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Analysis of the Efficacy of Neuroendoscopic Hematoma Evacuation in the Treatment of Chronic Subdural Hematoma and its Influence on the Neurological Function of Patients

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Abstract: *Objective:* To analyze the effect of neuroendoscopic hematoma evacuation on neurological function in patients with chronic subdural hematoma (CSDH). *Methods:* From September 2019 to September 2022, 113 patients with CSDH were selected and randomly divided into group A for neuroendoscopic hematoma evacuation and group B for soft channel drainage. The differences in neurological function of these two groups were compared. *Results:* Except for intraoperative blood loss and duration of surgery, all surgical indicators in group A were better than those in group B , $P < 0.05$. One month after operation, the neurological deficit (CSS) score in group A was lower than that in group B, and the quality of life (SF-36), activities of daily living (ADL) scores were higher than those in group B, with $P < 0.05$. 7 days after operation, the scores of superoxide dismutase (SOD), malondialdehyde (MDA), glutathione peroxidase (GSH-Px) and other oxidative stress indicators were better than those in group B, $P < 0.05$; the complication rate in group A was lower than that in group B, with $P < 0.05$. *Conclusion:* Neuroendoscopic hematoma evacuation therapy can regulate oxidative stress indicators, improve nerve defects, and improve the outcome of CSDH patients.

Keywords: Chronic subdural hematoma; Neuroendoscopy; Hematoma evacuation; Neurological function; Curative effect

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1. Introduction

Chronic subdural hematoma (CSDH) refers to a brain hematoma that occurs when the head is damaged for more than 3 weeks, and it is located at the arachnoid and dura mater. CSDH accounts for a relatively high proportion of neurosurgical diseases. It is related to venous sinuses, cerebral cortical vein rupture, and also brain contusion. It can cause bleeding of cortical blood vessels and excessive accumulation of local blood in the dura mater cavity. In addition, CSDH is an insidious disease with a high incidence in the middle-aged and elderly people. It accounts for about 10% of intracranial hematoma diseases. The typical pathological sign is the increase in intracranial pressure [1]. Therefore, the hematoma should be removed as soon as possible after the onset of the disease to avoid the impact of long-term hematoma-induced cerebrovascular compression on the blood supply to the brain, thereby reducing the risk of brain atrophy and stroke. At present, CSDH is mostly treated via surgery, such as puncture drainage, single-hole drainage, and flushing of the hematoma cavity. It is extremely important to explore efficient treatment options for CSDH. In this paper, the efficacy of neuroendoscopic hematoma evacuation was explored through 113 patients.

2. Materials and methods

2.1. Information

From September 2019 to September 2022, a sample of 113 patients with chronic subdural hematoma (CSDH) was treated and subsequently randomly allocated into two groups, group A and group B. There were no statistically significant differences in the data pertaining to CSDH patients between these two groups ($P > 0.05$). Detailed information can be found in **Table 1**.

Table 1. Basic information of CSDH patients

Group	No	Gender		Age (years)		Course of head trauma (months)		Hematoma volume (mL)	
		Male	Female	Range	Average	Range	Average	Range	Average
Group A	57	37	20	58–77	64.28 ± 2.11	1–8	4.18 ± 0.43	79–124	96.15 ± 2.88
Group B	56	35	21	58–78	64.31 ± 2.16	1–9	4.19 ± 0.48	80–125	96.17 ± 2.91
χ^2/t	-	0.0711		0.0747		0.1167		0.0367	
P	-	0.7897		0.9406		0.9073		0.9708	

2.2. Inclusion and exclusion criteria

Inclusion criteria: (i) Patients with diagnosed with CSDH through MRI and CT, (ii) patients with traumatic brain injury duration > 3 weeks, (iii) patients with GCS score ≥ 8 points, (iv) patients aged > 60 years.

Exclusion criteria: (i) patients in whom the successful placement of a neuroendoscope was not possible, (ii) patients with narrow operating space, (iii) patients with abnormal blood coagulation indicators, (iv) patients with a history of statin therapy, (v) patients with a history of craniocerebral surgery.

2.3. Treatment methods

Group A was treated with neuroendoscopic hematoma evacuation: A venous channel was created under general anesthesia, and the was placed in a supine position. The dense hematoma area was identified through CT. A 4–5 cm incision was created, and a 2.5–3.0 cm milling cutter was used open a bone window for treatment. The dura mater was then cut open with a "cross"-shaped incision. The vascular capsule underneath the incision was opened, followed by electrocoagulation for hemostasis. A suction device was then used to suck out the hematoma in the bone hole area, and then a flexible fiber endoscope (2.8 mm in outer diameter) was inserted into the hematoma cavity. Suction and flushing was performed at the same time at the same time to clear the floc and hematoma. Then, under the guidance of the endoscope, the fibers were separated and connected with a 3-way stopcock. The hematoma cavity was then flushed with 0.9% NaCl solution, and the flushing was suspended when solution turns clear. Following the procedure, the patient was closely monitored for any signs of bleeding. In the absence of bleeding, the drainage tube was securely placed. The endoscope was then carefully withdrawn, the bone hole was sealed using a gelatin sponge, and the bone flap was repositioned and sutured. A CT scan was performed to re-evaluate the local hematoma status approximately 2 hours postoperation. If no bleeding was detected, the drainage tube was removed, and observations were made for any residual hematoma. The duration of drainage was adjusted based on the patient's condition.

