Cerebral Blood Flow Perfusion Between the Two Groups of Patients

Postoperatively, CBF and CBV were higher than before

surgery, and TTP and MTT were shorter than before surgery in both groups ($P < 0.05$), but there was no statistical significance between the groups ($P > 0.05$), as shown in Table 3.

Table 3. Comparison of cerebral blood flow perfusion between the two groups ($\bar{x} \pm s$)

Group	Time	CBF [mL/(100g•min)]	CBV [mL/(100g•min)]	TTP(s)	MTT(s)
Observation Group($n=75$)	Preoperative	51.39 $\pm$ 6.35	62.47 $\pm$ 6.82	24.86 $\pm$ 3.05	14.06 $\pm$ 2.63
	Postoperative 7 days	73.56 $\pm$ 7.58a	84.53 $\pm$ 8.05a	19.35 $\pm$ 1.61a	7.89 $\pm$ 0.72a
Control Group($n=62$)	Preoperative	52.04 $\pm$ 6.72	61.36 $\pm$ 7.34	24.53 $\pm$ 3.17	14.31 $\pm$ 2.75
	Postoperative 7 days	74.08 $\pm$ 7.61a	83.18 $\pm$ 8.26a	19.62 $\pm$ 1.74a	8.02 $\pm$ 0.78ab

Note: Compared with before intervention, ^a $P < 0.05$.

3.3. Comparison of Postoperative Complications between the Two Groups

The total complication rate in the observation group was lower than that in the control group ($P < 0.05$), as shown in Table 4.

4. Discussion

After an intracranial aneurysm ruptures, if subarachnoid hemorrhage cannot be absorbed in time. It can lead to obstruction of cerebrospinal fluid circulation and cause complications such as hydrocephalus [4-6]. Interventional treatment is currently a common method for treating ruptured

intracranial aneurysms. However, there are still different views on the best time for surgery. Among them, early surgery for patients with low Hunt-Hess classification can achieve

better clinical outcomes. However, patients with high-grade Hunt-Hess are in critical condition, and their optimal timing for surgery is controversial.

Table 4. Comparison of postoperative complications between the two groups [n (%)]

Group	Hydrocephalus	Rebleeding	Intracranial Infection	Cerebral Infarction	Cerebral Vasospasm	Always Happen
Observation Group(n=75)	2(2.67)	0(0.00)	1(1.33)	1(1.33)	1(1.33)	5(6.67)
Control Group(n=62)	5(8.06)	2(3.23)	1(1.61)	1(1.61)	2(3.23)	11(17.74)
t						4.036
P						0.045

The results of this study show that patients treated very early have lower intraoperative hemodynamic stability. It shows that endovascular intervention within 48 hours of onset of disease can effectively reduce intraoperative hemodynamic stability and maintain hemodynamic stability. After an intracranial aneurysm ruptures, blood flows into the subarachnoid space. This causes a sharp increase in intracranial pressure, and the blood vessel wall around the aneurysm is under huge pressure. In this case, even small fluctuations in blood pressure may cause the aneurysm to rupture and bleed again. Ultra-early interventional treatment quickly relieves the pressure load on the aneurysm by embolizing the aneurysm. The pressure on the blood vessel wall is returned to normal, thereby reducing the impact of hemodynamic stability on the aneurysm. On the other hand, the results of this study showed that the cerebral blood flow perfusion in the two groups was similar at 7 days after surgery. It suggests that similar perfusion benefits can be obtained when treated within 96 hours. This may be because within 96 hours after the onset of the disease, although the brain tissue has a certain degree of ischemic and hypoxia damage, it still has strong self-repair and compensatory capabilities. Even if intervention is performed at a relatively late time, by restoring vascular patency, brain tissue can still re-establish effective collateral circulation and improve cerebral perfusion. But this does not mean that the patient's treatment timing can be indefinitely delayed. In addition, the total complication rate in the observation group was lower than that in the control group in this study. The reason is that ultra-early treatment can reduce the risk of rebleeding, mainly due to early thrombosis. Interventional embolization within 48 hours of onset can quickly seal the aneurysm breach and promote thrombosis at the breach. After thrombosis is formed, blood is effectively prevented from flowing into the subarachnoid space again, thereby reducing the possibility of rebleeding.

In summary, ultra-early endovascular intervention (within 48 hours of onset) has significant advantages in terms of

intraoperative blood pressure stability and postoperative complications in patients with Hunt-Hess high-grade ruptured intracranial aneurysms. Ultra-early interventional therapy can effectively reduce intraoperative hemodynamic stability. It provides a stable hemodynamic environment for the smooth operation and reduces the risk of aneurysm rupture. The shortcoming of this study lies in the lack of long-term neurological prognosis data. Although the study observed the occurrence of complications within 6 months after surgery. However, the assessment of patients' long-term neurological function recovery, such as cognitive function and motor function, is insufficient, and this issue needs to be further studied in clinical practice.

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