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Case Report

Three-dimensional computed tomography reconstruction-guided stereotactic aspiration of pontine hemorrhage: a case report

Chao Du[1], Sibo Wang[2], Zifeng Zhu[3], Yu Tian[1], Miao Li[1]

[1]*Department of Neurosurgery, China-Japan Union Hospital of Jilin University, Changchun, China; Departments of* [2]*Neurology,* [3]*Interventional Therapy, The First Hospital of Jilin University, Changchun, China*

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Abstract: A 40-year-old male experienced several episodes of vomiting with progressing paralysis. A CT scan showed the presence of a 9.8 ml pontine hematoma (PH). The patient became comatose approximately 2 hours after onset. Pending three days of conservative treatment to manage hemostasis and pre-existing high blood pressure, the patient underwent 3D CT reconstruction-guided stereotactic aspiration of 6.8 ml of dark clotted blood. The patient regained consciousness approximately 3 weeks later and a follow-up CT scan showed that the remains of the hemorrhage (approximately 3.0 ml) were completely absorbed. After hyperbaric oxygen treatment and rehabilitation therapy, the patient recovered from the episode albeit with limited speech and the ability to walk with the use of rehabilitation equipment. The use of 3D CT reconstruction imaging is extremely helpful in pinpointing the exact location as well as accurately calculating the volume of a brainstem hemorrhage. These data are critical for neurosurgeons in deciding whether a patient is a good candidate for evacuation of the hemorrhage via stereotactic aspiration. To the best of our knowledge, this is the first report in the English-language literature of a three-dimensional CT reconstruction-guided stereotactic aspiration of PH.

Keywords: 3D CT, stereotactic, aspiration, pontine hemorrhage, hematoma, brain

Introduction

Computed tomography (CT)-guided stereotactic aspiration has been used in treatment of brain hematomas since 1987 [1]. More recently, CT-guided stereotactic aspiration has been utilized for the treatment of brainstem lesions [2-4] and PHs [5, 6]. In cases where certain regions of the brain are more difficult to access (eg, targeting the foramen ovale in trigeminal neuralgia), standard stereotaxis has been successfully combined with three dimensional (3D) CT reconstruction [7]. Here, we report a case of a 40-year-old male who presented to our hospital Emergency Room with sudden unconsciousness approximately two hours after experiencing an emotional event.

Case report

A 40-year-old male experienced several episodes of vomiting with progressing paralysis. An emergency CT scan was performed and showed a pontine hematoma which involved a high density shadow in brainstem (pons) areas and no midline shift (**Figure 1**). After the onset, the patient vomited a number of times, but there was no observation of seizures or episodes of incontinence. He was unable, however, to move his limbs. Medical history was significant for untreated hypertension of 3 years' duration with blood pressure as high as 190/110 mmHg. Upon hospital admission, physical examination revealed a body temperature of 39°C, respiration rate of 24 breaths/minute, blood pressure 220/140 mmHg, and pulse rate of 110 beats/minute. The patient was moderately comatose with closed eyes and inability to speak; however, he did respond to pain by flexion and his Glasgow Coma Scale (GCS) score was 6. Pupils were bilaterally pinpoint (diameter of 2.0 mm), medially fixed, and unresponsive to light. There were no autonomous activities of the limbs and the Babinski's reflex was bilaterally positive. The patient

