ORIGINAL ARTICLE

Effect of Electroacupuncture Preconditioning on Serum S100β and NSE in Patients undergoing Craniocerebral Tumor Resection

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ABSTRACT Objective: To investigate the effect of electroacupuncture preconditioning on the serum level of S100 calcium-binding protein beta (S100β) and neuron-specific enolase (NSE) in patients undergoing craniocerebral tumor operation. Methods: A total of 32 patients, who would go through craniocerebral tumor resection under general anesthesia, were randomly assigned to two groups, 16 in each group. Patients in the electroacupuncture (EA) group received electroacupuncture on Fengfu acupoint (Du16) and Fengchi acupoint (GB20) for 30 min, 2 h before operation. The stimulus is 1-4 mA with a density wave frequency of 2/15 Hz. Patients in the control group received no pretreatment. Anesthesia was maintained with remifentanil at the dose of 4-8 mg/kg per hour, pumped intravenous drip of vecuronium at 1.0-2.0 μg/kg each hour, and discontinuous intravenous drip with vecuronium bromide at 0.5-1 mg. The serum levels of S100β and NSE were measured with ELISA before operation, before skin incision, after tumor removal, at the end of operation, and at 24 h after operation. Results: The serum level of S100β and NSE did not change before skin incision. The serum level of NSE increased significantly and the level of S100β increased insignificantly after the tumor resection. The serum levels of S100β and NSE in the EA group and the control group were 1.16 ± 0.28 μg/L vs 1.47 ± 0.33 μg/L, 24.7 ± 13.3 μg/L vs 31.4 ± 14.1 μg/L at the end of the operation, respectively. Twenty-four h after operation, the correspondence indices were 1.18 ± 0.31 μg/L vs 1.55 ± 0.28 μg/L, and 25.5 ± 12.4 μg/L vs 32.4 ± 11.7 μg/L. The two indices at these two time points were significantly increased than those before operation, respectively (P<0.05). At the end of the operation and 24 h post-operation, the serum levels of S100β and NSE in the EA group were significantly lower than those in the control group (P<0.05). Conclusion: Electroacupuncture Fengchi and Fengfu for 30 min before craniocerebral tumor operation could decrease the serum level of S100β and NSE, thus may have potential protective effect on brain damage, which needs to be further studied.

KEYWORDS electroacupuncture, preconditioning, S100 calcium-binding protein beta, neuron-specific enolase, craniotomy

It has been proved that electroacupuncture (EA) preconditioning could fight against the ischemic damage of the middle cerebral artery occlusion (MCAO) in rats, reduce the infarct volume, and improve the neurological scores(1). In clinic, EA has been used in the treatment of brain ischemia. However, the effect of EA pretreatment is still unclear. In this study, the patients scheduled for craniocerebral tumor resection were pretreated with EA, and serum levels of S100 calcium-binding protein beta (S100β) and neuron-specific enolase (NSE), two neural damage markers, were observed in these patients.

METHODS

Patients
A total of 32 adult patients of either sex, aged 18 to 60 years, ASA I - II with full preoperative Glasgow Coma Score undergoing elective craniotomy for brain tumors were enrolled in the study. Patients were equally randomly assigned to the EA group and the control group by a random number table. Patients in the EA group underwent 30 min of EA pretreatment at the Fengchi (GB20) and Fengfu (Du16) acupoints 2 h before induction, while those in the control group received no pretreatment. Patients with liver or renal
dysfunction or patients with the operation time more than three hours were excluded. The protocol was approved by the human ethics and research committee of our institute, and the informed consent form was signed by all patients.

