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ORIGINAL ARTICLE

Retrospective Study

# Short-term effect and long-term prognosis of neuroendoscopic minimally invasive surgery for hypertensive int-racerebral hemorrhage

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**Author contributions:** Wei JH and Tian YN design the experiment; Zhang YZ drafted the work; Wang XJ, Guo H and Mao JH collected the data; Wei JH and Tian YN analysed and interpreted data; Wei JH, Tian YN and Zhang YZ wrote the article.

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## Abstract

*BACKGROUND*

Hypertensive intracerebral hemorrhage is a common critical disease of the nervous system, comprising one fifth of all acute cerebrovascular diseases and has a high disability and mortality rate. It severely affects the patients' quality of life.

*AIM*

To analyze the short-term effect and long-term prognosis of neuroendoscopic minimally invasive surgery for hypertensive intracerebral hemorrhage.

*METHODS*

From March 2018 to May 2020, 118 patients with hypertensive intracerebral hemorrhage were enrolled in our study and divided into a control group and observation group according to the surgical plan. The control group used a hard-channel minimally invasive puncture and drainage procedure. The observation group underwent minimally invasive neuroendoscopic surgery. The changes in the levels of serum P substances (SP), inflammatory factors [tumor necrosis factor-α, interleukin-6 (IL-6), IL-10], and the National Hospital Stroke Scale (NIHSS) and Barthel index scores were recorded. Surgery related indicators and prognosis were compared between the two groups.

*RESULTS*

The operation time (105.26 ± 28.35) of the observation group was min longer than that of the control group, and the volume of intraoperative bleeding was 45.36 ± 10.17 mL more than that of the control group. The hematoma clearance rates were 88.58% ± 4.69% and 94.47% ± 4.02% higher than those of the control group at 48 h

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and 72 h, respectively. Good prognosis rate (86.44%) was higher in the observation group than in the control group, and complication rate (5.08%) was not significantly different from that of the control group ($P > 0.05$).The SP level and Barthel index score of the two groups increased ($P < 0.05$) and the inflammatory factors and NIHSS score decreased ($P < 0.05$). The cytokine levels, NIHSS score, and Barthel index score were better in the observation group than in the control group ($P < 0.05$).

*CONCLUSION*

Neuroendoscopic minimally invasive surgery is more complicated than hard channel minimally invasive puncture drainage in the treatment of hypertensive intracerebral hemorrhage; however, hematoma clearance is more thorough, and the short-term effect and long-term prognosis are better than hard channel minimally invasive puncture drainage.

**Key Words:** Neuroendoscopic minimally invasive surgery; Hard-channel minimally invasive puncture drainage; Hypertensive intracerebral hemorrhage; Prognosis Hematoma clearance



**Core Tip:** By comparing the surgical effects of hard channel minimally invasive drainage and neuroendoscopic minimally invasive surgery in hypertensive cerebral hemorrhage, it is confirmed that the latter is relatively complicated compared with the former, but the hematoma is removed more thoroughly and the prognosis is better.

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## INTRODUCTION

Hypertensive intracerebral hemorrhage is a common clinical critical illness of the nervous system, accounting for one-fifth of all acute cerebrovascular diseases with a high incidence of disability and mortality[1]. Various factors cause the blood vessels in the brain to rupture into the brain parenchyma. Nearly a quarter of patients die within one day of illness due to the disease. The mortality rate in one month is greater than 50%[2] having a serious impact on the quality of life of patients. Some Chinese scholars report that the incidence of hypertensive cerebral hemorrhage is 50-80 people per 100000, with the highest rate of death and disability among various types of strokes. Presently, operative treatment is a significant therapy for hypertensive intracerebral hemorrhage[3]. Operative treatment aims at clearing the intracranial hematoma and relieving intracranial pressure effectively, thus reducing secondary brain injury. Currently, hard-channel minimally invasive puncture drainage and neuroendoscopic minimally invasive surgery are the common methods[4]. Both these methods have advantages, such as minimal invasion, quick recovery, excellent prognosis, *etc*. However, there are no reports comparing these two methods in clinical practice[5]. Therefore, the objective of this study was to compare the effects of hard-channel minimally invasive puncture drainage and neuroendoscopic minimally invasive surgery on hypertensive intracerebral hemorrhage.

