Cellular and Molecular Biology

Journal homepage: www.cellmolbiol.org

Study of Compound Sanqi Nanoparticles for Local Infection of Hydrocephalus Patients after Neurosurgery Medium Craniocerebral Injury

Yongfeng Ni*, Gaoyuan Wu, Wenliang Wu, Jun Yin, Zhi Liu, Wenqing Hong

Department of Neurosurgery, The First People's Hospital of Anqing, Anqing, 246052, PR China

ARTICLE INFO

Original paper

Article history:
Received: October 25, 2021
Accepted: March 11, 2022
Published: March 31, 2022

Keywords:
Compound Notoginseng Nanoparticles, Neurosurgery Department, Craniocerebral Injury, Hydrocephalus Patient

ABSTRACT

Panax notoginseng is the dried root and rhizome of Panax notoginseng, which has the effect of lowering blood lipid, lowering blood pressure and promoting blood circulation to remove blood stasis. At present, the research on Panax notoginseng is mainly focused on its pharmacological action and its compound preparation, but the research on the granule of Panax notoginseng is less. This paper mainly studied the clinical study of compound notoginseng nanoparticles in the treatment of local infection in patients with hydrocephalus after medium craniocerebral injury in neurosurgery. The purpose of this article is to investigate the effects of compound notoginseng nanoparticles on serum TNF-α, IL-2 and IL-6 in rats with craniocerebral injury and to verify the protective effect of compound notoginseng nanoparticles on the body after craniocerebral injury. In this paper, 90 patients admitted to a hospital in this city were divided into a control group, model group and compound notoginseng nanoparticle group. According to the Zealonga method, the neurological function deficit score of experimental rats in each group was evaluated. The levels of TNF-α, IL-2 and IL-6 in the serum of the three groups were observed 1, 3 and 5 days after treatment. RESULTS: Compared with serum TNF-α, IL-2 and IL-6 of the three groups, there were significant differences in the main effects of time and intervention ($P < 0.05$). CONCLUSIONS: Compound notoginseng nanoparticles can reduce the contents of TNF-α and IL-6 in serum and increase the expression of IL-2 in rats with craniocerebral injury.

DOI: http://dx.doi.org/10.14715/cmb/2022.68.3.46

Introduction

Traumatic brain injury (TBI) mainly refers to the Traumatic brain injury caused by sudden external violence, shock or shock. With the development of industrial level and transportation, the incidence of Traumatic brain injury is increasing gradually, about 180 ~ 250 persons per 100,000. It is one of the major causes of death and disability among young people in developed and developing countries and regions, so traumatic brain injury has become a global public health problem (1). Posttraumatic hydrocephalus (PTH) is one of the most common complications after craniocerebral trauma decompression. At present, there is no consensus on the pathogenesis of post-traumatic hydrocephalus (PTH). It is generally believed that the mechanism is the obstruction of the ventricular system, the impairment of CSF absorption and the dynamic changes of CSF, among which the impairment of CSF absorption is the main one, leading to abnormal accumulation of CSF. Ventricles or cisterns lead to ventricular dilation and hydrocephalus formation (2). Improper management of post-traumatic hydrocephalus (PTH) will seriously affect the prognosis of patients. Clinically, the influencing factors of post-traumatic hydrocephalus (PTH) after craniotomy decompression can be identified so as to facilitate early intervention and treatment and reduce the occurrence of post-traumatic hydrocephalus (3).

After craniocerebral trauma, the rupture of hematoma into the ventricle system can directly lead to the occurrence of PTH, while hematomas near the ventricle system, especially the hematomas in the posterior fossa and large cerebral infarction and brain edema secondary to craniocerebral trauma, can weaken the venous return of cerebrospinal fluid and cause PTH (4). Foreign scholars have reported 2 cases of mild head trauma patients with PTH caused by midbrain actual obstruction, which was later confirmed by neuroendoscopy to be caused by the new diaphragm, but the experience of this rare case deserves clinical attention. It is traditionally believed that CSF is reabsorbed through arachnoid granulations and that multiple craniotomy procedures are at greater

*Corresponding author. E-mail: aqyynyf@163.com

risk of such obstruction (5). Intracranial infection after TBI will further aggravate brain tissue adhesion, resulting in aggravation of cerebrospinal fluid outflow channel obstruction. In addition, some studies have shown that dural venous sinus, nasal lymphatic system, olfactory nerve root sheath and capillaries in brain tissue all have the function of reabsorbing cerebrospinal fluid, and further studies are needed to confirm whether the damage of these parts after craniocerebral trauma plays a promoting role in the development of PTH (6-7).

Found in a large number of clinical data, this paper compound notoginseng nanoparticles have a good therapeutic effect in the treatment of craniocerebral injury patients. In order to further explore the compound Panax notoginseng nanoparticles craniocerebral injury protection mechanism, this article through to the city of hydrocephalus after craniocerebral injury patients admitted in a hospital using compound notoginseng nanoparticles treatment, on the basis of this model, the effects of compound notoqi nanometer granules on serum contents of TNF-α, IL-2 and IL-6 in patients with craniocerebral injury were observed.

