

Original Article

Surgical clipping and endovascular embolization for senile patients with posterior communicating artery aneurysms complicated with oculomotor nerve palsy

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Abstract: Objective: To explore the clinical effect of the surgical clipping and endovascular embolization for senile patients with posterior communicating artery aneurysms (PCoMA) complicated with oculomotor nerve palsy (ONP) and their neurological recovery. Methods: A total of 96 senile patients with PCoMA complicated with ONP admitted to our hospital from May 2018 to May 2019 were selected and assigned into the experimental group and the control group according to the randomization method, with 48 cases in each group. The patients in the control group underwent surgical clipping, whereas the patients in the experimental group received the endovascular embolization. Subsequently, their surgical therapeutic effect, postoperative blood chemistry parameters, the incidence of complications, the recovery of neurological function and prognosis were analyzed and compared. Results: The operation duration, bleeding volume, respiratory recovery time and the time to extubation were significantly in favor of the experimental group when compared with the control group ($P < 0.001$); Senile patients in the experimental group had markedly lower levels of blood chemistry parameters than the control group ($P < 0.001$); The neurological recovery in the experimental group was found to be remarkably better than that in the control group ($P < 0.05$); The experimental group showed a distinct decrease in the incidence of complications compared to the control group ($P < 0.05$); A significant difference in good prognosis was observed between the control group and the experimental group ($P < 0.05$). Conclusion: Endovascular embolization is more effective in the treatment of senile PCoMA with ONP. It is superior to the traditional surgical clipping, and has a lower incidence of complications, thereby contributing to the better recovery of neurological function and prognosis.

Keywords: Surgical clipping, endovascular embolization, communicating aneurysm, oculomotor paralysis, neurological function

Introduction

The posterior communicating artery is defined as the internal carotid artery that connects the vertebrasilar artery to the posterior cerebral artery and transports material to nourish the back of the brain. Posterior communicating artery aneurysms (PCoMA) serve as one of the common intracranial aneurysm diseases. Along with the growth and expansion of the tumor, it is easy to compress the oculomotor nerve accompanied by abnormal bleeding, and the nerve displacement or edema is more likely to occur, leading to posterior communicating aneurysm with oculomotor nerve palsy (ONP). It has a negative impact on the vision of patient and their normal life [1, 2]. Generally, PCoMA grow at the arterial openings, with high disability rate and mortality as well as poor prognosis

recovery, substantially affecting patients' quality of life. Surgical clipping is a more conventional treatment in clinical practice. Although effective, it lacks satisfactory postoperative recovery [3]. With an increasingly wide application of vascular interventional procedure clinically, it demonstrates the advantages of small injury, rapid recovery, remarkable efficacy, etc. In view of this, the authors attempted to test and compare the clinical effect of the surgical clipping and endovascular embolization for senile PCoMA complicated with ONP and their neurological recovery.

Materials and methods

General data

A total of 96 senile patients with PCoMA complicated with ONP admitted to our hospital from

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May 2018 to May 2019 were selected and assigned into the experimental group and the control group according to the randomization method, with 48 cases in each group. The control group consisted of 28 male and 20 female patients aged 61-80 years; the experimental group consisted of 25 male and 23 female patients aged 60-79 years.

Inclusion criteria

① Those who were eligible for the clinical diagnostic criteria for PComA with ONP [4]; ② Those who were above 60-year-old; ③ This study was approved by the ethics committee of our hospital. Patients and their families were aware of the purpose and procedures of the experimental study, agreed to the treatment regimen and signed the informed consent form.

Exclusion criteria

① Complicated with other neoplasm malignant or significant diseases; ② A history of severe intracranial and extracranial injury or vascular disease; ③ No surgical sign or embolization intervention intolerance; ④ Mental and other cognitive impairment or refused to cooperate; ⑤ Refused to follow-up.

Methods

Ninety-six patients with PComA and ONP were preoperatively identified for arterial tumor location, and prepared themselves for other surgeries. Patients in the control group and experimental group were treated by the identical medical staff [5].

Patients in the control group were administered for conventional surgical clipping. The procedure used microscopy to assist in searching for standard or extended pterion approach so as to separate relevant arteries, followed by the separation of the aneurysm and the carrier artery, and finally completely separated the aneurysm before clamping the PComA tumor [5]. According to the basic conditions such as aneurysm size and neck length, it was necessary to select the appropriate aneurysm clip. In light of the aneurysm, the aneurysm clip was appropriately adjusted to ensure complete clamping and avoid the compression on the surrounding tissues. Finally, port oozing was handled. Later, the artery was wet packed with papaverine cot-

ton piece, and nimodipine was used to prevent vasospasm [5, 6].