## MATERIALS AND METHODS

### General information

We enrolled 118 patients with hypertensive intracerebral hemorrhage in our hospital

from March 2018 to May 2020; they were divided into two groups on the basis of operation strategy. The control group underwent hard-channel minimally invasive puncture drainage and the observation group underwent neuroendoscopic minimally invasive surgery. Each group had 59 cases. The inclusion criteria were as follows: (1) Conforming to the standard of "all kinds of cerebrovascular disease diagnosis", and diagnosed as supratentorial hematoma on head computed tomography (CT); (2) Age ≥ 18 years, and ≤ 75 years; (3) Was the first episode and a score of Glasgow Coma Scale ≥6; (4) Traditional craniotomy was intolerable; (5) Admission time < 24 h; and (6) Clinical information was integrated. The exclusion criteria were as follows: (1) Patient with herniation of the brain; (2) Volumes of hemorrhage < 20 mL or > 70 mL; (3) Hemorrhage from ruptured intracranial aneurysm or cerebrovascular malformation; (4) Combined with principal organs diseases of the heart, liver and kidney; (5) Patients with disordered coagulation mechanism; and (6) Used antibiotics, glucocorticoid and immunosuppressant treatment for a long time.

### Methods

In the control group, we carried out hard-channel minimally invasive puncture drainage, conducted CT positioning after moderate local anesthesia to confirm the depth of hematoma and angle of puncture, usually selecting the maximum level center of hematoma as the target of puncture, and avoiding blood vessels and important functional areas. The incision was made on the patient's scalp; the dura was pierced with a puncture needle and the F12 silicone ventricular drainage tube was inserted in the hematoma center, and connected to an extracorporeal drainage tube with a general suction volume of 20%-30%. Additionally, 50000 U of urokinase was injected into the hematoma cavity every day after completion, closed the tube, and opened the drainage two hours later for 3-7 d until 80%-90% of the hematoma was removed, drew out the tube.

In the observation group, we performed neuroendoscopic minimally invasive surgery by making a 3-4 cm cut where the maximum level of hematoma volume was present after moderate local anesthesia drilled within the skull plate, 1-1.5 cm closest to the hematoma center, separated the local brain tissue with bipolar electrocoagulation after incising the dura, punctured using a trocar along the direction of CT-identified the hematoma and applied the tube and suction equipment to clean the hematoma with monitor guidance, used bipolar electrocoagulation for hemostasis at the bleeding source, reserved ectocoelic drainage tube of hematoma, utilized gelatin sponge to fill the drill, and sewed up the incisions after removing the trocar.

### Indicators of observation and methods of detection

Cytokine levels; National Hospital Stroke Scale (NIHSS) score; variation of Barthel index between the two groups before and after surgery; indices, such as operation time, bleeding volume, and hematoma clearance rate; and rate of complication and prognosis within 6 mo after surgery of the two groups were compared. The NIHSS score has a total score of 42 ranging from 0 to 42; a score < 7 is classified as mild neurological impairment; a score of 7–15 signifies moderate defect; a score > 15 is classified as severe defect. The Barthel index has a total score of 100. The score is directly proportional to independence and inversely proportional to dependence. Prognosis within 6 mo was assessed by the Glasgow Coma Scale (GCS score), with class I being death, class II being vegetative state, class III and IV being severe and mild disability respectively, and class V being good recovery. Class IV-V have a good prognosis.

### Statistical analysis

Data was analyzed using SPSS19.0. (IBM SPSS Statistics for Windows, version 19, IBM Corp., Armonk, NY, United States). Description of measuring index with mean ± SD, application of t test, count data with $\chi^2$ test, there was Statistical significance was set at $P < 0.05$.

## RESULTS

### Comparison of general information between two groups

There was no significant difference in the between-group comparison of general information of sex, age, hemorrhage location, *etc.* between two groups ($P > 0.05$) (Table 1).