Pathogenesis of Hydrocephalus

Hydrocephalus is one of the common complications after decompression craniotomy, especially in patients with severe craniocerebral injury. It is one of the main factors affecting the death and disability of patients and has become a public health problem of common concern in countries all over the world. The main manifestations were an abnormal accumulation of cerebrospinal fluid (CSF) in the cerebral ventricle and subarachnoid space after craniocerebral injury and compensatory enlargement of the ventricle (8).

At present, it is believed that the essence of hydrocephalus is the dynamic balance disorder between the production and absorption of cerebrospinal fluid, but the pathogenesis of post-traumatic hydrocephalus has not been fully clarified, and the main mechanisms are as follows:

(i) Mechanical obstruction of the ventricle system

Traumatic brain injury (TBI) causes intraventricular hematocele, which leads to obstruction of the cerebrospinal fluid flow system in the interventricular foramen, third ventricle or fourth ventricle. The hematoma around the ventricle has an obvious space-occupying effect, which causes the ventricle system to be completely or partially compressed and the circulation of cerebrospinal fluid to be obstructed due to displacement, especially when the lesions occur in the posterior fossa. Cerebrospinal fluid accumulated in the ventricle, intracranial pressure increased significantly, and hydrocephalus appeared (9).

(ii) CSF absorption disorder

Now, most people are of the opinion that traumatic cerebrospinal fluid malabsorption is an important contributor to the formation of hydrocephalus when it causes brain pool after craniocerebral injury and subarachnoid hemorrhage and produces aseptic inflammation, adhesion, arachnoid granulations appeared to appear subarachnoid fibrosis change, thus seriously affect the absorption of arachnoid granulations ability, the abnormal accumulation of cerebrospinal fluid resulted in hydrocephalus (10).

(iii) Changes in cerebral hemodynamics

The results show that the arachnoid granules are absorbed by the pressure between the subarachnoid space and the venous sinus in a one-way piston manner. When craniocerebral trauma to bone disc decompression and after opening the dura mater, cranial cavity of the normal physiological balance is broken, atmospheric pressure through the skin directly ACTS on the brain, causing the displacement and deformation of brain tissue, beating associated with brain of cerebrospinal fluid pressure conduction out through defect of skull and abate, cause of cerebrospinal fluid circulation dynamics change, can cause subdural effusion; subsequently, hydrocephalus may form (11).

At present, it is believed that the mechanism of occurrence of acute hydrocephalus is different from that of chronic hydrocephalus. Acute hydrocephalus is usually obstructive hydrocephalus, which is mainly manifested by massive blood accumulation in the cerebral ventricle after trauma, blocking the circulation pathway of cerebrospinal fluid, accompanied by traumatic diffuse axonal injury, swelling of brain tissue and diffuse traumatic subarachnoid hemorrhage. Aggravating cerebrospinal fluid circulation system obstruction and then acute hydrocephalus. And chronic hydrocephalus is

considered traffic sex hydrocephalus after trauma. The general course of development is more slowly and hidden, most thought to be caused by cerebrospinal fluid malabsorption, when craniocerebral injury, especially to bone disc decompression surgery, brain pool or subarachnoid produced after the bursting of red blood cells of decomposition, aseptic inflammation, causing the adhesion of the arachnoid granulations and arachnoid fibrosis formation, it is accompanied by the destruction of intracerebral pressure balance and the change of cerebrospinal fluid circulation dynamics, resulting in the decline of arachnoid granules' ability to absorb cerebrospinal fluid and the formation of chronic hydrocephalus. Some scholars have pointed out that the occurrence of post-traumatic hydrocephalus is related to fibrosis and obstruction of the cerebrospinal fluid circulation pathway (12-13). The increase of extracellular matrix collagen and the decrease of brain parenchymal cells occurred after craniocerebral trauma. Studies have found elevated levels of transforming growth factor (TGF-β) and vascular endothelial growth factor (VEGF) in cerebrospinal fluid (CSF) after traumatic brain injury. Therefore, it is believed that TGFβ is released into the cerebrospinal fluid (CSF) during traumatic brain injury, thereby promoting cellular signal transduction and causing extracellular matrix fibrosis, leading to the fibrosis of the CSF circulation pathway and the formation of chronic hydrocephalus. In conclusion, the occurrence of post-traumatic hydrocephalus is complex and varied (14). The essence of its occurrence is the imbalance of the generation and absorption of cerebrospinal fluid. Admittedly, its occurrence may be the result of the combined action of multiple mechanisms.

Diagnosis of Hydrocephalus

Time of onset: It is usually seen 3 ~ 6 weeks after injury or as late as 6 ~ 12 months. The relatively accepted diagnostic standard is 12 months after craniocerebral trauma.

Imaging findings: The main CT findings were ventricular enlargement without significant cortical atrophy. Sagittal MRI can clearly show the structure of the third and fourth ventricles, the dilation of the midbrain aqueduct and median foramen, and the interventricular foramen in coronal MRI (15).

