Am J Transl Res 2021;13(7):7687-7694
www.ajtr.org /ISSN:1943-8141/AJTR0132917

Original Article

Effect of risk management combined with precision care in interventional embolization of cerebral aneurysm in elderly patients

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Received March 8, 2021; Accepted April 14, 2021; Epub July 15, 2021; Published July 30, 2021

Abstract: Objective: To investigate the effect of risk management combined with intraoperative precision care on the efficacy and safety of interventional embolization therapy for elderly patients with cerebral aneurysms. Methods: In this prospective randomized controlled study, we included 60 elderly patients with cerebral aneurysm treated with interventional embolization. The patients were randomly divided into an experiment group (n=30) and a control group (n=30). The control group received conventional care during the interventional procedure, while the experiment group received risk management combined with precision care. The outcome of the procedure, time to disappearance of clinical symptoms, length of hospitalization, incidence of complications, neurological function and quality of life before and 3 months after the procedure in both groups were assessed and compared. Results: Compared with the control group, the experiment group had significantly less intraoperative bleeding, shorter operative time (all P<0.001), shorter time to disappearance of clinical symptoms and shorter hospitalization (all P<0.001), and a lower rate of surgical complications (P<0.05). Three months after the operation, the experiment group had better neurological function and quality of life, with significantly lower mRs scores (modified Rankin scale), NIHSS (National Institute of Health Stroke Scale) and higher SF-36 scores (MOS item short from health survey) than those of the control group (both P<0.001). Conclusion: Risk management combined with precision care can effectively improve the surgical safety of interventional embolization in elderly patients with cerebral aneurysm, reduce the incidence of surgical complications, and thus improve the prognosis.

Keywords: Cerebral aneurysm, interventional embolization, risk management, precision care, elderly

Introduction

Cerebral aneurysm, also known as intracranial aneurysm (UIA), is a common type of cerebrovascular disease in clinical practice [1]. Cerebral aneurysms are prone to sudden rupture under exertion, stress, and elevated blood pressure, resulting in spontaneous subarachnoid hemorrhage, with high rates of death, disability, and recurrence [2, 3]. Early surgical intervention before aneurysm rupture is the key to improving the prognosis.

Intravascular interventional embolization is currently one of the main clinical treatment methods for cerebral aneurysms [4]. Effective perioperative care in the courses of interventional embolization of cerebral aneurysms is crucial to the treatment and prognosis, and intraoperative nursing cooperation is especially important for a smooth and successful operation and is closely relevant to the prognosis [5, 6]. Studies have illustrated that conventional care in interventional embolization of elderly patients with cerebral aneurysms lacks foresight, flexibility, and systematization, resulting in a higher risk of postoperative complications [7]. Further improving the quality of perioperative care, especially intraoperative care, for interventional embolization of cerebral aneurysms in elderly patients is of great significance to improve the safety of the procedure and reduce the risk of complications.

Quite a few studies have demonstrated that enhanced risk management can greatly reduce risks and nursing-related accidents and errors, thereby improving the quality of care and prog-

nosis [8-10]. Precision care is a nursing model developed based on the concept of precision medicine, which aims at developing individualized plans and provide precise care to improve the outcomes based on the physio-psychological features of patients and the characteristics of diseases [11, 12]. However, few clinical studies have applied risk management and precision care to interventional embolization of elderly with cerebral aneurysms, and the effectiveness of the application needs further verification. Elderly patients with cerebral aneurysms require more stringent risk management and tailored interventional embolization care in the perioperative period. In this study, we investigated the effectiveness of risk management combined with intraoperative precision care in elderly patients undergoing cerebral aneurysm interventional embolization, with the aim of providing clinical guidance.

Material and methods

Patients

A total of 60 patients with cerebral aneurysm received interventional treatment in Xuanwu Hospital of Capital Medical University between March 2019 and June 2020 were included in this study, and the patients were randomly divided into an experiment group (n=30) and a control group (n=30) using the random number table. The control group was given conventional care, while the experiment group was given additional risk management combined with precision care on the basis of the care in the control group. All patients were diagnosed with cerebral aneurysm by digital subtraction angiography (DSA) [1].

Inclusion criteria: (1) patients over 65 years old; (2) the onset time was within 24 h; (3) patients with unruptured aneurysm; CVS did not occur, or CVS was not yet apparent; (4) patients agreed to receive interventional embolization.

