MEDS Clinical Medicine (2026)
Clausius Scientific Press, Canada

DOI: 10.23977/medsc.2026.070306
ISSN 2616-1907 Vol. 7 Num. 3

Effects of lumbar puncture and lumbar cistern drainage on postoperative cerebrospinal fluid parameters and clinical prognosis in patients with aneurysmal subarachnoid hemorrhage

Lei Yang*, Xiong Yang, Ben Tan, Xiaoming Wei, Qingqing Zhou

Department of Neurosurgery, First People's Hospital of Jingzhou, Jingzhou, Hubei, 434000, China
**Corresponding author: Lei Yang, 617167825@qq.com*

Keywords: Aneurysmal subarachnoid hemorrhage; Lumbar puncture; Lumbodural pool drainage; Cerebrospinal fluid; Lactate dehydrogenase; Prognosis

Abstract: This study aims to compare the effects of lumbar puncture (LP) and lumbar cistern drainage (LD) on cerebrospinal fluid parameters and clinical outcomes in postoperative aSAH patients, and to identify prognostic risk factors. A retrospective analysis was conducted on clinical data of 98 patients who underwent cerebrospinal fluid drainage after aSAH, including 65 cases in the LP group and 33 cases in the LD group. Baseline characteristics, cerebrospinal fluid pressures, white blood cell counts, red blood cell counts, lactate dehydrogenase (LDH) levels, protein levels on days 1, 3, and 7 postoperatively, as well as the rate of favorable prognosis (mRS scores 0–2) at discharge were compared between the two groups. Univariate and multivariate logistic regression analyses were performed to identify independent prognostic risk factors. No statistically significant differences were observed in baseline characteristics between the two groups ($P > 0.05$). On day 1 postoperatively, the LD group exhibited significantly higher values for cerebrospinal fluid white blood cells [472.5×10^6/L vs. 118×10^6/L], red blood cells [268×10^9/L vs. 148×10^9/L], LDH [57 U/L vs. 30 U/L], and protein [3.09g/L vs. 0.89g/L] compared to the LP group ($P < 0.05$). At days 3 and 7 postoperatively, no statistically significant differences were observed in any cerebrospinal fluid parameters between the groups ($P > 0.05$). The favorable prognosis rate was higher in the LP group (86.2%, 56/65) than in the LD group (69.7%, 23/33), but the difference was not statistically significant ($P = 0.051$). Univariate analysis revealed that the poor-prognosis group exhibited higher ages, greater proportions of Hunt-Hess grades III–V and Fisher grades 3–4, as well as elevated levels of white blood cells, red blood cells, LDH, and protein in cerebrospinal fluid on days 1 and 3 postoperatively ($P < 0.05$). Multivariate logistic regression analysis demonstrated that cerebrospinal fluid LDH levels on day 3 postoperatively were an independent risk factor for poor prognosis (OR = 1.015, 95% CI: 1.002–1.029, $P < 0.05$). Both lumbar puncture and lumbar cistern drainage demonstrate favorable safety profiles for cerebrospinal fluid drainage following aortic subarachnoid hemorrhage (aSAH). Elevated cerebrospinal fluid LDH levels on day 3 postoperatively represent an independent risk factor for poor prognosis, and dynamic monitoring of LDH levels aids in early identification of high-risk patients. The prognostic impact of these two drainage approaches requires further validation through prospective studies.

1. Introduction

Aneurysmal subarachnoid hemorrhage (aSAH) is one of the most common types of hemorrhagic cerebrovascular disease, causing severe damage to the central nervous system and exerting pathological effects on multiple organs throughout the body [1]. Despite significant advancements in medical and surgical techniques that have substantially improved patient outcomes, the condition still carries high rates of disability and mortality [2].