Differentiation from brain atrophy: MRI showed significant ventricular enlargement (including the fourth ventricle) in NPH but no sulci enlargement. In patients with brain atrophy, the ventricle is slightly enlarged and the fourth ventricle is not involved. The gyri of the brain were obviously widened, and no brain tissue was displaced or protruded in the small femoral groove area. In patients with hydrocephalus, the enlargement of the ventricle is often significantly greater than the enlargement of the cistern and the widening of the cerebral sulci and the anterior and posterior feet of the lateral ventricle are obviously round, and some patients even have the temporal horn. The Angle of the anterior horn of the lateral ventricle was less than 120°, and the Evans index (the ratio of the maximum diameter of the anterior horn of the ventricle to the maximum diameter of the intracranial inner plate on the same plane) was >0.3. After traumatic brain atrophy, the cerebral ventricle and cistern were evenly expanded, the sulcus was significantly widened, and the Angle of the anterior horn of the lateral ventricle was ≥140°. Interstitial edema was usually formed due to cerebrospinal fluid exudation from the anterior horn of the lateral ventricle. Lateral ventricles are often more obvious in MRI scans of the head (16-17).

For patients undergoing decompression by craniotomy, the continuous dilation of the bone window after the acute phase often indicates the presence of hydrocephalus, while brain atrophy leads to the collapse of the bone window (18).

Risk Factors for Hydrocephalus

Craniocerebral injury is one of the most common diseases in neurosurgery. Decompression with a craniotomy flap can remove not only the intracranial hematoma and brain contusion under direct vision but also relieve the compression of hematoma on adjacent brain tissue, craniocerebral nerves and blood vessels. And the increase of relative cranial cavity volume, the volume pressure curve moves to the right, compensatory increase compliance of brain tissue, local brain tissue to reduce intracranial pressure increase blood perfusion, for bone flap reduction technique for the treatment of craniocerebral trauma clinical and theoretical basis, is currently the neurosurgeon one of the common surgical procedure in the treatment of craniocerebral trauma. It should

not be ignored that post-traumatic hydrocephalus (PTH) is a common complication after decompression of bone flap. The understanding of the risk factors and mechanism of post-traumatic hydrocephalus (PTH) after traumatic brain injury (TBI) has not been unified. It is of great significance to clarify the independent risk factors of post-traumatic hydrocephalus (PTH) after bone flap decompression and to take necessary clinical intervention and timely preventive measures to reduce the incidence of PTH (19-20). The literature review found on admission GCS low case fatality rate is higher in the short term, patients with severe head injury indirectly result in the decrease of the incidence of PTH, and light) in patients with traumatic craniocerebral injury probability of PTH is low, so the target population of this study was moderately severe craniocerebral injury patients, with the clinical common unilateral to bone disc decompression. However, there are few studies on the risk factors of post-traumatic hydrocephalus (PTH).

(i) Glasgow Coma Score

The Glasgow Coma Scale (GCS) was originally proposed to assess the state of consciousness in patients with traumatic brain injury (TBI). It is an important method to evaluate the conscious state of patients with TBI. It mainly includes the response of the patient's eyes opening, speech and limbs, which has been widely used in clinical work. Previous literature has reported that the lower the CCS score on admission, the higher the probability of hydrocephalus, especially the GCS score <6, which is currently considered to be an independent risk factor for post-traumatic hydrocephalus (PTH). After decompressive craniectomy, the incidence of hydrocephalus was higher when the GCS was lower at admission. The reason that GCS scores low patients often accompanied by severe cerebral contusion, intracranial hematoma and diffuse axonal injury, especially the craniocerebral injury with midline shift and compression ring pool, the fourth ventricle and cerebrospinal fluid circulation path appear in areas such as the midbrain aqueduct obstruction, compensatory ventricular expansion, which form the hydrocephalus. On the other hand, in the case of severe brain contusion and laceration, the dura opens and brain tissue is removed, causing serious damage to the normal structure of the subarachnoid space composed of arachnoid and pia meninges, which is easy to lead to extensive adhesion and occlusion of the subarachnoid space, resulting in hydrocephalus. Compression ring pool with the incidence of post-traumatic hydrocephalus (PTH) there is significant correlation, cerebrospinal fluid circulation obstacle for compression ring pool occlusion, compensatory higher pressure, cause the ventricular brain expansion of brain tissue to reduce around ventricle, with sagittal sinus was squeezed, postoperative ring pool opens incomplete, causing brain decompensated indoor pressure rise, Causes brain cell ischemia, hypoxia, forms hydrocephalus. In conclusion, the decrease of cerebrospinal fluid circulation patency is one of the main factors leading to hydrocephalus.

(ii) Risk factors

It was found that after a large area of bone flap resection, the intracranial cerebrospinal fluid pressure pulse was transmitted through the bone window defect, which changed the intracranial pressure system and flattened the normal double-pulse pulse of intracranial pressure. After the opening of the cranial cavity, part of the brain tissue loses the protection of the cranial flap, resulting in cerebral vein and dural sinus compression, brain tissue extruding outward, cerebral hemisphere venous return, such as increased extracellular fluid absorption of plasma and tissue fluid, resulting in decreased brain volume, compensatory enlargement of the ventricle, and eventually hydrocephalus. Long-term destruction of skull integrity and changes in cranial volume accumulation can lead to ventricular displacement and deformation and local hemodynamic changes, resulting in blocked absorption of cerebrospinal fluid and hydrocephalus. Some studies believe that once the function of subarachnoid granulation is permanently damaged, post-traumatic hydrocephalus (PTH) will inevitably occur regardless of whether the skull is repaired.

