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Analysis of the Therapeutic Effect and Prognosis of Frameless Stereotactic Soft Channel Intracranial Hematoma Evacuation for Severe Basal Ganglia Hemorrhage

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Abstract: *Objective*: To analyze the therapeutic effect and prognosis of frameless stereotactic soft channel intracranial hematoma evacuation for severe basal ganglia hemorrhage. *Methods*: Clinical data of 411 patients with severe basal ganglia hemorrhage admitted to the Neurological Intensive Care Unit of Linyi People's Hospital from January 2020 to December 2021 were collected. According to the modified Rankin Scale (mRS) score at 180 days after onset, the patients were divided into the good prognosis group and the poor prognosis group. The therapeutic effect of frameless stereotactic soft channel intracranial hematoma evacuation on severe basal ganglia hemorrhage was explored, and the influencing factors of prognosis were analyzed. *Results*: Multivariate Logistic regression analysis showed that the admission Glasgow Coma Scale (GCS) score was an independent protective factor for the prognosis of patients with severe basal ganglia hemorrhage, while age, preoperative hematoma volume, random blood glucose level, and mechanical ventilation were independent risk factors. *Conclusion*: Frameless stereotactic soft channel intracranial hematoma evacuation has a good therapeutic effect on severe basal ganglia hemorrhage. However, it is necessary to screen the patients' basic information before surgery and provide medical care based on their specific conditions to promote their rapid recovery.
Keywords: Frameless stereotactic soft channel intracranial hematoma evacuation; Severe basal ganglia hemorrhage; Therapeutic effect; Prognosis

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1. Introduction

Severe basal ganglia hemorrhage is a serious cerebrovascular disease caused by massive bleeding in the basal ganglia region, characterized by high disability and mortality rates [1]. The etiologies of this disease include aneurysms, arteriosclerosis, hypertension, and moyamoya disease, among which hypertension is a key risk factor [2]. Clinically, the main treatment methods for this disease include conservative treatment and surgical treatment. Common surgical approaches include stereotactic minimally invasive drainage, neuro-endoscopic–assisted minimally invasive hematoma evacuation, and craniotomy with bone flap removal for intracerebral hematoma evacuation [3]. For patients with large amounts of bleeding and severe conditions, surgery is the preferred treatment option. However, traditional craniotomy is prone to causing secondary damage to patients or difficulties in hemostasis. Frameless stereotactic soft channel intracranial hematoma evacuation is a minimally invasive and precise intracranial hematoma evacuation technique. It has advantages such as high precision, minimal trauma, and rapid recovery, making it suitable for the treatment of severe basal ganglia hemorrhage. Some scholars have found through research that stereotactic soft channel intracranial hematoma evacuation can not only remove hematomas but also minimize damage to the surrounding brain tissue to the greatest extent, promote the recovery of neurological function, improve prognosis, and reduce the incidence of complications [4]. This study aims to systematically evaluate the therapeutic effect and prognosis of this technique in the treatment of severe basal ganglia hemorrhage, so as to provide a scientific basis for clinical treatment.

2. Materials and methods

2.1. General information

Clinical data of 411 patients with severe basal ganglia hemorrhage admitted to the Neurological Intensive Care Unit of Linyi People's Hospital from January 2020 to December 2021 were collected. According to the modified Rankin Scale (mRS) score at 180 days after onset, the patients were divided into the good prognosis group (mRS ≤ 3) and the poor prognosis group (mRS > 3). All patients in this study voluntarily participated and signed the informed consent form. This study has been approved by the hospital ethics committee, with the ethics approval number YX200437.

2.1.1. Inclusion criteria

Aged ≥ 18 years old; Diagnosed with spontaneous cerebral hemorrhage confirmed by imaging examination; Underwent modified (frameless) stereotactic soft-channel intracranial hematoma evacuation in our hospital; Complete clinical data and follow-up data.

2.1.2. Exclusion criteria

Cerebral hemorrhage secondary to abnormal brain structure, thrombolysis/thrombectomy therapy, or trauma; Patients who had undergone cerebral hemorrhage surgery in other hospitals and were admitted to our hospital for reoperation; Cerebral hemorrhage complicated with new cerebral infarction; Presence of other conditions that may interfere with follow-up and result evaluation; Incomplete clinical data and follow-up data.

