Strategies for Persistent Intracranial Infection Associated With Subcutaneous Effusion in the Posterior Fossa

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Research Article

Keywords: subcutaneous effusion, posterior cranial fossa, intracranial infection

Posted Date: September 15th, 2021

DOI: https://doi.org/10.21203/rs.3.rs-874278/v1

Abstract

Objective: Due to the particularity of anatomy, there are many subcutaneous effusions after posterior fossa surgery. This paper discusses the characteristics and treatment strategies of persistent infection related to subcutaneous effusions in the posterior fossa.

Methods: Seventeen patients with persistent intracranial infection after neurosurgical posterior fossa surgery from March 2015 to July 2020 were retrospectively analyzed. According to different stages of infection, the treatment process of intracranial infection was divided into the acute infection stage, clinical response stage and infection cure stage, and the measures taken in the different stages were summarized.

Results: Compared with the acute infection stage, the indices of body temperature, blood and cerebrospinal fluid in the clinical response stage were improved, but there was no significant difference. There was a significant difference in each index between the acute infection stage and the infection cure stage. After the infection was cured, 17 patients were significantly relieved or cured of subcutaneous effusions by various methods.

Conclusion: It is necessary to be alert to the existence of subcutaneous effusions in cases of poor effects or repeated infections after routine treatment. Multiple replacements and flushing of subcutaneous effusions are an important means of treating this kind of infection.

Introduction

Intracranial infection is one of the common complications after neurosurgery, with an incidence of 4.6–25% [1], especially in posterior fossa surgery. Due to the characteristics of the narrow space, obvious bone flap defects after craniotomy, tight dura sutures, poor wound healing and cerebrospinal fluid leakage, the incidence of infection in posterior fossa surgery is three times that of cerebral hemisphere surgery [2]. It is also prone to postoperative subcutaneous effusions. The incidence of subcutaneous effusions is the highest with the retrosigmoid approach. The generation of a subcutaneous effusion delays wound healing, induces wound infection, and even increases the risk of intracranial infection [3].

When intracranial infection is suspected after an operation, the process examination and operation should be performed according to the guideline consensus [4], such as routine blood examination, cerebrospinal fluid examination, bacterial culture, etc. When the infection is confirmed or the patient's clinical symptoms are obvious, vancomycin combined with cephalosporin or carbapenem antibacterial treatment can be used empirically. When the infection is serious, cerebrospinal fluid drainage and intrathecal injection of antibiotics can be used. After a full course of antibiotics and treatment, the vast majority of infections can be controlled and cured. However, there were still a few cases of alternating infection after treatment, which worsened after remission and was even repeated many times. One of the important reasons is the existence of subcutaneous effusions in the posterior cranial fossa. In this study, 17 patients with intracranial infections of subcutaneous effusions after posterior fossa surgery were

analyzed retrospectively to explore the characteristics and treatment strategies of persistent infections related to subcutaneous effusions.

Methods

Data: Seventeen patients with persistent intracranial infection after neurosurgical posterior fossa surgery at Tangdu Hospital of Air Force Military Medical University from March 2015 to July 2020 were analyzed retrospectively. Persistent intracranial infection is the process of postoperative diagnosis of intracranial infection. After routine systemic antibiotic use, lumbar cistern catheterization/lumbar puncture and intrathecal injection of vancomycin, the intracranial infection was relieved, and the infection was aggravated again. Subcutaneous effusion refers to the soft skin bulge around the surgical incision, and the volume of effusion extracted is greater than 20 ml. There were 9 males and 8 females, aged 5 to 57 years (mean 48 years). They were diagnosed with acoustic neuroma in 7 cases, trigeminal schwannoma in 3 cases, trigeminal neuralgia in 1 case, cerebellar hemisphere hemangioma in 1 case, hemangioblastoma in 1 case, ependymoma in the fourth ventricle in 2 cases and hemangioblastoma in 2 cases. Inclusion criteria were as follows: ① cases of intracranial infection after infratentorial posterior fossa surgery; ② no pathogenic bacteria were cultured in the treatment of intracranial infection; ③ the infection is alleviated and aggravated repeatedly after treatment; and ④ an obvious subcutaneous effusion has formed around the wound. Exclusion criteria were as follows: ① uninfected cases after operation; ② there were clear pathogenic bacteria in cultures after infection; ③ the infection gradually improved and was cured, with no repeated infections; or ④ no subcutaneous effusion. The above case study was approved by the hospital ethics committee, and all patients or family members signed informed consent for treatment.

