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Original article

Efficacy of lumbar cistern drainage combined with intrathecal antibiotherapy for the treatment of ventriculo-subarachnoid infections following surgery for hypertensive intracerebral hemorrhage

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ABSTRACT

Objective. – The aim of this study was to investigate the efficacy of lumbar cistern drainage combined with intrathecal injection of antibiotics (LCD-ITI) in treating postoperative intracranial infections of hypertensive intracerebral hemorrhage (pHIH-ICI).
Methods. – Sixty pHIH-ICI patients were randomly divided into the control group and the treatment group, with 30 patients in each group. Conventional treatment was performed in the control group, while LCD-ITI was performed in the treatment group. The clinical outcomes, Glasgow Outcome Score (GOS), activities of daily living (ADL) scores, incidence rates of hydrocephalus and other indicators were compared.
Results. – The improvement time of clinical symptoms, infection control time and hydrocephalus incidence of the treatment group were significantly lower than the control group ($P < 0.05$). Also the infection control rate, GOS score and ADL score of the treatment group were significantly higher or better than the control group ($P < 0.05$).
Conclusion. – LCD-ITI could improve clinical treatment and prognosis of pHIH-ICI patients.

1. Introduction

Hypertensive intracerebral hemorrhage (HIH) is a common severe disease, particularly when combined with cerebral intraventricular hemorrhage. Due to age, physical weakness, or postoperative long-term coma, often accompanied by chronic diseases, HIH patients normally need external ventricular drainage. Also in the aged, the patient's immunity level is low, therefore postoperative intracranial infection (ICI) may easily occur, resulting in high morbidity and mortality, as well as a poor prognosis [1–4]. Traditional therapies are more frequently used in China to reduce intracranial pressure, together with the use of systemic antibiotics and other symptomatic supportive treatment, but efficacy is poor, and mortality remains high. To improve the success rate of HIH, increasing intracranial pressure caused by intraventricular hemorrhage must be well controlled. Moreover, removing intraventricular hemorrhage in time, reducing blood pressure, reducing bleeding rates and controlling ICI effectively have been the keys to the treatment of this disease [5]. Once the infection occurs, lumbar cistern drainage (LCD) or intrathecal antibiotherapy should be performed as early as possible, which often results in a better outcome [6–9]. Our prospective randomized clinical trial compared continuous LCD combined with an intrathecal injection (ITI) in 30 patients with postoperative intracranial infection following hypertensive intracerebral hemorrhage (pHIH-ICI), and 30 patients treated with intravenous injection during the same period.

2. Materials and methods

2.1. Subjects

Based on previously reported studies [2,5–7,10–12], 60 randomized patients with pHIH-ICI admitted to our hospital from January 2010 to December 2012 were selected. All the patients met the diagnostic criteria for surgical intracranial infection (Harrison criteria):

- clinical manifestations of high fever, headache, vomiting, unconsciousness, and positive meningeal irritation;

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- cerebrospinal fluid (CSF) routine and biochemical tests: white blood cell count > 1180×10^6/L, protein > 2200 mg/L, glucose < 1.9 mmol/L;
- there was a definite source of infection and the bacteria cultures from CSF obtained via external ventricular drainage, lumbar drainage, or lumbar puncture were positive.

CSF bacteria culture plus drug sensitivity assay were performed in all cases. There were 29 cases of *Staphylococcus aureus*, 17 cases of *Staphylococcus epidermidis*, 8 cases of *Klebsiella pneumoniae*, 3 cases of *Pseudomonas aeruginosa*, 2 cases of proteus syndrome and 1 case of fecal streptococci.

The patients were randomly divided into a control group and a treatment group, with 30 patients in each group. Among the 60 patients, 34 patients were male and 26 patients were female, aged 43 to 80 years, with the mean age of 57.35 ± 9.47 years; their hypertension medical histories ranged from 3 to 35 years, with the measured blood pressure values above the threshold level. There was no statistically significant difference in age, sex, disease duration and disease condition, etc., between the 2 groups ($P > 0.05$). This study was conducted in accordance with the declaration of Helsinki and received approval from the Ethics Committee of the First People's Hospital of Tonglu County. Written informed consent was obtained from all participants.