Following a subarachnoid hemorrhage (sAH), not only is primary damage inflicted on brain tissue, but secondary brain injuries such as early re-rupture bleeding of the aneurysm, acute hydrocephalus, and cerebrovascular spasm also occur [1]. Studies indicate that erythrocytes begin to lyse 3 days after subarachnoid hemorrhage, reach peak levels between days 6 and 8, and decline around day 12. Following erythrocyte lysis, hemoglobin converts into various spasmogenic substances including oxyhemoglobin, triggering a chain reaction of vascular spasms that damages vascular smooth muscle and endothelial cells, further producing additional vasospastic mediators and leading to excessive vascular contraction and apoptosis [3–4]. Additionally, blood clots obstructing the ventricles, cerebral aqueducts, cisterns, or arachnoid granules can impair cerebrospinal fluid circulation dynamics and absorption, resulting in hydrocephalus [5–6].

Both lumbar puncture for cerebrospinal fluid drainage and lumbar cistern drainage can release bloody cerebrospinal fluid, thereby reducing its irritative effects. Studies have demonstrated that continuous lumbar cistern drainage postoperatively enables early drainage of bloody cerebrospinal fluid, decreases the number of red blood cells in the fluid, effectively reduces the production of spastic substances derived from red blood cell breakdown, and mitigates the occurrence of vascular spasms. Additionally, research suggests that prompt cerebrospinal fluid drainage following subarachnoid hemorrhage helps minimize abnormal cerebrospinal fluid circulation or absorption and lowers the risk of hydrocephalus [7–8]. Furthermore, continuous external lumbar cistern drainage in patients with acute subarachnoid hemorrhage (aSAH) significantly alleviates headache symptoms, reduces complications, and improves treatment outcomes [9]. Comparative studies evaluating the clinical efficacy of lumbar puncture versus lumbar cistern drainage for managing postoperative complications in aneurysmal subarachnoid hemorrhage revealed that lumbar cistern drainage significantly reduces disability rates and postoperative complication incidence [10]; it also more rapidly decreases mean flow velocity in the middle cerebral artery and Lingdegaard index levels, shortens cerebrospinal fluid clearance time, and effectively prevents cerebral vasospasm in subarachnoid hemorrhage patients [11]. However, the specific impacts of these two drainage approaches on cerebrospinal fluid parameters and overall patient prognosis remain unclear.

2. Materials and methods

2.1 Study subjects

Inclusion criteria: Patients with imaging-confirmed aneurysmal subarachnoid hemorrhage (aSAH) who require cerebrospinal fluid drainage after surgical clipping or interventional embolization; aged 18–80 years; and with complete clinical data.

Exclusion criteria: non-aneurysmal subarachnoid hemorrhage (SAH); severe cardiac, hepatic, or renal dysfunction; coagulation disorders; history of central nervous system diseases; and missing clinical data.

Grouping method: Patients were divided into the lumbar puncture group (LP group) and the lumbar cistern drainage group (LD group) based on the actual drainage method employed. Case data were retrospectively collected to ensure matching of baseline characteristics (age, gender, Hunt-Hess classification, etc.) between the two groups.

2.2 Research methods

Baseline data: demographic characteristics, Hunt-Hess classification, Fisher classification, aneurysm location, and treatment modality.

Cerebrospinal fluid parameters: Record cerebrospinal fluid pressure, red blood cell count, white blood cell count, protein content, etc., for both groups of patients on days 1, 3, and 7 postoperatively.

Imaging data: Preoperative and postoperative head CT/MRI were performed to assess the volume of hemorrhage, hydrocephalus, and secondary cerebral infarction.

Intervention measures: Lumbar puncture group (LP group): Perform lumbar puncture daily or every other day to drain cerebrospinal fluid, with each drainage volume ranging from 20 to 30 mL; record the number of procedures performed and any complications (e.g., low intracranial pressure, infection).

Lumbodural drainage group (LD group): Maintain continuous lumbodural drainage at a controlled rate of 5–10 mL/h, monitor the characteristics and volume of drainage fluid, and record the duration of drainage as well as any complications (e.g., tube obstruction, infection).

2.3 Observation indicators

(1) Differences in clinical characteristics between the lumbar puncture group and the lumbar cistern drainage group, including gender, age, Hunt-Hess classification, Fisher classification, and other indicators.

