

# Application of Bundle Care in Patient with Individualized Sedation Care During the Interventional Therapy for Anterior-circulation Acute Ischemic Stroke

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**Abstract:** Objective: With the rapid development of interventional diagnosis and treatment technology and the shortage of nursing human resources, the workload of interventional surgery has increased dramatically. In the face of an increasing number of patients or emergency operations with potential sedation needs, especially in the emergency of AIS patients, the nurses are often responsible for the monitoring and nursing of sedated patients under the instructions of doctors. This paper aims to analyze and evaluate the effects of individualized sedation care during the interventional therapy for anterior-circulation Acute Ischemic Stroke (AIS). Methods: According to the actual situation, 106 patients were treated with sedation care, dynamic evaluating, medicating and restricting programmatically. And patients were grouped into 2 groups according to the sedation medication option, comparing the door-to-reperfusion time in the digital subtraction angiography (DSA) suite and occurrence of adverse reactions. Results: Nurses and doctors successfully cooperated during therapies. The door-to-reperfusion time in the DSA suite of the Midazolam Group and the Dexmedetomidine Group were  $38.7 \pm 9.8$  min and  $38.4 \pm 10.9$  min, which reached the reference level reported in the literature. The rates of adverse reactions were low and no death cases. There was no significant difference in blood oxygen desaturation, blood pressure decline, vomiting, sedation deficiency and over sedation between the two groups ( $P > 0.05$ ). But there were significant differences in image artifacts between the two groups ( $P < 0.05$ ). Conclusion: With individualized sedation care, it can benefit to shorten the reperfusion time and provide safety for the emergency interventional therapy for AIS patients.

**Keywords:** Bundle Care, Individualized Sedation Care, Acute Ischemic Stroke

## 1. Introduction

The treatment of Acute Ischemic Stroke (AIS) is to recanalize blood vessels within the treatment time window, rescue reversible ischemic tissue and reduce the final infarct size. However, symptoms of patients, for instance, confusion, agitation, and vomiting often delay the time of intravascular thrombectomy, in which sedation or anesthesia has, therefore, become an important step. According to the latest guidelines [1], there is no significant difference in the prognosis between general anesthesia and non-general anesthesia in AIS patients with circulatory occlusion during thrombectomy, and individualized sedation is recommended according to specific

conditions. By the principle of "Time is brain and every second counts", the emergency interventional operation of AIS patients with anterior circulation occlusion is generally done without notice or waiting for anesthesiologists, and the sedation and nursing of patients are often undertaken by the interventional nurses under the instructions of doctors [2-5]. Bundle of care integrates a series of treatment and nursing measures based on evidence-based medicine, and an individualized sedation bundle of care is very important to ensure the safety of patients and shorten the time of emergency intravascular thrombectomy [6]. Our hospital has ripe operating experience in the green channel of AIS intervention, and the interventional surgery team has, through

continuous optimization and improvement, achieved great results in the application of individualized sedation nursing. Now the summary report is as follows.

## 2. Materials and Methods

### 2.1. Research Object

In this research, 106 patients with anterior circulation AIS, 83 males, and 43 females, aged 26-88 years with an average age of ( $69.8 \pm 16.3$ ) years, who were sent to our emergency green channel of AIS for intravascular thrombectomy from March 1, 2018, to February 28, 2019, were selected as the subjects. Selection criteria: (1) NIHSS score was 8-30 when the patient was hospitalized, and CT or MR excluded the signs of intracranial hemorrhage or massive cerebral infarction within 24 hours; (2) Cerebral angiography was confirmed as proximal occlusion of great vessels in anterior circulation; (3) Local anesthesia and sedation were used to cooperate with individual sedation nursing during the operation. Exclusion criteria: (1) NIHSS score was  $< 8$  or  $> 30$ ; (2) CT or MR showed signs of intracranial hemorrhage or massive cerebral infarction; (3) There was a history of craniocerebral operation or trauma within 2 months; (4) coagulation dysfunction; (5) other important organ dysfunction or failure. According to different medication schemes, 106 patients were divided into the Midazolam Group ( $n = 72$ ) and the Dexmedetomidine Group ( $n = 34$ ). There was no statistical significance in the comparison between the two groups in gender, age, history, offending vessels, stroke mechanism, and other general data, therefore they were of comparative value. This study has been approved by the Hospital Ethics Committee, and all the family members of the patients have signed the informed consent forms.