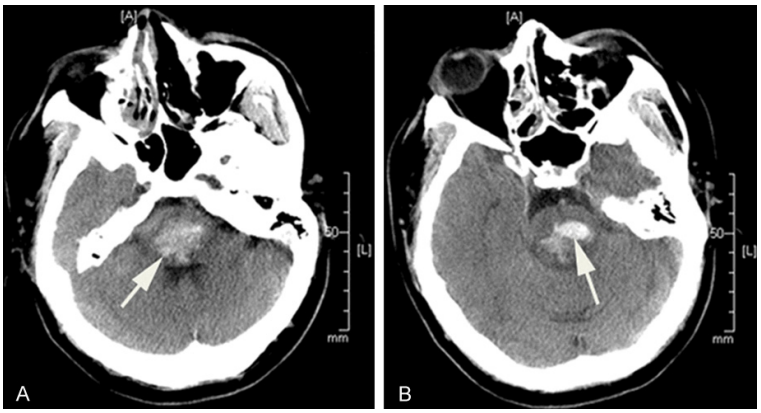

Figure 1. CT images of the pontine hemorrhage before operation. A, B: CT scans showing the pontine hemorrhage (white arrows).

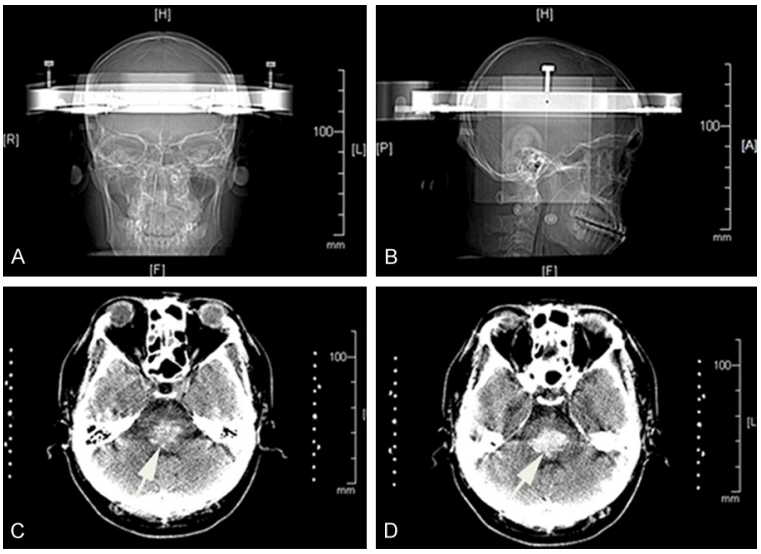

Figure 2. CT images for stereotactic operation. A: Coronal image; B: Sagittal image; C, D: Axial images showing the pontine hemorrhage (white arrows).

underwent an emergency tracheotomy under local anesthesia on the day of admission. After hemostasis, blood pressure management, and conservative treatment for three days, a CT scan showed no increase in the volume of the hematoma.

Four days post admission, the patient underwent stereotactic hematoma aspiration surgery at the request of his family via a Komai CT-guided stereotactic apparatus. Before the operation, the patient's head was fixed in a stereotactic head frame. The CT thin-slice (0.625 mm) scans and 3D CT reconstruction images measured the hematoma volume at 9.8 ml (**Figures 2**-**4**). The patient was placed in a supine position. An intracranial point was determined by measuring 4 cm from the midline in the direction of the left occipital nodes. A single burr hole was drilled in the skull to allow access to the hematoma with a 2 mm puncture needle. The needle was slowly guided through the tentorium to the target site. The neurosurgeon used a syringe along the long axis of the hematoma to slowly aspirate 6.8 ml of dark red non-clotting blood. The following day, a CT scan of the head showed a substantially reduced hematoma volume (**Figure 5**).

One week after surgery, the patient's condition was notably improved. His body temperature ranged between 37°C to 38°C and he could open his eyes. His bilateral pupils were round with diameter of 2.0 mm and sensitive to light. Hyperhidrosis had resolved and his limbs were without autonomous activities and bilateral Babinski's pathology was negative. The CT thin-slice (0.625 mm) scans and 3D CT reconstruction images showed a decreased hematoma volume (3.0 ml) one week post-operation (**Figures 6**-**8**). Two weeks after surgery, the patient could open his eyes and respond physically to verbal commands. His limb muscle strength was grade 2. Three weeks after the procedure, the patient regained consciousness and a follow-up CT scan one week later (one month after the operation) showed that the hematoma was completely absorbed. Hyperbaric oxygen treatment was provided for 8 months and the patient underwent rehabilitation for 24 months. By the 3-year follow-up visit, the patient was conscious, had regained the ability to speak a few words, and could walk with the aid of equipment in the rehabilitation clinic. He experienced diplopia and his Glasgow Outcome Score (GOS) was 3.

