

Application of Sedation and Analgesia Nursing in Endovascular Treatment of Patients with Acute Ischemic Stroke

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Abstract: Background: For acute ischemic stroke (AIS) patients with anterior circulation occlusion, local anesthesia can significantly shorten the time from endovascular treatment to recanalization. Objective: To investigate the application of individualized sedation and analgesia nursing in endovascular treatment (EVT) of patients with anterior-circulation AIS. Methods: From October 2019 to October 2020, all of 78 patients who underwent EVT with anterior-circulation AIS were retrospectively collected. Before interventional preoperative, doctors and nurses cooperated to comprehensively evaluate the patient's condition. Based on fully considering patients' respiratory function, hemodynamic status and pathological and physiological status, individualized sedation and analgesia targets were formulated. The nurses dynamically assessed the patients' sedation score with Sedation-Agitation Scale (SAS) and analgesia score with Critical-Care Pain Observation Tool (CPOT), monitored the depth of sedation and analgesia in real time, adjusted the drug dose, and maintained the ideal sedation and analgesia state of the patients. During the operation, we actively prevented and dealt with the occurrence of adverse reactions such as hypersedation and respiratory depression, and placed oropharyngeal airway to improve ventilation for patients with retroglossal drop and respiratory depression. Results: The SAS score of 78 patients was 5.8 ± 3.7 while entering the operating room. Among them, 71 patients were treated with the midazolam with an average dose of 5.3 ± 2.7 mg, as well as the SAS score of 3.3 ± 1.8 during the operation, and the other 7 patients were cooperated with consciously. Sixty patients were sedated with fentanyl solution at an average dose of 0.38 ± 0.22 mg, and the CPOT score was 4.8 ± 3.2 during the operation. The other 18 patients did not use analgesics. The time of Door to Recanalization (D2R) in 78 patients was 50.8 ± 28.6 min. During the operation, there was good cooperation between doctors and nurses, no case of intracranial hemorrhage and no case died. Conclusion: In the EVT of the anterior-circulation AIS patients, medical cooperation developed individualized sedation and analgesia, and the nurses dynamically evaluated the sedation and analgesia score of the patients. By monitoring the depth of sedation and analgesia in real time to adjust the dosage of drugs, patients can maintain in a moderate sedation and analgesia state to ensure the safety of EVT performed.

Keywords: Acute Ischemic Stroke, Endovascular Treatment, Sedation-Agitation Scale, Respiratory Depression, Door to Recanalization Time

1. Introduction

At present, stroke has become the first cause of death in China [1]. Among the new patients, acute ischemic stroke

(AIS) is the most common type of stroke, accounting for about 70% of the total [2]. The treatment of AIS patients in the acute stage ushered in a major breakthrough in 2015 [3, 4]. Compared with traditional intravenous thrombolysis,

endovascular treatment technology based on stent thrombectomy has achieved significant effect in the treatment of severe stroke patients caused by large vessel occlusion [5]. In 2018, China has adopted the guidelines for endovascular treatment of acute ischemic stroke, and mechanical thrombectomy has been taken as the treatment scheme of "Class I; Level of Evidence A" for large vessel occlusion [6]. AIS endovascular treatment (EVT) has certain risks, and there is still a big controversy about whether patients are more suitable for tracheal intubation general anesthesia or conscious sedation and analgesia [7, 8]. AIS intervention operation team in our hospital continuously carried out continuous improvement activities. Through the cooperation of preoperative doctors and nurses, we comprehensively evaluated the patient's condition, formulated individualized sedation and analgesia scheme, and applied individualized sedation and analgesia nursing in the EVT of patients with acute anterior circulation AIS, and achieved ideal results. Now we summarize as follows.

2. Materials and Methods

2.1. General Information

About 86 patients with anterior circulation AIS who were admitted to our department for EVT through stroke green channel from October 2019 to October 2020 were collected, and 78 patients met the inclusion criteria. There were 50 males and 28 females with an average age of 65.2 ± 13.8 years (range, 32-86 years) and an average onset time of 3.5 ± 1.6 hours. The National Institute of Health stroke scale (NIHSS) score was 17.8 ± 7.3 on admission. There were 23 cases of hypertension, 14 cases of diabetes, 12 cases of coronary heart disease and 8 cases of rheumatic heart disease. After admission, the first diagnosis and preoperative preparation were completed in the emergency department. After the imaging department completed the imaging examination and no cerebral hemorrhage was found, they were delivered to the interventional operation room. The intracranial vascular occlusion was confirmed by whole brain angiography, including 31 cases of internal carotid artery occlusion, 27 cases of M1 segment occlusion of middle cerebral artery, and 20 cases of M2 segment and distal segment occlusion of middle cerebral artery.