(2) Comparison of cerebrospinal fluid pressure between the lumbar puncture group and the lumbar cistern drainage group: Cerebrospinal fluid pressures were measured on days 1, 3, and 7 postoperatively to compare differences among the groups.

(3) Comparison of cerebrospinal fluid red blood cell counts between the lumbar puncture group and the lumbar cistern drainage group: Cerebrospinal fluid red blood cell counts were measured on days 1, 3, and 7 postoperatively to compare differences among the groups.

(4) Comparison of cerebrospinal fluid white blood cell counts between the lumbar puncture group and the lumbar cistern drainage group: Cerebrospinal fluid white blood cell counts were measured on days 1, 3, and 7 postoperatively, and differences among groups were compared.

(5) Comparison of clinical outcomes between the lumbar puncture group and the lumbar cistern drainage group: mRS scores were obtained from patients in each group, and those were categorized as having favorable or poor prognosis based on their scores; differences among groups were then compared.

2.4 Statistical analysis

Using SPSS 26.0 software, quantitative data were expressed as mean ± standard deviation ($\bar{x} \pm s$) or median (interquartiles), with intergroup comparisons performed using t-test or Mann-Whitney U test; categorical data were presented as rates (%), and intergroup comparisons were conducted using χ^2 test or Fisher's exact test.

Correlation analysis: Logistic regression was employed to analyze the relationship between drainage methods and prognosis, with adjustment for confounding factors (e.g., age, severity of bleeding).

Significance level: A *P*-value <0.05 was considered statistically significant.

3. Results

3.1 Comparison of baseline clinical characteristics between the two patient groups

A total of 98 eligible patients with aSAH were enrolled, including 65 in the lumbar puncture group (LP group) and 33 in the lumbar cistern drainage group (LD group). Baseline characteristics such as age, gender, comorbidities, and aneurysm size showed no statistically significant differences between the two groups (*P* > 0.05), indicating comparability (Table 1).

Table 1 Differences in fundamental factors and cerebrospinal fluid parameters among different CSF drainage methods

	Lumbar puncture (n=65)	Lumbodural drainage (n=33)	*P*
Sex			
man	18(27.7)	13(39.4)	0.239
woman	47(72.3)	20(60.6)	
Age	65(55,68)	60(55,67)	0.465
Comorbidities			
hypertension	32(50.0)	20(60.6)	0.481
diabetes mellitus	2(3. 1)	1(3.0)	
none	27(42.2)	9(27.3)	
Hunt-Hess grading			
III-V	16(24.6)	21(63.6)	0.000
I-II	49(75.4)	12(36.4)	
Fisher grading			
0-2	42(64.6)	14(42.4)	0.036
3-4	23(35.4)	19(57.6)	
Prognosis			
Good prognosis	56(86.2)	23(69.7)	0.051
Poor prognosis	9(13.8)	10(30.3)	
Aneurysm size	3.25(2.83,4.03)	3.60(3.00,4. 10)	0.282
Location of aneurysm			
Pre-circuit	32(49.2)	9(27.3)	0.037
Back Cycle	33(50.8)	24(72.7)	
Cerebrospinal fluid pressure (1 D)	250(200,310)	235(155,310)	0.160
White blood cells in cerebrospinal fluid (1 D)	118(47,431)	472.5(184, 1066)	0.001
Cerebrospinal fluid red blood cells (1 D)	148(64,328)	268(156, 1049)	0.029
Cerebrospinal fluid LDH (1 D)	30(20,47)	57(28, 131)	0.006
Cerebrospinal fluid proteins (1D)	0.89(0.50, 1.70)	3.09(2.34,4.52)	0.000
Cerebrospinal fluid pressure (3D)	180(150,220)	165(120,425)	0.073