2.2. Research methods

All patients underwent frameless stereotactic soft-channel intracranial hematoma evacuation, and the operation process was as follows:

2.2.1. Pre operative procedure

Based on the results of standard head CT scan with the orbitomeatal line as the baseline, the maximum cross-section of the hematoma was selected as the puncture and catheterization level. The puncture site and direction were determined according to the shape of the hematoma, and the depth of catheterization was confirmed. The patient's head was shaved. All patients with basal ganglia hemorrhage were placed in the supine position, and the frontal approach was adopted. A hard pillow or head pad was placed under the head with an appropriate height, requiring the line connecting the palpebral fissure and the external auditory meatus to be perpendicular to the operating table. Modified stereotactic technology was used to mark the body surface projections of the puncture site, puncture plane, and catheterization angle on the patient's head.

2.2.2. Surgical implementation

The skin in the surgical area was disinfected, and local infiltration anesthesia was applied; intravenous anesthesia enhancement was added if necessary. A grooved hand awl was used to bluntly pierce the scalp at the puncture site. A triangular cranial hand awl was used to penetrate the outer table of the skull, then a T-shaped hand drill was used to penetrate the inner table of the skull. The grooved hand awl was again used to polish the skull hole to make it smooth. A guiding steel needle was first inserted into the bone hole to detect the tension and depth of the dura mater, and then the triangular cranial hand awl was quickly inserted into the cranial cavity. The guiding steel needle was inserted into the drainage catheter. With the support of the guiding steel needle, the drainage catheter passed through the scalp at the puncture site, the skull hole, and the dural hole into the cranial cavity, and was placed along the long-axis approach of the hematoma to the distal end of the hematoma cavity, 0–5 mm away from the distal end of the hematoma. The guiding steel needle was pulled out, and a 5 mL empty syringe was connected to slowly aspirate the old blood. During aspiration, the syringe could be gently rotated to make the drainage catheter rotate in the hematoma cavity, achieving initial decompression. The drainage catheter was fixed, connected to a three-way valve and external drainage devices. The wound was dressed, and the dressing was fixed. The operation was completed. Postoperatively, urokinase was used to liquefy and drain the hematoma. Brain CT reexaminations were performed to dynamically observe the changes of intracranial hematoma.

2.3. Observation indicators

The therapeutic effect of patients was counted. According to the mRS score at 180 days after onset, patients were divided into the good prognosis group (mRS ≤ 3) and the poor prognosis group (mRS > 3). Multivariate Logistic regression analysis was conducted to explore the relevant factors affecting prognosis.

2.4. Statistical analysis

SPSS 26.0 software was used for statistical analysis of data. Measurement data did not conform to the normal distribution, and were expressed as median (quartile) [M(QL, QU)], and analyzed by Mann-Whitney U rank sum test. Count data were expressed as frequency (percentage), and analyzed by chi-square test. Multivariate Logistic regression analysis was performed. A p value < 0.05 was considered statistically significant.

3. Results

3.1. Baseline data of patients

Among the 411 patients with severe cerebral hemorrhage included in this study, 278 were male, accounting for 67.64%, and 133 were female, accounting for 32.36%. There were 286 patients with a history of hypertension, accounting for 69.59%, and 40 patients with a history of cerebral hemorrhage, accounting for 9.73%. Other specific baseline data are shown in **Table 1**.

Table 1. Descriptive analysis of count data in patients with severe basal ganglia hemorrhage

Factor	Category	Cases (%)
Gender	Male	278 (67.64)
	Female	133 (32.36)
History of hypertension	Yes	286 (69.59)
	No	125 (30.41)
History of cerebral hemorrhage	Yes	40 (9.73)
	No	371 (90.27)
History of cerebral infarction	Yes	54 (13.14)
	No	357 (86.86)
History of diabetes mellitus	Yes	36 (8.76)
	No	375 (91.24)
History of coronary heart disease	Yes	16 (3.89)
	No	395 (96.17)
History of antiplatelet drug use	Yes	65 (15.82)
	No	346 (84.18)
Smoking history	Yes	124 (30.17)
	No	287 (69.83)
Drinking history	Yes	166 (40.39)
	No	245 (59.61)
Secondary ventricular hemorrhage	Yes	192 (46.71)
	No	219 (53.28)
Endotracheal intubation	Yes	193 (46.96)
	No	218 (53.04)
Tracheotomy	Yes	58 (14.11)
	No	353 (85.89)
Mechanical ventilation	Yes	96 (23.36)
	No	315 (76.64)

