Saudi Journal of Biological Sciences 27 (2020) 873–880

Contents lists available at ScienceDirect

Saudi Journal of Biological Sciences

journal homepage: www.sciencedirect.com

Original article

Therapeutic mechanism of intracranial infection in patients with hydrocephalus after craniocerebral injury based on decompressive craniectomy

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ARTICLE INFO

Article history:
Received 17 October 2019
Revised 24 December 2019
Accepted 25 December 2019
Available online 3 January 2020

Keywords:
Decompressive craniectomy
Hydrocephalus after craniocerebral injury
Intracranial infection
Treatment mechanism
Meta-analysis

ABSTRACT

The objective of this study is to analyze the treatment mechanism of decompressive craniectomy for intracranial infection in patients with hydrocephalus after craniocerebral injury, and to provide a treatment plan for intracranial infection in patients with hydrocephalus after craniocerebral injury. In this study, literature screening and data acquisition were carried out firstly based on the research content, and then heterogeneity analysis, Meta-analysis, sensitivity analysis, and publication bias analysis were performed using statistical methods for the unilateral and bilateral decompressive craniectomy. Heterogeneity analysis, Meta-analysis and sensitivity analysis of indiscriminate unilateral decompressive craniectomy was performed; heterogeneity analysis, Meta-analysis, cumulative Meta-analysis, and sensitivity analysis for bilateral decompressive craniectomy were performed. In this study, the order of influence on patients with hydrocephalus after brain injury was as follows: bilateral decompressive craniectomy > unilateral and bilateral decompressive decompression > indiscriminate unilateral decompressive. Intracranial infection in patients with hydrocephalus after the craniocerebral injury should be comprehensively evaluated before the surgery and given clinical treatment in time.

1. Introduction

The general condition of hydrocephalus after craniocerebral trauma refers to the changes in the structure and normal physiology of the brain parenchyma after trauma to the brain. There are also special cases that the patient's cerebrospinal fluid has a normal circulation path changes due to the use of various treatments, and the reflux of cerebrospinal fluid is weakened (Du et al., 2017; Yu et al., 2017). Both of these conditions can lead to the occurrence of hydrocephalus after craniocerebral trauma, which was reported by Professor Dandy, but Professor Dandy did not explain the influencing factors (Chen et al., 2018; Ming, 2017). Influencing factors and development mechanisms of hydrocephalus after traumatic brain injury have been studied by scholars in recent years, but there are many different opinions and no conclusions.

At present, the main means of intracranial decompression for patients with craniocerebral trauma is decompressive craniectomy. However, more and more infections after decompressive craniectomy occurred. Hydrocephalus after craniocerebral trauma is the most obvious complication of decompressive craniectomy. Whether there is a connection between decompressive craniectomy and traumatic hydrocephalus, the current medical research has not reached a unified statement (Huang et al., 2017; Low et al., 2018; Jiang et al., 2017). Correlation analysis of Winston et al. (2018) showed that decompressive craniectomy is an independent influencing factor for the development of hydrocephalus after intracranial trauma. The study has shown that the secretion (or absorption) of brain tissue cells is related to the heartbeat cycle, and the use of decompressive craniectomy for the patient will result in the destruction of this connection, which will increase the speed of hydrocephalus and also increase the amount of cerebrospinal fluid storage. At the same time, some studies have shown that after the decompressive craniectomy of the patient, the distance from the upper part to midline of the bone window edge will

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Peer review under responsibility of King Saud University.

Production and hosting by Elsevier

https://doi.org/10.1016/j.sjbs.2019.12.039
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be very close, which will make the limitation of the bone plate to the bridge vein disappear, leading to an increase in venous drainage and further reducing the volume of the brain parenchyma, so that a series of reactions further enlarge the ventricular system and form hydrocephalus after traumatic brain injury (Ittleman et al., 2017; Shai et al., 2017; Jiang et al., 2018). However, Jin and Li (2017) conducted experiments on animals and concluded that the conclusions different from the above. At present, there is no unified conclusion on whether decompressive craniectomy is a high-risk factor for hydrocephalus after craniocerebral injury (Alamri et al., 2018; Zhang et al., 2018; Walter et al., 2017). Therefore, there is currently no corresponding treatment for infection treatment of patients with hydrocephalus caused by decompressive craniectomy.

In summary, in order to study the infection treatment mechanism of patients with hydrocephalus after craniocerebral injury caused by decompressive craniectomy, in this study, it firstly selected the literature and obtained the data through the existing database, and then heterogeneity analysis, Meta-analysis, sensitivity analysis, and publication bias analysis were performed using statistical methods for unilateral and bilateral decompressive craniectomy. Heterogeneity analysis, Meta-analysis and sensitivity analysis of indiscriminate unilateral decompressive craniectomy was performed; heterogeneity analysis, Meta-analysis, cumulative Meta-analysis, and sensitivity analysis for bilateral decompressive craniectomy were performed. This article analyzed the correlation between decompressive craniectomy and hydrocephalus after the craniocerebral injury to guide the infection treatment of patients with hydrocephalus after craniocerebral injury.

2. Method

2.1. Materials and methods

The research material in this study is the literature published from April 2016 to April 2019. The research content is a case-control study related to intracranial infection factors in patients with hydrocephalus after craniocerebral injury. Decompressive craniectomy is used as an exposure factor in published literature.