Treatment: Seventeen patients underwent lesion resection via the posterior occipital median approach, paramedian approach or retrosigmoid approach. Intermittent or continuous fever (38.1 ℃–39.2 ℃) was observed 3–7 days after the operation. Obvious fluctuations were observed around the wound, the wound was soft to touch, and the wound was free of redness and swelling. Subcutaneous fluid accumulation was considered. The subcutaneous effusion was extracted, and cerebrospinal fluid samples were obtained by lumbar puncture. The results showed whether the cerebrospinal fluid was red/yellow or turbid/slightly turbid and had low sugar, low chlorine, high protein, abnormally increased leukocytes and/or increased leukocytes in routine blood tests. Combined with clinical manifestations, it was diagnosed as an intracranial infection and drainage through the lumbar cistern (cerebrospinal fluid drainage 270–3300 ml every 24 h) and intrathecal injection of 20 mg/20 ml vancomycin every 24 h. At the same time, after an empirical intravenous drip of meropenem 2 g TID plus vancomycin 1 g BID (5–7 days), the body temperature fluctuated between 37.4 ℃ and 38 ℃, and the properties and biochemical indices of the cerebrospinal fluid were significantly improved (but still abnormal). Cerebrospinal fluid culture was still negative. After 2–3 days of observation after drug withdrawal and lumbar cistern extraction, the body temperature rose again, the properties and biochemical indices of the cerebrospinal fluid were obviously abnormal, and the above symptoms were repeated many times (generally 1–2 times, lasting for 1–2 weeks). The treatment was the same as before. After that, the subcutaneous effusion was

extracted by puncture and replaced with meropenem normal saline (10 mg/100 ml every 12 h). After replacing the subcutaneous effusion for 2 days, the body temperature was within the normal range. After this the process was continued for 3–5 days, the properties of the cerebrospinal fluid were clear and transparent, and the biochemical values were within normal ranges. The patient had no fever and was followed up at 1 month after discharge. The patient had no fever, and the intracranial infection was cured.

Statistical methods: SPSS 21.0 software was used for statistical analysis. Continuous data are expressed as the mean ± standard deviation (±s), which means that the mean between groups was compared by analysis of variance (ANOVA), with $P < 0.05$ as the difference, which was statistically significant.

Results

According to different stages of infection, the treatment process of intracranial infection is divided into three stages. The acute infection stage was 3–7 days after operation. The body temperature and cerebrospinal fluid results were obviously abnormal, so intracranial infection was declared. The clinical response stage were significantly better than those in the acute infection stage, but they were still not within the normal ranges. The duration was generally 1–2 weeks. The infection cure stage is the process of gradual normalization of body temperature and cerebrospinal fluid through repeated replacements of the subcutaneous effusion. The time was generally within 1 week. According to the statistical results, the sugar, total number of CSF cells, leukocyte count and protein content of cerebrospinal fluid were improved in the acute infection stage compared with the clinical response stage, but there was no significant difference. There were significant differences in each index between the acute infection stage and the infection cure stage (Table 1).