Cerebrospinal fluid white blood cells (3D)	131(52.5,282.5)	1003(570.5, 1039)	0.113
Brainstem cerebrospinal fluid red blood cells (3D)	158(51,273)	377(240,392)	0.167
Cerebrospinal fluid LDH (3D)	34(21,50)	163(114, 179)	0.019
Cerebrospinal fluid proteins (3D)	0.48(0.32,0.82)	0.97(0.96, 1.23)	0.046
Cerebrospinal fluid pressure (7 D)	175(148,220)	200(110,220)	1.000
White blood cells in cerebrospinal fluid (7 D)	172(68,695)	250(83,630)	0.586
Brainstem cerebrospinal fluid red blood cells (7 D)	37(19,92)	19(6,51)	0.111
Cerebrospinal fluid LDH (7 D)	74(41, 173)	99(60, 165)	0.422
Cerebrospinal fluid proteins (7 D)	0.51(0.35, 1.03)	0.55(0.38, 1.22)	0.726

3.2 Comparison of postoperative cerebrospinal fluid parameters between the two groups

On the first postoperative day, no statistically significant difference in cerebrospinal fluid pressure was observed between the two groups (P> 0.05). On the same day, the white blood cell count in the cerebrospinal fluid of patients in the lumbar puncture group was 118 $\times 10^6$/L, whereas that in the lateral recess drainage group was 472.5 $\times 10^6$/L; this difference was statistically significant (P = 0.001). The red blood cell count in the cerebrospinal fluid of patients in the lumbar puncture group was 148$\times 10^9$/L, compared to 268$\times 10^9$/L in the lateral recess drainage group; this difference was also statistically significant (P = 0.029). The LDH level in the cerebrospinal fluid of patients in the lumbar puncture group was 30 U/L, whereas that in the lateral recess drainage group was 57 U/L; this difference was statistically significant (P = 0.006). The protein level in the cerebrospinal fluid of patients in the lumbar puncture group was 0.89 g/L, compared to 3.09 g/L in the lateral recess drainage group; this difference was statistically significant (P = 0.000).

On day 3 postoperatively, the cerebrospinal fluid LDH levels were 34 U/L in patients in the lumbar puncture group and 163 U/L in those in the lumbar cistern drainage group, with a statistically significant difference between the two groups (P = 0.019). On day 3, no statistically significant differences were observed between the two groups regarding cerebrospinal fluid pressure, white blood cell count, red blood cell count, or protein levels (P > 0.05). By day 7, no statistically significant differences remained in these parameters or in LDH levels between the two groups (P > 0.05; Table 1).

3.3 Comparison of clinical prognosis between the two groups

The LP group exhibited a favorable prognosis (mRS scores of 0–2) in 56 cases (86.2%), whereas the LD group showed a favorable prognosis in 23 cases (69.7%). The favorable prognosis rate was higher in the LP group than in the LD group, but the difference was not statistically significant (P = 0.051).

A total of 98 patients were enrolled, including 79 cases (80.6%) in the favorable-prognosis group and 19 cases (19.4%) in the poor-prognosis group. Comparative analysis between the two groups revealed that the age of patients in the poor-prognosis group was significantly higher than that in the favorable-prognosis group [69 (61,74) vs. 61 (54,67), P = 0.007]; the proportions of Hunt-Hess grades III–V (63.2% vs. 31.6%, P = 0.011) and Fisher grades 3–4 (78.9% vs. 34.2%, P < 0.001) were significantly elevated in the poor-prognosis group. No statistically significant differences were observed between the two groups regarding gender, distribution of comorbidities (hypertension, diabetes, hypertension with diabetes, or no comorbidities), cerebrospinal fluid drainage methods (lumbar puncture vs. lumbar cistern drainage, P = 0.051), or aneurysm size and location (anterior circulation vs. posterior circulation) (all P > 0.05).