The literature retrieval method refers to the retrieval of experimental research purposes through the literature search. This paper summarized the current medical database and summarized the search time range, as shown in Table 1.

The search for keywords and topics was performed in the databases listed in Table 1. The foreign language database was mainly searched in English. The search terms are Traumatic Brain Injury, Decompressive craniectomy, Diffuse Brain Injury, Treatment Mechanism, Intracranial Infection, Post-Traumatic Hydrocephalus, etc. The keyword search in the Chinese database includes decompressive craniectomy, traumatic hydrocephalus, intracranial infection, and treatment mechanism.

Table 1
Common medical database summary and search time range.

Database	Name of database	Search time range
Foreign language database	Medline Embase Cochrane Web of science	April 2016 to April 2019
Chinese database	China Biology Medicine disc WAN FANG data Cqvip China National Knowledge Infrastructure	

2.2. Screening of literature and methods for obtaining effective data

In this study, the matching of literature titles with abstracts and content was considered in the literature screening process. The literature with a higher matching degree was selected and read. The screening of the adopted literature required two evaluators to decide whether to become valid information and if there is a disagreement, the third person will judge. The inclusion criteria of the literature have the following aspects: Firstly, the design of the study must be the study of the case group and the control group. Secondly, the relevance of the study in the literature needs to explore the high-risk factors of hydrocephalus after craniocerebral trauma. Thirdly, the research subjects in the literature must be patients with hydrocephalus after craniocerebral trauma after clinical diagnosis. And the diagnosis time of the research subject must be more than 6 weeks, and the cases with clinical manifestations of neurological dysfunction (such as mental retardation, urinary incontinence, and limb instability) should be excluded. The imaging data show communicating hydrocephalus (need to exclude the encephalography patients). Fourthly, the data in the literature needs to ensure its integrity. Fifthly, the evaluation factors should be exposed to the literature. Based on the above-mentioned literature inclusion criteria, the process of screening by the two evaluators is as follows: at first, one evaluator evaluates the literature. Then, another evaluator will review the selected literature. If there is still disagreement on the data and still can't reach a consensus after discussion, a third person needs to evaluate. In the screening literature, if the literature data is missing, deficient, unclear or has a problem with the expression, the third person needs to contact the author of the literature to verify the literature with data problems, and this literature will not be used without the reply of the author of the literature.

In this study, the decompressive craniectomy was divided into three cases according to the research content and the combined literature: no distinction between unilateral/bilateral decompressive craniectomy, unilateral decompressive craniectomy and bilateral decompressive craniectomy. In the process of document data collection, the pieces of literature don't specifically describe unilateral or bilateral, which was treated as unilateral decompressive craniectomy in this study.

2.3. Statistical analysis methods

Heterogeneity analysis means that there will be statistical differences in the literature studies that will be included in the same Meta-analysis, so heterogeneity is the variation between different literature studies. According to the principle of Meta-analysis statistics, when the data to be analyzed can't be merged or the homogeneity is not good, the heterogeneity test of the research data of the literature needs to be performed first, so that different test results can be obtained, and then the appropriate effect model can be selected. Perform effect merging. The heterogeneity test can also be called heterogeneity recognition, which is mainly represented by the graphic method and statistical method. In this study, the latest heterogeneity evaluation index I^2 was selected, and the value range of I^2 is generally 0–100%, the evaluation index usually reflects the proportion of the heterogeneity part of the total effect in the variation. In general, the larger the I^2, the greater the heterogeneity. The generation of I^2 is generally caused by the description of the data of each study, so I^2 is not caused by the sampling error. Therefore, using I^2 to measure the degree of heterogeneity between multiple studies is a very good statistic indicator. In the statistical evaluation system, heterogeneity of less than 50% of I^2 is acceptable.

Sensitivity analysis is an analytical method in Meta-statistical analysis to determine the sensitivity of a research result, or to use its data size to guide how Meta-analysis transforms the system's analytical methods. Sensitivity analysis can be used to assess how systematic data and the uncertainty of application method affect the robustness of system results. The methods of sensitivity analysis are usually: firstly, how to change the type of research included in the literature in the included standard literature or exclude standard and other observations; secondly, the literature that is not clear about the research needs to be re-examined, or excluded certain literature that needs to be studied; thirdly, some of the acquired data need to be changed, and some estimates need to be re-analyzed; fourthly, certain pieces of literature that don't conform to the criteria should be gradually removed or directly rejected. Sensitivity analysis is based on the stratification analysis of the included literature based on the different characteristics of the study (such as statistical methods and sample size), and the combined effect size difference analysis.

Cumulative Meta-analysis means that each time literature is added in a specific order, a research purpose is dynamically processed, and the research subject is regarded as a dynamic whole. Meta-analysis is performed in turn, and cumulative Meta-analysis can be used to reflect the tendency of overall outcome changes due to a specified order change. In this study, the change of unilateral decompressive craniectomy to the bilateral decompressive craniectomy, that is, the surgical method was observed as a cumulative factor.

Bias analysis refers to systematic error analysis. Bias analysis exists because the literature in the process of data collection, analysis, interpretation and publication, conclusions and true values will have different tendencies due to these factors. The literature biases that are included in the Meta-analysis, in general, are selection bias, implementation bias, loss bias, measurement bias, and reporting bias.