Patients in the experimental group underwent the endovascular embolization. Puncture was performed from the femoral artery with microguide wire, and appropriate electrolytic detachable coils were selected according to the shape and size of the tumor and placed in the tumor cavity with dense packing [7, 8]. If it was a wide-necked aneurysm, then the procedure was assisted with the help of a balloon or vascular stent, and finally the tumor was visualized by arteriographic techniques and the embolic effect was assessed, with no visualization or subtle auricular visualization being preferred [9].

Observation indicators

Primary observation indicators

Surgical treatment indicators: The operation duration, intraoperative bleeding volume, postoperative respiratory recovery time and the time to extubation were observed and documented in the two groups.

Neurological recovery: After half a year, the neurological recovery of the two groups was compared. Statistical analysis was carried out according to the criteria of complete recovery (CR), partial recovery (PR) and no recovery (NR). CR signified that the eyeball could move normally, without diplopia and photophobia, and the pupillary response remained normal. PR indicated the significant improvement in ocular condition compared to preoperative period. NR suggested no improvement or worsening in ocular condition compared to the preoperative period.

Prognosis recovery: Glasgow Outcome Scale (GOS) was applied. A score of 5 was considered as good prognosis, 4 as mild disability (able to complete part of work and life autonomously), 3 as severe disability, 2 as persistent vegetative state and 1 as death.

Secondary observation indicators

Postoperative blood chemistry parameters: After surgery, 4 ml of venous blood was drawn from the patients, centrifuged, and the supernatant was taken for lactate and glucose test-

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Table 1. Comparison of the general data of senile patients between the experimental group and the control group (n = 48)

Group	Gender ratio		Age	Tumor location		Diabetes mellitus	Hypertension
	Female	Male		Left	Right		
Experimental group	47.92% (23/48)	52.08% (25/48)	68.04±4.33	37.5% (18/48)	62.5% (30/48)	25% (12/48)	18.75% (9/48)
Control group	41.67% (20/48)	58.33% (28/48)	67.41±4.15	41.67% (20/48)	58.33% (28/48)	27.08% (13/48)	20.83% (10/48)
X ² /t	0.3791	0.3791	1.356	0.1742	0.1742	0.0541	0.0656
P		> 0.05	0.745	> 0.05	> 0.05	> 0.05	> 0.05

Table 2. Comparison of surgical treatment indicators between the experimental group and the control group (n = 48)

Group	Operation duration (h)	Bleeding volume (mL)	Postoperative respiratory recovery time (min)	Postoperative time to extubation (h)
Control group	3.54±0.38	713.09±80.97	40.72±5.22	25.13±3.54
Experimental group	2.81±0.25	9.33±1.65	31.32±5.01	7.50±0.78
t	11.1189	60.2048	9.0012	34.5559
P	< 0.001	< 0.001	< 0.001	< 0.001

Table 3. Comparison of the neurological recovery between the experimental group and the control group (n = 48)

Group	CR	PR	NR
Experimental group	52.08% (25/48)	31.25% (15/48)	16.67% (8/48)
Control group	22.92% (11/48)	35.42% (17/48)	41.67% (20/48)
X ²	8.711	0.188	9.635
P	0.003	0.665	0.001

the control group and the experimental group (P < 0.05) (**Table 1**).

Primary outcomes

Comparison of the surgical treatment indicators

The operation duration, intraoperative bleeding volume, postoperative respiratory recovery time and the time to extubation were displayed in **Table 2**. The operation duration, bleeding volume, respiratory recovery time and the time to extubation were markedly in favor of the experimental group when compared with the control group (P < 0.001).

Comparison of the neurological recovery

The neurological recovery of elderly patients with posterior communicating artery aneurysms and oculomotor nerve palsy is rated as CR, PR, and NR. The experimental group showed a remarkably higher CR compared with the control group, but a marked lower NR than the control group (P < 0.05) (**Table 3**).

Comparison of the prognosis recovery

There were 52.08% patients of good recovery, 33.33% patients of mild disability, 12.5% patients of severe disability, 2.08% patients of persistent vegetative state in the experimental group. There were 27.08% patients of good recovery, 41.67% patients of mild disability,

ing. Afterwards, the content of neuron-specific enolase was measured by enzyme-linked immunosorbent assay.

Incidence of complications: The incidence of complications after discharge was followed up and recorded, and the incidence rate was calculated, including cerebral infarction, cerebral vasospasm, cerebrovascular rupture and cerebral edema.

Statistical analyses

The experimental data were analyzed and processed using SPSS 20.0 software. The enumeration data were analyzed with χ^2 test, and represented as [% (n)]. The measurement data were analyzed with t test, and represented as mean \pm standard deviation ($\bar{x} \pm sd$). P < 0.05 was considered as statistically significant difference.