Exclusion criteria: (1) patients with recurrent intracranial aneurysm; (2) Hunt-Hess grade 0 or V; (3) patients complicated with serious cardiovascular, liver, kidney and hematopoietic system diseases that cannot tolerate the procedure; (4) patients with malignant brain tumor or psychiatric history; (5) patients without complete clinical data.

Ethical statement

This study was conducted following the Declaration of Helsinki, and was approved by the ethics committee of our hospital (Approval Number: 20181206). All patients and their families were informed of the contents of this study and signed an informed consent form.

Care of interventional procedures

Care of the control group: In the control group, a protocol of conventional care was implemented during the interventional procedure [13]. (1) Preparation of patients and surgical items: before the procedure, the medical staff routinely checked the patient's information, coagulation result, electrocardiogram result and so on. The patients were asked about the history of contrast allergy and orally given 15 mg of phenobarbital (Xi'an Disai Biological Pharmaceutical Co., Ltd., China, State Drug Administration H61021400, size 15 mg) to sedate. The medical staff prepared items related to the interventional procedure including disposable operation kits, catheters and guidewires for contrast, possible drugs such as nimodipine, heparin, glycerol heparin sodium injection (China Shanghai ShangPharma First Biochemical Pharmaceutical Co., Ltd., State Drug Quantifier H31022051, specification: 2 mL:12500 units), and fructose. (2) Intraoperative cooperation: nurses assisted the doctor to fulfill all aspects of interventional embolization and related operations, such as systemic heparinization, continuous drip of 0.9% NaCl, right femoral artery puncture and placement of 6F catheter sheath, DSA angiography, filling the spring ring and so on. During the operation, the nurses were responsible to keep the patients warm and closely observed patient's condition, consciousness, changes in vital signs, and the presence of allergies. Any abnormality was reported to the doctor or anesthesiologist in time.

Care of the experiment group: The experiment group was implemented with risk management combined with intraoperative precision care on the basis of care in the control group [9, 11]. The specific scheme are shown in **Table 1**.

Outcome measures

Primary outcome measures: (1) Time to disappearance of clinical symptoms and length of

Table 1. Content of risk management combined with intraoperative precision care

	Specific measure
Risk management	
Training of risk management	We regularly train and assess our nursing staff on risk awareness and management knowledge, including surgical considerations, knowledge about intracranial aneurysms, and strategies for risk assessment and intervention.
Inspection and management of instruments	A dedicated nurse regularly maintains and checks the equipment and instruments related to the interventional operation to prevent the occurrence of adverse events due to equipment operation failures and deficiencies.
Assessment and screening of risk factors	We assess factors such as age, hypertension, and renal insufficiency. Before imaging, we also monitored urine output, urine routine, urea nitrogen, endogenous creatinine, serum creatinine clearance and other indicators.
Precision care	
Prevent stress and adverse reactions	According to the condition, appropriate enteral nutrition is given to reduce the stress response. We use laryngeal mask anesthesia for patients (except comatose patients) and strengthen anesthesia management to prevent anesthesia-related adverse events such as anesthesia accidents, postoperative nausea, and urinary retention.
Temperature setting	The room temperature is set at 22°C-26°C and adjusted according to the specific conditions of the patient.
Monitoring of systemic heparinization	After systemic heparinization (5000-10000 units intravenous drip), the patient's ACT is measured hourly to monitor whether it is maintained between 250 s and 300 s. Heparin is supplemented if necessary.
Indwelling catheter	
Monitoring of blood pressure	The ideal blood pressure during surgery is (110-155)/(70-90) mmHg. Any abnormal elevation will be reported to the anesthesiologist and 5-8 μg/kg of nimodipine (China Fu Jen Pharmaceutical Group Co., Ltd., State Drug Administration H20068125, Specification 20 mL:4 mg) will be administered to control the blood pressure.
Control the embolization speed	The infusion rate is strictly controlled during Onyx embolization with slow embolization, and Onyx is closely observed for proximal reflux.
Incident report	Any abnormalities found during the procedure, especially in blood pressure and heart rate, should be reported to the physician, and the nursing staff provide cooperation to prevent adverse events.
Handover of postoperative care	After the surgery, we explain the care precautions with the ward nurses, such as elevating the head of the bed 15-30° to reduce cerebral edema, applying low-molecular heparin, continuously pumping nimodipine (10-100 μg/kg•h^{-1}) intravenously, preventing complications such as aneurysm rupture and rebleeding, cerebrovascular spasm, early postoperative nutrition, and rehabilitation training.

Note: ATC: activated clotting time; Onyx: ethylene-vinyl alcohol copolymer.

hospitalization were compared between the two groups.