The cerebrospinal fluid parameters in the poor-prognosis group were significantly higher than those in the good-prognosis group: white blood cells [453 (248,1676) $\times 10^6$/L vs. 134.5 (55,475) $\times 10^6$/L , P = 0.002], red blood cells [275 (156, 1049) $\times 10^9$/L vs. 139 (64, 335) $\times 10^9$/L, P = 0.008], LDH [126 (54, 161) U/L vs. 29 (20, 45) U/L, P < 0.001], and protein [2.19 (1.20, 4.47) g/L vs. 0.98 (0.51, 2.07) g/L, P = 0.003]. In contrast, cerebrospinal fluid pressure showed no significant difference between the two groups (P = 0.156). On day 3, white blood cell count (P = 0.034), LDH (P = 0.002), and protein levels (P = 0.003) remained significantly elevated in the poor-prognosis group, while the difference in red blood cell count was only near statistical significance (P = 0.062), and cerebrospinal fluid pressure showed no significant variation (P = 0.158). By day 7, none of the cerebrospinal fluid parameters (pressure, white blood cell count, red blood cell count, LDH, or protein) exhibited statistically significant differences between the two groups (all P > 0.05); however, LDH (P = 0.095) and protein levels (P = 0.068) showed a trend toward being higher than those in the good-prognosis group. Details are presented in Table 2.

Table 2 Differences in baseline characteristics and cerebrospinal fluid parameters among patients with different prognoses

	Overall	Good prognosis (n=79)	Poor prognosis (n=19)	*P*
Sex				
man	31(31.6)	26(32.9)	5(26.3)	0.579
woman	67(68.4)	53(67.1)	14(73.7)	
Age	62(55,68)	61(54,67)	69(61,74)	0.007
Comorbidities				
hypertension	52(53.6)	40(51.3)	12(63.2)	0.372
diabetes mellitus	3(3.1)	3(3.8)	0(0)	
none	36(37.1)	31(39.7)	5(26.3)	
Hunt-Hess classification				
III-V	37(37.8)	25(31.6)	12(63.2)	0.011
I-II	61(62.2)	54(68.4)	7(36.8)	
Fisher classify				
0-2	56(57.1)	52(65.8)	4(21.1)	0
3-4	42(42.9)	27(34.2)	15(78.9)	
Cerebrospinal fluid drainage methods				
Lumbar puncture	65(66.3)	56(70.9)	9(47.4)	0.051

Lumbodural drainage	33(33.7)	23(29.1)	10(52.6)	
Aneurysm size	3.33(2.83,4.05)	3.28(2.70,4.05)	3.63(3.20,4.75)	0.222
Location of the aneurysm				
Pre-circuit	65(66.3)	44(55.7)	13(68.4)	0.313
Back Cycle	33(33.7)	35(44.3)	6(31.6)	
Cerebrospinal fluid pressure (1 D)	250(204,320)	260(210,320)	200(145,305)	0.156
White blood cells in cerebrospinal fluid (1 D)	184.5(75,539.5)	134.5(55,475)	453(248,1676)	0.002
Cerebrospinal fluid red blood cells (1 D)	185(71.5,344.5)	139(64,335)	275(156,1049)	0.008
Cerebrospinal fluid LDH (1 D)	31(21,61)	29(20,45)	126(54,161)	0
Cerebrospinal fluid proteins (1D)	1.18(0.59,2.39)	0.98(0.51,2.07)	2.19(1.20,4.47)	0.003
Cerebrospinal fluid pressure (3D)	180(150,220)	190(150,225)	175(145,180)	0.158
Cerebrospinal fluid white blood cells (3D)	136.5(22,342)	128(46.5,260)	325.5(106,1671)	0.034
Brainstem cerebrospinal fluid red blood cells (3D)	159(55,282)	134(44,273)	225(122,330)	0.062
Cerebrospinal fluid LDH (3D)	35(21,59)	31(19,50)	112(42,205)	0.002
Cerebrospinal fluid proteins (3D)	0.50(0.32,0.95)	0.44(0.29,0.78)	0.93(0.66,1.36)	0.003
Cerebrospinal fluid pressure (7 D)	207(74.5,662.5)	200(148,245)	153(140,170)	0.114
White blood cells in cerebrospinal fluid (7 D)	136.5(22,342)	192(74.5,541)	248(65.5,1029)	0.676
Brainstem cerebrospinal fluid red blood cells (7 D)	34(11,81)	28(11,63)	71(21,129)	0.301
Cerebrospinal fluid LDH (7 D)	86(54,169)	78(48,112)	165(60,347)	0.095
Cerebrospinal fluid proteins (7 D)	0.51(0.36,1.08)	0.48(0.35,0.76)	1.03(0.53,1.60)	0.068

