Original Article

Systematic review and meta-analysis of the efficacy and safety of cerebrospinal fluid drainage and lumbar puncture in the treatment of cerebrospinal fluid leakage after craniocerebral injury

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Background: Commonly used clinical treatments for intracranial hypertension include continuous lumbar cerebrospinal fluid drainage (CLCFD) and conventional lumbar puncture. However, lumbar puncture is more invasive, requires multiple punctures. CLCFD has less trauma, and drainage can be manipulated to avoid repeated lumbar puncture. However, CLCFD may also lead to complications such as intracranial hematoma and intracranial pneumothorax. Therefore, there is no agreement on which method is more effective. This study evaluated the efficacy of CLCFD and conventional lumbar puncture in the treatment of cerebrospinal fluid leakage after craniocerebral injury.

Methods: The search terms ‘brain injury’ and ‘CLCFD’ were used to search CNKI, Wanfang, VIP, Longyuan, PubMed, Embase, Cochrane Library and other databases (from inception to November 1, 2022). Inclusion criteria: (I) randomized controlled trials (RCTs), CLCFD and conventional lumbar puncture drainage for patients with cerebrospinal fluid leakage after craniocerebral injury; (II) evaluation of indicators such as cerebrospinal fluid leakage stop time, clearance time, intracranial infection and complications. Cochrane systematic review was performed to assess the quality of the literature. RevMan 5.3 software was used for systematic analysis.

Results: A total of 8 studies, involving 568 patients. There is some publication bias in the statistics. The cessation time of cerebrospinal fluid leakage (95% confidence interval (CI): −3.65 to −2.86, Z=16.21, P<0.00001), the time to return to normal pressure (95% CI: −3.13 to −2.09, Z=9.79, P<0.00001), cerebrospinal fluid clearing time (95% CI: −1.96 to −1.09, Z=6.91, P<0.00001), hospitalization time (95% CI: −1.99 to −0.91, Z=5.27, P<0.00001), incidence of intracranial infection (95% CI: 0.07–0.27, Z=5.84, P<0.00001) and complications (95% CI: 0.10–0.43, Z=4.22, P<0.0001) in the CLCFD group were lower than those in the conventional group. The cure rate of the CLCFD group was significantly higher than that of the conventional group (OR =3.75, 95% CI: 2.26–6.23, Z=5.11, P<0.00001); the difference in mortality between the two groups was not statistically significant (P>0.05).

Conclusions: Compared with conventional lumbar puncture, CLCFD can significantly increase the cure rate, shorten the recovery time of cerebrospinal fluid, and significantly reduce the incidence of intracranial infections, reduce complications, is conducive to the prognosis of patients.

Keywords: Craniocerebral injury; postoperative cerebrospinal fluid leakage; continuous lumbar cerebrospinal fluid drainage (CLCFD); random; meta-analysis

Submitted Oct 27, 2022. Accepted for publication Jan 05, 2023. Published online Jan 13, 2023.
doi: 10.21037/apm-22-1302
View this article at: https://dx.doi.org/10.21037/apm-22-1302

Introduction

Severe craniocerebral injury is a common clinical condition with complexities and complications, and epidemiological reports suggest that the morbidity and mortality rate of severe craniocerebral injury as high as 45% (1,2). Conventional surgery is the most common clinical treatment for severe craniocerebral injury, but postoperative patients are prone to cerebrospinal fluid leakage. While this can be self-resolving within 1 week, there are many patients in whom this does not heal for a long time, and this can lead to intracranial infections and other complications, thus increasing the mortality rate. This, coupled with other critical conditions, prolonged hospitalization, and more pipelines, can result in an increased risk of nosocomial infection (3). Therefore, timely and reasonable implementation of management measures is crucial to the prognosis of patients with cerebrospinal fluid leakage after craniocerebral injury surgery. Patients with cerebrospinal fluid leakage after craniocerebral injury are often treated with conventional lumbar puncture, but it is more traumatic. Continuous lumbar cerebrospinal fluid drainage (CLCFD) is minimally invasive, controllable and easy to operate (4). However, the application of CLCFD may also lead to complications such as intracranial infection, intracranial hematoma and intracranial pneumatosis (5). Therefore, the effect of these two surgical methods on the cure of cerebrospinal fluid leakage after craniocerebral injury has not yet been unified. This meta-analysis systematically analyzed and evaluated the clinical efficacy of CLCFD in the treatment of postoperative cerebrospinal fluid leakage after craniocerebral injury. Literatures related to craniocerebral injury, postoperative cerebrospinal fluid leakage, and CLCFD, were identified from well-known Chinese and overseas medical databases and examined. We present the following article in accordance with the PRISMA reporting checklist (available at https://apm.amegroups.com/article/view/10.21037/apm-22-1302/rc).

Highlight box

Key findings

- CLCFD is an effective and safe treatment compared to conventional lumbar puncture.

What is known and what is new?

