

# Management of Perioperative Target Blood Pressure in Bridging Therapy for Acute Ischemic Stroke

Lin Zhu\*, Qinghong Wang, Cuncun Liu

Department of Neurology, Affiliated Hospital of Xuzhou Medical University, Xuzhou, 221002, China

**Abstract: Objective:** To investigate the management of perioperative target blood pressure in the treatment of acute ischemic stroke with intravenous thrombolytic bridging. **Methods:** Retrospective analysis of the blood pressure management and nursing experience of 36 patients with acute ischemic stroke who received endovascular treatment with bridge mode from November 2017 to January 2019 in our hospital. Through correct monitoring of basic blood pressure, rapid and stable blood pressure reduction before the bridge treatment, close cooperation during the operation, and close observation and treatment of postoperative blood pressure fluctuations, the patient's blood pressure can be controlled within the target range. **Results:** The blood vessels of 36 patients were partially or completely recanalized after treatment. Clinical outcomes: Two cases died. After 90 days, 29 patients with good clinical outcomes were followed up, and 5 patients with poor clinical prognosis. **Conclusion:** Effective blood pressure management is a necessary measure in the perioperative period of bridging therapy for patients with acute ischemic stroke, which can reduce the postoperative complications of patients treated with bridging therapy, obtain good therapeutic effect and improve the prognosis of patients.

**Keywords:** Acute ischemic stroke; Bridged; Endovascular treatment; Perioperative period; Blood pressure management

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**Corresponding Author:** Lin Zhu, 1023109967@qq.com

## 1 Introduction

Acute ischemic stroke (AIS) is the most common

type of stroke, with extremely high mortality and disability, causing huge social burden and economic loss<sup>[1]</sup>. Early recanalization of the occluded vessels and rescue of the ischemic penumbra area is a key therapeutic strategy to AIS. Intravenous administration of recombinant tissue plasminogen activator (rt-PA) within the first 4.5 hours from symptom onset is a well-established effective therapy for early vascular recanalization in patients presenting with AIS, and has been widely used in the world<sup>[2]</sup>. Unfortunately, due to the narrow time window for thrombolysis therapy, and a poor vascular recanalization rate of 13% to 18% for patients presenting with AIS with large vessel occlusion (AIS-LVO), clinical benefits are limited<sup>[3]</sup>. In recent years, with the progressive development of endovascular therapies, bridging approach with intravenous thrombolytic therapy for patients with large vessel occlusion has shown obvious advantages, which has been unanimously recommended by guidelines both from China and abroad<sup>[4, 5, 6]</sup>. Due to the impact of thrombolysis, surgery and patients themselves, the perioperative hemodynamics are unstable and blood pressure fluctuations are obvious, especially for patients with hypertension. Poor blood pressure control often leads to serious complications, including hemorrhage. Conversion and hyperperfusion syndrome, while active and strict blood pressure control is an important preventive measure. Therefore, management of perioperative target blood pressure is critical to patient outcomes. Thirty-six patients with AIS admitted to our hospital during November 2017 and January 2019 who underwent intravascular thrombolysis with bridging endovascular therapy (stent mechanical thrombolysis or stent implantation) were treated with effective blood pressure management and achieved a good therapeutic effect. It is reported as follows.

## 2 Clinical data

### 2.1 Patients

Thirty-six consecutive patients with AIS admitted to our hospital during November 2017 and January 2019 who underwent intravascular thrombolysis with bridging endovascular therapy (stent mechanical thrombolysis or stent implantation) were collected for study. Of the 36 patients, 25 were males and 11 were females, 51 to 82 years old with a mean age of  $63.6 \pm 12.7$ , and the National Institutes of health stroke scale (NIHSS) of  $14.86 \pm 5.63$ . All the patients met the relevant diagnostic criteria in the *Guidelines for Early Intravascular Interventional Therapy for Acute Ischemic Stroke in China, 2018*<sup>[7]</sup> and were excluded for intracranial hemorrhage at admission by emergency plain head CT scanning, and were diagnosed with intracranial and extracranial vascular occlusion by CTA, with Alberta stroke program early CT score (ASPECTS)  $\geq 6$ . Among them, 21 cases were diagnosed with middle cerebral artery occlusion, 6 with internal carotid artery occlusion, 5 with intracranial artery intracranial segment with middle cerebral artery occlusion, and 4 with vertebral basilar artery occlusion. Informed consent forms were obtained from all patients and the diagnosis and treatment procedures were in accordance with medical practice standards.