3.4 Multivariate logistic regression factors affecting prognosis

The variables with P<0.05 in the univariate analysis (including age, Hunt-Hess classification, Fisher classification, and cerebrospinal fluid levels of white blood cells, red blood cells, LDH, and protein on days 1 and 3) were included in the multivariate logistic regression model. The results demonstrated that cerebrospinal fluid LDH levels on day 3 postoperatively were an independent risk factor for poor patient prognosis (OR = 1.015,95% CI: 1.002–1.029, P < 0.05); specifically, each 1 U/L increase in cerebrospinal fluid LDH on day 3 postoperatively was associated with an approximately 1.5% elevated risk of poor prognosis. The ROC curve area under the curve (AUC) for this multivariate model was 0.803 (P < 0.05). See Figure 1 for details.

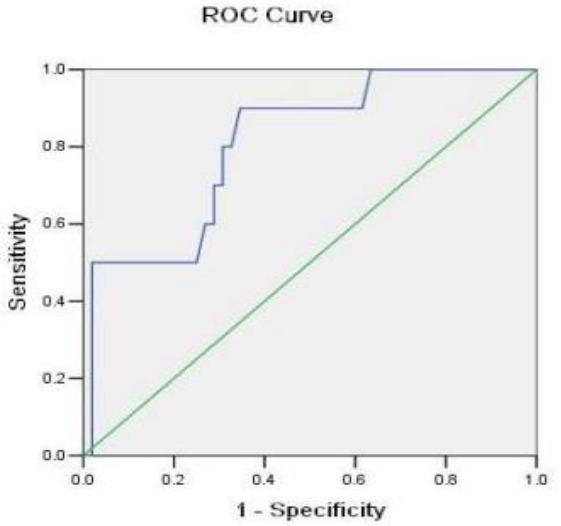

Figure 1 ROC curve influencing patient clinical prognosis

4. Discussion

This study retrospectively analyzed the clinical data of 98 patients who underwent surgery for aneurysmal subarachnoid hemorrhage (aSAH) to compare the effects of two cerebrospinal fluid drainage methods—lumbar puncture (LP) versus lumbar cistern drainage (LD)—on cerebrospinal fluid parameters and prognosis, and further investigated potential prognostic risk factors. The results demonstrated that the LP group and LD group exhibited comparable baseline characteristics. On postoperative day 1, the levels of leukocytes, red blood cells, LDH, and protein in the cerebrospinal fluid were significantly higher in the LD group than in the LP group; however, no significant differences were observed between the two groups at days 3 and 7. The rate of favorable prognosis was higher in the LP group (86.2%) compared to the LD group (69.7%), although this difference was not statistically significant (P = 0.051). Multivariate logistic regression analysis identified LDH levels on postoperative day 3 as an independent risk factor for poor prognosis (OR = 1.015,95% CI: 1.002–1.029). The key findings are discussed below.

In this study, there were no significant differences between the two patient groups in baseline characteristics such as age, gender, comorbidities, aneurysm size, or location, ensuring comparability and providing a foundation for subsequent comparisons. Regarding prognosis, the favorable outcome rate was higher in the LP group (86.2%) than in the LD group (69.7%), although P=0.051—far from meeting the traditional statistical significance threshold but approaching it. This trend may be influenced by the following factors: First, the small sample size (only 33 cases in the

LD group) may have limited statistical power, preventing detection of true differences; Second, LD group patients exhibited significantly higher levels of cerebrospinal fluid leukocytes, red blood cells, LDH, and protein on postoperative day 1 compared to the LP group, suggesting potentially more severe initial conditions in the LD group (despite no differences in routine baseline parameters) and the presence of unmeasured confounding factors (e.g., degree of aneurysm rupture or severity of early brain injury); Third, selection bias in drainage method may have occurred, as more severe cases tended to receive LD. In multivariate regression analysis, drainage method was excluded from the final model, while LDH on day 3 emerged as an independent risk factor, indicating that the impact of drainage method on prognosis may be partially mediated by cerebrospinal fluid LDH levels or may not exert a significant independent effect [11,12].