The average treatment time of 17 patients with infection was 23.5 ± 4.7 days. After the infection was cured, the subcutaneous effusion was significantly reduced in 6 cases by extracting subcutaneous cerebrospinal fluid and pressure bandaging. Eight cases gradually formed a communicating hydrocephalus after infection. After 3 months of ventriculoperitoneal shunting, the subcutaneous effusion was extracted, the pressure was bandaged, and the subcutaneous effusion was significantly reduced (Fig. 1). Three patients underwent surgical exploration, repair and tight suturing of the dura mater. The subcutaneous muscles were sutured layer by layer, and the subcutaneous effusion basically disappeared after the pressure bandage.

Typical case:

A 32-year-old male was hospitalized for 5 days due to sudden headache, intermittent vomiting and unstable walking. Left cerebellar hemisphere hemangioma was diagnosed on admission. Cerebellar focused resection was through a left paramedian approach under elective general anesthesia. Old bleeding and dysplastic small vascular masses were seen during the operation. The hematoma was removed, and most of the vascular mass was removed. The dura mater was sutured intermittently, part of

the bone flap was restored, and the muscles, subcutaneous tissue and skin were sutured layer by layer. A sudden and continuous high fever occurred 5 days after the operation. Lumbar puncture, routine blood examination, routine biochemical analysis of cerebrospinal fluid and blood leukocytes were performed. Considering intracranial infection, the treatment process was the same method. Three months after the infection was cured, a ventriculoperitoneal shunt procedure was performed, the ventriculoperitoneal system was significantly reduced, and the subcutaneous effusion basically disappeared.

Discussion

Causes of subcutaneous effusion [5] include: cerebrospinal fluid extravasation (remember the operation space of the posterior cranial fossa is narrow). To expose the operation field, the cerebrospinal fluid should be released as much as possible, which reduces pressure and open multiple arachnoid cisterns, resulting in the disruption of cerebrospinal fluid circulation balance and the change of intracranial pressure gradient. The cerebrospinal fluid converges in the subdural cavity of the bone window with the pressure gradient passing through the arachnoid incision. The tight suturing of the dura of the posterior cranial fossa is very difficult. Most of them have dural gaps, and cerebrospinal fluid seeps from the gaps to the subcutaneous layer with the pressure gradient. Such a dural notch is usually a one-way valve-like structure, and cerebrospinal fluid cannot return to the subdural cavity, resulting in a continuous increase in the subcutaneous effusion. When the intracranial pressure decreases, it may return to the brain through the dural notch to participate in cerebrospinal fluid circulation. Inflammatory reaction and exudation of cells and tissues. Postoperative subcutaneous hematocele, titanium plate and screw implantation, intraoperative electrotome and electrocoagulation stimulated epidermal tissue, resulting in an inflammatory reaction and exudation of cellular tissue.

Although the infection was controlled after the routine treatment of intracranial infection, there was continuous and repeated fever. Good results were achieved by repeatedly extracting the subcutaneous effusion and replacing it many times. It was clear that the root cause of the repeated fever was the subcutaneous effusion. Analyzing the causes, antibiotic sterilization and lumbar cistern drainage could play certain roles, which are also the reasons for the relief of clinical symptoms. After stopping and removing the lumbar cistern, a small amount of the subcutaneous effusion continues to flow into the brain and participate in cerebrospinal fluid circulation, which is the main reason for the recurrence of infection. By extracting and replacing the subcutaneous effusion, hidden infection foci can be eliminated, nutrition can be actively strengthened, and immunity can be improved, which is the reason for the rapid disappearance of infectious symptoms.

Therefore, the prevention of subcutaneous effusions is an important reason to avoid such persistent infections. The posterior cranial fossa is prone to subcutaneous effusions due to its narrow operation space and complex anatomical structure. Studies have confirmed that [6] intracranial hypertension, no reduction of bone flaps, secondary operation and no bandage compression are high-risk factors for subcutaneous effusions. Therefore, the dura mater should be tightly sutured; the defect can be repaired by artificial dura mater; the bone flap can be reset; the open mastoid process can be closed [7]; the

muscle, subcutaneous and skin should be sutured layer by layer and wrapped with bandage; and appropriate dehydrating drugs should be used to reduce intracranial pressure [8]. If a subcutaneous effusion is obvious, local puncture and pressure bandaging can be carried out, and the lumbar cistern can be continuously drained [9]. If there is still a subcutaneous effusion, it is necessary to find the cause, timely CT/MRI examination of the head, hydrocephalus, etc.