### 2.2 Methods

Of the 36 patients, 23 were given local anesthesia and 13 were given general anesthesia according to patients' cooperation. After anesthesia, the right femoral artery was punctured using modified Seldinger techniques, cerebral angiography was performed to identify the occlusion site, and endovascular therapy was administered (Solitaire FR stent mechanical thrombectomy or stent implantation).

### 2.3 Results

Thirty-one cases out of the 36 patients achieved a modified thrombolysis in cerebral infarction (mTICI) score of 2b or 3 in postoperative distal blood flow, 4 patients who failed in the removal of emboli after 3 times of thrombectomy, achieved a satisfactory result after stent implantation (residual stenosis rate less than 40%); thirty-six patients had a preoperative mean NIHSS score of  $19.86 \pm 4.63$  points, and  $8.67 \pm 3.15$  points one week after operation; among the 36 patients, 3 cases had symptomatic intracranial hemorrhage within 24 hours after surgery, of whom 2 died and 1

had a mRS score of 2 points one month later. Follow-up results after 90 days showed that 29 patients had good clinical outcomes and 5 cases had a poor clinical prognosis.

## 3 Key points for blood pressure regulation

### 3.1 Blood pressure regulation before intravenous thrombolysis

After admission to hospital, patients with hypertension who met the indications for intravenous thrombolysis were subjected to a rapid and steady lowering of blood pressure. About 70% of the patients presenting with ischemic stroke had elevated blood pressure in the acute phase<sup>[8]</sup>, the main reasons include: pre-existing hypertension, postoperative headache, nausea and vomiting, loss of function, unfamiliarity with thrombolysis and intravascular therapy and worries about the high cost of surgery, leading to patients to have obvious anxiety and nervousness. The guidelines require that blood pressure be reduced to lower than 185/110 mmHg prior to thrombolysis therapy with rt-PA. For patients who are prepared for thrombolysis with bridging endovascular thrombectomy, their blood pressure should be controlled lower than 180/105 mmHg<sup>[9]</sup>. Therefore, it is an urgent task to rapidly reduce blood pressure and reduce in-hospital delay in patients with hypertension who meet the indications for thrombolysis. Main points for nursing: (a) Mental nursing: After patient admission to hospital, nurses from the stroke team should take the initiative to care for and comfort patients, assist doctors to communicate with patients and their families, inform them of possible changes in the acute phase of stroke and the benefits and risks of intravascular thrombolytic bridging therapy within the time window, stabilize patients' mood, and obtain family cooperation. (b) Assessment and treatment: After patient admission to hospital, nurses from the stroke team should quickly assess the patient's symptoms and vital signs, establish two intravenous access, assist doctors to improve the relevant laboratory examinations quickly, accompany patients to do head CT, head and neck CTA and other examinations to determine that catheter is retained as appropriate after the endovascular therapy. (c) Bedside ECG monitoring: After patient admission to hospital, the two upper arm blood pressure is measured in comparison, which is subject to the higher upper arm blood pressure, and the blood pressure and heart rate are monitored and the changes of consciousness and muscle strength

were observed. After initiation of drug infusion, measure the blood pressure once at 5 min and adjust the infusion speed according to the blood pressure and heart rate of the patient. When the patient's blood pressure was stabilized at the target value of lower than 180/105 mmHg, intravenous rt-PA was given according to the doctor's instructions. Adjust the dosage and infusion speed of the drugs according to the change of blood pressure at any time until the patient enters the interventional treatment room. (d) Safe transport while giving rt-PA for intravenous thrombolysis, assist the doctors to quickly and smoothly transfer the patient to the interventional operating room. In this study, the blood pressure of 29 patients at admission was 186-230/80-136 mmHg, and the difference between the systolic pressure of the two upper arms was 8-42 mmHg. Urapidil hydrochloride injection was slowly injected intravenously in a 10-25 mg bolus according to the doctor's instructions and repeated at an interval of 5-10 min until the target blood pressure was achieved, then a continuous infusion of the drug was administered at a speed of 5-10 mg/h via a micro-pump to maintain the systolic pressure at 140-180 mmHg. After sequential treatment with urapidil, 6 patients failed in meeting the criteria for blood pressure reduction, and the blood pressure reached the target smoothly after the drugs were replaced with nicardipine and other drugs.