(2) The perioperative complications were compared between groups, including cerebral vasospasm (CVS), aneurysm rupture, hydrocephalus, puncture site hematoma, subarachnoid hemorrhage, elevated intracranial pressure, and recurrence.

(3) Before and 3 months after surgery, the neurological function was compared between the two groups using the Modified Rankin Scale (mRs) and the National Institute of Health Stroke Scale (NIHSS) [14, 15]. The total score of mRs was 6, with 0 as normal, 1-5 as slight, mild, moderate, moderate to severe, and severe neurological impairment, and 6 as death. The lower the score, the better the neurological function. The NIHSS includes 11 areas of consciousness, speech, neglect, visual field loss, extraocular movements, motor strength, ataxia, dysarthria, and sensory loss, with 15 items, each scored out of 3 to 5, with 0 representing normal function and higher scores indicating more deficits. The total score of the NIHSS was 45, with lower scores indicating better neurological improvement in patients.

(4) Before and 3 months after surgery, the quality of life in both groups were assessed. The MOS item short from health survey (SF-36) was used to evaluate the change in quality of life before and after treatment. The total score of the scale was 100, and lower scores represented poorer quality of life and vice versa [16].

Secondary outcome measures: (1) The results of aneurysm embolization were compared between the two groups. According to the results

Table 2. Baseline information in both groups (n (%)/($\bar{x}$ ± sd))

	Experiment group (n=30)	Control group (n=30)	t/χ^2	P
Gender (n, %)			0.606	0.436
Male	18 (60.00)	15 (50.00)		
Female	12 (40.00)	15 (50.00)		
Age (years, $\bar{x}$ ± sd)	70.2±5.5	69.8±6.2	0.264	0.793
Aneurysm site (n, %)			0.659	0.417
Front loop	21 (70.00)	18 (60.00)		
Post loop	9 (30.00)	12 (40.00)		
Proportion of multiple aneurysms (n, %)	1 (3.33)	3 (10.00)	1.071	0.301
Grade of Hunt-Hess (n, %)			0.915	0.822
I	20 (66.67)	18 (60.00)		
II	5 (16.67)	7 (23.33)		
III	4 (13.33)	3 (10.00)		
IV	1 (3.33)	2 (6.67)		

of postoperative DSA, the embolization results were classified as complete embolization (embolization range 100%), sub-complete embolization (embolization range 90-99%) and incomplete embolization (embolization range <90%) [17].

(2) The intraoperative bleeding and operative time were compared between the two groups.

Statistical analysis

SPSS 23.0 (SPSS, Inc., Chicago, IL, USA) was used for statistical analysis and GraphPad Prism 7 was used to draw statistical graphs. The count data was expressed as the number of cases (percentage) (n, %), and the χ^2 test was performed at a level of α=0.05 bilaterally. The measurement data conforming to normal distribution were expressed as mean ± standard deviation ($\bar{x}$ ± sd). Independent sample t test was used for comparison between groups, paired t test was used for comparison before and after the same group, and the test level was chosen as two-sided α=0.05. P<0.05 was considered statistically significant.

Results

Baseline information in both groups

A total of 60 patients were enrolled and randomly divided into two groups, the experiment group and the observation group, with 30 patients in each group. The baseline information of the two groups is described in **Table 2**, which shows that there were no significant differences between the groups in gender, age, aneurysm site, proportion of multiple aneurysms, and preoperative Hunt-Hess grade (all P>0.05), indicating that the two groups were comparable (**Table 2**).

Surgical indicators in both groups

By angiography, we compared the postoperative embolization results between the two groups. The rate of complete embolization was higher in the experiment group than that in the control group, but did not yet reach a statistical difference (P>0.05). There was also no significant difference between the rates of sub-complete and incomplete embolization in the two groups (both P>0.05), but a significant reduction in intraoperative bleeding and operative time was observed in the experiment group compared with the control group (both P< 0.001; **Table 3**).

Time to disappearance of clinical symptoms and hospitalization in both groups

Compared with the control group, the time to disappearance of headache and vomiting as well as the length of hospitalization were significantly shorter in the experiment group (all P<0.001). In particular, the length of hospitalization in the experiment group (4.5±1.3 d vs. 8.7±2.2 d) was almost half of that in the control group (**Figure 1**).