It is generally believed that subarachnoid hemorrhage and intraventricular hemorrhage are important pathological factors leading to the occurrence of post-traumatic hydrocephalus (PTH), especially the distribution and thickness of traumatic subarachnoid hemorrhage are significantly correlated with the occurrence of hydrocephalus. After

subarachnoid hemorrhage can release a large number of free radicals and vasoactive substances, can cause cerebral artery spasm, contraction, and then affect the absorption of cerebrospinal fluid, accompanied by the destruction of the blood-brain barrier, increased permeability, increased protein in cerebrospinal fluid, fibrosis formation, hinder the absorption of cerebrospinal fluid. But this study found no subarachnoid hemorrhage significantly correlated with the incidence of hydrocephalus. The reason may be that once found that patients with diffuse subarachnoid hemorrhage, in time for dehydration and cerebrovascular spasmolysis medicine, clinical waste continuous drainage of large pool or lumbar puncture out hemorrhagic cerebrospinal fluid and inflammatory substances can reduce intracranial pressure and slow subarachnoid inflammatory adhesion. However, the study found that ventricular hematocele was significantly correlated with the occurrence of hydrocephalus, which was consistent with the results of other previous studies, and further confirmed the theoretical support of hydrocephalus caused by ventricular hematocele. With the passage of time, the blood clot formed by the cerebral ventricle is gradually dissolved, and its metabolites can block the arachnoid granules, causing the adhesion of the subarachnoid space so that the absorption of the cerebrospinal fluid by the arachnoid granules is obstructed, and then the cerebral ventricle is enlarged and hydrocephalus is formed. Previous literature has reported that patients with traumatic craniocerebral injury with subarachnoid hemorrhage and ventricular hematocele underwent decompression with bone flap removal, continuous lumbar cistern drainage or lumbar puncture to release cerebrospinal fluid and inflammatory substances, which can reduce intracranial pressure and reduce the occurrence of hydrocephalus.

Intracranial infection is one of the common complications after nerve trauma operation, especially when the open craniocerebral injury is accompanied by a long operation time, which is also considered to be one of the factors of hydrocephalus after trauma. Once intracranial infection occurs, it promotes the release of inflammatory factors, causing inflammatory adhesion in the subarachnoid space, thickening of arachnoid accompanied by fibrosis, aggravating the absorption barrier of arachnoid granules, and eventually causing ventricular effusion and hydrocephalus. In this study, through multivariate analysis, no correlation was found between intracranial infection and hydrocephalus, which was related to timely anti-infection treatment and reduction of inflammatory response once the intracranial infection was diagnosed clinically.

It is generally believed that age is a risk factor for post-traumatic hydrocephalus (PTH). It is generally believed that with the increase of age, the compliance of cerebral ventricles and brain tissues decreases, the degree of meningeal fibrosis increases, the absorption of CSF decreases, and the circulation is caused by the relative accumulation of CSF is prolonged. Some scholars have pointed out that the upper boundary of the bone window is less than 25mm from the midline, which is an independent risk factor for post-traumatic hydrocephalus (PTH). The current study aimed to investigate the investigation of Sanqi nanoparticles compound for local infection of hydrocephalus patients after neurosurgery medium craniocerebral injury.

Materials and Methods

Experimental Subject

The data of this study were from the clinical data of 90 patients with a severe craniocerebral injury who received surgical treatment in the neurosurgery department of a hospital in this city in recent 3 years. Entry criteria are as follows:

(i) The preoperative Glasgow Coma Scale (GCS) score of the patients was 3-8 points, and all the patient data included course records, including injury time, injury mechanism, pupil changes, GCS score and surgical records.

(ii) Investigators of postoperative complications were included, and all patients received postoperative head CT scan;

(iii) No previous serious diseases of the respiratory system, cardiovascular system, liver and kidney and other important organs, no organ failure such as heart failure, respiratory failure and kidney failure, no fractures of femur and pelvis, no liver and kidney injury or other important organs;

(iv) Exclusion criteria: lack of complete imaging data and medical records before and after surgery; Preoperative organ failure such as heart and lung failure, or combined with severe chest and abdominal

injuries requiring surgical intervention, or combined with diffuse axonal injury, primary brain stem injury, etc., can not accurately determine the prognosis; failure to complete follow-up, such as automatic discharge or loss of contact.

Data Collection

General information

Collect the patient's medical record number, name, gender, age, ethnicity, admission time, injury cause, allergy history, past medical history, discharge date, etc.

Factors related to post-traumatic hydrocephalus

Collected on admission in patients with GCS score, hematoma preoperative type and location of the midline deviation degree, intraventricular hemorrhage, traumatic subarachnoid hemorrhage, degree of compression ring pool, duration of surgery, surgical procedure, to the area of the bone flap and bone flap on the edge of the distance away from the midline, postoperative hydrocephalus time, whether postoperative subdural effusion, the location of the fluid, postoperative cerebral infarction, postoperative intracranial infection, postoperative skull repair time and so on.

