

# *Application of lumbar drainage based on flow control in patients with intracranial infection after craniocerebral surgery*

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**Abstract:** To explore the application effect of lumbar cistern based on flow control in patients with intracranial infection, 40 patients with postoperative intracranial infection and lumbar cistern surgery in our hospital from January 2021 to December 2023 were selected as the study subjects. The random number table method was used to divide the participants into an observation group and a control group. The control group received routine drainage, while the observation group received flow control. Both groups were intervened until the end of drainage, then the drainage situation, incidence of complications, and cerebrospinal fluid characteristics were compared. There was no statistically significant difference in drainage speed, drainage time, and total drainage volume between the two groups. The observation group showed lower white blood cell count, intracranial pressure, protein and glucose quantification, and overall incidence of complications compared to before drainage, and was superior to the control group. The lumbar cistern based on flow control is more stable in patients with intracranial infection after craniotomy, and has positive significance in improving cerebrospinal fluid indicators, reducing complications, and patient prognosis.

## 1. Introduction

Intracranial infection is a common postoperative complication in patients with cerebral hemorrhage, which is severe and difficult to treat. Conventional antibiotics cannot cross the blood-brain barrier of patients with intracranial infections, making it difficult to achieve effective blood drug concentrations, resulting in unsatisfactory treatment outcomes. Continuous drainage of the lumbar cistern promotes cerebrospinal fluid metabolism and reduces infection symptoms by diverting intracranial inflammatory cerebrospinal fluid out of the body<sup>[1]</sup>. Its application in patients with intracranial infection has been supported by multiple studies.

Continuous drainage of the lumbar cistern promotes cerebrospinal fluid metabolism and reduces infection symptoms by diverting intracranial inflammatory cerebrospinal fluid out of the body. However, changes in drainage speed are one of the key factors affecting drainage effectiveness. Excessive drainage can cause significant instantaneous fluctuations in intracranial pressure, leading to pneumocephaly, low intracranial pressure pain, and inducing brain herniation<sup>[2-3]</sup>. However, slow drainage can easily lead to tube blockage, which not only reduces the effectiveness of intracranial

pressure control but also increases the risk of infection, seriously affecting the patient's prognosis<sup>[4]</sup>.

Therefore, this article intends to select patients with postoperative intracranial infection and lumbar cistern surgery as the research object, and explore the application effect of lumbar cistern based on flow control. The following is the report:

## 2. Materials and Methods

### 2.1 General information

40 patients with postoperative intracranial infection and lumbar cistern surgery in our hospital from January 2021 to December 2023 were selected as the study subjects. There are 12 males and 8 females in the observation group, aged between 32 and 69 years old; Location of bleeding: 10 cases in subarachnoid space and 10 cases in ventricles. There are 11 males and 9 females in the control group, aged 35-69 years old; Location of bleeding: 12 cases in the subarachnoid space and 8 cases in the ventricles. There was no statistically significant difference between the two groups in terms of gender, age, bleeding site, preoperative cerebrospinal fluid characteristics, hematological examination, GOS score, and basic data.

Inclusive criteria: All patients underwent craniotomy+lumbar cistern drainage, and were diagnosed as intracranial infection according to the relevant criteria in the Diagnosis and Treatment of infectious diseases of the Nervous System; Patients or family members support this research protocol and sign a consent form. Exclusion criteria: Functional failure of important organs such as heart, liver, and kidney; The deceased and those who do not cooperate during the drainage process.