2.2. Inclusion and Exclusion Criteria

Inclusion criteria: (1) NIHSS score 8 ~ 30 points; (2) onset time within 6 ~ 8 hours; (3) CT examination excluded intracranial hemorrhage, and there was no sign of large area cerebral infarction on CT or DWI; (4) cerebral angiography confirmed proximal occlusion of large intracranial vessels. Exclusion criteria: (1) NIHSS score >30; (2) intracranial hemorrhage or obvious low-density lesions on CT examination; (3) history of craniocerebral operation or trauma within 2 months; (4) coagulation dysfunction; (5) other important organ dysfunction or failure, resulting in failure of endovascular treatment. The hospital ethics committee has

approved this study, and all patients and their families have signed the informed consent.

2.3. Operation and Sedation Nursing

The patients with AIS confirmed by imaging examination were sent to the interventional operation room. The doctors and nurses cooperated closely to comprehensively evaluate the patient's condition and formulate individualized sedation and analgesia plan: after entering the room, the patients were given midazolam (1 ml: 5 mg) 10mg, diluted to 50 ml with 0.9% normal saline, and intravenous injection of 5 ~ 10 ml (10 ~ 15 ml). The loading dose ($\mu\text{g/kg}$) made the patients reach Riker sedation agitation scale (SAS) quickly. During the operation, critical-care pain observation tool (CPOT) [9, 10] was used to evaluate the degree of pain and CPOT score ≥ 3 , that is, small dose of fentanyl (10 ml: 0.5 mg) 0.5 mg was diluted to 50 ml with 0.9% normal saline, and 5 ~ 10 mg was given. Intravenous injection of 10ml loading dose, rapid analgesia, low-dose 2 ~ 5 ml / h ($0.5 \sim 1.0 \mu\text{g} \cdot \text{kg}^{-1} \cdot \text{h}^{-1}$) pump analgesia, maintain when CPOT score ≤ 3 . The right femoral artery was punctured by Seldinger's method. Digital subtraction angiography (DSA) of aortic arch and superselective vessels was performed. Endovascular interventional therapy was performed after displaying the diseased vessels.

The nurses closely observed the patient's consciousness, and monitored the changes of ECG, blood pressure, respiratory curve and SpO_2 . The above physiological parameters were obtained every 10 minutes. The dosage of sedation and analgesia was adjusted according to the change of parameters and operation process. SAS score and CPOT analgesia score were dynamically evaluated to maintain the ideal sedation and analgesia state. At the same time, we should actively prevent and deal with the occurrence of adverse reactions such as excessive sedation and respiratory depression. For patients with obesity or tongue drop after sedation, oropharyngeal airway was placed to improve ventilation [11].

2.4. Prevention and Treatment of Complications

The biggest risk of sedative drugs is the inhibition of cardiovascular and respiratory. In the process of sedation and analgesia, patients need to observe their consciousness closely, expression, pupil size, light reflex and limb activity. At the same time, pay attention to observe whether there is headache, vomiting, restlessness, delirium, drowsiness, coma, etc., and report to the doctor in time for corresponding treatment. In the process of medication, nurses closely observed the frequency, rhythm, amplitude and sound of patients' breathing. Patients with obesity and tongue base falling back after sedation were given oropharyngeal ventilation, medium flow oxygen, keeping airway unobstructed, timely clearing vomit and secretion in oral and nasal cavity. When respiratory rate was less than 10 times per minute, chest movement became shallow, SpO_2 decreased, and use was suspended. The speed of drug injection was

reduced when the hypotension occurred after sedation. If necessary, the administration was suspended, and the speed of fluid resuscitation was appropriately accelerated.