- Indicators such as cessation time of cerebrospinal fluid leakage, time to return to normal pressure, cerebrospinal fluid clearing time hospitalization time and complications, there have been more clinical studies reported.
- Systematic analysis on the cure rate and the incidence of intracranial infection showed that CLCFD can significantly improve the cure rate and reduce the incidence of intracranial infection compared with conventional lumbar puncture.

What is the implication, and what should change now?

- CLCFD should be standardized in clinical operation to avoid infection.

Methods

Inclusion and exclusion criteria

Inclusion criteria

Based on the principle of PICOS, that is, participants, intervention, control, outcome, study design, the following inclusion criteria were developed: (I) patients with cerebrospinal fluid leakage after craniocerebral injury were confirmed as craniocerebral injury by head CT scan, and cerebrospinal fluid was confirmed by quantitative analysis of glucose in leakage fluid; (II) the intervention method of the observation group was CLCFD; (III) the intervention method of the control group was routine lumbar puncture drainage; (IV) the prognosis indexes such as the stopping time of cerebrospinal fluid leakage, the recovery time of cerebrospinal fluid pressure, the clearance time of cerebrospinal fluid, the hospitalization time, the cure rate, the fatality rate and the safety indexes such as intracranial infection and complications were taken as the outcome indexes; (V) the study type was RCT.

Exclusion criteria

The following exclusion criteria were applied: (I) duplicate publications by the same author; (II) publications where the full text was not available; (III) studies with incomplete or incorrect data in the literature; (IV) comparative studies of non-CLCFD for postoperative cerebrospinal fluid leakage after craniocerebral injury; (V) studies where the baseline information between groups was not clearly comparable; (VI) literatures that were inconsistent with the topic of this study; and (VII) investigations in which the treatment methods were inconsistent with those of this study.

Literature search

The Cochrane Collaboration Network requirements were used as the basis to develop the search strategy for the literature of this study. The English database, PubMed, Embase, Cochrane Library, and the Chinese databases, CNKI, Wanfang, Longyuan Journal Network, and Vipshop (VIP), were searched from inception of database to November 1, 2022. The search was limited to the English and Chinese languages.

Search terms

The following search terms were applied: “brain injury”, “postoperative cerebrospinal fluid leakage”, “continuous lumbar cerebrospinal fluid drainage”, “CLCFD”, and “control”.

Search strategy

A combination of subject terms and free words were jointly customized by two researchers based on a subject pre-search. If there is disagreement between the two opinions, consult the senior personnel for decision.

Literature screening and data extraction

The Endnote 9.3 software was used to screen and exclude duplicate literature, and two researchers independently performed the primary and secondary screenings. An Excel spreadsheet was constructed to collate the basic information of the included literature, including authors, publication date, included cases, general information of study subjects, interventions, and observation indicators. Any disagreements were resolved via consultation with senior personnel.

Literature quality assessment

The quality of the literature included in the study was evaluated according to the 6 criteria of bias risk in the Cochrane system evaluator manual 5.3. All 6 items were satisfied, the possibility of various kinds of bias was minimum = low risk; partially satisfied, and the probability of bias was medium = some concerns; completely not satisfied, the highest probability of bias = high risk.

Statistical analysis

The Review 5.3 software was used for collation and analysis of data. The 95% confidence interval (CI) was calculated. The odds ratio (OR) was used as the effect size for the count data. For the measure data, the variable indicators, measurement tools and measurement time points extracted from the included 8 literature studies may be inconsistent, so standardized mean difference (SMD) is selected as the effect size. By searching for sources of heterogeneity, the effects on the results before and after exclusion were compared. For heterogeneity tests, if $P<0.05$ or $I^2>50\%$, the effect was evaluated with a random-effects model; and if the converse was true, the effect was evaluated with a fixed-effects model. Heterogeneity may come from included cases, interventions, observation indicators, etc. A P value <0.05 was considered statistically significant.

Results

A total of 67 papers were included in the initial screening. The primary screening was performed by applying Endnote 9.3 to exclude 31 duplicate papers, leaving 36 papers. Two researchers read the titles and abstracts for secondary screening, and 22 articles were excluded, leaving 14 articles. Then 2 articles were excluded with reports not retrieved. The full text was read again to exclude 2 articles with inconsistent interventions and 2 articles with incomplete data, and 8 articles were finally included. The corresponding literature screening process and results are detailed in *Figure 1*.

Basic characteristics of the included literatures

A total of 8 studies, published from 2016 to 2021, were finally included in this meta-analysis, including a total of 568 patients with cerebrospinal fluid leakage after craniocerebral injury surgery. The basic characteristics of each study are detailed in *Table 1*.

Quality assessment of the included study literature

The Cochrane system was applied to assess the quality of the eight literatures included in this study. The specific scores are detailed in *Table 2*.

