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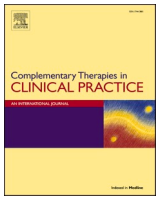

Treatment of traumatic facial paralysis in a child with electroacupuncture and hyperbaric oxygen: A case report

Li Wang [a], Hui Shi [b,*]

[a] School of Clinical Medicine, Hangzhou Medical College, Hangzhou, Zhejiang, China
[b] Department of Rehabilitation Medicine, Second Affiliated Hospital, Zhejiang University, Hangzhou, Zhejiang, China

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ABSTRACT

Background: Facial paralysis is a common clinical entity that is characterized by movement dysfunction of the facial expression muscles without age restrictions. Currently, many strategies are used to treat facial paralysis in clinical practice, such as glucocorticoids, surgery, and biofeedback therapy; however, the therapeutic effect of these therapies is not ideal. Among all types of facial paralysis, traumatic facial paralysis is difficult to treat. Finding an effective treatment is necessary.

Patient presentation: The patient is a 2-year-old girl who was struck in the head by a car. She was noted to have right peripheral facial paralysis 12 h after the injury. A therapy combining electroacupuncture and hyperbaric oxygen was used to treat her. The patient was cured after 8 weeks of treatment (House-Brackmann Grade I).

Conclusion: By reporting this successful case, this combined treatment for child traumatic facial paralysis is recommended. However, further research is necessary to determine whether this treatment has such a positive effect on all cases.

1. Introduction

The facial nerve is one of the cranial nerves that is easily injured by trauma. Studies have reported that the incidence of craniocerebral trauma complicated by facial nerve injury is approximately 3% [1]. The causes of facial nerve injuries include fractures of the cranial fossa, which could result in fractures at the petrous or mastoid parts of the temporal bone [2]. Thus, injuries caused by external forces or contusions always lead to early-onset or delayed facial paralysis. For early-onset facial paralysis, patients have facial muscle paralysis immediately after the injury, and the paralysis is always manifested by the loss of facial expression with the mouth askew on the injured side. In delayed facial paralysis, facial muscle paralysis often appears 5–7 days after the injury [3]. Currently, there are no standard treatments for traumatic facial paralysis, and the efficacy of existing treatments is not stable and clear. Xu et al.(2017) [4] studied subtotal facial nerve decompression surgery in patients (all age groups) with temporal bone trauma, and the number of patients who achieved good recovery of House-Brackmann grade I was only 22 of 80 (27.5%). Nevertheless, there are few studies on traumatic facial paralysis in children. Reddy et al.(2015) [5] suggested that penetrating injuries to the facial nerve are relatively rare in children and have a poor prognosis unless surgical repair is completed. It is worth noting, however, that instituting early decompression of facial nerve is superior to decompression in advanced stages after traumatic facial paralysis [6].

2. Patient presentation

Since the patient was only 2 years old, according to Chinese law, her parents signed an informed consent form on her behalf. The patient had been anonymized.

The patient is a 2-year-old girl who was struck in the head by a car. She bled on the right side of the head, nose, and right ear. She had clear consciousness when sent to the hospital and immediately underwent an evaluation of her skull. Computed tomography (CT) images showed multiple fractures of the temporal bones, occipital bone, and right frontal bone. In addition, there was a hematoma accompanied by gas deposition on the right side of the forehead scalp (Fig. 1). Magnetic resonance imaging (MRI) of the head showed small hematoma in the left occipital subdura and the frontal scalp, and hematocele on the mastoid parts of the temporal bone bilaterally (Fig. 2). Routine treatments were immediately initiated to stop the bleeding, reduce the intracranial

* Corresponding author.
E-mail addresses: 2011032035@hmc.edu.cn (L. Wang), 2319015@zju.edu.cn (H. Shi).