3.2. Univariate analysis of prognosis in the two groups

As shown in **Table 2**, there were statistically significant differences between the two groups in the following factors (all $p < 0.05$): age, history of cerebral infarction, history of diabetes mellitus, history of coronary heart disease, antiplatelet drug use, drinking history, admission GCS score, time from onset to surgery, preoperative hematoma volume, duration of intracranial drainage tube placement, length of ICU stay, admission random blood glucose level, secondary ventricular hemorrhage, and performance of endotracheal intubation, tracheotomy, or mechanical ventilation during hospitalization. These factors were identified as univariate factors influencing patient prognosis.

Table 2. Comparison of general clinical data between the two groups

Variable		Good prognosis group (n = 187)	Poor prognosis group (n = 224)	t/χ^2	p
Age (years)		51.30 (42.54, 57.65)	61.00 (51.00, 70.00)	12.154	< 0.001
Gender	Male	119	159	3.241	0.072
	Female	68	65		
History of hypertension	No	52	73	0.864	0.353
	Yes	135	151		
History of cerebral hemorrhage	No	19	21	0.053	0.818
	Yes	168	203		
History of cerebral infarction	No	149	208	14.414	< 0.001
	Yes	38	16		
History of diabetes mellitus	No	161	214	12.303	< 0.001
	Yes	26	10		
History of coronary heart disease	No	175	220	4.193	0.041
	Yes	12	4		
Antiplatelet drug use	No	145	201	7.963	0.005
	Yes	42	23		
Smoking history	No	128	159	0.193	0.660
	Yes	59	65		
Drinking history	No	123	122	6.044	0.014
	Yes	64	102		
Admission GCS score (points)		9 (8,10)	6 (5,7)	-10.657	< 0.001
Time from onset to surgery (h)		26.00 (17.85,40.54)	17 (5.33,28.60)	-7.451	< 0.001
Preoperative hematoma volume (mL)		31.62 (23.50,41.33)	48.65 (32.60,74.58)	-8.848	< 0.001
Hematoma evacuation rate (%)		85.62 (74.30,94.10)	89.74 (75.33,94.28)	-0.801a	0.419
Duration of drainage tube placement (d)		2 (1,3)	3 (2,4)	-6.488	< 0.001
Length of ICU stay (d)		33 (3,5)	5 (4,9)	-4.736	< 0.001
Random blood glucose (mmol/L)		9 (8,10)	6 (5,7)	-10.540	< 0.001
Secondary ventricular hemorrhage	No	68	151	34.785	< 0.001
Endotracheal intubation	Yes	119	73	19.055	< 0.001
	No	63	155		
Tracheotomy	Yes	124	69	6.767	0.009
	No	142	211		
Mechanical ventilation	Yes	45	13	15.024	< 0.001
	No	115	200		

3.3. Multivariate logistic regression analysis

Variables including age, gender, history of cerebral infarction, history of diabetes mellitus, antiplatelet drug use, drinking history, admission GCS score, time from onset to surgery, preoperative hematoma volume, duration of intracranial drainage tube placement, length of ICU stay, admission random blood glucose level, secondary ventricular hemorrhage, and performance of endotracheal intubation, tracheotomy, or mechanical ventilation during hospitalization were assigned values and subjected to multivariate Logistic regression analysis. The results showed that age, admission GCS score, preoperative hematoma volume, random blood glucose level, and mechanical ventilation were independent influencing factors for the prognosis of patients with severe basal ganglia hemorrhage (all $p < 0.05$). Among them, admission GCS score was an independent protective factor, while age, preoperative hematoma volume, random blood glucose level, and mechanical ventilation during hospitalization were independent risk factors. Details are shown in **Table 3**.

Table 3. Multivariate logistic regression analysis of prognostic factors in patients with severe cerebral hemorrhage

Variable	B value	SE value	value	*p* value	OR value	95%CI
Age	0.088	0.010	80.016	< 0.001*	1.092	1.071–1.113
Admission GCS score	-0.174	0.043	16.156	< 0.001*	0.840	0.772–0.915
Preoperative hematoma volume	0.016	0.005	11.211	0.001*	1.016	1.007–1.025
Random blood glucose	0.080	0.038	4.442	0.035*	1.083	1.006–1.167
Mechanical ventilation	0.969	0.305	10.078	0.002*	2.635	1.449–4.793

Note: * indicates $p < 0.05$.