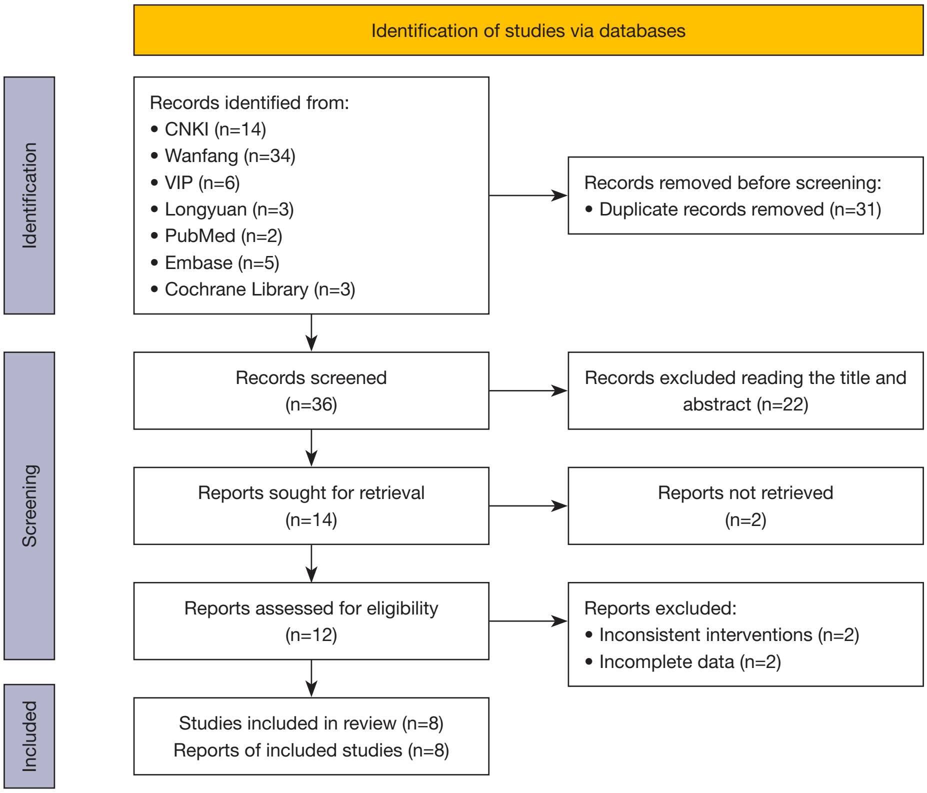

Figure 1 The literature screening process and results.

Meta-analysis results

Recovery of cerebrospinal fluid

Time to cessation of cerebrospinal fluid leakage

All 8 included studies (6-13) evaluated the time to cessation of cerebrospinal fluid leakage, and a total of 568 patients with cerebrospinal fluid leakage after craniocerebral injury were included. There was significant heterogeneity among studies in the literature ($P=0.02$, $I^2=57\%$), and a random-effects model was used for the effect size analysis. The results showed a statistically significant difference in the time to cessation of cerebrospinal fluid leak between the two groups (SMD =−3.25, 95% CI: −3.65 to −2.86, Z=16.21, P<0.00001), with the time to cessation being significantly shorter in the CLCFD group compared to the conventional group (*Figure 2*). Further analysis of the sources of heterogeneity between studies was performed by excluding the included literature studies one by one. There was a significant difference before exclusion of the study by Lu (11) ($I^2=57\%$) and after its exclusion ($I^2=0\%$). Otherwise, SMD remained between −3.36 and −3.05, 95% CI between −3.77 and −2.80, and I^2 between 51% and 63%, which indicated good stability of the results. This is suggested that the study by Lu (11) may be a source of heterogeneity in the time to cessation of cerebrospinal fluid leakage across studies.

Time to normalization of cerebrospinal fluid pressure

Time to normalization of cerebrospinal fluid pressure was evaluated in 2 studies (9,13), which included 108 patients with cerebrospinal fluid leakage after craniocerebral injury. There was no significant heterogeneity among the studies ($P=0.99$, $I^2=0\%$), and the effect size analysis was performed using a fixed-effects model. The results showed that the difference in time to normalization of cerebrospinal fluid pressure was statistically significant when comparing the two groups (SMD =−2.61, 95% CI: −3.13 to −2.09, Z=9.79, P<0.00001), and the time to normalization was significantly less in the CLCFD group compared to that in the conventional group (*Figure 3*).

Cerebrospinal fluid turn-around time

Two studies (9,13) evaluated the time to cerebrospinal fluid translucency and included a total of 108 patients with cerebrospinal fluid leakage after craniocerebral injury surgery. There was no significant heterogeneity between