**Table 1 Comparison of general information between two groups**

| Groups | *n* | Male/female | Age (yr) | Hypertension duration (yr) | Volume of hematoma (mL) | GCS score (point) | Hemorrhage location | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Basal ganglia | Thalamus | Lobe |
| Control group | 59 | 33/26 | 57.63 ± 9.32 | 11.25 ± 2.05 | 51.85 ± 12.69 | 9.12 ± 2.32 | 43 (72.88) | 9 (15.25) | 7 (11.86) |
| Observation group | 59 | 35/24 | 56.86 ± 11.04 | 11.31 ± 1.97 | 52.14 ± 12.17 | 9.05 ± 2.41 | 41 (69.49) | 10 (16.95) | 8 (13.56) |
| $\chi^2$/t | | 0.139 | 0.409 | 0.162 | 0.127 | 0.161 | 0.167 | | |
| *P* value | | 0.709 | 0.683 | 0.872 | 0.899 | 0.873 | 0.920 | | |

### *Comparison of surgical related indicators between two groups*

The observation group had a longer operation time of 105.26 ± 28.35 min than the control group, and a higher volume of intraoperative hemorrhage of 45.36 ± 10.17 mL than the control group. Hematoma clearance rates of the observation group at 48 h and 72 h postoperatively were 88.58% ± 4.69% and 94.47% ± 4.02% respectively, and higher than those of the control group ($P < 0.05$) (Table 2).

### *Comparison of cytokine level, NIHSS score and Barthel index score between the two groups*

On postoperative day 14, serum P substances (SP) level increased in the two groups, whereastumor necrosis factor-α (TNF-α), interleukin (IL)-6, IL-10 Levels decreased compared to their preoperative values. The above-mentioned cytokines in the observation group were higher than in the control group ($P < 0.05$). Similarly, on postoperative day 14, the Barthel index scores of the two groups increased, and the NIHSS score decreased compared to the preoperative values (Table 3). The Barthel index score of the observation group was higher than that of the control group, and the NIHSS score was lower than that of the control group ($P < 0.05$) (Table 4).

### *Comparison of complication rate during the hospital stay between two groups*

Table 5 shows that there was no significant difference in the complication rates between the two groups ($P > 0.05$).

### *Comparison of prognosis within 6 mo between the two groups*

Table 6 shows that both groups had no occurrence of class 1 case; the observation group had a significantly better prognosis than the control group ($P < 0.05$).

## DISCUSSION

Minimally invasive puncture hematoma drainage surgery is commonly used in clinical practice. The operation is simple and can be completed under local anesthesia, which is suitable for application in frail and older patients or patients with serious diseases [6]. The operation causes minor trauma to the patient, which is conducive to the recovery of the patient. Needle drainage advocates earlier reduction of the compressive effect of the hematoma and less brain damage[7].

However, the hematoma clearance rate is low. Drainage of the hematoma requires time, and the nerve function damage caused by the hematoma compression cannot be completely relieved within a short time[8]. It was found that the operation time of the observation group was prolonged, and the intraoperative bleeding higher, but the hematoma clearance rate increased. Because neuroendoscopic surgery can treat accurate positioning of the hematoma, use the transparent outer tube to observe the distribution of the surrounding hematoma, so as to facilitate clinical observation as much as possible Limit hematoma removal[9].

Currently, neuroendoscopy is considered for the surgical treatment of hypertensive cerebral hemorrhage. The first indication is that the operation should be performed after 6 h of the episodeas much as possible, and the operation time should be delayed as much as possible for patients who have been taking aspirin for a prolonged duration; second, it is suitable for patients with a hematoma volume of 30-90 mL, and is especially suitable for a deep hematoma. This operation is not suitable forpatients

**Table 2 Comparison of surgical related indicators between two groups (mean ± SD)**

| Groups | Cases | Operation time (min) | Volume of hemorrhage with introperative (mL) | Hematoma clearance rate (%) | |
|---|---|---|---|---|---|
| | | | | 48 h after surgery | 72 h after surgery |
| Control group | 59 | 42.55 ± 9.14 | 22.36 ± 3.85 | 72.56 ± 7.02 | 89.35 ± 5.61 |
| Observation group | 59 | 105.26 ± 28.35 | 45.36 ± 10.17 | 88.58 ± 4.69 | 94.47 ± 4.02 |
| *t* | | 16.171 | 16.246 | 14.575 | 5.698 |
| *P* value | | 0.000 | 0.000 | 0.000 | 0.000 |