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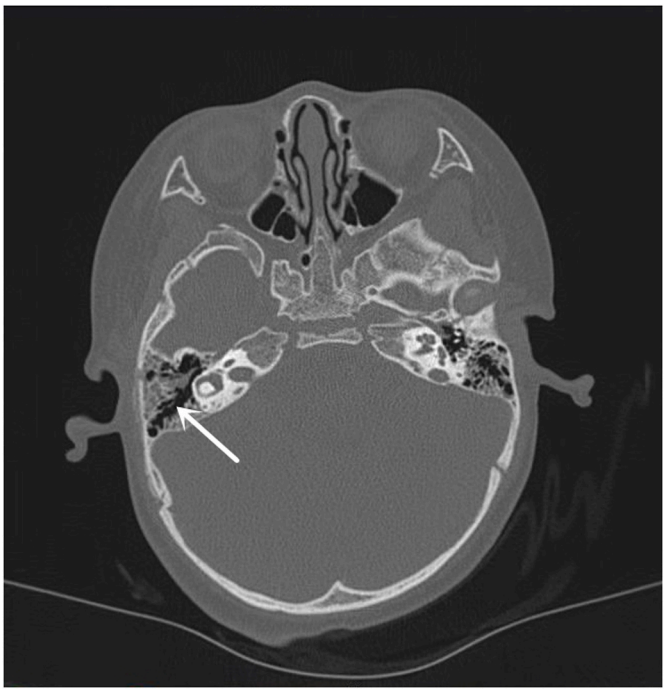

Fig. 1. Computed tomography image of the patient after the injury. The arrow refers to the focus.

Fig. 2. Magnetic resonance imaging of the patient after the injury. The arrow refers to the focus.

pressure, and prevent infection. Thereafter, the vital signs were stable. It was noted that the patient had right facial paralysis 12 h after the injuries, which was characterized as follows: disappearance of the forehead lines on the right side of the forehead; a lateral squint of the right eye; the mouth was askew to the left; the nasolabial fold was shallow on the right side; discordant pupil size (the right pupil was 3–4 mm with slow light reflection, and the left pupil was 2 mm with normal light reflection); and slightly worse limb fine movements on the right side. The limb muscle strength and muscle tension were normal, and Babinski's sign was negative (Fig. 3). A later electromyography showed that the conduction latency period for the right facial nerve (orbicularis oculi muscle and orbicular muscle of the mouth) was longer than that for the left facial nerve (2.78 ms vs 1.85 ms, 2.51 ms vs 1.98 ms). The amplitude of evoked potentials of motor conduction for the right facial nerve (orbicularis oculi muscle, frontal muscle, orbicular muscle of the mouth, nasal muscle, and lip muscle) was lower than that for the left side (0.224 mV vs 1.47 mV, 0.113 mV vs 0.364 mV, 0.72 mV vs 1.74 mV, 0.137 mV vs 0.51 mV, 0.134 mV vs 0.978 mV). Evaluation based on the House-Brakmann score system was grade V. Combined with history, imaging findings, and facial signs, it is believed that the patient's facial paralysis was peripheral facial paralysis caused by right temporal bone fracture.

Five days after admission, the patient began facial nerve rehabilitation treatment with electroacupuncture and hyperbaric oxygen. The two treatments were carried out on the same day. By connecting to the 1-Hz continuous wave pulse needle, the strength of the electroacupuncture was adjusted to tolerable ranges for the patient, and then the four groups of acupuncture points (BL2/GB14, EX-HN4/EX-HN5, ST4/ST7, and GB12/ST6) were stimulated once for 30 min daily. In addition, ST2/ST3 as well as LI4/SJ5 bilaterally were stimulated with normal acupuncture. All treatments were rendered for 5 days each week (except weekends) with continuous treatment for 8 weeks. Along with electroacupuncture therapy, the patient was treated with hyperbaric oxygen therapy under the following conditions: single hyperbaric oxygen chamber (NG90-III B, Ningbo hyperbaric oxygen chamber factory, China); cabin pressure = 1.5 ATA; oxygen concentration = 75%; 70 min per treatment (15 min of pressurization, 40 min of steady pressure, and 15 min of decompression). The treatment was administered 5 days each week (except weekends) with continuous treatment for 8 weeks. At the beginning of the treatment, methylprednisolone was also used for 3 weeks. The initial dose of methylprednisolone was 13 mg intravenously twice a day and then gradually decreased and changed to oral administration. At the end of glucocorticoid treatment, the paralysis symptoms did not improve significantly. In the course of treatment, a 0.25-mg mecobalamin tablet was taken orally twice a day. One month after the end of the course of combination treatment, the facial symptoms were significantly improved, and both feelings and movements basically returned to normal (Fig. 4). Evaluation based on the House-Brakmann score system