4. Discussion

Severe basal ganglia hemorrhage is a cerebrovascular disease characterized by massive bleeding in the basal ganglia region, with high disability and mortality rates [5]. The etiology of severe basal ganglia hemorrhage is complex, and hypertension is the most important risk factor [6]. This disease has an acute onset and rapid progression, leading to neurological deficits in patients and endangering their lives. Traditional treatment methods include conservative treatment and craniotomy. However, conservative treatment is difficult to effectively remove hematomas and reduce intracranial pressure, while craniotomy may cause secondary damage due to large trauma and difficult hemostasis, affecting patient prognosis. Therefore, finding a minimally invasive, precise, and effective treatment method has become the focus of clinical research [7].

Frameless stereotactic soft-channel intracranial hematoma evacuation is a minimally invasive surgical method based on modern imaging technology and stereotactic principles [8]. Through preoperative CT scanning, this technology accurately locates the hematoma. Combined with the "four lines and three points" positioning method, the puncture site and path are determined. During the operation, a soft-channel drainage catheter is inserted along the long axis of the hematoma to gradually aspirate the hematoma, and urokinase is used for liquefaction and drainage to achieve precise hematoma removal [9]. Compared with traditional craniotomy, this technology has good minimally invasive characteristics: it only requires local anesthesia and a small scalp incision, avoids extensive skull opening and brain tissue exposure, and significantly reduces surgical trauma and bleeding risk. It has high precision: stereotactic technology enables precise positioning and puncture of the hematoma, minimizing damage to surrounding brain tissue and protecting neurological function [10]. It also promotes rapid recovery: patients have a short recovery time after surgery and a low incidence of complications, making it suitable for elderly patients or those with multiple underlying diseases [11].

In this study, multivariate Logistic regression analysis showed that admission GCS score was an independent protective factor for the prognosis of patients with severe basal ganglia hemorrhage, while age, preoperative hematoma volume, random blood glucose level, and mechanical ventilation were independent risk factors [12]. This result is consistent with previous studies, suggesting that the early neurological status (GCS score) has a key impact on prognosis. Advanced age, massive bleeding, hyperglycemia, and mechanical ventilation may worsen prognosis by aggravating cerebral edema and secondary infection [13].

Combined with the results of univariate analysis, there were significant differences ($p < 0.05$) between the good prognosis group and the poor prognosis group in indicators such as age, history of cerebral infarction, history of diabetes mellitus, admission GCS score, and preoperative hematoma volume. This further emphasizes the importance of early intervention and hematoma control. In addition, as an independent risk factor, mechanical ventilation may be associated with complications such as ventilator-associated pneumonia and atelectasis, indicating that clinical practice needs to strictly grasp the indications for mechanical ventilation and strengthen respiratory tract management [14].

This study also found that there was no significant difference in hematoma evacuation rate between the two groups, but the good prognosis group had a shorter duration of drainage tube placement and ICU stay ($p < 0.001$). Therefore, in clinical practice, it is necessary to comprehensively evaluate patients' conditions and formulate individualized treatment plans: for elderly patients, those with massive bleeding, or those with hyperglycemia, perioperative monitoring should be strengthened, blood glucose management optimized, and the necessity of mechanical ventilation carefully evaluated; at the same time, through precise surgical operations and early postoperative rehabilitation intervention, the prognosis of patients should be improved to the greatest extent [15].

5. Conclusion

In conclusion, frameless stereotactic soft-channel intracranial hematoma evacuation has a significant therapeutic effect on severe basal ganglia hemorrhage, but the prognosis is affected by multiple factors. In the future, it is necessary to further explore multimodal monitoring technologies, such as intracranial pressure monitoring and cerebral oxygen saturation detection; and comprehensive intervention strategies to improve the treatment level of severe cerebral hemorrhage.

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The authors declare no conflict of interest.