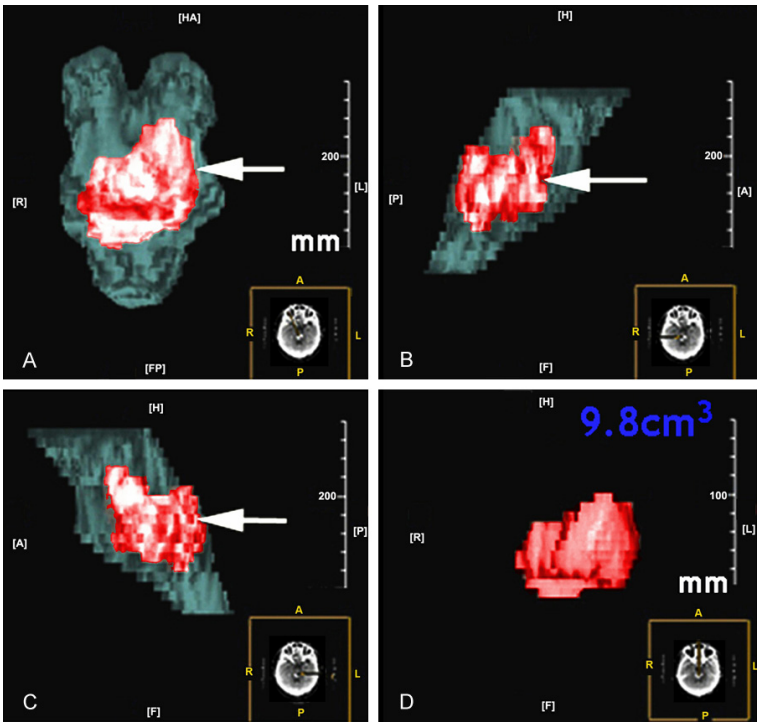

Figure 3. 3D CT reconstruction images of pontine hemorrhage before stereotactic operation. The volume of the hemorrhage was 9.8 cm^3. A-C: 3D CT reconstruction images of the brainstem and hemorrhage; D: 3D CT reconstruction image of the hemorrhage.

Discussion

There are many reports about brainstem hemorrhages [5, 6, 8-22], including pontine hemorrhages [5, 6, 8-16].

The pons is a critical part of the brain that serves as the communication and coordination center between the two hemispheres of the brain as well as aiding in the transfer of nervous system messages between various parts of the brain and the spinal cord. Since several cranial nerves originate in the pons, PHs can result in transient or permanent disabilities including issues related to sleep, respiration, swallowing, bladder control, hearing, equilibrium, taste, eye movement, facial expressions, facial sensation, and posture. Although the incidence of spontaneous PH is rare (approximately 5-10% of all intracranial hemorrhages), the diagnosis is highly lethal with an overall mortality rate of nearly 50% [8, 9]. Uncontrolled hypertension is the primary predisposing factor [10]. Additional contributing factors that portend a poor prognosis include level of consciousness upon hospital admission, extensive intraventricular spread, and the presence of acute hydrocephalus [8].