In order to reduce the occurrence of DSA image artifacts, elastic bandage could be used to press the eyebrow arch of patients with appropriate strength to fix the head of some patients when they sleep until their head vibrates. After sedation, the patient's autonomic activity decreased, and the occurrence of pressure ulcer should be prevented. Pay attention to check the integrity of the skin of auricle, occipital, sacrococcygeal and other easily compressed parts. Keep the operating bed flat without wrinkles, clean and dry, without debris. At the end of the operation, doctors and nurses cooperated to evaluate the patient's condition, and stopped sedation and analgesia according to the doctor's advice.

2.5. Statistical Analysis

All data were analyzed by SPSS 17.0 statistical software, and the measurement data were expressed as mean \pm standard deviation ($\bar{x}\pm s$). The dosage of sedative and analgesic drugs were recorded, SAS sedation score and CPOT analgesia score from the beginning to the end of the operation were counted, and the evaluation was conducted every 30 minutes during the operation. The incidence of adverse reactions was analyzed, such as insufficient sedation, excessive sedation, circulation fluctuation and respiratory depression.

3. Results

All the 78 patients underwent endovascular treatment through femoral artery. There was no death during the operation. The cooperation between doctors and nurses was good. There were 69 patients whose distal blood flow returned to grade 2B or above, and 9 patients with grade 1-2a blood flow. The general condition and limb muscle strength of 42 patients were improved immediately after operation. The examination of Dyna CT was performed immediately after the operation, and there was no case of intracranial hemorrhage. 71 patients were sedated with midazolam group solution, the average dose was 5.3 ± 2.7 mg, the SAS score was 3.3 ± 1.8 , and the other 7 patients were conscious; 60 patients were sedated with fentanyl group solution, the average dose was 0.38 ± 0.22 mg, the CPOT score was 4.8 ± 3.2 , and the other 18 patients did not use analgesics. The door to recanalization (D2R) time of 78 patients was 50.8 ± 28.6 min, which was lower than the reference level of literature [12], and the average operation time was 65.1 ± 38.4 min.

During the operation, 6 patients had obvious agitation, SAS score >5 , which was improved by increasing the injection speed of midazolam group and analgesia; 4 patients had deep sedation, SAS score ≤ 2 , which was improved by reducing or suspending the injection speed of midazolam group; SpO₂ decreased in 7 patients, including 3 patients with mild decrease of SpO₂, 4 patients with respiratory depression, SpO₂ decreased to 75% ~ 80%. After oropharyngeal ventilation, SpO₂ recovered to more than 93%; 2 patients had

significant sputum sounds, which were improved after sputum suction nursing; vital signs were stable during operation, map decreased after sedation in 3 patients, and the amplitude was small. Four patients developed severe vomiting during EVT. The patient's head was turned to one side in time to help them discharge vomit. After expectoration nursing, the operation was carried out smoothly. The statistics of intraoperative adverse events were shown in Table 1.

Table 1. Distribution of adverse reactions to sedation in patients.

Adverse reactions	Number of cases	Incidence rate (%)
SAS score >5 points	6	7.69
SAS score ≤ 2 points	4	5.13
SpO ₂ drops	7	8.97
Respiratory depression	4	5.13
Vomiting	4	5.13
Intraoperative sputum suction	4	5.13
MAP decreased	3	3.85

SAS, Riker sedation agitation scale; SpO₂, Blood oxygen saturation; MAP, Mean arterial pressure

4. Discussion

With the release of "China guidelines for endovascular treatment of acute ischemic stroke 2018", the time window of EVT in acute stage of AIS patients has been further expanded [6]. It emphasized that interventional treatment should be implemented as soon as possible for patients with indications for EVT [13]. Mechanical thrombectomy, as a treatment scheme of "Class I; Level of Evidence A" for large vessel occlusion, was applied to more AIS patients. At present, according to literature reports [14-16], most advanced stroke centers adopt the anesthesia mode of "local anesthesia and sedation" for AIS patients with anterior circulation occlusion. Compared with the general anesthesia mode of endotracheal intubation, there were significantly shorten the D2R time from the diagnosis of EVT to vascular recanalization, and win valuable time for opening the blocked vessels as soon as possible and saving the ischemic penumbra. However, the selection and individualized application of sedative drugs are still in the exploratory stage, and there are differences among stroke centers [17-19]. Cerebral infarction patients with acute large vessel occlusion have severe condition and rapid change, with great individual differences. Meanwhile, the risk of neurointerventional surgery itself was very high. Therefore, it is particularly important for preoperative doctors and nurses to cooperate with sufficient condition assessment, individualized sedation and analgesia goal formulation, and strict sedation and analgesia nursing during operation, especially for the observation and prevention of sedation adverse reactions.