Experimental Methods

Patients were grouped

The patients with post-traumatic hydrocephalus were divided into three groups: control group, model group and compound notoginseng nanoparticle group (experimental group), with 30 patients in each group.

Neurological function score

Behavioral observation and scoring of each group were conducted before sampling. After referring to relevant literature and several preliminary experiments, Zealonga scoring method was used to score three groups of patients with post-traumatic hydrocephalus (1,3,5 days) at three time points. The higher the score, the more severe the neurological function injury.

Sampling and index detection

On the 1st, 3rd and 5th day after modeling, 2% pentobarbital sodium was given intraperitoneal anesthesia (3mL/kg), and 5mL blood was taken from the aorta of the patients to measure TNF-α, IL-2 and IL-6. The amount of TNF-α, IL-2 and IL-6 was measured by radioimmunoassay, and the specific experimental procedures were performed according to the kit instructions.

Statistical Analysis

For the T-test, all results are expressed as mean±standard deviation (X±S) using SPSS22.0 statistical software package, and the difference between groups shall be tested by the T-test of the mean of the two groups. P value indicates statistical difference, and $P<0.05$ indicates significant difference.

The regression analysis algorithm and selection algorithm were used in this study. There are many ways to choose. This article uses the commonly used roulette wheel selection method.

Results and discussion

Independent Risk Factors for Hydrocephalus

As shown in Table 1, in order to identify the risk factors for post-traumatic hydrocephalus, clinical factors with statistical differences in univariate analysis were included in multivariate Logistic regression analysis. The results showed ventricular hemorrhage (P=0.028, OR=5.017), decompression area of craniectomy (P=0.016, OR=1.028), interherical subdural effusion (P=0.001, OR=6.692) were independent risk factors for post-traumatic hydrocephalus (PTH) after craniectomy.

Table1. Multivariate analysis of clinical risk factors for post-traumatic hydrocephalus

Clinical factors	OR Value	95% confidence interval	P value
Bone flap area	1.028	1.003-1.064	0.0016
Intraventricular hemorrhage	5.017	1.917-13.095	0.0028
Interhemispheric effusion	6.692	2.011-15.172	0.001

Role of Compound Notoginseng Nanoparticles

As shown in Table 2, the study found that Sanqi compound nanoparticles can significantly reduce the specific volume of blood cells in the carotid artery model and prolong the time of thrombosis, suggesting that it may be through reducing hematocrit, reducing the release of DP and inhibiting platelet aggregation, so as to achieve the anti-thrombosis effect.

Table 2. Effect of notoginseng compound nano-granules on the time of thrombosis induced by electrical stimulation

	Dose g/kg	Thrombus formation time
Model group	0	79.31
Experimental group	2.2	157.18
Aspirin group	0.017	163.18

Comparison of Serum indexes in Group Treatment

As shown in Figure 1, compared with the control group, the content of TNF-α in the model group was significantly increased at each time point, and the pairwise comparison showed a statistical difference (P < 0.05). Compared with the model group, the content of TNF-α in the compound notoginseng granules group decreased at each time point, and there was a statistical difference between pairwise comparison and pairwise comparison (P < 0.01).

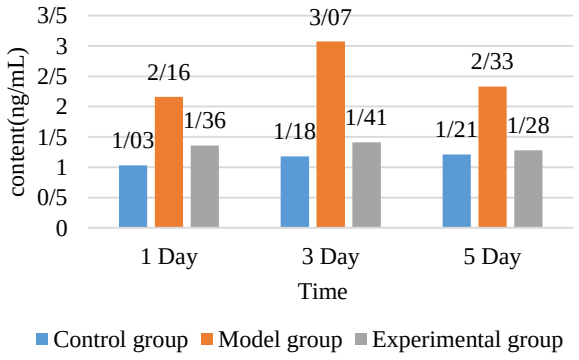

Figure 1. Serum TNF-α content before and after treatment in each group (x ± s)

Serum IL-6 content before and after treatment

As shown in Figure 2, compared with the control group, the IL-6 content in the model group was significantly increased at each time point, and there was a statistical difference between pairwise comparisons (P < 0.05). Compared with the model group, the content of IL-6 in the compound sanqi granules group decreased at each time point, and the difference between the pairwise comparison and model group was statistically significant (P < 0.01).

Serum IL-2 content before and after treatment

As shown in Figure 3, compared with the control group, the IL-2 content in the model group was significantly decreased at each time point, and the pairwise comparison showed a statistically significant difference (P < 0.01). Compared with the model group, IL-2 content in the compound sanqi granules group increased at each time point, and the difference between pairwise comparison and pairwise comparison was statistically significant (P < 0.01).