3. Results

3.1. Search results

Fig. 1 is a flow chart of document screening. As can be known from Fig. 1, a total of 215 related articles were searched according to keywords and topics. Among them, there are 17 English documents and 198 Chinese documents. Since patent-type research results involve intellectual property issues and can't be considered as valid information, documents involving patent types need to be deleted, and academic dissertations need to be excluded. Then duplicated documents were removed, leaving 214 articles. The literature that is inconsistent with the research content were further excluded, a total of 155 articles. In this way, a total of 25 articles were finally included in the study. Of the 25 articles included in the study, 16 were in Chinese and 9 in English, and there were 21 articles on the correlation analysis of hydrocephalus after craniocerebral injury without discriminating unilateral and bilateral decompressive craniectomy (which including 17 Chinese documents and 4 English documents). There were 12 articles in the analysis of the correlation between unilateral decompressive craniectomy and hydrocephalus after craniocerebral injury (which including 10 Chinese literature and 2 English literature). There were 4 articles in the analysis of the correlation between bilateral decompressive craniectomy and hydrocephalus after craniocerebral injury (which including 3 Chinese documents and 1 English document).

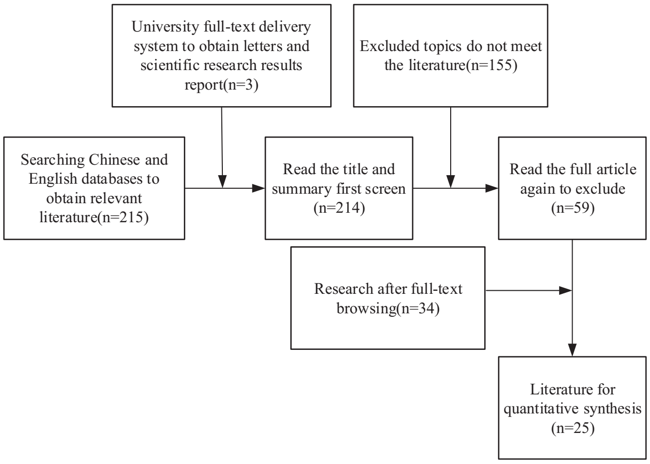


Fig. 1. Search flow chart for included literature.

3.2. Analysis of the correlation between indiscriminate unilateral and bilateral decompressive craniectomy and hydrocephalus after traumatic brain injury

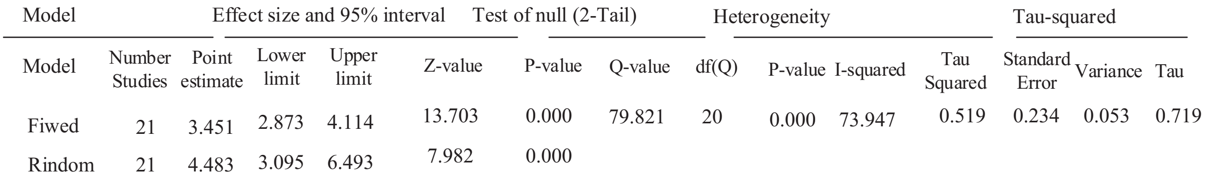
Firstly, this study conducted a mixed analysis without distinguishing between unilateral or bilateral decompressive craniectomy. Before performing heterogeneity analysis, it is necessary to verify whether it has the conditions for combined analysis. Therefore, the heterogeneity test was performed by CMA software. The obtained results are shown in Fig. 2. It can be observed from Fig. 2 that $I^2 = 73.977\%$, the heterogeneity was too high, so the data did not have the conditions for the combined analysis, and the data needed to be heterogeneously processed before the heterogeneity test analysis.

Therefore, this study needs to review the included literature again. The study combined the NOS (network operating system) information to find that there were four documents that have imperfections in some factors. Therefore, the four documents were excluded. The heterogeneity test was performed again on the literature after excluding, $I^2 = 64.113\%$, and the results obtained are shown in Fig. 3. Fig. 4 is a Meta-analysis after heterogeneity adjustment of decompressive craniectomy as an exposure factor and correlation between hydrocephalus after craniocerebral injury. Fig. 4 shows that OR = 5.531, 95% CI = (3.889, 7.736) ($P < 0.05$), after the combination, the results of the random model Meta-analysis showed that the risk of hydrocephalus after craniocerebral injury was 5.521 times in patients with decompressive craniectomy compared with those without decompressive craniectomy.

Fig. 5 is a publication biased funnel diagram. It can be observed from Fig. 5 that the effect values of the independent studies in this test were not uniformly distributed symmetrically next to the true values, basically, all of them were concentrated at the top of the funnel graph, which suggested that the sample size of the study was too large, and nine groups of studies were outside the 95% CI (confidence interval) range.

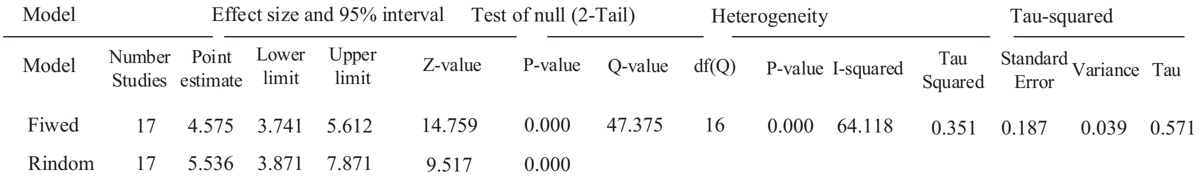
Fig. 6 is a complement graph of the publication bias funnel plot. Since there is a publication bias in Fig. 5, in order to eliminate the publication bias, another 9 sets of studies need to be added, and the other 7 sets of studies were placed outside the interval, and 1 group was placed within the 95% CI range. Referring to Figs. 5 and 6, it was found that the publication bias complement graph of Fig. 6 has obvious publication bias, so it is necessary to further explore the existence of publication bias.