Table 3. Comparison of surgical indicators between two groups ($\bar{x} \pm sd$)

	Experiment group (n=30)	Control group (n=30)	t/χ^2	P
Embolization result (n, %)				
Complete embolization	25 (83.33)	21 (70.00)	1.491	0.222
Sub-complete embolization	4 (13.33)	5 (16.67)	0.131	0.718
Incomplete embolization	1 (3.33)	4 (13.33)	1.964	0.161
Intraoperative blood loss (mL)	143.58±4.53	166.05±4.82	18.602	<0.001
Operation time (minute)	49.25±5.28	60.65±6.50	7.456	<0.001

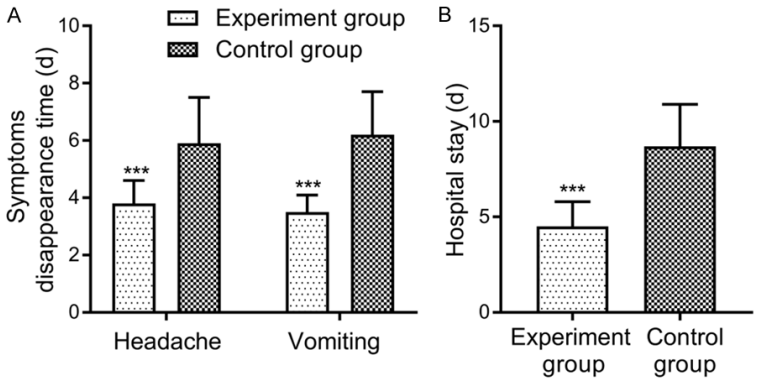

Figure 1. Time to disappearance of clinical symptoms (A) and length of hospitalization (B) in both groups. Compared with the control group, ***P<0.001.

Surgical complications in both groups

Compared with the control group, the incidences of complications such as CVS, aneurysm rupture, hydrocephalus, puncture site hematoma, subarachnoid hemorrhage and relapse were significantly lower in the experiment group (all P<0.05). There was no difference in the incidence of elevated intracranial pressure between the two groups (P>0.05; **Table 4**).

Prognosis of neurological function in both groups

We further compared the neurological prognosis of the two groups (**Figure 2**), and the results showed that there was no significant difference in the preoperative scores of mRs and NIHSS between the two groups (both P>0.05). Three months after surgery, the scores of mRs and NIHSS in both groups were significantly lower than those before surgery (both P< 0.001). Meanwhile, the experiment group had lower mRs score and NIHSS score three months after intervention as compared with the control group (both P<0.001; **Figure 2**).

Quality of life in both groups

Before surgery, quality of life was similar in the two groups (P>0.05). Three months after surgery, the SF-36 scores of both groups were significantly higher than those before surgery (P<0.001). Compared with the control group, the experiment group had a higher SF-36 score, with a significant difference between the two groups (P<0.001; **Table 5**).

Discussion

Nursing care is a major component of clinical treatment process and an important safeguard for effective treatment [5, 6]. As a special population in clinical practice, elderly people need more comprehensive and meticulous nursing measures to improve clinical outcomes [18]. To further optimize the perioperative care (with emphasis on intraoperative care), we investigated the effects and advantages of risk management combined with intraoperative precision care in interventional embolization of cerebral aneurysms in elderly patients.

The results of this study showed that risk management combined with intraoperative precision care is an ideal protocol for interventional embolization of cerebral aneurysms in elderly patients. Specifically, risk management combined with intraoperative precision care significantly improved the safety, with significant reductions in intraoperative bleeding and operative time in the experiment group, and significant reductions in the time to disappearance of clinical symptoms and lengths of hospitalization. More promisingly, the incidence of complications was significantly reduced in the experi-

Table 4. Comparison of surgical complications between the two groups (n, %)

Complication	Experiment group (n=30)	Control group (n=30)	χ^2	P
CVS	1 (3.33)	6 (20.00)	4.043	0.044
Ruptured aneurysm	0 (0.00)	7 (23.33)	7.925	0.005
Hydrocephalus	1 (3.33)	7 (23.33)	5.192	0.023
Hematoma at the puncture site	0 (0.00)	5 (16.67)	5.455	0.020
Increased intracranial pressure	2 (6.67)	4 (13.33)	0.741	0.389
Subarachnoid hemorrhage	2 (6.67)	9 (30.00)	5.455	0.020
Relapse	1 (3.33)	6 (20.00)	4.043	0.044

Note: CVS: cerebral vasospasm.