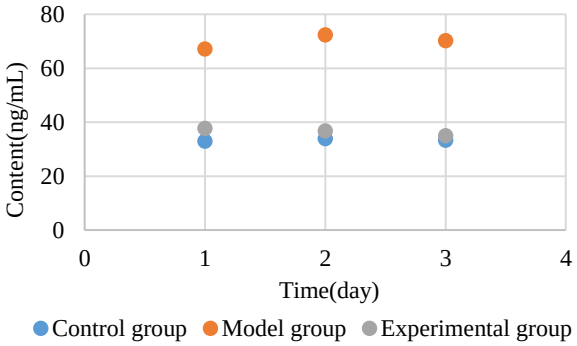

Figure 2. Serum IL-6 content of patients before and after treatment

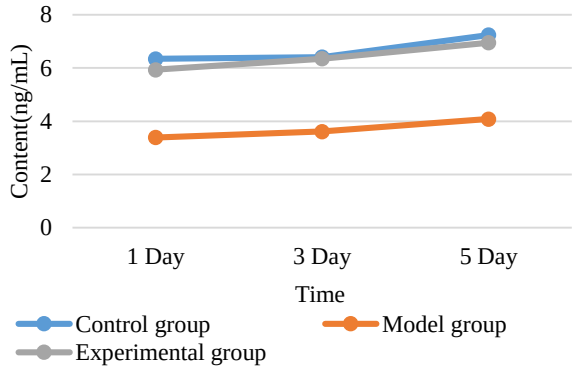

Figure 3. Serum IL-2 content of patients before and after treatment

Neurological Function Scores were Compared between Groups

As shown in Table 3, compared with the control group, the mean neurological impairment scores in the model group reached the peak on the first day after the injury and were significantly increased on the third day and the fifth day after injury (P<0.01). Compared with the model group, the neurological deficit score of the compound notoginseng nanoparticle group reached the peak on the first day after the injury and was significantly decreased on the third and fifth days after injury (P<0.01), but lower than that of the model group (P<0.01).

Table 3. Comparison table of neurological function scores after treatment

	1 Day	3 Day	5 Day
Control group	1.07	0.00	0.00
Model group	2.91	2.33	1.82
Experimental group	2.86	1.95	1.17

Comparison of Water Content in Brain Tissue after Group Treatment

As shown in Figure 4, compared with the control group, the water content of brain tissue in the model group was significantly increased on the first day after the injury, peaked on the third day, and was still significantly increased on the fifth day ($P<0.01$). Compared with the model group, the water content of brain tissue in the compound notoginseng nanoparticle group began to decrease on the first day after the injury and significantly decreased on the third day and the fifth day after injury ($P<0.01$).

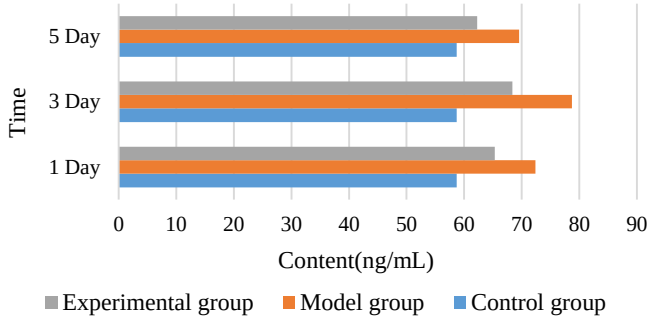

Figure 4. Comparison table of brain tissue moisture content after treatment

Panax notoginseng (Panax notoginseng) is known as "the holy medicine of trauma, the magic medicine of hemostasis, and the wonderful product of regulating blood". Its pharmacological effect of "making raw and cooking tonifying" is widely spread among people. In recent years, Panax notoginseng (Panax notoginseng), as traditional Chinese medicine, has been well known by many scholars at home and abroad, and its pharmacological effect has also been deeply studied.

Studies have confirmed that after brain injury, stimulated by some cytokines (such as TNF-α, IL-8 and IL-6), a large number of neutrophils and monocytes accumulate and infiltrate, leading to the blood-brain barrier, brain tissue edema, and degeneration and necrosis of nerve cells. When the blood-brain barrier is damaged, plasma proteins, water and sodium penetrate into the brain tissue, forming vasogenic brain edema, which can lead to increased intracranial pressure and even brain herniation. The results of this experiment showed that after the application of compound notoginseng nanoparticles, the morphology of nerve cells, the basic rules of organelles and the structure of vascular endothelium were improved, the thickness of the basement membrane was uniform, and the symptoms of nerve function defects were obviously recovered. This paper suggests that its protective effect is to resist cerebral vasoconstriction caused by norepinephrine, improve cerebral blood flow and microcirculation, improve brain edema and promote the recovery of nerve function.

In ancient medicine, medicines were obtained from plants (21-24). It is possible to recognize the medicinal substances used by the ancient Egyptians from the sacred papyri left by them. The most valuable of these papyri is "Papyrus Smith" (25-26). Egyptians used almost all parts of the plant. Babylonian medicine is left behind by small tablets with the names of medicines written in cuneiform on them. The elements they used were basically of plant origin (27-229). In the Babylonian orders, unlike the Egyptians, weight and size are not mentioned. In ancient Indian texts, medicinal plants are divided into two groups. The first group is either used as laxatives, emetics, or laxatives, or they facilitate bowel movements, and the other group is sedatives. Next to acupuncture, which was invented in China, the most important part of traditional Chinese medicine has been the science of herbal medicine (30-31).

