

One Craniotomy at the Highest Altitude in the World and Follow-up Study

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To the Editor: Here we report a craniotomy under general anesthesia successfully performed at a 4350-m altitude and the patient's follow-up results. To the best of our knowledge, this is one craniotomy carried out at the highest altitude in the world to date.

A 21-year-old man occurred spontaneous light headache in the Ali area at a 4350-m altitude in the Tibet autonomous region of China on October 23, 2011, and his headache became severe gradually. Three days later, the patient was in a coma with 5 scores (E1V1M3) on the Glasgow Coma Scale (GCS); his left pupil diameter was 5.0 mm and right pupil diameter was 3.0 mm, both direct and indirect light reflex of the bilateral pupils disappeared. Craniocerebral computed tomography (CT) scan indicated a large acute subdural hematoma located in the left fronto-temporo-parietal region, widespread subarachnoid hemorrhage and brain herniation [Figure 1a-c]. Emergency treatment was given for the patient in time, including continuous mask oxygen inhalation, strong dehydration (20% mannitol 250 ml + furosemide 10 mg + dexamethasone 5 mg, fast intravenous drip, once per 5 h), and medical hemostasis.

After the professional medical team reached by helicopter and quick preoperative preparation, a left fronto-temporo-parietal decompressive craniectomy^[1] involving evacuation of the subdural hematoma and lavage of the subarachnoid hemorrhage was performed emergently under tracheal intubation and general anesthesia on October 27, 2011. Intraoperatively, it was seen that two of bridging veins located respectively on the parietal and temporal brain surface were actively bleeding, and absolute hemostasis of both was achieved by cautery. Moreover, we discovered that the staxis of the surgical region was extensive and achieving hemostasis was very difficult, which may be associated with the increased capillary fragility and permeability^[2] and the abnormality of blood clotting function^[3] due to the patient living on the plateau. Therefore, careful surgical hemostasis, a large dose of hemostatic agent (2 units of haemocoagulase by intravenous

injection and 2 units by intramuscular injection, respectively; a hemostatic mixture (normal saline 250 ml + etamsylate 3.0 g + carbamazepine 0.3 g + vitamin C 3.0 g), intravenous drip) and proper blood transfusion (whole blood volume 400 ml) were adopted, all these measures ensured the successful completion of the operation.

Postoperatively, a comprehensive treatment was given, including medical hemostasis, dehydration, anti-infection, corticosteroid, anti-stress ulcer, sedation and nutritional support. At 6 h after operation, the patient began to recover partial consciousness and his GCS increased to 13 scores (E3V4M6). However, the patient's condition became serious again on postoperative day 2, and his consciousness fell into confusion with 9 scores of GCS (E2V2M5), although craniocerebral CT re-examination disclosed that the intracranial condition improved obviously [Figure 1d-f].

In view of the adverse influence for the patient's recovery in the hypobaric hypoxia environment, including high altitude cerebral edema, high altitude pulmonary edema and hemorrhagic tendency,^[4] the patient was successfully evacuated to another better hospital at a 1300-m altitude via helicopter for further therapy on postoperative day 5. Through continual conservative therapy, the patient recovered consciousness again 4 days after the evacuation, and his condition improved gradually. Two weeks after the operation the patient could speak clearly and eat smoothly. One and a half months after the operation, the patient could walk slowly, and CT re-examination showed that the intracranial condition improved further [Figure 1g-i]. Although at the same period the patient appeared several times of tonic-clonic seizure, which was well-controlled by proper oral administration of antiepileptic drugs (sodium valproate sustained release tablets, 0.5 g, b.i.d. and phenobarbital tablets, 60 mg, t.i.d.). At 9 months after craniotomy, a cranioplasty was performed uneventfully for the patient [Figure 1j-l]. Now the patient has recovered well and can do certain physical work with 5 scores on the Glasgow Outcome Scale.