For those patients who manage to survive this kind of cerebral trauma, outcomes range from complete recovery to being left with substantial lifelong neurologic impairments and physical disabilities. Case reports in patients with pontine insults have shown complete recovery in a toddler with acute myeloid leukemia and central pontine myelinolysis who presented with dysphagia, quadriparesis, and respiratory insufficiency requiring mechanical ventilation [23] to patients with inferior olivary hypertrophy resulting in rhythmic hyperkinesias including ocular myoclonus, symptomatic palatal tremor, and synchronous jerks of limb muscles [24]. Because the pons is Gait dysfunction is one of the most disabling sequelae of PH with persistent abnormalities reported in more than 20% of patients [25]. The location of the hematoma has also been found to correlate with functional outcome (using the GOS). Patients with unilateral tegmental hematomas generally reported better outcomes compared to patients with basal or massive hematomas in which the prognosis was typically poor [26].

In the past, a diagnosis of PH was generally assumed to be fatal. However, the advent and widespread use of CT allows even small hemorrhages to be identified, thereby resulting in reduced mortality rates [27]. Treatment options include emergent stabilization including protecting the airway and managing hypertension and coagulopathies. Surgical evacuation via standard open surgical approach (craniotomy) and more recently, minimally invasive surgical techniques including craniopuncture for clot aspiration with stereotactic guidance with or without fibrinolytic agents. Advances in the fields of stereotactic surgery and microsurgery have resulted in improved outcomes in patients with PH [27]. A CT-guided stereotactic approach has been used safely and effectively to treat

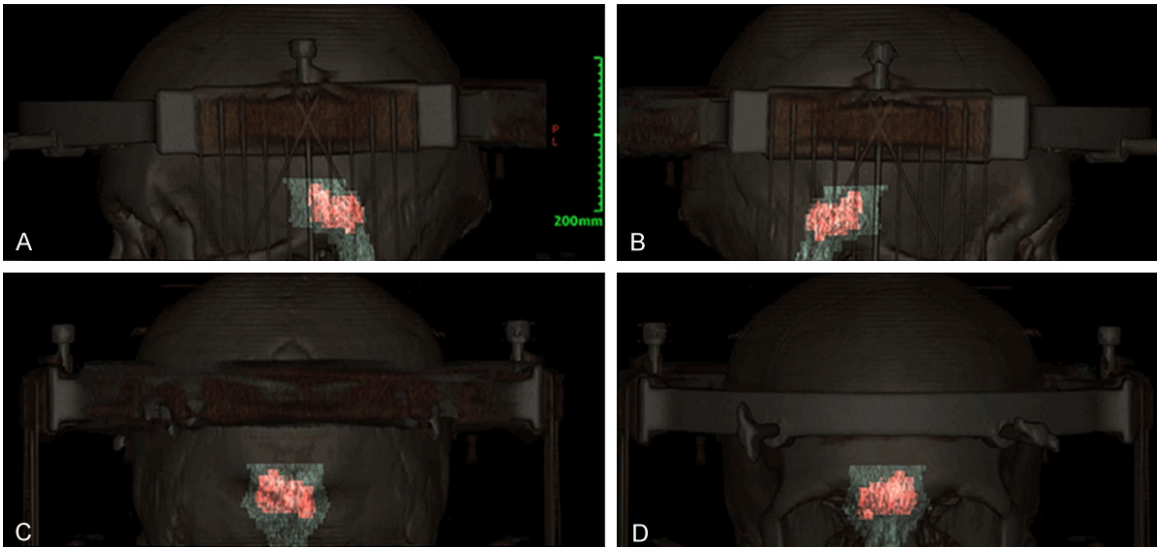

Figure 4. 3D CT reconstruction images on transparent background processing of skull, pons (blue area), and hemorrhage (red area) before stereotactic operation. A: View from the left side of head; B: View from the right side of head; C: View from the back of head; D: View from the front of head.