Conclusions

The experiment results show that the compound notoginseng nanoparticles can reduce serum craniocerebral injury of each point in time the TNF alpha and IL - 6, and prove its inhibiting the inflammatory reaction, reduce the inflammation factor of aggregation and infiltration, reduce vascular permeability and reduce plasma protein leakage, thus relieve cerebral edema, improve nerve function, which has the effect of brain protection.

Acknowledgments

Not applicable.

Interest conflict

The authors declare that they have no conflict of interest.

References

1. Fotakopoulos G, Tsianaka E, Siasios G, Vagkopoulos K, Fountas K. Posttraumatic Hydrocephalus after Decompressive Craniectomy in 126 Patients with

Severe Traumatic Brain Injury. J Neurol Surg A Cent Eur Neurosurg. 2016 Mar;77(2):88-92. doi: 10.1055/s-0035-1558411. Epub 2015 Sep 9. PMID: 26351868.
2. Lu VM, Carlstrom LP, Perry A, Graffeo CS, Domingo RA, Young CC, Meyer FB. Prognostic significance of subdural hygroma for post-traumatic hydrocephalus after decompressive craniectomy in the traumatic brain injury setting: a systematic review and meta-analysis. Neurosurg Rev. 2021 Feb;44(1):129-138. doi: 10.1007/s10143-019-01223-z. Epub 2019 Dec 16. PMID: 31845199.
3. Otun A, Morales DM, Garcia-Bonilla M, Goldberg S, Castaneyra-Ruiz L, Yan Y, Isaacs AM, Strahle JM, McAllister JP 2nd, Limbrick DD Jr. Biochemical profile of human infant cerebrospinal fluid in intraventricular hemorrhage and post-hemorrhagic hydrocephalus of prematurity. Fluids Barriers CNS. 2021 Dec 24;18(1):62. doi: 10.1186/s12987-021-00295-8. PMID: 34952604; PMCID: PMC8710025.
4. Ammar, Ahmed. Hydrocephalus || Post-traumatic Hydrocephalus in Adults and Paediatrics. 2017; 10.1007/978-3-319-61304-8(Chapter 11): 153-160.
5. Pinto FC, Stump G, Valiengo L, Oliveira MF. Resolution of Othello-like syndrome following ventricular shunting in a post traumatic normal pressure hydrocephalus subject. Archives of Clinical Psychiatry (São Paulo). 2016 Sep;43:132-3.
6. Bonow RH, Oron AP, Hanak BW, Browd SR, Chesnut RM, Ellenbogen RG, Vavilala MS, Rivara FP. Post-Traumatic Hydrocephalus in Children: A Retrospective Study in 42 Pediatric Hospitals Using the Pediatric Health Information System. Neurosurgery. 2018 Oct 1;83(4):732-739. doi: 10.1093/neuros/nyx470. PMID: 29029289.
7. Spennato P, Ruggiero C, Parlato RS, Trischitta V, Mirone G, De Santi MS, Cinalli G. Acute post-traumatic hydrocephalus in children due to aqueductal obstruction by blood clot: a series of 6 patients. Childs Nerv Syst. 2019 Nov;35(11):2037-2041. doi: 10.1007/s00381-019-04318-6. Epub 2019 Jul 25. PMID: 31346735.
8. Fattahian R, Bagheri S, Sadeghi M. Development of Posttraumatic Hydrocephalus Requiring Ventriculoperitoneal Shunt After Decompressive Craniectomy for Traumatic Brain Injury: a Systematic Review and Meta-analysis of Retrospective Studies. Med Arch 2018; 72(3): 214-219.
9. Krejí, Lipina. Posttraumatic hydrocephalus. Rozhledy v chirurgii : Mesicnik Ceskoslovenske Chirurgicke Spolecnosti 2018; 97(6): 258-261.
10. Puccino, Ava, Zhang, et al. CSF Cytokine Profile of Patients with Post-Traumatic Hydrocephalus Following Severe Traumatic Brain Injury. J Neurosurg 2017; 126(4): A1442-A1442.
11. Sanders CM, Hornyak JE 4th, Voss LM. Poster 458 Improvement of Premorbid Developmental Delay Following Treatment of Post Traumatic Hydrocephalus: A Case Report. PM R. 2016 Sep;8(9S):S310. doi: 10.1016/j.pmrj.2016.07.380. Epub 2016 Sep 24. PMID: 27673205.
12. Manet R, Schmidt EA, Vassal F, Charier D, Gergelé L. CSF Lumbar Drainage: A Safe Surgical Option in Refractory Intracranial Hypertension Associated with Acute Posttraumatic External Hydrocephalus. Acta Neurochir Suppl. 2016;122:55-9. doi: 10.1007/978-3-319-22533-3_11. PMID: 27165877.
13. Ramesh VG, Narasimhan V, Balasubramanian C. Cerebrospinal fluid dynamics study in communicating hydrocephalus. Asian Jo Neurosurg 2017; 12(2): 153-158.
14. Pereira M A, Freedson PS. Lateral Ventricle to Sylvian Fissure Shunt for Obstructive Hydrocephalus: First Report. J Neurol Surg A Cent Eur Neurosurg, 2017; 78(05): 513-516.
15. Chrastina J, Z Novák, V Feitová. *Is hydrocephalus after spinal cord injury really caused by the injured spinal cord? Two case reports and a literature review.* Rozhledy v chirurgii: měsíčník Československé chirurgické společnosti, 2016; 95(5): 203-205.
16. Munakomi S, Chaudhary P, Cherian I. Posttraumatic cervicovertebral junction acute subdural hematoma and cisterna magna subarachnoid hemorrhage presenting with progressive hydrocephalus. Asian J Neurosurg 2018;13(1): 66-67.
17. Mas MF, Mathews A, Gilbert-Baffoe E. Rehabilitation Needs of the Elder with Traumatic Brain Injury. Phys Med Rehabil Clin N Am. 2017 Nov;28(4):829-842. doi: 10.1016/j.pmr.2017.06.014. PMID: 29031347.
18. Kaestner S, Poetschke M, Roth C, et al. Different origins of hydrocephalus lead to different shunt revision rates. Neurologia I Neurochirurgia Polska, 2017;51(1): 72-76.
19. Watanabe J, Maruya J, Nishimaki K . Sinking skin flap syndrome after unilateral cranioplasty and ventriculoperitoneal shunt in a patient with bilateral decompressive craniectomy. Interdiscip Neurosurg 2016; 5(C): 6-8.
20. Huliyappa H, Jaiswal M, Singh S, et al. Retrograde Partial Migration of Ventriculoperitoneal Shunt with Chamber: Review of Causative Factors and Its Prevention. J Pediatr Neurosci, 2017; 12(1): 93-95.
21. Ganjali S, Khajeh H, Gholami Z, Jomeh-ghasemabadi Z, Fazeli-Nasab B. Evaluation of Dormancy Failure Datura stramonium Plant Seeds under the Influence of Different Treatments. Agrotech Indu Crops 2022 Mar 28;2(1):32-41. doi: 10.22126/atic.2022.7656.1049.
22. Masoumi SM, Kahrizi D, Rostami-Ahmadvandi H, Soorni J, Kiani S, Mostafaie A, Yari K. Genetic diversity study of some medicinal plant accessions belong to Apiaceae family based on seed storage proteins patterns. Mol Biol Rep. 2012 Dec;39(12):10361-5. doi: 10.1007/s11033-012-1914-3. Epub 2012 Oct 20. PMID: 23086265.
23. Ghamarnia H, Palash M, Dousti B. Camelina Zoning for Different Climate Conditions in Kurdistan Province. Agrotech Indu Crops 2022;2(1): 49-56. doi: 10.22126/atic.2022.7903.1056.
24. Raziei Z, Kahrizi D, Rostami-Ahmadvandi H. Effects of climate on fatty acid profile in Camelina sativa. Cell Mol Biol (Noisy-le-grand). 2018 Apr 30;64(5):91-96.