Group B was treated with soft channel drainage. The patients were placed in a supine position, and the surgery was performed with local anesthesia. A CT scan was performed to precisely locate the intersection of the largest one-third of the hematoma within the brain and the scalp while ensuring the avoidance of blood vessels and critical brain regions during the puncture. An incision of approximately 2 cm was made at the surgical center, followed by careful scalp and skull opening and periosteum removal. A 1 cm diameter bone hole was drilled, penetrating the skull. A "cross"-shaped incision was made in the dura mater area, followed by careful vascular capsule opening and hemostasis using electrocoagulation. A No. 14 silicone catheter was threaded through the dura incision to reach the subdural space. Upon reaching bloody drainage fluid, the catheter was adjusted to reach the hematoma's distal end while maintaining a depth of 5–10 cm for unobstructed drainage. The catheter was secured, the incision closed, and the drainage tube connected to a device. After two hours, a follow-up CT assessed the hematoma, and tube removal occurred when residual volume was < 10 mL.

2.4. Statistical analysis

The data of the patients were analyzed using SPSS 21.0. The count data were represented as percentages and analyzed using the (χ^2 test), while measurement data were presented as (means ± standard deviation) and analyzed using the *t*-test. $P < 0.05$ indicated statistical significance.

3. Results

3.1. Surgical indicators

Except for intraoperative blood loss and duration of surgery, all surgical indicators in group A were better than those in group B ($P < 0.05$), as shown in **Table 2**.

Table 2. Comparison of surgical indicators in patients with CSDH (mean ± standard deviation)

Group	Duration of indwelling drainage tube (d)	Operation time (min)	Intraoperative blood loss (mL)	Length of hospital stay (d)	Hematoma clearance rate 7 days after operation (%)
Group A (*n* = 57)	2.51 ± 0.48	35.25 ± 2.42	29.51 ± 2.43	7.12 ± 1.05	92.39 ± 2.42
Group B (*n* = 56)	3.24 ± 0.56	35.11 ± 2.39	28.87 ± 2.39	9.01 ± 1.11	81.92 ± 1.69
t	7.4444	0.3094	1.4113	9.2998	26.6201
P	0.0000	0.7576	0.1610	0.0000	0.0000

3.2. Rehabilitation indicators

One month after operation, the CSS score of group A was lower than that of group B, and the scores of SF-36 and ADL were higher than those of group B ($P < 0.05$), as shown in **Table 3**.

Table 3. Comparison of rehabilitation indicators of CSDH patients (mean ± standard deviation)

Group	CSS (min)		SF-36 (min)		ADL (points)	
	Preoperative	1 month after operation	Preoperative	1 month after operation	Preoperative	1 month after operation
Group A (*n* = 57)	31.89 ± 3.25	11.99 ± 1.52	62.15 ± 2.43	89.42 ± 3.51	61.85 ± 2.48	92.42 ± 3.25
Group B (*n* = 56)	31.92 ± 3.27	18.15 ± 1.69	62.17 ± 2.41	76.36 ± 2.96	61.84 ± 2.49	76.85 ± 2.89
t	0.0489	20.3796	0.0439	21.3633	0.0214	26.8948
P	0.9611	0.0000	0.9650	0.0000	0.9830	0.0000

3.3. Oxidative stress indicators

Seven days after operation, the superoxide dismutase (SOD), malondialdehyde (MDA), glutathione peroxidase (GSH-Px), and other indicators in group A were better than those in group B ($P < 0.05$), as shown in **Table 4**.

Table 4. Comparison of oxidative stress indicators in patients with CSDH (mean ± standard deviation)

Group	SOD (U/L)		MDA (nmol/ml)		GSH-Px (U/L)	
	Preoperative	7d after operation	Preoperative	7d after operation	Preoperative	7d after operation
Group A (*n* = 57)	214.32 ± 3.51	276.15 ± 4.18	7.31 ± 1.01	5.05 ± 0.85	109.11 ± 3.25	150.43 ± 5.15
Group B (*n* = 56)	214.31 ± 3.49	253.62 ± 3.96	7.29 ± 1.03	6.11 ± 0.96	109.13 ± 3.24	134.11 ± 4.36
t	0.0152	29.4032	0.1042	6.2171	0.0328	18.1654
P	0.9879	0.0000	0.9172	0.0000	0.9739	0.0000

3.4. Complication indicators

The complication rate of CSDH patients in group A was lower than that in group B ($P < 0.05$), as shown in in **Table 5**.