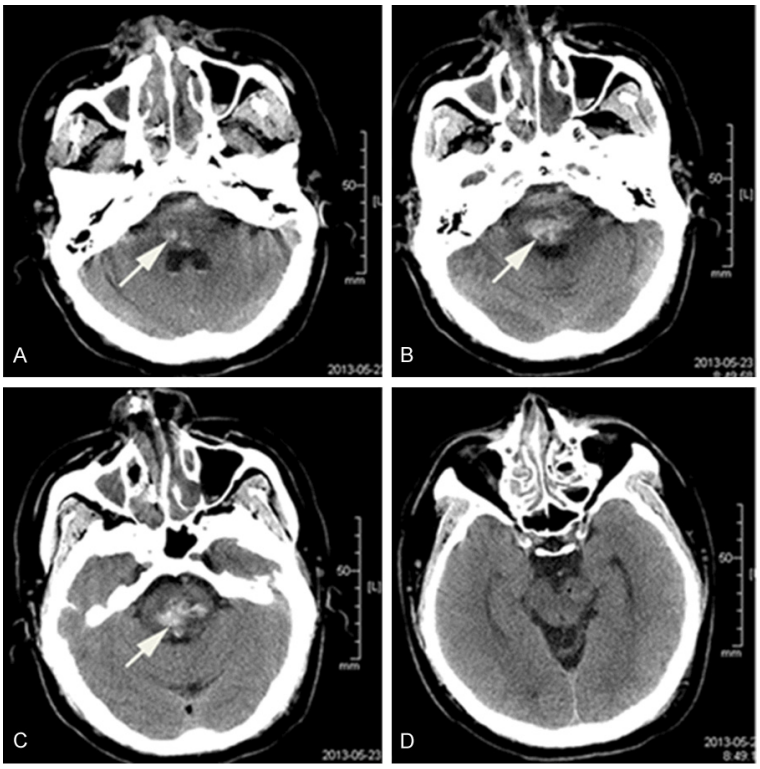

Figure 5. CT images of pontine hemorrhage one day after stereotactic operation. A-D: CT scans showing the pontine hemorrhage (white arrows).

patients with intracerebral hemorrhages [11] and PHs [5], as well as in patients with cerebral targets that are difficult to access, ie, foramen ovale [7]. While controlled studies are still needed, an international group of neurologists and neurosurgeons with the goal of studying functional recovery and developing new medical and surgical treatments to facilitate improved clinical outcomes in patients with spontaneous intracerebral hemorrhages hypothesize that "minimally invasive techniques, including clot aspiration with stereotactic guidance, may give better results with improved clinical outcomes compared with standard open surgical approaches" [11]. Combining the stereotactic approach with a 3D CT reconstruction model is likely to be of substantial benefit to help neurosurgeons more accurately visualize the exact location and volume of the hematoma.

Surgical therapy is not yet standard in patients with PH and the efficacy of surgical intervention is debatable. However, several studies and case reports have shown positive outcomes [9]. Until there are larger controlled comparative clinical trials, the decision to utilize surgical evacuation of PHs should be guided by individual patient charac-