### 2.2 Method

Both groups received continuous drainage from the lumbar cistern and received routine care.(1)Preparation before drainage: ventilate and disinfect the ward, limit the number of accompanying personnel, reduce visits and lower the risk of infection. (2) Health education: We distribute to conscious patients health promotion manual, guide patients and their families to read together.We make them have a correct understanding of the waist,the importance and necessity of large pool drainage, drainage effect, and precautions during drainage wait.Drainage related videos were played to encourage patients to intuitively experience,reduce tension psychologically, and then have face-to-face communication with the patient to understand their doubts.One-on-one answers were provided to ensure that patients can relax and undergo drainage treatment.(3) Catheter care:Conscious patients were informed of the puncture purpose and puncture intention before puncture function.Patients were advised to cooperate with nursing care.But if they are unable to cooperate due to excessive tension or other factors,the patient was given sedative medication as instructed by the doctor. (4) Nursing during drainage: A drainage tube was placed during drainage the opening position of the flow bag and drainage tube is 10-15cm higher than the plane of the lateral ventricle.Daily replacement drainage bag and dressing at the interface, disinfected with 75% alcohol to keep the local skin clean and dry.Blood pressure was regularly observed whether there is redness, swelling, or bleeding at the incision site,handle any abnormal situations. We strictly controlled the flushing speed when the drainage tube was flushed to avoid complications such as low intracranial pressure and intracranial hemorrhage.If low intracranial pressure occurred immediately, we assisted the patient in lying flat,and raising the drainage bag. If intracranial hemorrhage occurred, the patient should be advised to rest in bed and avoid changing positions.

The control group did not adjust the flow rate during the drainage process, and the drainage flow rate was not fixed. The observation group implemented nursing interventions based on flow control theory on a routine basis.The cerebrospinal-fluid drainage bottle is suspended at the head of the

bed. The height of the drainage bottle is dynamically adjusted to regulate the brain Spinal fluid drip rate (flow rate controlled at 2-3 drops/min, 10-15ml/h), which can be adjusted appropriately to increase the flow rate and reach the extreme value.

During the recovery period of the disease, the drainage volume can be appropriately reduced, and the drainage volume value should be recorded during the drainage process. If the drainage fluid becomes cloudy or flocculent, immediately notify the physician was treated. Simple skull After 3 consecutive days of cerebrospinal fluid examination showing normal results, patients with internal infections can have their tubes removed, and patients with combined cerebrospinal fluid leakage showed normal results on continuous 3 days of cerebrospinal fluid examination, while after no cerebrospinal fluid outflow or clarification, the tube can be removed. Both groups intervened until drainage was achieved.

### 2.3 Observation indicators

(1) Compare the drainage situation between two groups. (2) Compare intracranial pressure, white blood cell count, protein quantification before and after drainage between two groups Sugar quantification. (3) Calculate the incidence of complications in both groups upon discharge. (4) After discharge 3, the patient's prognosis was evaluated using GOS every month, with a score range of 1-5 points. The higher the score, the better the outcome

### 2.4 Statistical analysis

Independent samples with homogeneity of variance tested by Bartlett. T-test shows differences in data between groups and does not test for homogeneity of variance within the group. At the same time point, t-test was used for differences, and the counting data was described as [n (%)]. Two groups were divided into two groups

Classification data comparison adopts  $\chi^2$  test, GOS score shows an orderly change within 3 months after discharge Measure using Mann Whitney U test. Bilateral testing, using  $\alpha = 0.05$  is the test Level. The difference is statistically significant when  $P < 0.05$ .

## 3. Results

There was no statistically significant difference in drainage speed, drainage time, and total drainage volume between the two groups; The observation group showed lower white blood cell count, intracranial pressure, protein and glucose quantification, and overall incidence of complications compared to the control group before drainage, as detailed in the **Table 1**:

Table 1: Comparison of relevant data (control group and observation group)

Variable	Control group	Observation group	P
Drainage time(d)	8.39 ± 2.34	8.04 ± 3.32	0.398
Drainage speed(ml/d)	321.03 ± 69.83	302.94 ± 34.05	0.742
Induced flow rate(ml)	2 581.06 ± 549.17	2443.56 ± 285.75	0.988
Hospitalization time(d)	19.20 ± 4.65	16.45 ± 3.77	<b>0.001</b>
After 3days, White blood cells in hematological examination( $\times 10^9/L$ )	14.17 ± 3.24	6.86 ± 0.62	<b>0.000</b>
Cerebrospinal fluid intracranial pressure(mmH <sub>2</sub> O)	227.93 ± 38.94	228.06 ± 25.54	<b>0.046</b>