**Table 3 Comparison of cell factors between two groups (mean ± SD)**

| Groups | Cases | TNF-α (μg/L) | | IL-6 (ng/L) | | IL-10 (ng/L) | | SP (pg/mL) | |
|---|---|---|---|---|---|---|---|---|---|
| | | Before surgery | 14 d after surgery | Before surgery | 14 d after surgery | Before surgery | 14 d after surgery | Before surgery | 14 d after surgery |
| Control group | 59 | 65.38 ± 8.52 | 46.32 ± 4.11[a] | 57.25 ± 7.14 | 20.03 ± 4.36[a] | 11.24 ± 3.23 | 3.85 ± 0.54[a] | 13.55 ± 4.05 | 21.14 ± 4.58[a] |
| Observation group | 59 | 64.96 ± 7.86 | 40.25 ± 3.71[a] | 58.02 ± 7.63 | 14.88 ± 3.14[a] | 11.08 ± 3.39 | 2.41 ± 0.27[a] | 13.61 ± 3.82 | 27.81 ± 4.21[a] |
| *t* | | 0.278 | 8.421 | 0.566 | 7.362 | 0.262 | 18.321 | 0.083 | 8.236 |
| *P* value | | 0.781 | 0.000 | 0.572 | 0.000 | 0.793 | 0.000 | 0.934 | 0.000 |

[a]*P* < 0.05, compared between groups before surgery. TNF-α: Tumor necrosis factor-α; IL: Interleukin; SP: Serum P substances.

**Table 4 Comparison of National Hospital Stroke Scale score and Barthel index between two groups (mean ± SD point)**

| Groups | Cases | NIHSS score | | Barthel index | |
|---|---|---|---|---|---|
| | | Before surgery | 14 d after surgery | Before surgery | 14 d after surgery |
| Control group | 59 | 19.25 ± 4.77 | 8.12 ± 2.03[a] | 15.36 ± 4.74 | 54.15 ± 5.33[a] |
| Observation group | 59 | 18.98 ± 5.02 | 6.98 ± 1.24[a] | 15.42 ± 5.02 | 66.05 ± 6.17[a] |
| *t* | | 0.299 | 3.681 | 0.067 | 11.211 |
| *P* value | | 0.765 | 0.000 | 0.947 | 0.000 |

[a]*P* < 0.05, compared between groups before surgery. NIHSS: National Hospital Stroke Scale.

**Table 5 Comparison of incidence of complications in hospital between two groups, *n* (%)**

| Groups | Cases | Intracranial infection | Pulmonary infection | Recurrent postoperative hemorrhage | Total |
|---|---|---|---|---|---|
| Control group | 59 | 3 (5.08) | 2 (3.39) | 2 (3.39) | 7 (11.86) |
| Observation group | 59 | 1 (1.69) | 1 (1.69) | 1 (1.69) | 3 (5.08) |
| $\chi^2$ | | | | | 1.748 |
| *P* value | | | | | 0.186 |

with poor cardiopulmonary function or in those who cannot tolerate general anesthesia[10].

After treatment, the observation group increased significantly compared with the control group, whereas TNF-α, IL-6, IL-10 decreased significantly in the observation group. Thus, neuroendoscopic minimally invasive surgery for the treatment of hypertensive cerebral hemorrhage can significantly reduce the degree of inflammation in patients. On between group comparison, on postoperative day 14, the quality of life of patients improved significantly after neuroendoscopic minimally invasive surgery and the patients recovered. The effect of neurological deficit is more obvious. The

**Table 6 Comparison of prognosis within 6 mo between two groups, *n* (%)**

| Groups | Cases | Class V | Class IV | Class III | Class II | Good prognosis rate |
|---|---|---|---|---|---|---|
| Control group | 59 | 9 (15.25) | 33 (55.93) | 12 (20.34) | 5 (8.47) | 42 (71.19) |
| Observation group | 59 | 16 (27.12) | 35 (59.32) | 6 (10.17) | 2 (3.39) | 51 (86.44) |
| $\chi^2$ | | | | | | 4.111 |
| *P* value | | | | | | 0.043 |

prognosis is better. Secondary brain damage caused by hematoma can cause serious damage to patients.