This study found that on postoperative days 1 and 3, cerebrospinal fluid (CSF) LDH levels were significantly higher in the poor-prognosis group compared to the good-prognosis group; on day 3, LDH emerged as an independent risk factor for poor prognosis independent of age, Hunt-Hess classification, Fisher classification, and other factors (OR = 1.015). LDH is an intracellular enzyme released into the CSF during cellular necrosis or disruption of the blood-brain barrier. Following a subarachnoid hemorrhage (aSAH), bloody CSF and secondary brain injury can lead to the destruction of neurons, glial cells, and red blood cells, releasing large amounts of LDH. Thus, CSF LDH levels reflect the severity of subarachnoid hemorrhage, the rate of hemolysis, and the extent of secondary brain injury. The results suggest that persistently elevated LDH levels on postoperative day 3 predict poorer neurological outcomes, potentially due to the following mechanisms: ① High LDH levels indicate extensive red blood cell lysis, producing vasospasm-inducing substances such as oxyhemoglobin and bilirubin, thereby increasing the risk of delayed cerebral ischemia; ② Elevated LDH levels indirectly suggest ongoing blood-brain barrier disruption and persistent inflammatory responses. Notably, by day 7, the LDH differences between the two groups disappeared ($P = 0.095$), indicating that LDH levels tend to converge as blood clearance and brain injury repair progress [13–15].

In addition to LDH, levels of white blood cells, red blood cells, and protein in the cerebrospinal fluid were significantly elevated on postoperative day 1 in the poor-prognosis group, and remained markedly elevated on day 3, indicating that the severity of early bloody cerebrospinal fluid and the degree of inflammatory response are closely associated with prognosis. This finding is consistent with previous studies: red blood cells and their degradation products directly contribute to vascular spasm; elevated white blood cell counts reflect aseptic inflammation, which can exacerbate cerebral edema and neuronal damage. However, these parameters were not included in the final model in the multivariate regression analysis, likely due to LDH's superior predictive power, multicollinearity among variables, or limited sample size.

This study observed that on postoperative day 1, the levels of white blood cells, red blood cells, LDH, and protein in the cerebrospinal fluid were significantly higher in the LD group compared to the LP group, suggesting potentially greater initial subarachnoid hemorrhage volume or more viscous bloody cerebrospinal fluid in LD patients. However, by days 3 and 7, no significant differences were observed between the two groups for these parameters, indicating that continuous lumbar cistern drainage may have accelerated the clearance of bloody cerebrospinal fluid, enabling it to match LP group levels at subsequent time points. In other words, although LD initially involved a higher burden, sustained drainage allowed parameter levels to reach those comparable to the LP group within 3–7 days. This finding indirectly supports LD's potential advantage in clearing bloody cerebrospinal fluid; however, the LD group did not demonstrate superior prognosis compared to the LP group in this study, likely due to more severe initial conditions or the need for larger sample sizes for further validation [16].

5. Conclusion

In patients with aSAH, cerebrospinal fluid LDH levels, particularly those measured on day 3 postoperatively, are independent risk factors for poor prognosis. Dynamic monitoring of cerebrospinal fluid LDH facilitates early identification of high-risk patients. This study found no definitive superiority between lumbar puncture and lumbar cistern drainage in terms of prognosis or complications. However, lumbar cistern drainage may accelerate the clearance of cerebrospinal fluid. In clinical decision-making, the choice of drainage method should be based on the patient's specific condition and the operator's experience, while also recognizing the predictive value of cerebrospinal fluid LDH levels.

Acknowledgement

Funded by: Jingzhou Science and Technology Program Project (2025HD143)

References

[1] Expert Committee on Neurocritical Care, Neurosurgery Branch of the Chinese Medical Doctor Association. Expert Consensus on Management of Severe Aneurysmal Subarachnoid Hemorrhage (2015 Edition) [J]. China Journal of Cerebrovascular Diseases, 2015,12(4):215-224.