Table 1 Basic characteristics of the included literatures

Included studies	Groups	Gender		Age (years)	Types			Surgical method	Final indicator
		Male	Female		Nasal leak	Ear leak	Incisional leak		
Du and Wang (6), 2019	Study group (n=49)	24	25	43.5–79.3; (54.7±7.8)	18	9	22	Continuous lumbar cerebrospinal fluid drainage	①⑤⑦
	Control group (n=49)	26	23	17–70; (41.19±2.35)	17	11	21	Lumbar puncture drainage	
Hu *et al.* (7), 2018	Study group (n=45)	25	20	35.78±10.17	9	12	24	Continuous lumbar cerebrospinal fluid drainage on the second day after operation	①④⑤⑥⑦⑧
	Control group (n=45)	22	23	36.98±9.38	10	13	22	Conventional lumbar puncture	
Huang *et al.* (8), 2017	CLCFD group (n=36)	28	8	45.9±8.2	13	9	14	Continuous lumbar cerebrospinal fluid drainage	①⑤⑦
	Control group (n=39)	30	9	46.4±8.7	14	11	14	Conventional lumbar puncture was performed on the 2nd postoperative day	
Li *et al.* (9), 2021	Study group (n=20)	12	8	35–72; (47.34±3.67)	15	5	–	Continuous lumbar cerebrospinal fluid drainage	①②③⑦⑧
	Control group (n=20)	12	8	36–69; (47.98±3.71)	14	6	–	Conventional lumbar puncture	
Liu *et al.* (10), 2016	CLCFD group (n=26)	20	6	17–56	9	7	10	Conventional lumbar puncture was performed on the 2nd postoperative day	①⑤⑦
	Control group (n=26)	21	5	23–57	8	12	6	Conventional lumbar puncture was performed on the 2nd postoperative day	
Lu (11), 2017	Study group (n=33)	19	14	18–73; (45.1±5.9)	11	7	15	Conventional lumbar puncture was performed on the 2nd postoperative day	①⑤⑦
	Control group (n=32)	14	18	23–54; (44.7±5.8)	10	9	13	Conventional lumbar puncture was performed on the 2nd postoperative day	
Sun *et al.* (12), 2019	Study group (n=40)	31	9	18–59; (45.79±4.23)	–	–	–	Conventional lumbar puncture was performed on the 2nd postoperative day	①⑤⑦
	Control group (n=40)	30	10	18–60; (45.81±4.19)	–	–	–	Conventional lumbar puncture was performed on the 2nd postoperative day	
Zhang *et al.* (13), 2019	Study group (n=34)	24	10	60–82; (73.2±5.5)	11	10	13	Conventional lumbar puncture was performed on the 2nd postoperative day	①②③④⑤⑥⑦⑧
	Control group (n=34)	25	9	73.7±4.1	10	10	14	Conventional lumbar puncture was performed on the 2nd postoperative day	

(I) Cerebrospinal fluid recovery: ① time to stop cerebrospinal fluid leakage (d), ② time to normalize cerebrospinal fluid pressure (d), ③ time to clear cerebrospinal fluid (d); (II) ④ hospitalization time; (III) prognosis: ⑤ cure rate, ⑥ morbidity and mortality rate; (IV) safety indicators: ⑦ intracranial infection, ⑧ occurrence of complications. Data are shown as mean ± standard deviation and/or range.

Table 2 The quality evaluation results of the included literatures

Documents	Year	Cochrane system evaluation results
Du and Wang (6)	2019	Some concerns
Hu *et al.* (7)	2018	Some concerns
Huang *et al.* (8)	2017	Some concerns
Li *et al.* (9)	2021	Some concerns
Liu *et al.* (10)	2016	Low risk
Lu (11)	2017	Some concerns
Sun *et al.* (12)	2019	Low risk
Zhang *et al.* (13)	2019	Some concerns

the studies (P=0.94, I^2=0%), so the effect size analysis was performed using a fixed-effects model. The results showed a statistically significant difference in the time to normalization of cerebrospinal fluid pressure between the two groups (SMD =−1.52, 95% CI: −1.96 to −1.09, Z=6.91, P<0.00001), and the time for cerebrospinal fluid to turn clear was significantly less in the CLCFD group than in the conventional group (*Figure 4*).

Length of hospital stay

Length of hospital stay was evaluated in 2 studies (7,13), which included 158 patients with cerebrospinal fluid leakage after craniocerebral injury surgery. There was significant

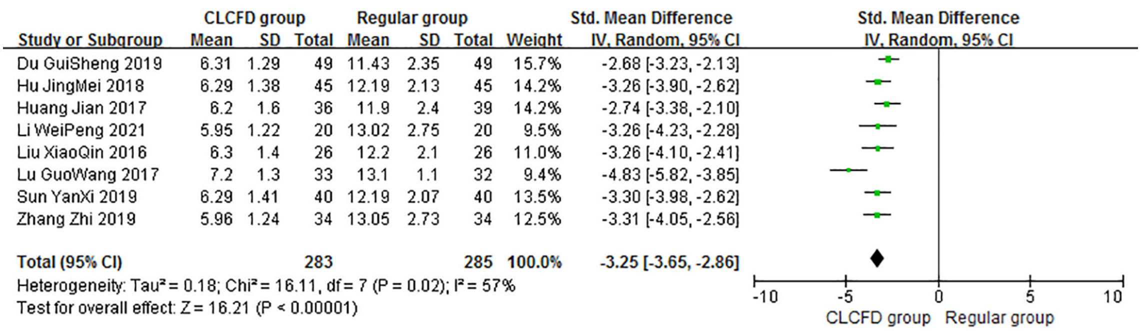

Figure 2 Meta-analysis forest diagram of the cessation time of cerebrospinal fluid leakage. CLCFD, continuous lumbar cerebrospinal fluid drainage; SD, standard deviation; CI, confidence interval.