Results

Comparison of general data

There was no statistical difference in terms of age, gender and other general data between

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Table 4. Comparison of the prognosis recovery between the experimental group and the control group (n = 48)

Group	good recovery	mild disability	severe disability	persistent vegetative state	death
Experimental group	52.08% (25/48)	33.33% (16/48)	12.5% (6/48)	2.08% (1/48)	0% (0/48)
Control group	27.08% (13/48)	41.67% (20/48)	14.58% (7/48)	12.5% (6/48)	4.17% (2/48)
X ²	8.412	0.204	0.635	0.124	0.158
P	0.001	0.675	0.998	0.795	0.874

Table 5. Postoperative blood chemistry parameters in the two groups (n = 48)

Group	Lactate (mmol/L)	Glucose (mmol/L)	Neuron-specific enolase (ug/L)
Experimental group	1.29±0.23	5.39±0.61	17.18±4.98
Control group	1.80±0.33	6.77±1.02	25.71±8.44
t	8.7842	8.0446	6.0306
P	< 0.001	< 0.001	< 0.001

14.58% patients of severe disability, 12.5% patients of persistent vegetative state, and 4.17% patients of death in the control group. There was a significant difference in good recovery between the experimental group and the control group (P < 0.05) (Table 4).

Secondary outcomes

Comparison of the postoperative blood chemistry parameters

Lower values of lactate, glucose and neuron-specific enolase tests in the experimental group were observed in the experimental group compared to those in the control group (P < 0.001), indicating that a statistical difference in the blood chemistry parameters was noted between the two groups (Table 5).

Comparison of the incidence of complications

The overall incidence of postoperative complications in elderly patients with PComA and ONP in the experimental group was significantly lower than that in the control group (P = 0.009). See Table 6.

Discussion

The vertebral artery, basilar artery, and posterior cerebral artery are collectively defined as the posterior communicating artery. Aneurysms refer to the formation of localized abnormal

enlargement in the lumen of the cerebral artery, which leads to rumen-like protrusion of the arterial wall [10, 11]. In most cases, clinical symptoms are related to the aneurysm size or whether it bleeds. If the tumor is relatively small, it generally does not bleed, the damage caused to the surrounding tissues is also relatively small, and the clinical manifestations are not obvious [12].

When aneurysm becomes larger, it will compress the oculomotor nerve and cause ONP, which can be accompanied by decreased visual acuity or visual field defect, as well as unilateral ptosis, pupillary abnormalities and other symptoms. Hence, emphasis should also be given to the treatment of PComA in clinical practice regarding the repair of neurological function, rather than the tumor condition only [13]. Surgical clamping treatment is the mainstay technique to treat PComA, and though certain desirable outcome has been garnered, the disadvantages in terms of long time operation, greater damage to the patient's body easily lead to various adverse events [14, 15]. Consequently, the alternative of the surgical approach is a key factor considering the later repair to reduce the surgical damage to the patient.

At present, a great body of trials on cerebrovascular interventional therapy has been carried out. The findings have shown that endovascular interventional therapy can make up for the shortcomings of surgical clipping, with less damage to patients and rapid postoperative recovery, especially suitable for elderly patients. Due to that elderly patients have lower physical fitness and slow recovery, this option can also be used for patients who are not suitable for surgical clipping therapy [16, 17]. The authors revealed that the operation duration, bleeding volume, respiratory recovery time, the time to

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Table 6. Comparison of the incidence of complications between the experimental group and the control group (n = 48)

Group	Cerebral infarction	Cerebral vasospasm	Cerebral vascular rupture	Brain edema	Overall incidence
Experimental group	2.1% (1/48)	2.1% (1/48)	4.2% (2/48)	4.2% (2/48)	12.5% (6/48)
Control group	4.2% (2/48)	10.4% (5/48)	8.3% (4/48)	12.5% (6/48)	35.4% (17/48)
χ^2					6.9184
P					0.009

extubation and blood chemistry parameters of elderly patients with PComA and ONP in the experimental group were distinctly better than those in the control group ($P < 0.001$). Subsequently, the oculomotor nerve function repair was followed up and recorded, the CR and NR in the experimental group performed better than the control group, and the incidence of complications and prognosis recovery in the experimental group were remarkably higher than those in the control group ($P < 0.05$). The experimental results were consistent with the study of Li et al. [18], which stated that “cerebrovascular interventional therapy is more beneficial to postoperative recovery than conventional clamping therapy, and interventional embolization can alleviate tumor pulsation and reduce the stimulation of neurons, thus effectively reducing the occurrence of complications and promoting the recovery of arterial and ophthalmic nerve function. The treatment of endovascular embolization is therefore a preferable option.

However, further studies are needed regarding larger sample size and long-term follow-up to yield more accurate data.

In summary, both surgical clipping and endovascular embolization have clinical efficacy for senile PComA complicated with ONP. But in relative terms, endovascular embolization exhibits obvious advantages, with good efficacy, less body injury, high safety and satisfactory recovery. Consequently, it is worthy of being widely used and popularized in clinical practice.

Disclosure of conflict of interest

None.

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