This section analyzed the correlation between indiscriminate unilateral and bilateral decompressive craniectomy and patients with hydrocephalus after craniocerebral injury. In this section, the heterogeneity analysis of the literature included in the study first indicated that the literature data did not have heterogeneity test conditions, and then the literature data were excluded according to the heterogeneity results, and the statistical Meta-analysis of



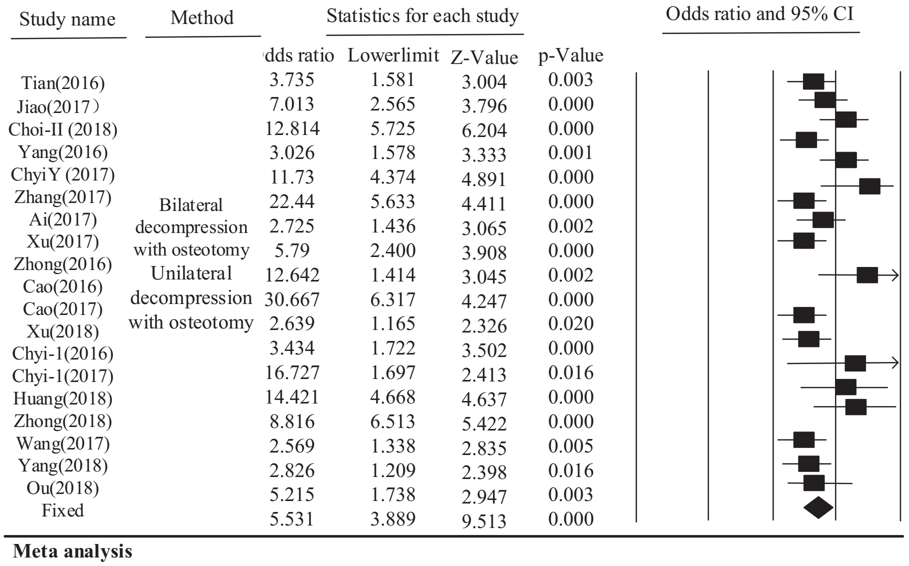
Model	Effect size and 95% interval				Test of null (2-Tail)		Heterogeneity				Tau-squared			
Model	Number Studies	Point estimate	Lower limit	Upper limit	Z-value	P-value	Q-value	df(Q)	P-value	I-squared	Tau Squared	Standard Error	Variance	Tau
Fiwed	21	3.451	2.873	4.114	13.703	0.000	79.821	20	0.000	73.947	0.519	0.234	0.053	0.719
Rindom	21	4.483	3.095	6.493	7.982	0.000								

Fig. 2. Heterogeneity test results of decompressive craniectomy.



Model	Effect size and 95% interval				Test of null (2-Tail)		Heterogeneity				Tau-squared			
Model	Number Studies	Point estimate	Lower limit	Upper limit	Z-value	P-value	Q-value	df(Q)	P-value	I-squared	Tau Squared	Standard Error	Variance	Tau
Fiwed	17	4.575	3.741	5.612	14.759	0.000	47.375	16	0.000	64.118	0.351	0.187	0.039	0.571
Rindom	17	5.536	3.871	7.871	9.517	0.000								

Fig. 3. Heterogeneity test results of literature after excluding.



Study name	Method	Statistics for each study				Odds ratio and 95% CI
		·dds ratio	Lowerlimit	Z-Value	p-Value	
Tian(2016)	Bilateral decompression with osteotomy Unilateral decompression with osteotomy	3.735	1.581	3.004	0.003	
Jiao(2017)		7.013	2.565	3.796	0.000	
Choi-II (2018)		12.814	5.725	6.204	0.000	
Yang(2016)		3.026	1.578	3.333	0.001	
ChyiY (2017)		11.73	4.374	4.891	0.000	
Zhang(2017)		22.44	5.633	4.411	0.000	
Ai(2017)		2.725	1.436	3.065	0.002	
Xu(2017)		5.79	2.400	3.908	0.000	
Zhong(2016)		12.642	1.414	3.045	0.002	
Cao(2016)		30.667	6.317	4.247	0.000	
Cao(2017)		2.639	1.165	2.326	0.020	
Xu(2018)		3.434	1.722	3.502	0.000	
Chyi-1(2016)		16.727	1.697	2.413	0.016	
Chyi-1(2017)		14.421	4.668	4.637	0.000	
Huang(2018)		8.816	6.513	5.422	0.000	
Zhong(2018)		2.569	1.338	2.835	0.005	
Wang(2017)		2.826	1.209	2.398	0.016	
Yang(2018)		5.215	1.738	2.947	0.003	
Ou(2018)		5.531	3.889	9.513	0.000	
Fixed						

Meta analysis

Fig. 4. Meta-analysis after heterogeneity adjustment of decompressive craniectomy as an exposure factor and correlation between hydrocephalus after craniocerebral injury.