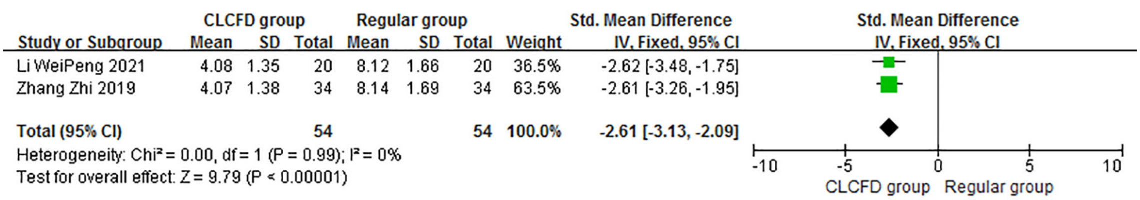

Figure 3 Meta-analysis forest diagram of the time required for cerebrospinal fluid pressure to return to normal. CLCFD, continuous lumbar cerebrospinal fluid drainage; SD, standard deviation; CI, confidence interval.

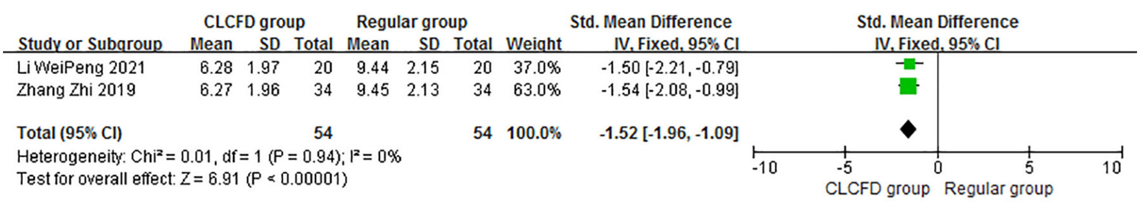

Figure 4 Meta-analysis forest diagram of the time required to achieve clear cerebrospinal fluid. CLCFD, continuous lumbar cerebrospinal fluid drainage; SD, standard deviation; CI, confidence interval.

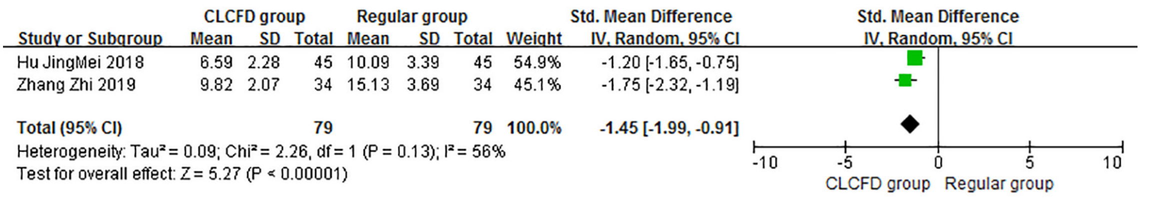

Figure 5 Meta-analysis forest diagram of the length of hospital stay. CLCFD, continuous lumbar cerebrospinal fluid drainage; SD, standard deviation; CI, confidence interval.

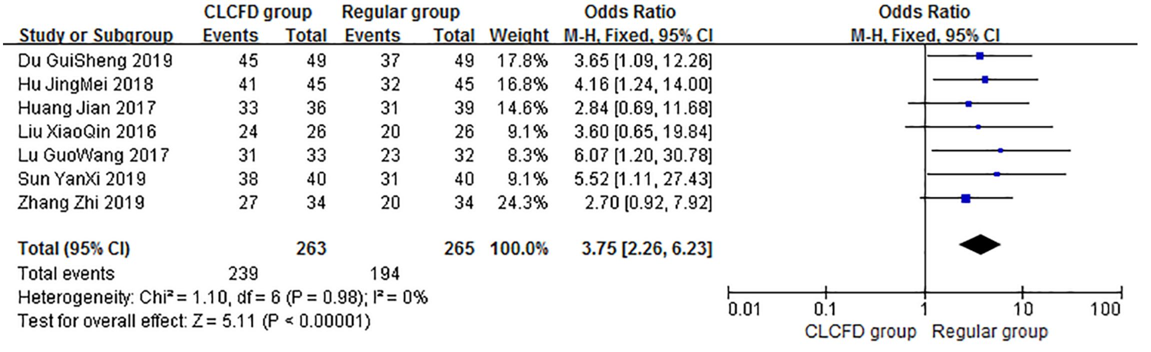

Figure 6 Meta-analysis forest diagram of the cure rate. CLCFD, continuous lumbar cerebrospinal fluid drainage; CI, confidence interval.

heterogeneity among the studies (I^2=56%>50%), so a fixed-effects model was used for the effect size analysis. The results demonstrated that the difference was statistically significant when comparing the length of hospital stay between the two groups (SMD =−1.45, 95% CI: −1.99 to −0.91, Z=5.27, P<0.00001), and the length of stay in the CLCFD group was significantly less than that in the conventional group (*Figure 5*).