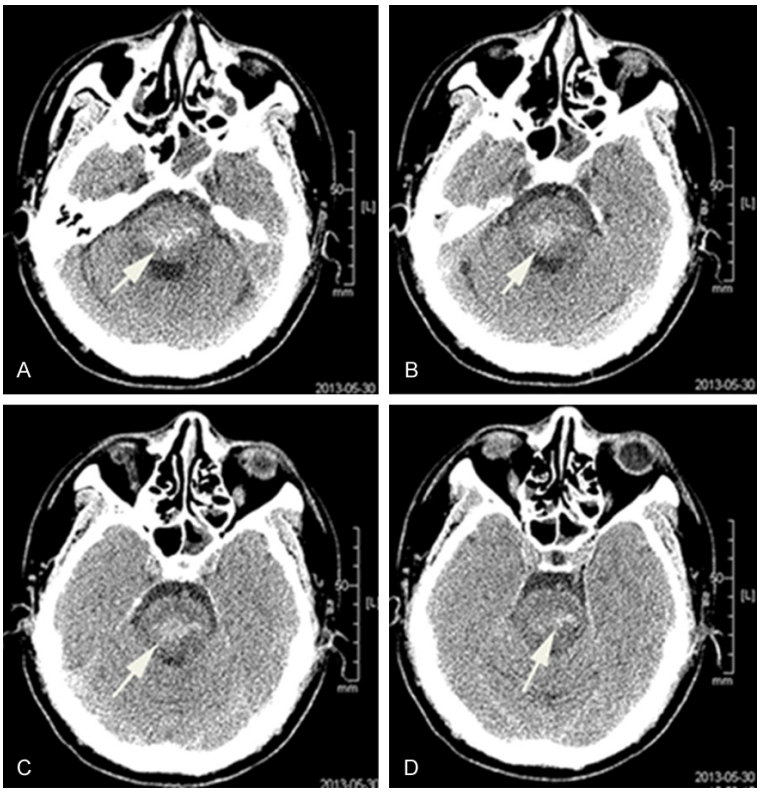

Figure 6. CT images of pontine hemorrhage one week after stereotactic operation. A-D: CT scans showing the pontine hemorrhage (white arrows).

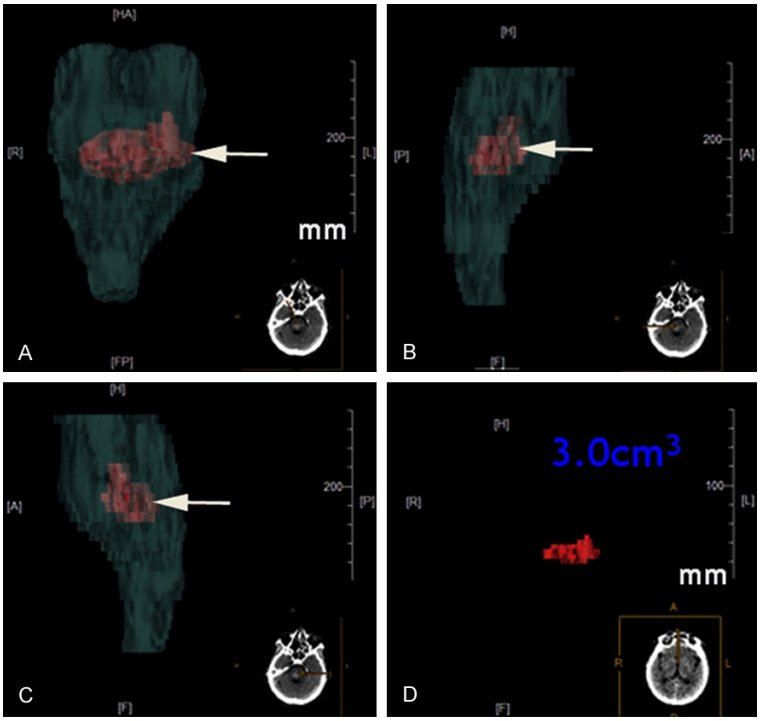

Figure 7. 3D CT reconstruction images of pontine hemorrhage one week after stereotactic operation. The volume of the hemorrhage was decreased to 3.0 cm^3. A-C: 3D CT reconstruction images of brainstem and hemorrhage (white arrows); D: 3D CT reconstruction image of the hemorrhage.

teristics at presentation and proximity to specialized centers with neurosurgeons who are highly skilled in suboccipital craniotomy or craniectomy and/or CT-guided stereotactic aspiration [27].

Conclusions

The use of 3D CT reconstruction imaging is extremely helpful in pinpointing the exact location as well as accurately calculating the volume of a brainstem hemorrhage. These data are critical for neurosurgeons in deciding whether a patient is a good candidate for evacuation of the hemorrhage via stereotactic aspiration. As concluded by Shitamichi and colleagues [5], this patient with a PH volume of 9.8 ml at presentation experienced a good outcome following the 3D CT reconstruction stereotactic aspiration procedure as noted by his regained ability to speak, although minimally, and walk with assistance.