### **3.2 Intraoperative blood pressure monitoring**

At present, there is insufficient evidence-based medical evidence for the target value of perioperative blood pressure management in patients with AIS undergoing bridging therapies. Doctors from the interventional team mainly rely on clinical experience and situation of patients' vascular occlusion and recanalization, area of infarction, collateral circulation and risk of hemorrhagic transformation to make decisions. Intraoperative determination of target blood pressure values in our hospital is based on the principles of individualization. The target value of systolic blood pressure was maintained at 140-160 mmHg before vascular recanalization and at 100-140/70-90 mmHg after vascular recanalization upon the requirements of doctors. Because of the complexity and uncertainty of endovascular therapy, as well as patients' unfamiliarity with the environment of the interventional therapy room and their incomprehension of interventional therapy, patients are prone to emotional fluctuations, affecting the stability of blood pressure. Main points for nursing: (a) Nursing hand-over of patient condition

and assessment: Nurses from the interventional team should quickly get to know the main conditions of patients, including vital signs, body weight, past history, allergy history, etc., focusing on assessing the changes of patients' consciousness, pupil, language, muscle strength, etc., and to understand the situation of rt-PA infusion for patients, understand the difference of patients' upper arm blood pressure, in order to make a good baseline comparison. (b) Psychological nursing: Nurses from the interventional team should briefly introduce the operation process to patients and the feelings that patients may experience during contrast injection, emphasize the key points of cooperation, ask patients whether the ambient temperature is appropriate, and give targeted psychological care to eliminate patients' stress and anxiety. (c) ECG monitoring: Blood pressure and heart rate were closely monitored during the operation, blood pressure was measured every 3-5 minutes. When necessary, blood pressure was measured at any time or measured manually for comparison. Abnormal blood pressure fluctuations occurred suddenly during the operation were alerted, and blood pressure was maintained within the target range according to the requirements of doctors from the interventional team. Five patients in this study suffered from restlessness, elevated blood pressure and poor effect after increase of antihypertensives. After emergency consultation with the anesthetists, 3 patients were sedated with dexmedetomidine and 2 were changed to general anesthesia. The patients' blood pressure gradually stabilized and maintained at an ideal level.

### **3.3 Postoperative blood pressure management**

Because of the difference of patients' baseline blood pressure, operation type, recanalization of blood vessels and collateral compensation, blood pressure control after acute endovascular therapy often becomes a difficult point in clinical decision-making. Hypertension easily leads to hemorrhagic transformation and hyperperfusion syndrome. Hypotension easily leads to the progress of occlusion and infarction, and the extent of fluctuation of blood pressure after operation will seriously affect the prognosis of patients<sup>[10]</sup>. Therefore, maintaining ideal blood pressure and minimizing blood pressure fluctuations are the key points for nursing after interventional therapy.

#### **3.3.1 Blood pressure monitoring techniques**

The patients were moved to the stroke unit after

operation and were routinely monitored by multi-functional ECGs. The main points for nursing were as follows: (a) Setting of blood pressure measuring frequency. The frequency of blood pressure measurement was adjusted dynamically according to the adjustment of drugs and blood pressure, and manual measurements were made if necessary for comparison. Usually, the frequency of blood pressure measurement is set at an interval of 5 minutes, and is adjusted to an interval of 10-15 minutes after stabilization, and is changed to 30 minutes after stabilization for 12 hours, lasting for 24 to 72 hours. (b) Setting of target blood pressure warning value. Purpose: Setting the alarm value close to the target value of blood pressure in order to adjust the infusion speed of antihypertensive drugs in time can not only control blood pressure safely and smoothly within the target range, but also avoid excessive fluctuations of blood pressure. Method: According to the span of target blood pressure, the lower alarm limit for the systolic blood pressure was set 5-10 mmHg higher than the minimum value of target blood pressure, and the upper alarm limit was set 5-10 mmHg lower than the maximum value of target blood pressure. (c) Conduct publicity and education on blood pressure measurement for conscious patients and their families: When measuring blood pressure, try to make the patient in a quiet and lying state. If the condition permits, take turns to measure the blood pressure of both upper arms. If the patient needs to lie on the side, measure the blood pressure of the upper limb on the lower side to reduce errors.

### 3.3.2 Treatment of hypertension

Hyperperfusion syndrome or hemorrhagic transformation often occurs in patients undergoing intravenous thrombolysis with bridging therapy. Active blood pressure management is an important measure to reduce hyperperfusion syndrome or hemorrhagic transformation after operation<sup>[11]</sup>. Main points for nursing: (a) Observation of patient's condition: Primary nurses should have a detailed understanding of the anesthesia method, types of operation and vascular recanalization during operation, closely observe patient's condition, regularly assess the changes in patient's consciousness, pupils, language, muscle strength, etc., observe symptoms such as headache, dizziness, vomiting, and assist doctors to regularly evaluate NIHSS, discover the precursors of complications such as hemorrhagic transformation