Prognosis

Cure rate

Seven studies (6-8,10-13) evaluated the cure rate and included a total of 528 patients with postoperative cerebrospinal fluid leakage after craniocerebral injury. There was no significant heterogeneity among the studies (P=0.98, I^2=0%), so the fixed-effects model was used for the analysis. There was a statistically significant difference in the cure rate between the two groups (OR =3.75, 95% CI: 2.26–6.23, Z=5.11, P<0.00001), and the cure rate in the CLCFD group was significantly higher than that in the conventional group (*Figure 6*).

Morbidity and mortality rates

The morbidity and mortality rates were evaluated in 2 studies (7,13), which included 158 patients with postoperative cerebrospinal fluid leakage after craniocerebral injury. The effect size analysis was performed using a fixed-effects model because there was no significant heterogeneity among the studies (P=0.85, I^2=0%). The results revealed that the difference in the morbidity and mortality rates was not statistically significant when comparing the two groups (OR =0.42, 95% CI: 0.06–2.90, Z=0.88, P=0.38; *Figure 7*).

Safety analysis

Intracranial infection

Intracranial infections were evaluated in 8 studies (6-13), which included a total of 568 patients with postoperative cerebrospinal fluid leakage after craniocerebral injury. There was no significant heterogeneity among the studies (P=0.92, I^2=0%), so the effect size was analyzed by a fixed-effects model. The results demonstrated that the difference in the incidence of intracranial infection between the two groups was statistically significant (OR =0.14, 95% CI: 0.07–0.27, Z=5.84, P<0.00001), and the incidence of intracranial infection in the CLCFD group was significantly lower than that in the conventional group (*Figure 8*).

Occurrence of complications

Three studies (7,9,13) evaluated the occurrence of

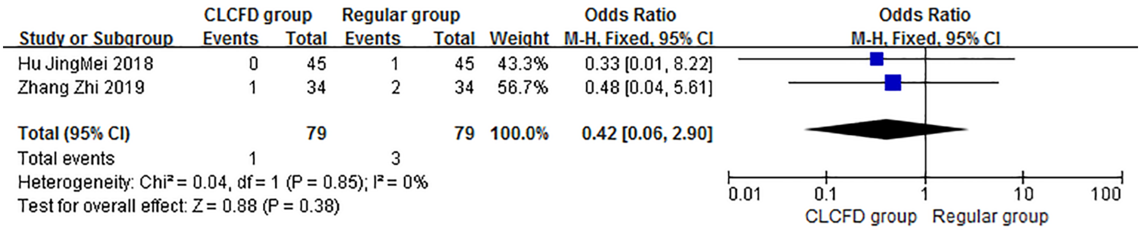

Figure 7 Meta-analysis forest diagram of case fatality rate. CLCFD, continuous lumbar cerebrospinal fluid drainage; CI, confidence interval.

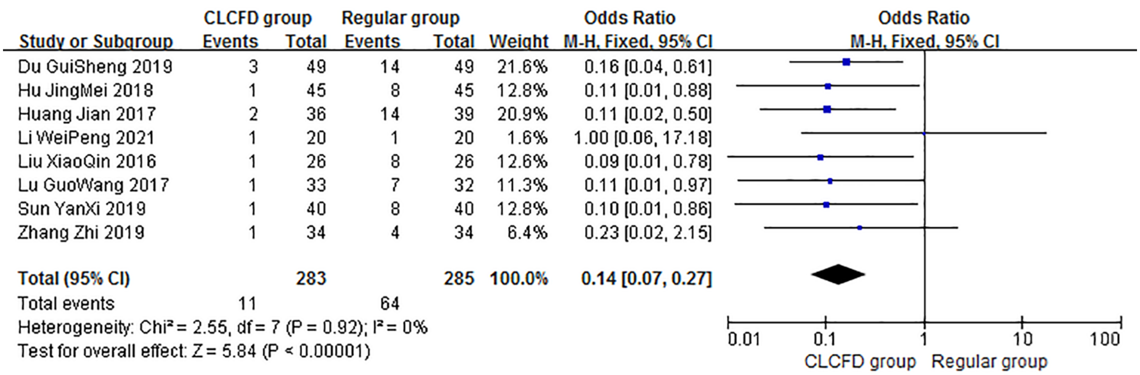

Figure 8 Meta-analysis forest diagram of the incidence of intracranial infection. CLCFD, continuous lumbar cerebrospinal fluid drainage; CI, confidence interval.