On the one hand, thrombin in the hematoma can cause inflammation in the body, affecting endothelial cells, neurons and glial cells and resulting in damage to the blood-brain barrier[11]; on the other hand, white blood cells and microglia in the body are activated after cerebral hemorrhage, producing a large number of inflammatory factors, and further destroying the blood-brain barrier; thus, there is a vicious cycle created, further aggravating brain tissuedamage[12]. The endoscopic surgery produces less trauma, and the operation with the cannula does not damage the brain tissue, and the bleeding is arrested under electrocoagulation resulting inhemostasis in the hematoma cavity[13]. Reducing the occurrence of postoperative bleeding and early and rapid removal of the hematoma is beneficial to patients in order for them to begin rehabilitation.

During the treatment, we summarized the following experiences: First, the incision should be mainly arc-shaped, and designed outside the bone window. At the same time, it is necessary to restore the bone flapto avoid a high tension of the incision and poor healing. Second, the outer sleeve should be inserted as much as possible once. Once the bottom of the hematoma cavity is reached, close attention should be paid to the removal of the hematoma. Third, due to the large number of accessories required for neuroendoscopy devices, strict attention should be paid to the implementation of aseptic procedures to reduce the chance of intracranial infection[14]. The disadvantage of endoscopic surgery is that the operating space is small, and the technical requirements are high, especially when active bleeding occurs. Lens contamination caused by the active bleeding can cause the doctor's vision to be blurred. Hemostasis is relatively difficult, suggesting that preoperative evaluation should be done, and craniotomy planning should be performed, if necessary[15].

This study analyzed the advantages and disadvantages of the two surgical methods used in the surgical management of hypertensive intracerebral hemorrhage and selected an appropriate surgical treatment, for clinical reasons. The treatment plan provides a certain basis, but the number of patients enrolled in this study was small, and some of the included evaluation indicators have certain main factors. View ability may lead to bias in the results, and it is necessary to expand the sample size and formulate more reliable evaluation indicators for further demonstration[16-20].

## CONCLUSION

In conclusion, neuroendoscopic minimally invasive surgery is more complicated than hard-channel minimally invasive puncture drainage in the treatment of hypertensive intracerebral hemorrhage, but has a more thorough hematoma clearance rate and a better short-term effect and long-term prognosis.

## ARTICLE HIGHLIGHTS

### *Research background*

Surgical treatment is a common method for hypertensive cerebral hemorrhage. The traditional craniotomy has a large skull window and good effect on removing edema, which is helpful for patients to pass through the peak period of brain edema. However, patients with this operation should be carried out under general anesthesia, and the wound caused by this operation is large. Therefore, most patients need blood transfusion. Some patients may have stronger edema reaction after surgical treatment, which is not conducive to postoperative recovery of patients.

### Research motivation

Explore the application value of neuroendoscopic minimally invasive surgery in the treatment of hypertensive intracerebral hemorrhage.

### Research objectives

The advantages and disadvantages of hard channel minimally invasive puncture drainage and neuroendoscopic minimally invasive surgery in hypertensive intracerebral hemorrhage were analyzed, which provided a basis for clinical rational selection of surgical treatment.

### Research methods

A total of 118 patients with hypertensive cerebral hemorrhage were reviewed. The control group was treated with hard-channel minimally invasive puncture and drainage, and the observation group was treated with endoscopic minimally invasive surgery. The changes of serum P substances, inflammatory factors, National Hospital Stroke Scale (NIHSS) score and Barthel index were recorded, and the surgical related indexes and prognosis of the two groups were compared.

### Research results

The operation time and intraoperative blood loss in the observation group were longer than those in the control group, with no advantages. Hematoma clearance rate and good prognosis rate at 48 h and 72 h after operation were higher than those in control group ($P < 0.05$); Complication rates in both groups not statistically significant ($P > 0.05$) The inflammatory cytokines, NIHSS score and Barthel index in the postoperative 14 d, observation groups were better than in the control group ($P < 0.05$).

### Research conclusions

Neuroendoscopic minimally invasive surgery for hypertensive intracerebral hemorrhage is relatively complex, but hematoma removal is more complete and the effect is better.

### Research perspectives

Minimally invasive neuroendoscopic surgery can be more widely used in the treatment of hypertensive cerebral hemorrhage.

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