### 2.2. Research and Intervention Methods

#### 2.2.1. Dynamic Assessment

Riker Sedative Agitation Score (SAS) and intensive Care Pain Observation Tool (CPOT) score were used to evaluate the sedative and analgesic state of patients. The patient was assessed quickly after entering the operating room and fed back to the surgeon. Combined with the shift reports, the appropriate medication scheme was selected under doctor's instructions. Inspection during the operation was strengthened and the patient was assessed every 10 minutes. The goal was to achieve a SAS score of 3-4 and a CPOT score of  $< 3$ . Report to the surgeon if the target score was not achieved, and adjust the usage and dosage of sedative and analgesic drugs if necessary.

#### 2.2.2. Medication Scheme

According to the scores and the doctor's advice, the following sedative medication schemes agreed with the neuro-interventional doctors shall be implemented: (1) In the Midazolam Group, after 0.05-0.10mg/kg loading dose of midazolam, 0.08-0.10mg/kg/h pump infusion was maintained; in the Dexmedetomidine Group, after 0.5~1 $\mu$ g/kg loading dose of dexmedetomidine, 0.2~0.5 $\mu$ g/(kg·h) pump infusion

was maintained; (2) According to the dynamic assessment during the operation, fentanyl citrate was given intravenously at a dose of 50 $\mu$ g each time under the doctor's instructions when necessary to improve the sedative effect; (3) The above drugs were diluted to 50ml solution with 0.9% normal saline and then injected intravenously to precisely control the injection of the solution and reduce the incidence of respiratory inhibition, which was conducive to shortening the treatment time.

#### 2.2.3. Restraint and Safety

For patients with agitation, hemiplegic paralysis or low coordination, rapid and appropriate restraint could not only ensure their safety but also facilitate ECG monitoring, establishment of channels, sedation and medication, disinfection and sterile sheet laying to shorten the treatment time. For patients who could not cooperate, procedural constraints should be carried out immediately after patients entering the operating room to avoid intraoperative interference: (1) Take CT bed restraint belt as reference to optimize the restraint tools of interventional operating table. A kind of elastic restraint belt was designed for patients with movable position, wide coverage area, high efficiency, and less strangulation. To prevent the patients from falling off or struggling to get up, their chests and knee joints were regularly restrained after entering the operating room; (2) Patients' wrists were fixed by the restraint belts to prevent their agitation from affecting the operation and even pulling out the sheath tube. Pay attention to the tightness of the restraint belt as over-tightening would easily cause skin or joint damage, while over loosening would lead to breaking away; (3) When some patients' heads swing uncooperatively, elastic bandages could be used to press the eyebrow arches with appropriate strength to fix their heads to avoid the occurrence of DSA image artifacts.

#### 2.2.4. Airway Nursing

Airway nursing is an important part of individualized sedation nursing [5]. Under the potential risk that some sedative and analgesic drugs may lead to respiratory inhibition, and cerebral ischemia-reperfusion injury may lead to vomiting of patients, nurses should: (1) Put the sputum suction device, tongue depressor, simple breathing airbag, and other emergency supplies in a standby state; (2) Master the nursing of sputum suction, clean the respiratory tract in time in case of vomiting or mucosal bleeding to avoid aspiration by mistake; (3) Master the use of oropharyngeal airway and open the airway in time to improve breathing in case of abnormal downward of tongue base or continuous blood oxygen desaturation. For patients with AIS bridging therapy or using antiplatelet drugs (tirofiban, eptifibatide, etc.), the nursing staff should action gently and strengthen the inspection to avoid the aspiration by mistake caused by mucosal hemorrhage; (4) Master the use of simple breathing airbag, conduct artificial ventilation in time when the patient's blood oxygen saturation declines further, and report to the operator for intubation ventilation if necessary.

### 2.2.5. Blood pressure Management

After successful recanalization of occlusive blood vessels, blood pressure may be properly reduced to prevent reperfusion injury. According to the guidelines, it is recommended to control the systolic blood pressure below 140mmHg, but attention should also be paid to avoid the sudden drop of blood pressure [1, 3]. Nurses should carry out continuous blood pressure management, understand the basic blood pressure of patients after entering the operating room, monitor the blood pressure fluctuation during the operation, and timely report to the neuro-interventional doctor when there is a significant rise or fall of blood pressure, especially before and after the recanalization of blood vessels. When necessary, nurses can follow the doctor's instructions to dispense and use urapidil hydrochloride, isosorbide nitrate and other drugs to control the blood pressure of patients and adjust the medication speed according to the basic blood pressure of patients.