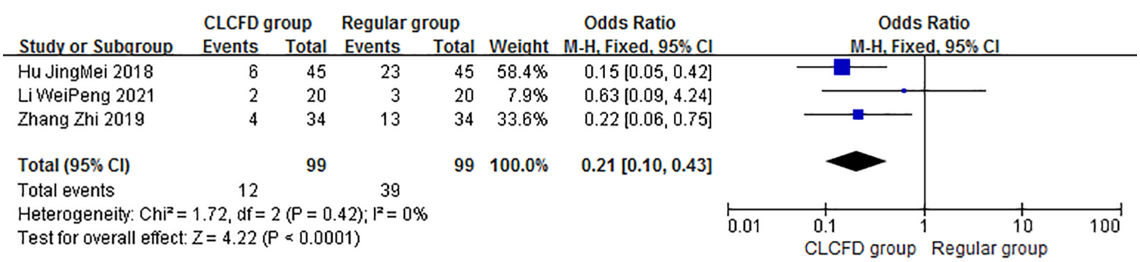

Figure 9 Meta-analysis forest diagram of the rate of complications. CLCFD, continuous lumbar cerebrospinal fluid drainage; CI, confidence interval.

complications and included a total of 198 patients with cerebrospinal fluid leakage after craniocerebral injury. There was no significant heterogeneity among the studies (P=0.42, I^2=0%), so the effect size was analyzed by a fixed-effects model. The results revealed that the difference in complication rates between the two groups was statistically significant (OR =0.21, 95% CI: 0.10–0.43, Z=4.22, P<0.0001), and the CLCFD group had a significantly lower complication rate than the conventional group (*Figure 9*).

Results of bias analysis

In this study, 8 literature studies were included, and the indicators with the largest number of included literature studies, cerebrospinal fluid leak stopping time and intracranial infection, were selected, and their respective funnel plots were drawn for bias analysis (*Figures 10,11*, respectively). The results revealed that both indicators, cerebrospinal fluid leak stopping time and intracranial infection, showed an inverted funnel shape, and all the

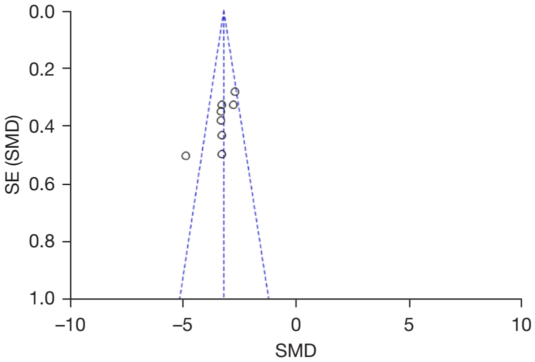

Figure 10 Funnel diagram of the cessation time of cerebrospinal fluid leakage. SE, standard error; SMD, standardized mean difference.

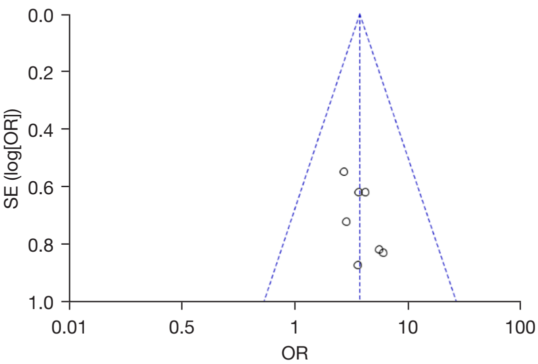

Figure 11 Funnel diagram of the incidence of intracranial infection. SE, standard error; OR, odds ratio.

literature studies of intracranial infection were within the 95% CI line, and there was no significant publication bias. Cerebrospinal fluid leakage stopping time had some literature outside the 95% CI line, and there was some publication bias.

Discussion

Basis for the selection of this paper

Cerebrospinal fluid is colorless and transparent, originates from the ventricular choroid plexus, is visible in the ventricles and subarachnoid space, and is able to maintain intracranial pressure. Meanwhile, it also plays an important role in brain and spinal cord metabolism (14). Cerebrospinal fluid leakage is a complication that commonly occurs in craniocerebral surgery and spinal surgery, with an incidence in the range of 2.3% to 9.4% (15). Lumbar puncture and drainage is a common postoperative tool in neurosurgery; however, this procedure requires a higher level of physician proficiency in human anatomy and strict adherence to the contraindications to performing lumbar puncture (16). Although the risk associated with lumbar puncture and drainage is low, the consequences can be very serious. Currently, CLCFD is widely used in the clinical treatment of subarachnoid hemorrhage and intracranial infection, and this procedure is performed by placing a drainage tube in the lumbar pool through lumbar puncture followed by cerebrospinal fluid drainage, and many clinical studies have shown that CLCFD has achieved good results in various causes of cerebrospinal fluid leakage (17). Dang (18) used CLCFD to treat traumatic subarachnoid hemorrhage and found that the CLCFD procedure could improve the patient's brain function and reduce various complications such as cerebral vasospasm and cerebral hemorrhage. A systematic analysis by Zhu *et al.* (19) revealed that CLCFD was commonly used and could significantly reduce the disability rate and improve the prognosis of patients. The above reports indicated that CLCFD has certain operability in the treatment of craniocerebral injury. Lumbar puncture and drainage is a common postoperative tool in neurosurgery. Cerebrospinal fluid leakage tends to be more severe in patients with craniocerebral injury, and commonly occurs in elderly patients. Such patients tend to have reduced stability of the internal environment of the body fluid, weak compensatory capacity, and reduced repair ability of the body, which can aggravate all kinds of primary diseases after craniocerebral injury, and complications can aggravate secondary injuries, thus posing a threat to life. While there are an increasing number of RCTs examining postoperative cerebrospinal fluid leakage after CLCFD treatment for craniocerebral injury, there is a paucity of large sample and multicenter data. Therefore, we herein conducted a systematic analysis and evaluation of postoperative cerebrospinal fluid leakage after CLCFD treatment for craniocerebral injury.