**Induction and Maintenance of Anesthesia**

The electrocardiogram (ECG), noninvasive blood pressure (NIBP), and pulse oxygen saturation (SpO2) were monitored as regular measurements without any sedation drugs before patients went into the operating room. The end tidal CO2 and respiratory rate were also monitored. Patients were given oxygen inhalation via face 4 L per min and were stimulated at Fengchi and Fengfu acupoints for 30 min by electro-acupuncture stimulator (Industrial Co., Ltd. Qingdao Xinsheng, G6805-II) at 2 h before anesthesia induction. The stimulus is 1-4 mA with density wave frequency of 2/15 Hz. Then anesthesia induction was achieved with fentanyl 2-4 μg/kg, midazolam 1-2 mg and propofol TCI with a target concentration of 6 μg/mL. Tracheal intubation was facilitated with vecuronium 1 mg/kg. Additional post-induction monitoring consisted of invasive blood pressure if necessary. Ventilation was adjusted to achieve an end-tidal CO2 tension of about 30 mm Hg (Datex Ohmeda Aestiva/5, Madison, USA). Anesthesia was maintained with 2-4 μg/mL propofol TCI, continuous infusion of sufentanil 0.1-0.3 μg/kg per min, and administered with vecuronium intermittently at the dose of 0.5-1 mg. Anesthesia was stopped at the end of skin suture. The trachea was extubated after adequate recovery of spontaneous breath, and then the patients were moved to the neurosurgical intensive care unit (NSICU) and mean arterial pressure (MAP), heart rate (HR) and SpO2 were recorded at 5 time points, which were: before induction, before skin incision, after tumor removal, at the end of operation, 24 h after operation, respectively. The conduct of recordings was done by an anesthesiologist who was blinded to the study groups.

**Determination of Serum S100β and NSE Levels**

A total of 2 mL of venous blood was collected through central venous catheter at 5 time points: before induction, before skin incision, after tumor removal, at the end of operation, and at 24 h after operation, respectively. Then the blood samples were centrifuged separately and the supernatant was collected and stored at -70 °C.

Serum S100β was measured with a commercially available ELISA kit (CanAg Diagnostics AB, Swiss), Bio-rad 680 Microplate Reader and 1575 Automatic plate washer (Bio-rad, USA). ELISA plates were coated with anti-S100 mAb (40 mg/L) at 4 °C for 48 h and washed three times using solution (PBS + 0.05% Tween 20), and then the standard sample (bovine S100β protein) and the samples to be determined were added for 1 h at 37 °C. After the plates were washed, S100 PcAb (1:5 000) was added overnight at 4 °C and then placed at room temperature for 1 h. IgG HRP (1:700) was added at 37 °C for 1 h. After the plate was washed, the color solution was added at 37 °C for 15-30 min for reading A 410 values. In this experiment, the diluent was used as a negative control, and the average of 10-hole values more than 2.1 times the negative control was considered as the positive standard to decide the lowest detection value. The concentration of S100β protein was calculated by using A 410 average values as the ordinate and the logarithm of S100β concentration as the abscissa.

The serum level of NSE was determined by a commercially available ELISA. The regent kit specific for human NSE was provided by CanAg Diagnostics AB, Swiss. All samples were analyzed in duplicate and results were calculated from the means of duplicate sample analysis.

**Statistical Analysis**

All data were analyzed with SPSS 12.0 software. Data were expressed as mean ± standard deviation. The comparison between groups was performed using one-way analysis of variance. A P value of 0.05 was considered statistically significant.

<table>
<thead>
<tr>
<th>Group</th>
<th>Case</th>
<th>Age (Yr.)</th>
<th>Gender (F/M)</th>
<th>Weight (kg)</th>
<th>Duration of surgery (min)</th>
<th>Midazolam (mg)</th>
<th>Propofol (mg)</th>
<th>Fentanyl (μg)</th>
<th>Remifentanil (mg)</th>
<th>Vecuronium (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EA</td>
<td>16</td>
<td>40±12</td>
<td>7/9</td>
<td>66±13</td>
<td>138±34</td>
<td>1.5±0.6</td>
<td>571±155</td>
<td>267±146</td>
<td>1.25±0.18</td>
<td>7.0±0.6</td>
</tr>
<tr>
<td>Control</td>
<td>16</td>
<td>46±15</td>
<td>6/10</td>
<td>59±12</td>
<td>145±56</td>
<td>1.2±0.4</td>
<td>486±142</td>
<td>100±53</td>
<td>1.18±0.33</td>
<td>7.0±0.5</td>
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</tbody>
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