In summary, it is necessary to be alert to the existence of subcutaneous effusions for cases with poor effects or repeated infections after routine treatment. Multiple replacements and flushing of subcutaneous effusions are an important means to treat such infections, and the effect is excellent. Of course, it is most important to avoid intracranial infection and subcutaneous effusions after posterior fossa craniotomy.

Declarations

Funding (information that explains whether and by whom the research was supported)

Conflicts of interest/Competing interests The authors declare that they have no financial or other conflicts of interest disclosure in relation to this article

Availability of data and material The raw/processed data required to reproduce these findings cannot be shared at this time as the data also forms part of an ongoing study

Code availability Not applicable

Ethics approval All procedures performed in the study were approved by the Research Ethics Committee of Tangdu Hospital of Air Force Medical University

Consent to participate All authors agree to participate

Consent for publication All authors agree to publish the article in the journal

Authors' contributions Qing Cai: Conceptualization, Methodology, Writing –original draft. Shoujie Wang: Writing - original draft. Min Zheng: Writing - original draft. Visualization, Investigation. Huaizhou Qin: Supervision.Dayun Feng: Writing - review & editing.

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Tables

Table 1: temperature changes and cerebrospinal fluid examination results in different stages of postoperative infection

	Acute infection stage	Clinical response stage	Infection cure stage	Normal range	P value
Temperature (℃)	38.4±0.5	37.8±0.7	36.3±0.6	36-37 (axillary)	*P=0.032
WBC* （×10E9/L）	11.9±3.7	8.7±2.6	4.8±1.9	3.2-9.7	*P=0.025
CSF color	Bloody / yellow	Light yellow	Colourless	Colourless	-
CSF properties	Muddy	Turbid / Slightly turbid	Transparent	Transparent	-
CL（mmol/L）	102.3±13.5	111.6±19.2	120.6±18.7	120-132	*P=0.015
GLU（mmol/L）	1.2±0.7	2.0±0.9	2.9±1.2	2.2-3.9	*P=0.041
CSF protein （mg/L）	1456.1±626.5	734.3±127.9	458.2±191.7	120-600	*P=0.017
WBC （×10E6/L）	318.4±121.0	127.3±32.6	32.6±15.1	0-10	*P=0.011
Total cells （×10E6/L）	1247.2±506.1	414.5±73.6	137.2±25.7	-	*P=0.009

Note: **CSF**: cerebrospinal fluid, **CL**: chlorine, **GLU**:glucose, **WBC***: white blood cell,**WBC**:cerebrospinal fluid white blood, **Total cell**s:total cerebrospinal fluid cells. #P is the comparison between acute infection stage and clinical reaction stage, * P is the comparison between acute infection stage and infection cure stage, & P is the comparison between clinical reaction stage and infection cure stage.