Our hospital AIS interventional operation team continued to carry out continuous improvement activities. In the endovascular treatment of patients with acute anterior circulation AIS, before the patients enter the interventional operation room, the doctors and nurses cooperated closely, strictly carried out NIHSS score, comprehensively evaluated

the patient's condition, and formulated individualized sedation and analgesia for patients on the basis of fully considering the patient's respiratory function, hemodynamic state and pathophysiological state Goals. At the same time, early enough analgesia is the premise of sedation. The CPOT score of patients with pain ≥ 3 points was evaluated, that is, small dose of fentanyl was given to maintain the patient's quiet cooperation during the operation. In the process of sedation and analgesia, nurses need to observe closely the patient's state of consciousness, expression changes, pupil size, light reflex and limb activity. At the same time, the changes of ECG, blood pressure, respiratory curve and SpO₂ were monitored. The dosage of sedation and analgesia was adjusted according to the changes of vital signs and operation process. SAS score and CPOT analgesia score were evaluated to maintain the ideal sedation and analgesia state. To prevent and deal with the adverse reactions, such as excessive sedation and respiratory depression, oropharyngeal airway should be placed to relieve the tongue drop for improve ventilation.

In the course of EVT, we found that patients had different degrees of pain stimulation response. Such as femoral artery puncture, larger diameter guide catheter (6F or 8F) through the end of internal carotid artery into the middle cerebral artery, microcatheter through the cerebral vascular occlusion site, thrombus removal stent release and recovery, as well as thrombus withdrawal and dragging process. The main manifestations were frowning, contraction of facial muscles, head twisting and restlessness of limbs. In this study, we evaluated the changes of CPOT score of patients with pain, and gave small dose of fentanyl for analgesia during operation, which effectively reduced the SAS >5 and ensured the safety of operation. On the other hand, the biggest risk of sedative and analgesic drugs was the inhibition of cardiovascular and respiratory. We observed 4 patients with SAS score ≤ 2 . After sedation, their blood pressure decreased significantly, SpO₂ continued to decrease, chest movement became shallow, tongue base fell back and respiratory depression. By reducing the speed of drug injection, suspending drug administration when necessary, appropriately speeding up the speed of fluid infusion, using booster drugs and other measures, the patient's blood pressure drop had be effectively treated. In order to maintain the cerebral perfusion, we increased the blood pressure moderately before the opening of blood vessels, and maintained the systolic blood pressure at 140-180 mmHg and the diastolic blood pressure below 105 mmHg. When the blood vessels recanalization, doctors and nurses cooperate to adjust the target value of blood pressure to avoid cerebrovascular damage and hemorrhage caused by hypertension. In order to keep the airway unobstructed, we tried to give oropharyngeal ventilation to patients with obesity and tongue drop after sedation. When the patient's respiratory rate is less than 10 times/min, the sedative and analgesic drugs should be suspended, and tracheal intubation assisted ventilation should be given when necessary. In the study, 4 patients developed vomiting, one of which occurred

in the process of stent thrombus pulling, which was considered to be caused by the pulling stimulation of stent to cerebral vessels during the process of stent thrombus pulling. The patient had a sudden headache, a transient increase in blood pressure and heart rate, accompanied by nausea and vomiting and other adverse reactions. In the other 3 patients, vomiting occurred after successful thrombectomy, which may be due to the sudden opening of the occluded blood vessels, resulting in excessive perfusion injury, manifested as cerebral edema, vomiting and other complications.

5. Conclusion

In the EVT of patients with anterior circulation AIS, doctors and nurses cooperate closely to comprehensively evaluate the patient's condition to formulate individualized sedation and analgesia goals. Nurses should maintain the patients in a moderate state of sedation and analgesia to ensure the safety of intravascular treatment by dynamically evaluating SAS and CPOT score during operation, and monitoring the depth of sedative and analgesic in real time, and adjusting the dosage of drugs. Meanwhile, we need to prevent and deal with the occurrence of over sedation, respiratory inhibition and other adverse reactions in the process of sedation. The deficiency of this study: it was a single center small sample study, lack of multi-center clinical practice evidence.

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