References

[1] Zhang D, 2024, Clinical Observation on the Efficacy of Microscopic Keyhole Craniotomy for Intracranial Hematoma Evacuation and Minimally Invasive Soft-Channel Drainage in the Treatment of Hypertensive Intracerebral Hemorrhage. Reflexotherapy and Rehabilitation Medicine, 5(7): 177–180.

[2] Li Y, Yang Y, Wang X, et al., 2023, Efficacy of Soft-Channel Hematoma Puncture Drainage and Neuroendoscopic Intracranial Hematoma Evacuation in the Treatment of Hypertensive Intracerebral Hemorrhage. The Journal of Practical Medicine, 39(07): 833–837.

[3] Lü D, Zhan Z, 2023, Clinical Efficacy and Prognostic Impact of SCPD and NEIHE in the Treatment of Hypertensive Intracerebral Hemorrhage. Chinese Science and Technology Journal Database (Full-text Version) Medicine and Health, 2023(12): 105–109.

[4] Kong L, Tian X, Zhang P, 2025, Observation on the Effect of Stereotactic Soft-Channel Intracranial Hematoma Evacuation in the Treatment of Elderly Patients with Hypertensive Intracerebral Hemorrhage. Chinese Journal of Practical Medicine, 52(08): 11–14.

[5] Chen C, Wang H, 2023, Effect of Neuroendoscopic Intracranial Hematoma Evacuation on Stress Response and Nerve Injury in Patients with Hypertensive Intracerebral Hemorrhage. Reflexotherapy and Rehabilitation Medicine, 4(5): 110–112.

[6] Xu W, 2023, Application of Stereotactic Precise Puncture Positioning in Minimally Invasive Surgery for Cerebral Hematoma. Chinese Science and Technology Journal Database (Full-text Version) Medicine and Health, 2023(6): 83–86.

[7] Yu S, 2024, Analysis of Neurological Function and Prognosis of Patients with Hypertensive Intracerebral Hemorrhage After Different Minimally Invasive Surgeries. Modern Medicine and Health Research Electronic Journal, 8(7): 34–36.

[8] Tang H, Liu D, Xu Y, et al., 2023, Observation on the Application Effect of Dynamic Precise Positioning Software-Assisted Soft-Channel Drainage Technology in Hypertensive Intracerebral Hemorrhage. Chinese Journal of New Clinical Medicine, 16(9): 931–935.

[9] Yan F, Wang M, 2024, Effect of Stereotactic Soft-Channel Minimally Invasive Drainage on Hypertensive Intracerebral Hemorrhage and Its Influence on Serum S100B and NSE Levels. Chinese Journal of Practical Medicine, 51(24): 12–14.

[10] Wang K, Zhang X, Meng M, 2024, Clinical Effect of Craniocerebral Puncture Guide-Assisted Hematoma Evacuation in the Treatment of Supratentorial Hypertensive Intracerebral Hemorrhage. Zhejiang Journal of Traumatic Surgery, 29(12): 2320–2322.

[11] Meng Y, Wang Y, Xu M, 2023, Effect of Soft-Channel Intracranial Hematoma Evacuation on Hypertensive Intracerebral Hemorrhage. Practical Clinical Journal of Integrated Traditional Chinese and Western Medicine, 23(16): 21–24.

[12] and Guo J, Zhou T, Liu J, et al., 2025, Correlation Analysis Between Peripheral Blood N-Myc Downstream Regulated Gene 3 Level Poor Prognosis in Patients with Intracerebral Hemorrhage. Chinese Journal of Medicine, 60(02): 211–214.

[13] Liu X, Jiang K, Li Y, 2024, Analysis of Factors Influencing Postoperative Disturbance of Consciousness in Patients with Hypertension-Related Intracerebral Hemorrhage and Discussion on Nursing Countermeasures. Nursing of Integrated Traditional Chinese and Western Medicine (Chinese & English), 10(09): 121–123.

[14] Si L, Zhao Y, Liu F, 2025, Serum MIP-1α and HBD3 Levels and Clinical Significance of Pulmonary Infection in Elderly Patients During Rehabilitation After Stroke. Journal of Pathogen Biology, 20(02): 239–243.

[15] Lin B, Zhao L, Ding C, et al., 2024, Effect of Sinisan Shengjiang Powder on Coagulation Function in Patients with Sepsis-Induced Capillary Leak Syndrome. Journal of Emergency in Traditional Chinese Medicine, 33(11): 1934–1937.