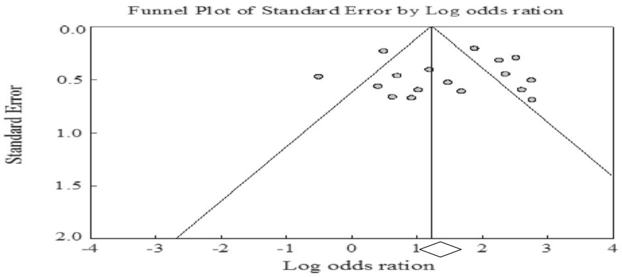


Fig. 5. Publication biased funnel plot (correlation analysis of decompressive craniectomy and occurrence of hydrocephalus after craniocerebral injury).

indiscriminate unilateral and bilateral decompressive craniectomy and hydrocephalus after craniocerebral injury was performed. The results of the random model Meta-analysis showed that the risk of hydrocephalus after craniocerebral injury was 5.521 times in patients with decompressive craniectomy compared with those without decompressive craniectomy. Then according to the characteristics of the research content, the sensitivity analysis of the gradual elimination study and the Meta-analysis of the cumulative effect amount were performed, in order to reduce the publication bias, this study used the funnel plot and the complement graph of the funnel plot for bias to perform the bias detection to further verify the authenticity of the effect value.

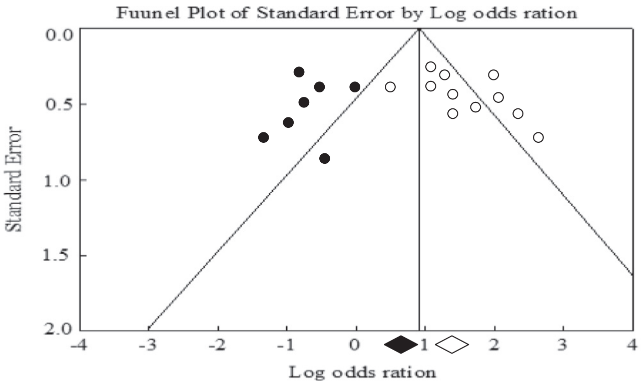


Fig. 6. Complement graph of the publication bias funnel plot (correlation analysis of decompressive craniectomy and occurrence of hydrocephalus after craniocerebral injury).

3.3. Analysis of the correlation between unilateral decompressive craniectomy and hydrocephalus after craniocerebral injury

There are two types of surgical methods for decompressive craniectomy, namely unilateral decompressive craniectomy and bilateral decompressive craniectomy. This study first analyzed the heterogeneity test of unilateral decompressive craniectomy. After processing the outstanding heterogeneity, the heterogeneity check result is as shown in Fig. 6. As shown in Fig. 6, I^2 = 45.157%, so the heterogeneity was acceptable, and then the fixed effect model was used for the combined analysis.

Fig. 7 is a Meta-analysis of a fixed-effect model of the correlation between unilateral decompressive craniectomy and hydrocephalus after craniocerebral injury. The combined OR = 3.804, 95%CI = (3.081, 4.728) ($P < 0.05$), therefore, the combined OR value was statistically significant. The unilateral decompressive craniectomy was used as an exposure factor. The risk of hydrocephalus after the craniocerebral injury caused by decompressive craniectomy was 3.802 times in patients with decompressive craniectomy compared with those without decompressive craniectomy. This result confirmed that unilateral decompressive craniectomy is a risk factor for hydrocephalus after craniocerebral injury.

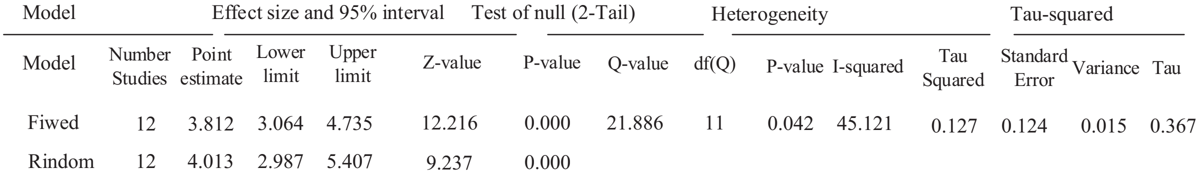
Fig. 8 is a sensitivity analysis of a fixed-effect model of the correlation between unilateral decompressive craniectomy and hydrocephalus after craniocerebral injury. As can be observed from Fig. 8, the individual study was adjusted and then combined with other studies. The OR value fluctuated around 3.882, and the 95% CI contact ratio was high. Therefore, the results showed that the data of the single study had little effect on the robustness of the combined results.

This section analyzed the correlation between unilateral decompressive craniectomy and hydrocephalus after craniocerebral injury. This study first analyzed the heterogeneity of the included studies and then used the Meta-analysis to analyze the included pieces of literature. The correlation between unilateral decompressive craniectomy and hydrocephalus after craniocerebral injury was analyzed, and then the sensitivity of the unilateral decompressive craniectomy and the fixed effect model of hydrocephalus correlation after craniocerebral injury were analyzed. The results showed that the risk of hydrocephalus after craniocerebral injury was 3.802 times in patients with decompressive craniectomy compared with those without decompressive craniectomy.