Table 5. Comparison of complications (*n* [%])

Group	Subdural hemorrhage	Intracranial infection	Pneumocephalus	Incidence rate
Group A (*n* = 57)	0 (0.00)	1 (1.75)	0 (0.00)	1.75
Group B (*n* = 56)	1 (1.79)	4 (7.14)	1 (1.79)	10.71
x^2	-	-	-	3.9025
P	-	-	-	0.0482

4. Discussion

CSDH accounts for about 10% of intracranial hematomas, and the risk of CSDH is higher in elderly patients. The pathogenesis is unknown. Some patients have a history of head trauma, which can increase osmotic pressure, cause tearing of bridging veins, and cause fibrinolysis hyperthyroidism, thereby promoting the progress of CSDH [2]. At present, CSDH is mostly treated with surgery. The conventional method is drilling and drainage, hematoma often recur post-surgery. The high risk of recurrence is related to many factors such as retrointimal, high hematoma density, and old age [3]. In addition, drilling and drainage cannot completely remove the hematoma, resulting in a high recurrence rate after drilling and drainage of CSDH [4].

With the rapid development of endoscopic technology, neuroendoscopic hematoma evacuation has been gradually used in the treatment of CSDH patients. A multi-angle lens is helpful for doctors to understand the local anatomical structure, as there is a broader field of view, and the hematoma's location can be easily identified. A good lightning system allows the doctors to observe the condition of the hematoma cavity in every corner, which is conducive to the complete removal of hematoma and the prevention of residual blood in the body. Using an endoscope allows accurate flushing of the hematoma cavity, making the process more efficient [5]. In addition, neuroendoscopic treatment of patients with septal CSDH can cause damage to the fibrous septum and lay a favorable foundation for hematoma aspiration. In neuroendoscopic hematoma evacuation, the problems of blind puncture and blind hemostasis can be avoided through electrocoagulation, thus improving the success rate of hemostasis [6]. According to relevant literature, , neuroendoscopic hematoma evacuation has a higher success rate of hematoma evacuation in CSDH patients and also a lower risk of recurrence compared to conventional soft channel drainage [7].

Combined with the data analysis in this paper, except for intraoperative blood loss and the duration of surgery, all surgical indicators in group A were better than those in group B ($P < 0.05$). In the treatment of chronic subdural hematoma (CSDH) patients, it is recommended to perform hematoma evacuation under neuroendoscopy. This involves inserting an endoscope into the local hematoma cavity to fully expose the hematoma's location, optimizing surgical indications. In the treatment of CSDH patients, neuroendoscopic hematoma evacuation was performed. The hematoma was flushed using tees, suction devices, and other tools while suctioning and flushing, expanding the surgical field, stabilizing intracranial pressure, and then completely removing the hematoma while protecting the brain tissue. The hematoma can be completely cleared above; by adjusting the suction force to treat septal hematoma and evaluate whether there is active bleeding locally, it can improve the effect of hematoma clearance and hemostasis [8]. Another set of data showed that the CSS score of group A was lower than that of group B, and the SF-36 and ADL scores of group A were higher than those of group B, $P < 0.05$. It is suggested that neuroendoscopic surgery can reduce oxidative stress and promote the treatment outcome patients with CSDH. This is because neuroendoscopic surgery can inhibit the production of oxygen free radicals, maintain a stable internal environment, and optimize the function of the central nervous system, so patients recover better [9]. Furthermore, neuroendoscopic surgery offers an improved field of view, enabling greater precision and protection of blood vessels, resulting in a milder oxidative stress reaction. The last group of data showed that the complication rate of CSDH patients in group A was lower than that in group B ($P < 0.05$), which indicates that neuroendoscopic surgery is safer. This is because neuroendoscopic hematoma evacuation has the following advantages: (i) an endoscope provides a multi-angle field of view for doctors, so that they can prepare sufficient saline to flush the hematoma cavity during the operation, which makes the intracranial hematoma removal more efficient and reduces the risk of recurrence; (ii) precise surgical operation under the guidance of endoscope can avoid damaging the adjacent brain tissues caused by blind puncture; (iii) the surgical path is in the same direction as the nerve fiber bundle, which can reduce the damage to the nerve conduction bundle and also avoid external factors from interfering with the surgical operation [10].

5. Conclusion

In conclusion, neuroendoscopic hematoma evacuation can promote the outcome of CSDH patients, so it should be popularized.

Disclosure statement

The authors declare no conflict of interest.

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