In conclusion, the condition of one patient suffering acute intracranial hemorrhage complicating brain herniation under extremely high altitude circumstance is very danger, and whose

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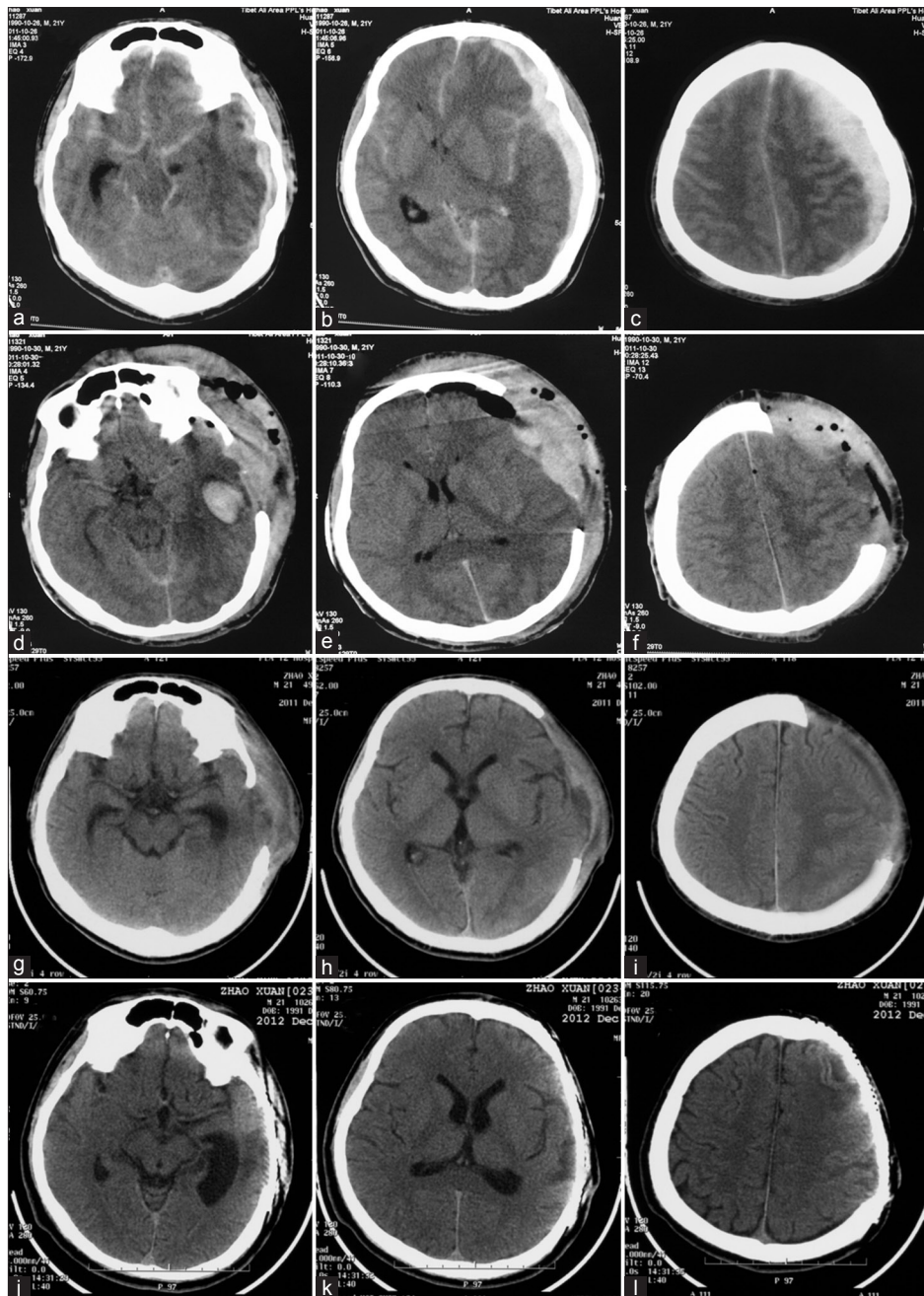


Figure 1: Craniocerebral computed tomography (CT) of the patient. (a-c) Preoperative CT scan indicated a large acute subdural hematoma in the left fronto-temporo-parietal region, widespread subarachnoid hemorrhage and brain herniation; (d-f) CT scan on postoperative day 2 disclosed that the subdural hematoma and subarachnoid hemorrhage almost disappeared, although a small intracerebral hematoma occurred in the left temporal lobe; (g-i) CT scan at postoperative one and a half months showed that the small intracerebral hematoma in the left temporal lobe had been absorbed; (j-l) CT scan at 5 months after cranioplasty indicated the cranial appearance was good.

disease progresses rapidly. The active emergency treatment, timely operation, and opportune evacuation are the optimal choice for the patient.

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