3.4. Correlation analysis results of bilateral decompressive craniectomy and hydrocephalus after craniocerebral injury

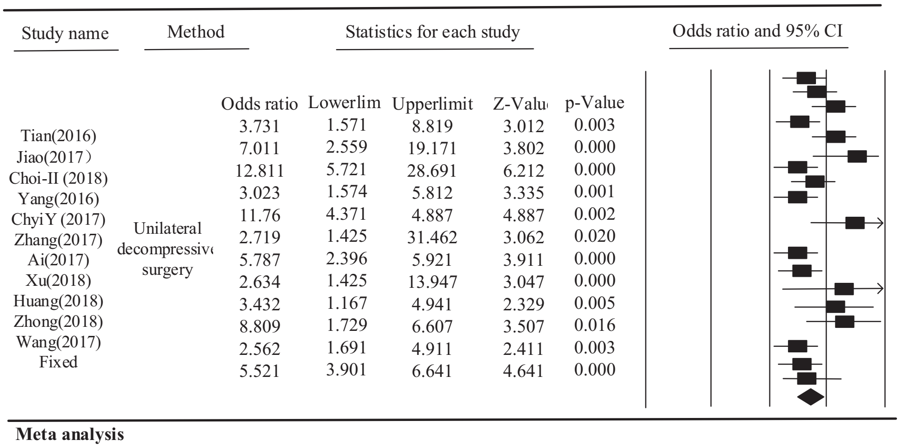
In the included study, there were only four references for bilateral decompressive craniectomy, and the literature for bilateral decompressive craniectomy was relatively less than for unilateral decompressive craniectomy. In this study, the heterogeneity analysis of bilateral decompressive craniectomy and hydrocephalus after craniocerebral injury found that $I^2 = 0$, which need to further use the fixed-effect model for Meta-analysis, the results are shown in Fig. 9. As can be observed from Fig. 9, OR = 21.382.95% CI = (10.597, 43.532) ($P < 0.05$), so the combined OR was statistically significant, and bilateral decompressive craniectomy was used as an exposure factor. The risk of hydrocephalus after the craniocerebral injury caused by decompressive craniectomy was 31.802 times in patients with decompressive craniectomy compared with those without decompressive craniectomy. This result confirmed that bilateral decompressive craniectomy is a risk factor for hydrocephalus after craniocerebral injury.

Then the fixed effect model was used to analyze the sensitivity, as shown in Fig. 10. As can be observed from Fig. 10, the individual study was adjusted and then combined with other studies, the OR value fluctuated around 21.135, and the 95% CI contact ratio was high. Therefore, the results show that the elimination of data from a single study has little effect on the robustness of the combined results.



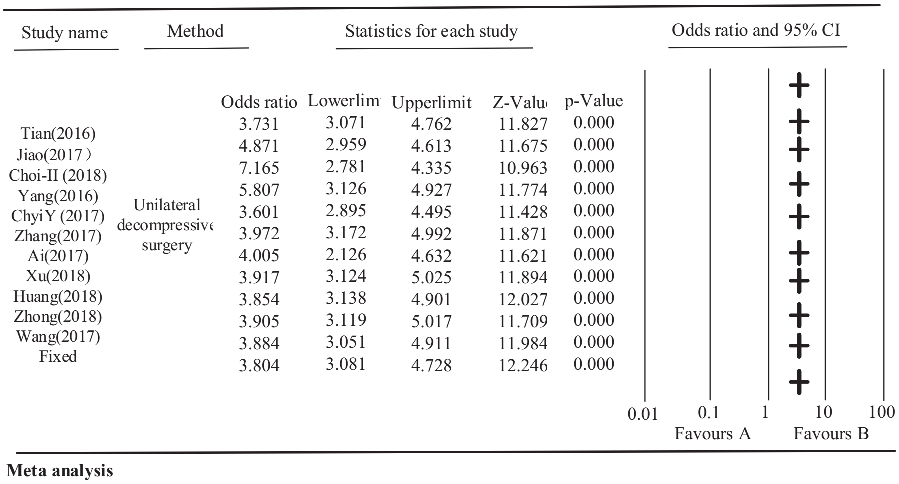
Model		Effect size and 95% interval			Test of null (2-Tail)		Heterogeneity				Tau-squared			
Model	Number Studies	Point estimate	Lower limit	Upper limit	Z-value	P-value	Q-value	df(Q)	P-value	I-squared	Tau Squared	Standard Error	Variance	Tau
Fiwed	12	3.812	3.064	4.735	12.216	0.000	21.886	11	0.042	45.121	0.127	0.124	0.015	0.367
Rindom	12	4.013	2.987	5.407	9.237	0.000								

Fig. 7. Heterogeneity test results for unilateral decompressive craniectomy.