Figures

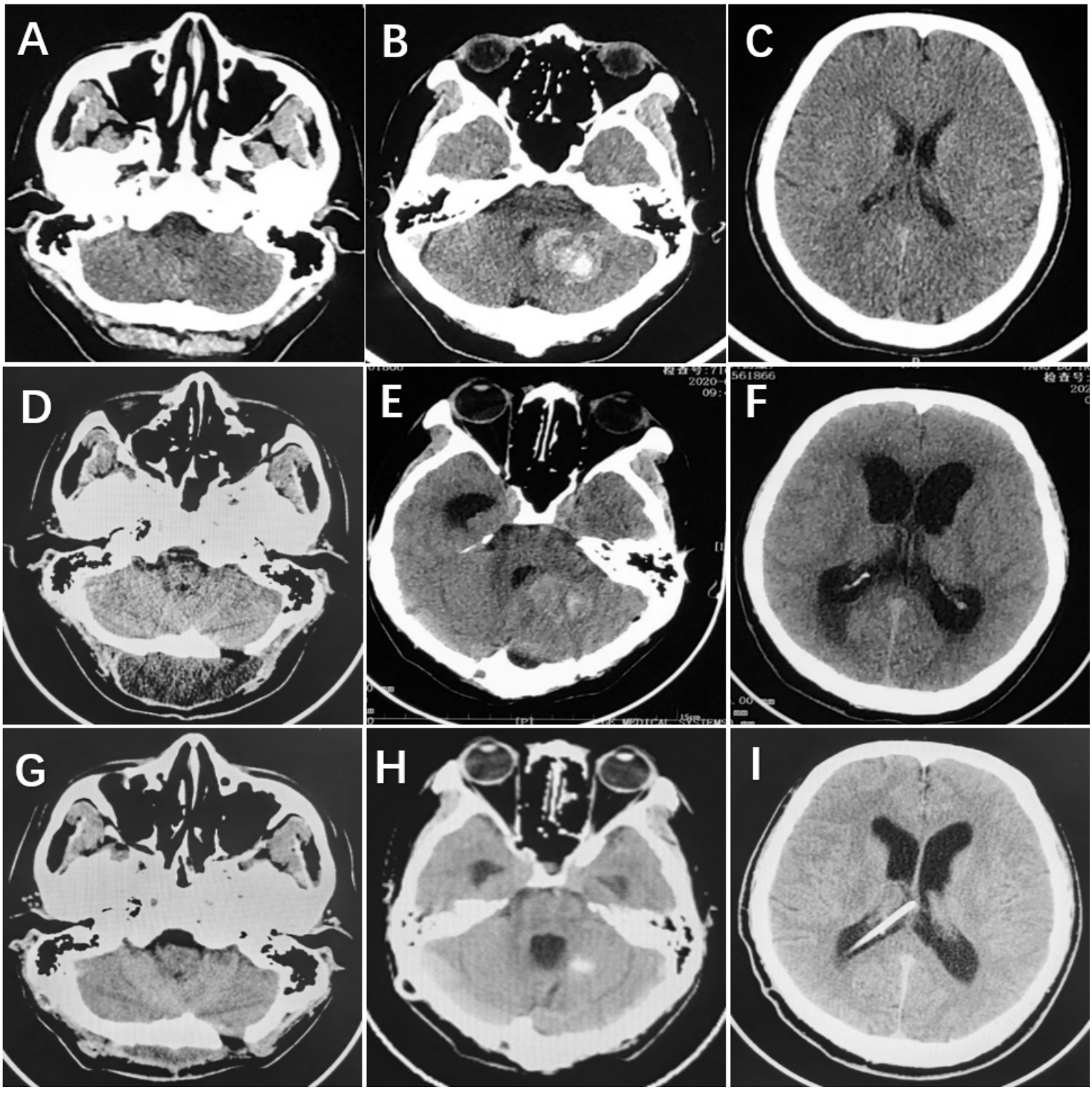

Figure 1

A-C: Left cerebellar hemisphere hemangioma, A: skin and muscle covering occipital bone, with continuous and complete bone; B: round-like high-density shadow can be seen in the left cerebellum, considering hemangioma with bleeding; C: morphology of the ventricles is normal. D-F: One week after resection of hemangioma, D: obvious subcutaneous effusion of occipital bone, discontinuous interruption of bone; E: round-like slightly high-density shadow can be seen in the left cerebellum, considering the postoperative changes; F: ventricles were dilated, frontal horn was rounded, and

interstitial exudation was observed; G-I: after ventriculoperitoneal shunt and 3 months after infection control, G: occipital subcutaneous effusion basically disappeared; H: most of the lesions were resected with a few calcifications; I: puncture tube at the end of the ventricle was in good position, and the ventricle was significantly smaller than that in the front.