### 2.3. Evaluation indexes

(1) According to the key time nodes of thrombectomy, the time from the patients entering the interventional operating room to recanalization of blood vessels (the time from entry into the operating room to recanalization) was calculated; (2) The changes of vital signs and special conditions during the operation were recorded, especially the decline of blood oxygen saturation, blood pressure, vomiting and image artifacts; (3) The sedative effect was evaluated by SAS: 1-2 represented excessive sedation; 3-4 represented moderate sedation; 5-7 represented insufficient sedation; (4) During the

operation, when the time of  $SpO_2 < 90\%$  was more than 5 minutes, it was evaluated as the blood oxygen desaturation; when systolic blood pressure was  $< 90\text{mmHg}$  or diastolic blood pressure was  $< 60\text{mmHg}$ , it was evaluated as blood pressure reduction; the image artifacts were determined by two experienced interventional physicians by subjective evaluation and an accordant conclusion was obtained after discussion.

### 2.4. Statistical Method

SPSS 23.0 software was used for data statistical analysis. The measurement data was expressed in the form of  $\bar{x} \pm s$  and checked by  $t$ ; the enumeration data was checked by  $\chi^2$ ;  $P < 0.05$  showed the difference was of statistical significance.

## 3. Results

All the 106 patients were treated successfully. The distal flow of 90 patients recovered to level IIB or above, and that of 16 patients recovered to level I to level IIA with no death during the operation. The average time from entry into the operating room to recanalization was  $38.6 \pm 10.1\text{min}$ . The adverse conditions during operations were as follows: 12 cases of blood oxygen desaturation (11.3%); 9 cases of blood pressure decline (8.5%); 5 cases of vomiting (4.7%); 9 cases of image artifacts (8.5%); 7 cases of sedation deficiency (6.6%) and 8 cases of oversedation (7.5%). The comparison of observation indexes between the two groups was shown in Table 1.

Table 1. Comparison of the observation indexes between the two groups of sedation-scheme patients.

Items	Midazolam Group	Dexmedetomidine Group	T value/ $\chi^2$ value	P value
Time from entry to recanalization (min)	38.7±9.8	38.4±10.9	0.30	0.762
Fentanyl citrate dosage ( $\mu\text{g}$ )	125.7±51.0	104.4±43.3	2.10	0.380
Blood oxygen desaturation (n)	10	2	1.47	0.225
Blood pressure decline (n)	5	4	0.69	0.406
Vomiting (n)	4	1	0.35	0.553
Image artifacts (n)	3	6	5.40	0.020
Sedation deficiency (n)	5	2	0.04	0.837
Oversedation (n)	6	2	0.19	0.656

## 4. Discussion

### 4.1. Individualized Sedation and Medication Scheme

Midazolam benzodiazepines have a quick effect, short action time and high forgetting rate during operation, therefore often used as the preferred sedative in the clinic. However, when injected too fast or in excessive doses, they may lead to adverse reactions such as respiratory inhibition and blood pressure reduction [7-9]. Therefore, nurses should pay close attention to the injection speed and volume in the process of individualized medication, especially for elderly patients. Dexmedetomidine is a highly selective  $\alpha_2$  adrenergic receptor agonist, which has a strong hypnotic and sedative effect, can produce effects similar to physiological sleep and has little

respiratory inhibition [7, 10]. Besides, dexmedetomidine can improve the balance of blood supply and oxygen supply of brain tissue during ischemia by reducing sympathetic activity, which has a certain protective effect on ischemic brain injury [11]. However, during the operation, patients often swing their heads unconsciously in a sound sleep, which is more likely to lead to image artifacts ( $P < 0.05$ ). However, dexmedetomidine may lead to hypotension and bradycardia in patients with hypovolemia, diabetes, chronic hypertension or hypotension and bradycardia for elderly patients [10]. Therefore, nurses and doctors should make a full evaluation before choosing the medication scheme, which is also one of the important tasks of individualized sedation. Also, fentanyl citrate is a kind of opioid peptide drug, which is commonly used in patient-controlled analgesia (PCA). Fentanyl citrate combined with sedative drugs can not only achieve the analgesic effect,