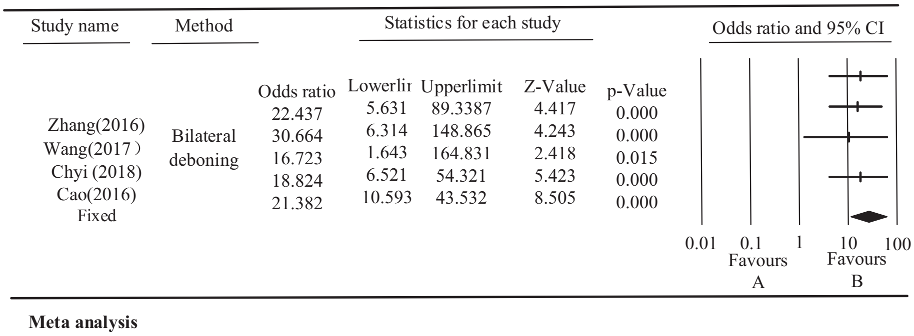
Study name	Method	Odds ratio	Lowerlim	Upperlimit	Z-Valu	p-Value
Tian(2016)	Unilateral decompressive surgery	3.731	1.571	8.819	3.012	0.003
Jiao(2017）		7.011	2.559	19.171	3.802	0.000
Choi-II (2018)		12.811	5.721	28.691	6.212	0.000
Yang(2016)		3.023	1.574	5.812	3.335	0.001
ChyiY (2017)		11.76	4.371	4.887	4.887	0.002
Zhang(2017)		2.719	1.425	31.462	3.062	0.020
Ai(2017)		5.787	2.396	5.921	3.911	0.000
Xu(2018)		2.634	1.425	13.947	3.047	0.000
Huang(2018)		3.432	1.167	4.941	2.329	0.005
Zhong(2018)		8.809	1.729	6.607	3.507	0.016
Wang(2017)		2.562	1.691	4.911	2.411	0.003
Fixed		5.521	3.901	6.641	4.641	0.000

Fig. 8. Meta-analysis of the correlation between unilateral decompressive craniectomy and hydrocephalus after craniocerebral injury.



Study name	Method	Odds ratio	Lowerlim	Upperlimit	Z-Valu	p-Value
Tian(2016)	Unilateral decompressive surgery	3.731	3.071	4.762	11.827	0.000
Jiao(2017）		4.871	2.959	4.613	11.675	0.000
Choi-II (2018)		7.165	2.781	4.335	10.963	0.000
Yang(2016)		5.807	3.126	4.927	11.774	0.000
ChyiY (2017)		3.601	2.895	4.495	11.428	0.000
Zhang(2017)		3.972	3.172	4.992	11.871	0.000
Ai(2017)		4.005	2.126	4.632	11.621	0.000
Xu(2018)		3.917	3.124	5.025	11.894	0.000
Huang(2018)		3.854	3.138	4.901	12.027	0.000
Zhong(2018)		3.905	3.119	5.017	11.709	0.000
Wang(2017)		3.884	3.051	4.911	11.984	0.000
Fixed		3.804	3.081	4.728	12.246	0.000

Fig. 9. Sensitivity analysis of a fixed-effect model of unilateral decompressive craniectomy and hydrocephalus correlation after craniocerebral injury.



Study name	Method	Odds ratio	Lowerli	Upperlimit	Z-Value	p-Value
Zhang(2016)	Bilateral deboning	22.437	5.631	89.3387	4.417	0.000
Wang(2017）		30.664	6.314	148.865	4.243	0.000
Chyi (2018)		16.723	1.643	164.831	2.418	0.015
Cao(2016)		18.824	6.521	54.321	5.423	0.000
Fixed		21.382	10.593	43.532	8.505	0.000

Fig. 10. A meta-analysis of the correlation between bilateral decompressive craniectomy and hydrocephalus after craniocerebral injury.

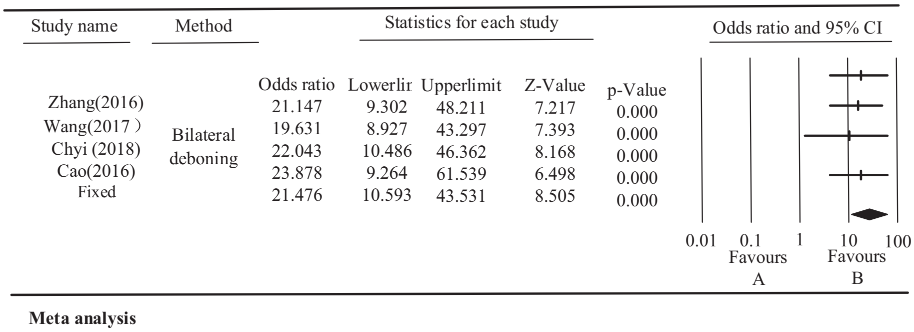
Fig. 11 is a cumulative Meta-analysis of the bilateral decompressive craniectomy and hydrocephalus after craniocerebral injury. It can be observed from Fig. 11 that the combined effect has not changed significantly with time, and the combined OR value fluctuated around 21.051, 95% CI contact ratio was higher (see Fig. 12).

This section analyzed the correlation between bilateral decompressive craniectomy and hydrocephalus after craniocerebral injury. Firstly, the heterogeneity analysis was carried out on the included studies. Then the Meta-analysis was used to analyze the included literature. The correlation between lateral decompressive craniectomy and hydrocephalus after craniocerebral injury was analyzed, and the sensitivity of the unilateral decompressive craniectomy and the fixed effect model of hydrocephalus correlation after craniocerebral injury were analyzed. The results indicated that the risk of hydrocephalus after the craniocerebral injury caused by decompressive craniectomy is 31.802 times in patients with decompressive craniectomy compared with those without decompressive craniectomy.