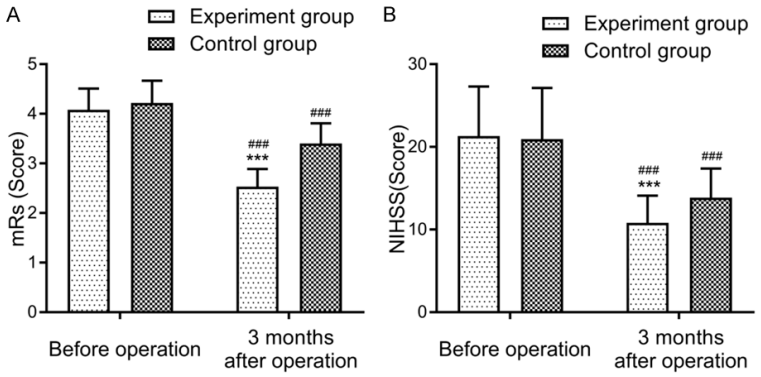

Figure 2. The mRs score (A) and NIHSS score (B) of the two groups before and after surgery. Compared with the same group before operation, ###P<0.001; compared with the control group after three months, ***P<0.001. mRs: modified Rankin Scale; NIHSS: National Institute of Health Stroke Scale.

Table 5. Comparison of SF-36 scores between the two groups before and 3 months after surgery ($\bar{x} \pm sd$)

Group	n	SF-36 score (scores)	
		Before surgery	After surgery
Experiment group	30	40.75±7.53	58.25±10.15*
Control group	30	41.52±8.22	67.85±11.63*
t		0.378	3.406
P		0.707	0.000

Note: Compared with before surgery, *P<0.05.

ment group, except for intracranial pressure elevation. As to prognosis, the experiment group had better neurological function and quality of life at 3 months after operation, with significantly lower mRs and NIHSS but higher SF-36 than the control group.

Elderly patients often have multiple underlying diseases, especially hypertension and atherosclerosis, and male patients may also have a long history of smoking [19]. Studies have shown that these are risk factors for the occurrence and rupture of cerebral aneurysms [20]. Therefore, we should pay attention to the risk management of interventional embolization of cerebral aneurysms in elderly patients [20]. We believed that the reason for fewer complications in the experiment group may be due to effective risk management, including enhanced awareness of risk prevention and control, proper management of surgical equipment and instruments, and assessment and screening of risk factors [21]. In particular, the assessment and screening of risk factors enabled scientific adjustment of care plans and the development of corresponding safe and effective coping strategies, thus effectively avoiding possible risk events. Even if a risk event occurred, it is more likely to be resolved quickly in response to minimize its harm [22]. A study by Xu et al. showed that identifying the risk factors preforms a crucial function in reducing the occurrence of adverse events [8]. In addition, precise intraoperative care can also lead to improved safety of surgery. Effective intraoperative care played a key role in the smooth implementation of surgery and improving the success rate [23, 24]. Precision care was also applied in our study, including alleviating stress, setting the appropriate temperature, closely monitoring coagulation and blood pressure, timely reporting of abnormalities and so on. It optimized the surgical procedure and effectively prevented the occurrence of intraoperative adverse events. Compared with the control group, the operative time was significantly shorter in the experiment group, indicating that the surgery was smoother in the experiment group and the operative time, which might be prolonged due to the

occurrence of intraoperative abnormalities, was reduced. The shorter operative time also reduced the risk of potential adverse events, such as the risk of anesthesia and surgical operations [25].

Previous studies have shown that the prognosis of interventional embolization of cerebral aneurysms is associated with procedural complications. In particular, CVS following aneurysmal subarachnoid hemorrhage is one of the major causes of death and disability in patients [13, 26]. In the present study, the neurological recovery at 3 months after surgery was significantly better in the experiment group, which was thought to be related to the significant reduction in surgical complications.

This study had some limitations. The focus of this study was to assess the optimal role of intraoperative care, but surgical complications may occur during the postoperative hospitalization. Therefore, despite the emphasis on considerations for perioperative care of patients, the results may be influenced by postoperative care. Second, the recovery of neurological function is also related to postoperative treatment and rehabilitation, but it was difficult to guarantee that both groups of patients received the same treatment [27, 28]. Third, the follow-up period was not sufficient, which may have an impact on the results. In addition, this was a single-center study with a small sample size, which may not be broadly representative. Therefore, further multicenter and large sample size studies are needed to validate the results and to focus on postoperative care and treatment aspects to improve the reliability of the results.

In summary, risk management combined with intraoperative precision care can effectively improve the surgical safety and reduce the incidence of procedural complications of interventional embolization for cerebral aneurysms in elderly patients, and thus improve patients' prognosis, implying great application potential in the interventional embolization for elderly patients with cerebral aneurysms.

Disclosure of conflict of interest

None.

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