White blood cells( $\times 10^7/L$ )	8.41 $\pm$ 3.81	7.91 $\pm$ 2.73	<b>0.005</b>
Protein quantification(g /L)	0.87 $\pm$ 0.48	0.70 $\pm$ 0.08	<b>0.000</b>
Glucose quantification(mmol/L))	3.93 $\pm$ 3.69	4.19 $\pm$ 1. 27	<b>0.006</b>
Complications			<b>0.000</b>
Cranial cavity gas accumulation	3	1	-
plugging	4	1	-
Intracranial hypotension headache	5	1	-
GOS rating			<b>0.000</b>
3	1	0	-
4	12	6	-
5	7	24	-
Statistically significant values are given in bold, $P < 0.05$ was considered a statistically significant difference.			

#### 4. Discussion

Continuous drainage of the lumbar cistern plays an important role in reducing bacterial concentration in cerebrospinal fluid, controlling intracranial pressure, and protecting brainstem function. At the same time, it can monitor the characteristics of cerebrospinal fluid, conduct bacteriological examinations, and is of great significance for timely handling of abnormal situations<sup>[5-6]</sup>. However, the drainage volume during the drainage process is affected by factors such as the height of the drainage volume and changes in the patient's position. Therefore, how to control the drainage speed has become an important content in the drainage process.

Continuous drainage of the lumbar cistern can increase cerebrospinal fluid secretion, allowing newly secreted cerebrospinal fluid to be well diluted and rinsed, forming a virtuous cycle. The importance of flow control in continuous lumbar drainage has gradually gained clinical attention. The best effect is achieved when the drainage speed of cerebrospinal fluid is controlled at 10ml/h, which not only reduces inflammatory reactions, shortens treatment time, but also has high safety. However, in patients with intracranial infection, the secretion of inflammatory cerebrospinal fluid increases and the absorption amount significantly decreases, so it is advisable to increase the drainage volume appropriately<sup>[7-8]</sup>. On the basis of previous research, the observation group of this article implemented nursing care based on flow control theory for patients with intracranial infection after cerebral hemorrhage surgery. By adjusting the height of the drainage bag at any time to control the drainage flow rate, it was controlled at 10-15ml per hour<sup>[9]</sup>. There was no significant difference in average drainage speed, drainage time, and total drainage flow rate. Compared with the conventional drainage mode, the fluctuation of drainage speed was small, ensuring a slow and uniform flow rate, and avoiding the formation of a large pressure gradient due to excessive drainage flow rate per unit time,

Therefore, the incidence of complications was lower, which is consistent with the research results of scholars such as Zhou Xiaoxiao<sup>[10-12]</sup>. In addition, this article compared the cerebrospinal fluid indicators and intracranial pressure before and after drainage in two groups. The results showed that the intracranial pressure, white blood cell count, and protein quantification in the drainage group were lower than before drainage, while the sugar quantification was higher than before drainage<sup>[13]</sup>. Moreover, the observation group had better indicators than the control group. It can be seen that nursing based on flow control theory helps promote normal physiological circulation in patients with continuous lumbar drainage, improve cerebrospinal fluid indicators, and enhance the effectiveness of intracranial pressure control<sup>[14]</sup>. The results of this study also found that

the observation group had a shorter hospital stay and a better prognosis three months after discharge.

In summary, nursing based on flow control theory has shown good results in improving the fluctuation of drainage speed, intracranial pressure, and cerebrospinal fluid indicators in patients with intracranial infection after cerebral hemorrhage surgery. This helps to reduce the risk of complications, shorten hospitalization time, and ensure better prognosis for patients.

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