2.2. Treatment methods

All the patients were administered a standard dose of 20% mannitol (125 ~ 250 mL q/8 h, ivgtt) to reduce intracranial pressure and other support therapies. After diagnosis of intracranial infection, the patients were administered a broad-spectrum antibiotics which also penetrated the blood-brain barrier more easily, such as penicillin, chloramphenicol, sulfadiazine, metronidazole, ceftazidime, etc. Then, depending on the CSF drug sensitivity results, sensitive antibiotics (such as meropenem) were applied. Intravenous injection was used in the control group. Continuous lumbar cistern drainage combined with an ITI was performed in the treatment group: the patient was placed in the lateral position, with chest and knees bended; punctured from L4–5 rib gap with a No. 17 epidural needle, the catheter implanted into the spinal subarachnoid space for about 5 cm, then the catheter is fixed to the waist and the catheter end connected to the one three-way valve; the other two ends of the three-way valve were connected with an infusion device and ventricular drainage device, with 10 ~ 15 cm longer than the bilateral external auditory canal of the drainage tube; the amount of drainage was controlled at approximately 200 mL/day (Brabden©, Shandong, China, Fig. 1). All the patients were treated with albumin, furosemide, and glucocorticoids, etc. In addition, nutritional support, respiratory support, cooling and other treatments were performed. CSF routine, biochemical tests and bacterial cultures were repeated daily until the sterility of CSF had been restored.

2.3. Evaluation criteria

Clinical evaluation standards:

- the body temperature returned to normal, and the symptoms and signs of patients were in remission;
- the appearance of cerebrospinal fluid was clear, and its routine and biochemical results were close to normal:
- no bacteria growth after 72 h CSF bacterial cultures.

Improvement of clinical symptoms: conditions mentioned above improved.

Infection control: body temperature remained normal, routine CSF and biochemical tests were normal for 3 days and 3 consecutive negative CSF bacterial cultures. The first day that clinical symptoms and examination were normal was defined as infection control day. Infection control rate meant the percentage of patients who achieved infection control criteria in a month.

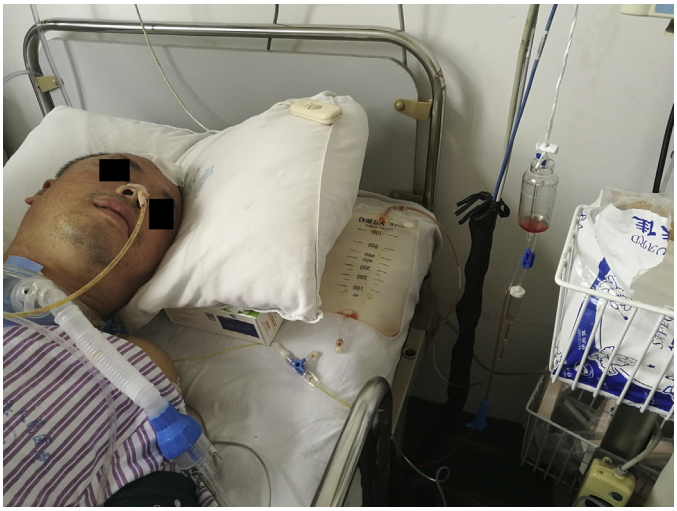

Fig. 1. A photograph of the entire device mentioned in the study.

Efficacy was evaluated according to the Glasgow Outcome Score (GOS) [13]: 5 points (good recovery): returned to normal life, although there existed slight defects; 4 points (mild disability): disability, while patient could live independently, and could work under supervision; 3 points (severe disability): sober, disability, needed to be taken care of daily; 2 points (vegetative state): only exhibited the minimal response (such as could open eyes with sleep/wake cycle); 1 point (death).

Activities of daily living (ADL) [14]: 5 points: fully independent; 4 points: mildly dependent; 3 points: moderately dependent; 2 points: severely dependent; 1 point: totally dependent. GOS scores and ADL scores were evaluated six months after surgery.

Incidence of a hydrocephalus rate was the occurrence of hydrocephalus during the 6 months after surgery.

2.4. Statistical analysis

SPSS12.0 software was used for the analysis. For data analysis, mean ± SD was used. Intergroup comparisons were performed using the independent *t*-test. The numerical data were analyzed using Chi^2 test. Nonparametric sum Mann-Whitney U-test (for independent variables) was used to compare the differences between the groups. $P < 0.05$ was considered to be statistically significant.

3. Results

3.1. Comparative analysis of clinical outcomes

Table 1 shows that the improvement days of clinical symptoms, and infection control days of the treatment group were significantly lower than the control group ($P < 0.05$), while the infection control rate was significantly higher than the control group ($P < 0.05$).

3.2. Comparison of GOS scores six months after surgery

The comparison of GOS scores between the 2 groups using the nonparametric Rank sum test, showed that the GOS score of the treatment group was significantly higher than the control group ($Z = -2.510$, $P = 0.013$, Table 2).