reduce patients' agitation and image artifacts, but also improve the sedative effect and reduce the dosage of sedative drugs. When combined with dexmedetomidine, the dosage of fentanyl can also be reduced, and the time to reach the optimal effect is shorter [7]. However, excessive fentanyl can lead to respiratory depression. In the process of individualized sedation, it is necessary to choose a reasonable medication scheme and dosage under the doctor's instructions for different individuals, and the nurse physician who qualifies for the prescription of anesthetic and the ability of intubation and ventilation should participate in the supervision. In this research, the medical cooperation was good, and the time from entry into the operating room to recanalization in both groups was lower than the reference level reported in the literature [12-14]. Meanwhile, the incidence of adverse reactions was low and there was no intraoperative death. Therefore, we believe that the individualized application of midazolam or dexmedetomidine combined with fentanyl citrate can be used as an appropriate sedative scheme in the emergency endovascular thrombectomy of AIS patients. At present, there is a long way to go for the development of AIS emergency intravascular thrombectomy. In many aspects, including the priority selection of sedative drugs, there are no clear guidelines and recommendations, and there are still some large samples entailing multi-center cooperation. Besides, before imaging examination and intravascular thrombectomy, whether individualized sedation in the emergency department will help to further reduce the treatment time remains to be further explored.

#### 4.2. Status quo and Countermeasures of Sedation Nursing in Interventional Operation

With the rapid development of interventional diagnosis and treatment technology and the shortage of nursing human resources, the workload of interventional surgery has increased dramatically. In the face of an increasing number of patients or emergency operations with potential sedation needs, especially in the emergency of AIS patients, the nurses are often responsible for the monitoring and nursing of sedated patients under the instructions of doctors, which is very common [2-4]. The American Association of Radiology and Imaging Nurses (ARIN) has proposed [15] that a professional anesthesiologist is not required in an interventional operation when a nurse with sufficient experience is responsible for the patient's moderate sedation. Arin, ASPAN, TJC, and other organizations have also proposed that nurses should have a reasonable positioning, continuous training and skill assessments, and should be organized to learn and master the knowledge and abilities required for the implementation of sedation related medical orders such as airway management, carbon dioxide monitoring, hemodynamic management and advanced cardiac life support (ACLS) [3, 15-18]. However, there are also reports in China on the involvement of full-time nurses in perioperative anesthesia management [19]. At present, sedation nursing is mature and well-orientated in ICU and

nurses are playing an important role in sedation treatment [20-22]. As an emergency department, the interventional operating room should also upgrade actively. To improve the ability of sedation nursing and the nursing of patients with acute and severe diseases, nurses in our department have completed the department-rounding study of ICU in batches, and have discussed and improved the individualized sedation scheme with the intervention doctors for many times. We reckon that nurses should play multiple roles as evaluators, observers, and managers. They should master related evaluation tools, be familiar with the basic pharmacology, dispensing methods, use methods and adverse reactions of common sedative drugs, so that they can quickly evaluate patients and give feedbacks to doctors quickly upon patient's entry, dispense and use drugs according to doctor's instructions. And for adverse reactions, they can take correct predictive nursing measures and deal with or give first aid. Also, in the aspect of constraint nursing, nurses should master the efficient and fast constraint methods to avoid the delay of treatment due to the imperfect constraint. To give full play to the role of nurses in individualized sedation, nurses should constantly accumulate sedation knowledge, be good at combining theory with practice in clinical practice. They should not just simply carry out doctor's orders, but strengthen medical cooperation and creatively design and apply sedation schemes and processes suitable for nursing, strengthen the evaluation and observation of patients to assist doctors to make reasonable adjustments. They should make efforts to explore a safer and more efficient treatment method with doctors [20].

## 5. Conclusion

To sum up, an individualized sedation bundle of care is conducive to shorten the time of emergency intravascular thrombectomy in patients with anterior circulation AIS, effectively control the occurrence of adverse reactions, and provide security for treatment. But at the same time, the bundle of care has a high level of professional requirements for interventional nurses. The thrombectomy in AIS is still in the initial stage of development, which still needs our in-depth study and exploration.

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