Analysis of the results of this study

This meta-analysis showed that compared with conventional lumbar puncture, CLCFD was a more effective treatment for postoperative cerebrospinal fluid leakage after craniocerebral injury, characterized by a significantly improved cure rate, a significantly shorter time to cessation of cerebrospinal fluid leakage, shorter time to restoration of normal cerebrospinal fluid pressure, reduced time to achieving clear cerebrospinal fluid, decreased incidence of complications, reduced intracranial infections, improved prognosis of patients, and significantly shortened hospitalization time. Compared with conventional lumbar puncture cerebrospinal fluid drainage, CLCFD achieve a controlled flow rate and maintain a slow and uniform speed with the help of the lumbar pool drainage device to promote a gentle decrease in intracranial pressure and reduce the pressure difference (20). During the treatment process, CLCFD can prevent damage to the brain tissues caused by pressure and flow rate. Furthermore, the lumbar pool drainage device can be used to replace the new cerebrospinal fluid to reduce neurocytotoxicity (21). In addition, CLCFD treatment can prolong the duration of drainage tube retention and promote patient recovery without aggravating injury to the base of the brain. The cranial cavity of patients with cerebrospinal fluid leakage is exposed to the outside world, which can easily lead to intracranial infection, and the longer the duration of cerebrospinal fluid leakage, the greater the probability of intracranial infection. Early administration of CLCFD can reduce the cerebrospinal fluid leak and decrease the pressure difference between the inside and outside of the leak, thus reducing the irritation of cerebrospinal fluid to the tissues around the leak and promoting the healing of the leak (22).

Study shortcomings

This report analyzed the risk of bias for indicators of cerebrospinal fluid leakage cessation time and intracranial infection in the form of a funnel plot. All studies examining intracranial infection were within the 95% CI line, and there was no significant publication bias. However, some of the literature examining cerebrospinal fluid leakage cessation time was outside the 95% CI line, and there was some publication bias. There were some limitations to this study. A meta-analysis is essentially a secondary literature study, and the quality of its evidence is mainly dependent on the quality of the original studies. Although the literature studies included in this study were RCTs, some of the literature reports did not mention blinding, allocation concealment, etc., and there may be a potential risk of bias.

Conclusions

This study systematically analyzed the controversial contents such as the cure rate and the incidence of intracranial infection, and found that CLCFD can significantly improve the cure rate and reduce the incidence of intracranial infection compared with conventional lumbar puncture. These may provide evidence for clinical treatment of patients with cerebrospinal fluid leakage after craniocerebral injury. However, the following issues should be noted during the administration of CLCFD: strict aseptic operation to prevent infections; good control of the drainage speed, while closely observing the changes in the patient's level of consciousness, pupils, and vital signs; good control of the drainage flow to prevent the occurrence of tension pneumothorax due to excessive drainage speed; daily biochemical and routine examination of cerebrospinal fluid to adjust the treatment plan if required; when assisting the patient to turn over, pay attention to avoid twisting and dislodging of the drainage tube to keep the drainage unobstructed; when moving the patient, temporarily close the drainage tube to prevent the reflux of cerebrospinal fluid.

Acknowledgments

Funding: This study was supported by the 2022 Medical Science Research Project of Hebei Province (No. 20220549).

Footnote

Reporting Checklist: The authors have completed the PRISMA reporting checklist. Available at https://apm.amegroups.com/article/view/10.21037/apm-22-1302/rc

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://apm.amegroups.com/article/view/10.21037/apm-22-1302/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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(English Language Editor: J. Teoh)

Cite this article as: Feng S, Lv X, Dai X. Systematic review and meta-analysis of the efficacy and safety of cerebrospinal fluid drainage and lumbar puncture in the treatment of cerebrospinal fluid leakage after craniocerebral injury. Ann Palliat Med 2023;12(1):121-132. doi: 10.21037/apm-22-1302