Fig. 3. Patient with facial paralysis after the injury.

Fig. 4. Patient with facial paralysis recovered after the treatment.

was grade I, and reexamination by electromyography showed that the evoked potential amplitude of conduction on the right side of the facial nerve was higher than that before treatment (orbicularis oculi muscle 0.491 mV vs 0.224 mV, frontal muscle 0.287 mV vs 0.113 mV, orbicular muscle of the mouth 0.804 mV vs 0.72 mV), which was consistent with a cure of facial paralysis. The patient was followed up approximately every 4–6 months, and at the most recent follow-up (June 2020), the patient's facial palsy had not recurred, maintaining a good outcome. The House-Brakmann score was grade I (Fig. 5).

3. Discussion

Cranial nerves cross in and out of the cranial cavity through bone foramina or cracks in the skull base; thus, fractures of the skull base usually cause cranial nerve injury [7]. Among all the cranial nerves, the facial nerve is the most likely to be paralyzed. The lesions are often located in the facial nerve tube of the petrous part of the temporal bone; 50% of vertical fractures and 25% of transverse fractures are associated with facial nerve injuries, especially vertical fractures parallel to the long axis of the petrous part [8]. Studies have shown that the mechanism of facial paralysis caused by temporal bone fractures is direct injury with secondary facial nerve edema [9]. As the facial nerve tube is volume-fixed, swelling of the facial nerve cannot accommodate the space, thus resulting in wall compression and increased facial nerve ischemic injuries [9]. Thus, facial nerve contusion swelling and facial nerve tube compression are the main causes of facial paralysis after a fracture. Therefore, reducing edema and promoting nerve repair are effective ways to treat traumatic facial nerve injuries.

In China, acupuncture treatment has a long history. To test whether acupuncture improves the prognosis of patients with facial paralysis, Cumberworth et al.(2012) [10] conducted an evidence-based study and screened out three standard research papers, including two systematic reviews and one randomized controlled trial. Through evidence-based medical analysis of acupuncture, they proposed that acupuncture might be an effective treatment for facial paralysis. Currently, electroacupuncture is widely used. Compared to ordinary acupuncture, electroacupuncture can stimulate contracted facial muscles to relax passively, improve muscle tissue excitability, and promote nerve repair via local blood circulation [11].

The mechanisms by which hyperbaric oxygen treats facial nerve injuries are as follows. First, hyperbaric oxygen therapy can improve the oxygen gradient around the hypoxic tissue to promote vasoconstriction and reduce facial nerve swelling as well as facial nerve tube pressure. Second, hyperbaric oxygen therapy can rapidly increase the blood oxygen partial pressure, increase the blood vessel oxygen diffusion distance, and promote the damaged facial nerve metabolism environment so that intracellular and extracorporeal edema can be improved. Third, hyperbaric oxygen therapy can provide an adequate oxygen supply for damaged tissues to promote regeneration and repair. Fourth, after facial nerve injury, effectors, such as muscle, atrophy because of the loss of neurotrophism, and hyperbaric oxygen can promote the recovery of connections and communications between nerves and effectors [12–15]. Toros et al. (2013) [16] studied facial nerve injuries in a murine model and reported that the combination of hyperbaric oxygen and glucocorticoids, such as prednisone, could reduce nerve axonal degeneration and vascular obstruction, thus increasing the diameter of the axons. Only one double-blind randomized controlled trial comparing hyperbaric oxygen therapy with prednisolone was found: Racic et al. (1997) [17] compared 79 cases of facial paralysis that had received hyperbaric oxygen and glucocorticoid therapy and found that 9 months after the treatment, the facial paralysis recovery rates were 95.2% and 75.7% in the hyperbaric oxygen and prednisone groups, respectively. The average recovery times were 22 and 34.4 days, respectively. Thus, these researchers suggested that hyperbaric oxygen therapy is superior to glucocorticoids for facial paralysis treatment.