in time, and provide more clinical evidence for doctors to adjust target blood pressure. (b) Nursing on administration: Primary nurses should closely monitor patients' blood pressure, heart rate and urine volume during the administration of antihypertensive drugs according to doctor's orders, and adjust the infusion speed of urapidil hydrochloride and labellol hydrochloride in time according to the changes of blood pressure, so as to maintain the blood pressure at the target value: 100-140/70-90mmHg. (c) Comfort nursing: The most prominent problems in patients receiving endovascular therapy within 24 hours are discomfort caused by bed rest, anxiety caused by immobilisation, fatigue, back pain, etc., which in turn affect the management of target blood pressure. Therefore, nurses should introduce the concept of humanistic care into the whole process of disease management. First of all, the primary nurses should explain the importance of limb immobilisation and bed rest to the patient to obtain the patient's understanding. They should guide the patient to move in an appropriate range and scope to shorten his/her time of bed rest and get out of bed as soon as possible according to the type of vascular occlusion device used and local skin condition at the site of puncture point. Secondly, for patients during their bed rest period, the primary nurses should take effective measures to relieve the patients' discomfort in addition to conducting periodical bedside evaluation on whether there are skin stasis and hematoma in the femoral artery puncture area, whether the dressing is clean and dry, whether there is swelling on the operative limb, whether the skin color and temperature at the end of the limb is changed, and on the pulsation of bilateral dorsal pedal artery. For example, massage the muscles of the patient's body, lower limbs and other sore parts, cushion a soft pillow under the patient's waist, assist the patient to roll over along the axis once every 2 hours after operation, encourage awake patients to complete ankle pump exercises alone, etc. This can not only effectively prevent the occurrence of deep venous thrombosis in lower limbs, but also relieve muscle soreness and discomfort, and increase the comfort and improve the compliance of bedridden patients. Thirdly, for patients who are ineffective to psychological comfort and physical massage, with extreme agitation and anxiety and poor blood pressure control, sedative drugs should be used according to doctor's orders without affecting the observation of the illness condition. In this group, eszopiclone was used in 2 patients after operation. After

sleeping for 2 to 4 hours, the patients were emotionally stable and their blood pressure was well controlled.

### 3.3.3 Treatment of hypotension

Perioperative hypotension often occurs after interventional therapy of carotid artery stenosis, mostly related to bradycardia. Primary nurses should assist doctors to actively identify the causes and give appropriate treatment. Main points for nursing: (a) Patient's condition observation: Observe the changes in patient's consciousness, pupil, language, muscle strength and find in time the early signs of cerebral infarction progression. (b) Nursing of drug administration: A separate 20 G indwelling needle was selected to give atropine and dopamine according to the doctor's advice. The infusion speed of dopamine was adjusted dynamically and slowly according to the change of blood pressure. The target systolic blood pressure was maintained above 100 mmHg to avoid excessive fluctuation of blood pressure. (c) Nursing of fluid rehydration: Assist doctors in giving intravenous and oral rehydration to replenish blood volume in patients. Perioperative hypotension occurred in one patient in this study group. The patient's blood pressure recovered to normal on the 4th day after operation after sequential administration of atropine and dopamine. After the dopamine was stopped, the systolic blood pressure was stabilized at above 100 mmHg.

## 4 Conclusions

At present, for patients presenting with AIS-LVO within 4.5 hours after the onset of AIS, intravenous thrombolysis with bridging endovascular therapy is still the preferred treatment recommended by the guidelines<sup>[12]</sup>, and proper post-operative management can improve the prognosis of patients. Studies have shown that in patients with complete reperfusion during endovascular therapy, continuous blood pressure control within 24 hours after surgery can improve functional recovery 3 months postoperatively<sup>[13]</sup>. In this study group, 82% of the patients were accompanied by hypertension. Clinically, perioperative blood pressure management of patients with acute ischemic stroke involves the departments of emergency, neurology, neurosurgery, imaging, intervention, anesthesiology and other related departments. On the one hand, nurses should communicate with the personnel of these departments effectively, so as to understand the patients' target value of blood pressure, patients' sensitivity

to drugs and hemodynamic changes in time. On the other hand, nurses should actively adopt individualized nursing management strategies, closely observe the condition of patients, correctly apply antihypertensive drugs according to doctor's orders, eliminate the factors that interfere with blood pressure changes in time, and stabilize blood pressure in the target range. In summary, blood pressure management is an important nursing work in the perioperative period of bridging therapy. In clinical practice, nurses should accumulate more experience in the perioperative target blood pressure management of stroke patients, establish nursing practice guidelines for interventional treatment of stroke patients as soon as possible, standardize nursing management, and improve the quality of medical care.

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