[2] Yang Zhongxin, Liu Haibo, Fan Yingjun, et al. The impact of cerebrospinal fluid drainage time and volume on hydrocephalus after aneurysmal subarachnoid hemorrhage [J]. International Journal of Neurology and Neurosurgery, 2020,47(3):249–253.

[3] Li Renpeng, Xu Yousong, Xu Xiaoming, et al. Endovascular treatment of acute rupture of grade IV and V intracranial aneurysms [J]. Journal of Dalian Medical University, 2014,36(5):456–459.

[4] SEHBA F A,HOU J,PLUTA R M,et al. The importance of early brain injury after subarachnoid hemorrhage[J]. Proy Neurobiol, 2012, 97(1): 14-37.

[5] Xu Hong, Kong Gang, Liu Chuanghong. Analysis of risk factors for shunt-dependent hydrocephalus after surgical treatment of aneurysmal subarachnoid hemorrhage [J]. China Clinical Medicine, 2019,26(2):92-97.

[6] Bothwell SW, Janigro D, Patabendige A, et al. Cerebrospinal fluid dynamics and intracranial pressure elevation in neurological diseases[J]. Fluids Barriers CNS,Fluids Barriers CNS, 2019, 16(7): 9-27.

[7] Hou Mingshan, Xu Yangan, Yang Jun, et al. Early endovascular embolization combined with cerebrospinal fluid drainage for treatment of aneurysmal subarachnoid hemorrhage [J]. Chinese Journal of Neurosurgical Diseases Research, 2017,16(2):165–166.

[8] Zhu Yufeng, Yang Peng, Jin Xiaoqing, et al. Meta-analysis on the sustained cerebrospinal fluid drainage effect after surgery for aneurysmal subarachnoid hemorrhage [J]. Chinese Journal of Neurosurgery, 2021,37(4):406–413.

[9] Zhang He. Efficacy of continuous external drainage with lumbar cistern catheter placement for aneurysmal subarachnoid hemorrhage [J]. China Practical Medicine, 2019,14(11):24-25.

[10] Yang Weike. Comparative clinical evaluation of microscopic aneurysm clipping combined with lumbar puncture and continuous lumbar cistern drainage for treating aneurysmal subarachnoid hemorrhage [J]. Sichuan Journal of Anatomy, 2020,28(2):172–173.

[11] Chu Guangxin, Hao Guangzhi, Jing Fangkun, et al. Efficacy comparison between early lumbar cistern drainage and lumbar puncture with cerebrospinal fluid exchange for subarachnoid hemorrhage [J]. Journal of Trauma and Critical Care Medicine, 2021,9(6):462–464.

[12] Yang J. Clinical efficacy of lumbar cistern drainage in treating delayed vasospasm following aneurysmal subarachnoid hemorrhage [J]. Journal of Integrated Traditional Chinese and Western Medicine for Cardiovascular and Cerebrovascular Diseases, 2023,21(22):4230–4233.

[13] Liu J, Chen Q, Sun K, et al. Comparative analysis of lumbar cerebrospinal fluid drainage versus lumbar puncture effectiveness in patients with aneurysmal subarachnoid hemorrhage[J]. Scientific Reports, 2025, 15(1): 21642.

[14] Yang FB, Hugejilebatu, Tian ZH, et al. Comparison of the prognosis of the repeated lumbar puncture and continuous drainage of lumbar cistern in aneurysmal subarachnoid hemorrhage[J].Chin Med Rec, 2018,19(3):89-92.

[15] Ji Y, Pei BG, Zhang J, et al. Therapeutic role of continuous lumbar cistern drainage after endovascular embolization for aneurysmal subarachnoid hemorrhage[J]. Anhui Med J, 2018,39(10):1217-1220

[16] Song Qixing, Zhu Biao, Liu Baoguo, et al. Efficacy of early continuous lumbar cistern catheter drainage in treating postaneurysmal subarachnoid hemorrhage-induced cerebral vasospasm [J]. China Contemporary Medicine, 2022,29(34):135-139.