Facial paralysis rarely occurs in children, and most children develop facial paralysis following trauma. As the sequelae of facial paralysis involve the face, social life is affected and serious physical and psychological injuries occur. Fortunately, the younger the patients are, the higher the probability of neurological rehabilitation after treatment is [18].

In the current study, the patient received electroacupuncture therapy combined with hyperbaric oxygen during the early stage of the injury and achieved satisfactory results after 8 weeks of treatment. This combination therapy can avoid the side effects of traditional glucocorticoids therapy, especially suitable for children. Thus, for children with traumatic facial paralysis, electroacupuncture combined with hyperbaric

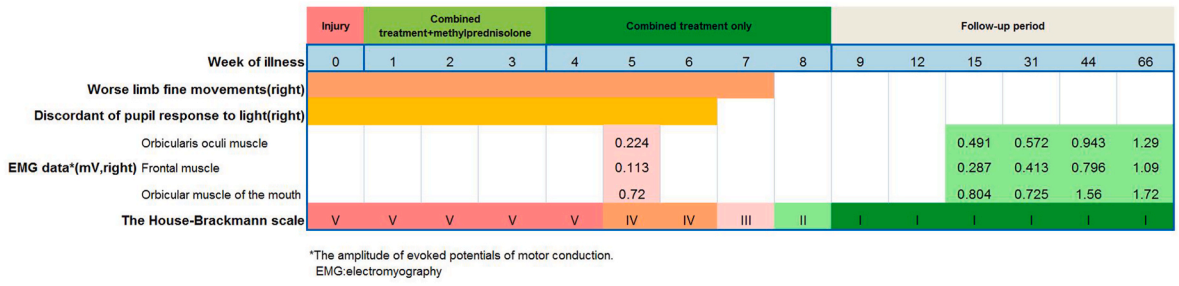

Fig. 5. The symptom changes when the treatment progressed.

oxygen therapy is an effective therapy during the early stage of injury, and the effectiveness of the therapy warrants further study.

Glucocorticoid has a significant effect of anti-inflammation and reducing edema, which can correct the state of facial nerve edema and alleviate the disease. However, glucocorticoid itself does not directly repair the nerve, so in this case, the early use of methylprednisolone did not bring a very significant effect. Long-term use of corticosteroids will bring obvious side effects. Therefore, after the control of the early disease, acupuncture, hyperbaric oxygen and other treatment measures are taken to promote the recovery of neurological function.

The limitations of this case report are that the incidence of traumatic facial paralysis in children is low, and the relevant research data are also limited. The treatment experience of a single case is not sufficiently generalizable. More cases and further studies are needed to support the treatment reported in this case.

4. Conclusion

Electroacupuncture combined with hyperbaric oxygen therapy showed excellent efficacy in this 2-year-old patient with traumatic facial palsy. In clinical practice, the use of glucocorticoids in pediatric patients often raises parental concerns, this combination therapy avoids the side effects of glucocorticoids and is particularly suitable for children. This combination therapy deserves further study.

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Authors' roles

Wang Li: Investigation, Data curation, Writing - original draft.
Shi Hui: Resources, Supervision, Writing - review and editing.

Declaration of competing interest

We have no conflicts of interest to disclose.

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