PMID: 29729699.

25. Ghamarnia H, Mousabeygi F, Rezvani SV. Water Requirement, Crop Coefficients of Peppermint (Mentha piperita L.) and Realizing of SIMDualKc Model. Agrotech Indu Crops 2021 Sep 1;1(3):110-21. doi: 10.22126/atic.2021.6791.1019.
26. Ghorbani T, Kahrizi D, Saeidi M, Arji I. Effect of sucrose concentrations on Stevia rebaudiana Bertoni tissue culture and gene expression. Cell Mol Biol (Noisy-le-grand). 2017 Aug 30;63(8):33-37. doi: 10.14715/cmb/2017.63.8.8. PMID: 28886311.
27. Aryafar S, Sirousmehr A, Najafi S. The Impact of Compost on Seed Yield and Essential Oil of Black Cumin under Drought Stress Conditions. Agrotech Indu Crops 2021 Sep 1;1(3):139-48. doi: 10.22126/atic.2021.7184.1026.
28. Zirgoli MH, Kahrizi D. Effects of end-season drought stress on yield and yield components of rapeseed (Brassica napus L.) in warm regions of Kermanshah Province. Biharean Biologist. 2015 Dec 1;9(2):133-40.
29. Almasi F. Organic Fertilizer Effects on Morphological and Biochemical Traits and Yield in Coriander (Coriandrum sativum L.) as an Industrial and Medicinal Plant. Agrotechniques in Industrial Crops. 2021 Mar 1;1(1):19-23. doi: 10.22126/etic.2021.6476.1011.
30. Kakaei M, Kahrizi D. Study of seed proteins pattern of brassica napus varieties via sodium dodecyl sulfate polyacrylamid gel electrophoresis. Int Res J Biotechnol 2011;2(1):026-8.
31. Shaafi B, Mosavi SS, Abdollahi MR, Sarikhani H. The optimized protocols for production, adaptation and keeping of the produced artificial seeds from encapsulated lateral buds in Stevia rebaudiana (Bertoni). Agrotechniques in Industrial Crops. 2021 Mar 1;1(1):24-35.doi: 10.22126/etic.2021.6246.1004.