4. Discussion

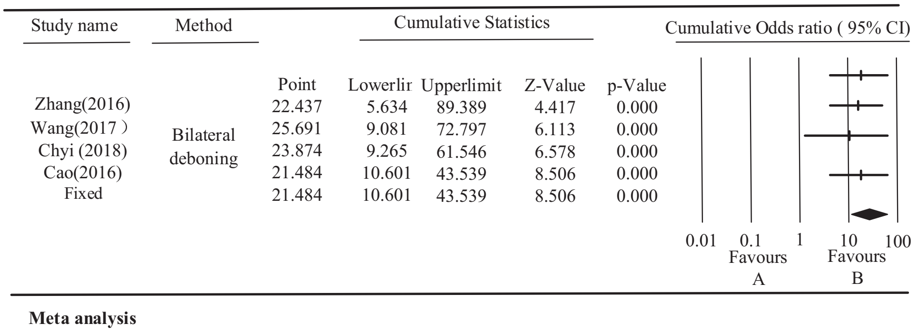
According to the relevant literature, the current medical research has not reached a unified statement on whether the decompressive craniectomy and the occurrence of traumatic hydrocephalus in the brain are related (Verweij, 2018; Wang et al., 2018), so this study used statistical Meta-analysis to analyze the correlation between decompressive craniectomy and intracranial infection in patients with hydrocephalus after craniocerebral injury. Heterogeneity analysis, Meta-analysis, sensitivity analysis, and publication bias analysis for unilateral and bilateral decompressive craniectomy; heterogeneity analysis, Meta-analysis, and sensitivity for unilateral decompressive craniectomy Sexual analysis; heterogeneity analysis, Meta-analysis, cumulative Meta-analysis, and sensitivity analysis for the bilateral decompressive craniectomy. This study found that decompressive craniectomy has a significant correlation with hydrocephalus after craniocerebral injury. Heterogeneity analysis, Meta-analysis, sensitivity analysis, and publication bias analysis were performed using statistical methods for the unilateral and bilateral decompressive craniectomy. Heterogeneity analysis, Meta-analysis and sensitivity analysis of indiscriminate unilateral decompressive craniectomy was performed; heterogeneity analysis, Meta-analysis, cumulative Meta-analysis, and sensitivity analysis for bilateral decompressive craniectomy were performed. This study found that decompressive craniectomy has a significant correlation with hydrocephalus after craniocerebral injury.

Related literature pointed out that patients with decompressive craniectomy have a greater probability of infection in patients with hydrocephalus after craniocerebral injury. The experimental results of this study indicate that the order of influence on patients with hydrocephalus after brain injury is: bilateral decompressive craniectomy > indiscriminate unilateral and bilateral decompressive craniectomy > unilateral decompressive craniectomy. The results of this experiment are consistent with the results of Jiang et al. (2018). Therefore, this study speculated that for patients with traumatic brain injury, bilateral decompressive craniectomy results in a higher risk of hydrocephalus after craniocerebral injury.



Study name	Method	Statistics for each study				
		Odds ratio	Lowerlir	Upperlimit	Z-Value	p-Value
Zhang(2016)	Bilateral deboning	21.147	9.302	48.211	7.217	0.000
Wang(2017）		19.631	8.927	43.297	7.393	0.000
Chyi (2018)		22.043	10.486	46.362	8.168	0.000
Cao(2016)		23.878	9.264	61.539	6.498	0.000
Fixed		21.476	10.593	43.531	8.505	0.000

Fig. 11. Sensitivity analysis of the fixed-effect model using bilateral decompressive craniectomy and hydrocephalus after craniocerebral injury.



Study name	Method	Cumulative Statistics				
		Point	Lowerlir	Upperlimit	Z-Value	p-Value
Zhang(2016)	Bilateral deboning	22.437	5.634	89.389	4.417	0.000
Wang(2017）		25.691	9.081	72.797	6.113	0.000
Chyi (2018)		23.874	9.265	61.546	6.578	0.000
Cao(2016)		21.484	10.601	43.539	8.506	0.000
Fixed		21.484	10.601	43.539	8.506	0.000

Fig. 12. A meta-analysis of the correlation between bilateral decompressive craniectomy and hydrocephalus after craniocerebral injury.

Relevant research results show that after the decompressive craniectomy of the patient, the distance from the upper part to midline of the bone window edge will be very close, which will make the limitation of the bone plate to the bridge vein disappear, leading to an increase in venous drainage and further reducing the volume of the brain parenchyma so that a series of reactions further enlarge the ventricular system and form hydrocephalus after traumatic brain injury (Jiang et al., 2017). In this paper, it can conclude that the decompressive craniectomy may be the case mentioned in the literature. Therefore, this study pointed out that in the treatment of intracranial infection in patients with hydrocephalus after craniocerebral injury, it is feasible to find a breakthrough point from decompressive craniectomy, comprehensive preoperative evaluation of patients, and clinical intervention before surgery provide new clues for the treatment of intracranial infections in patients with hydrocephalus after craniocerebral injury.

5. Conclusion

This study investigates the mechanism of decompressive craniectomy for intracranial infection in patients with hydrocephalus after craniocerebral injury, which has provided a reference for treating intracranial infection in patients with post-craniocerebral injury hydrocephalus. This study uses meta-analysis to analyze the correlation between unilateral and bilateral decompressive craniectomy and post-craniocerebral injury hydrocephalus, the correlation between unilateral decompressive craniectomy and post-craniocerebral injury hydrocephalus, and the bilateral decompressive craniectomy and post-craniocerebral injury hydrocephalus. The results show that the influencing order of these three conditions on patients with post-craniocerebral injury hydrocephalus is bilateral decompressive craniectomy, unilateral and bilateral decompressive craniectomy, and unilateral decompressive craniectomy. It shows that intracranial infection in patients with hydrocephalus after the craniocerebral injury should be comprehensively evaluated before the surgery and treated in time.

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