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Disclosure of conflict of interest

None.

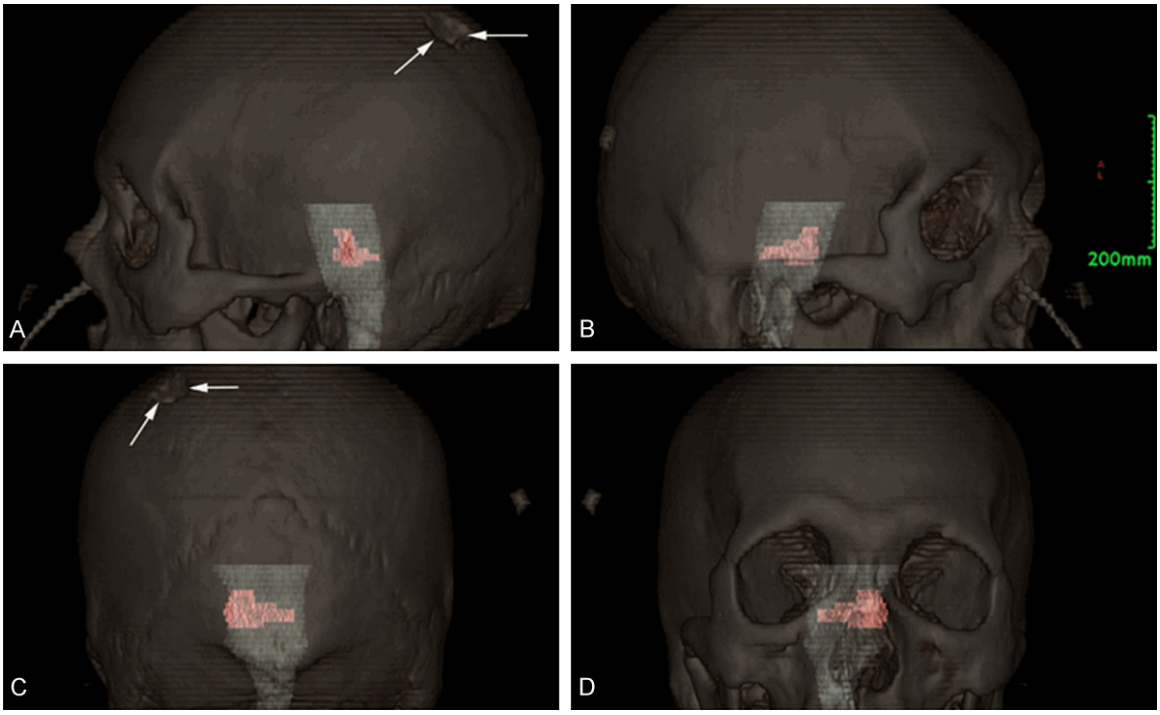

Figure 8. 3D CT reconstruction images on transparent background processing of skull, pons (blue area) and hemorrhage (red area) after stereotactic operation. A: View from the left side of head; B: View from the right side of head; C: View from the back of head; D: View from the front of head. A, C: White arrows indicate the area of the burr hole drilled in the skull.

Address correspondence to: Dr. Miao Li, Department of Neurosurgery, China-Japan Union Hospital of Jilin University, 126 Xiantai Street, Changchun 130033, China. E-mail: limiao@jlu.edu.cn

References

[1] Niizuma H and Suzuki J. Computed tomography-guided stereotactic aspiration of posterior fossa hematomas: a supine lateral retromastoid approach. Neurosurgery 1987; 21: 422-427.

[2] Zhao XL, Du C, Tian Y. Results of repeat gamma knife treatment: stereotactic aspiration surgery can improve the effect of gamma knife treatment for cystic small brainstem glioma: case report. Neurosurgery Quarterly 2012; 22: 22-25.

[3] Du C, Li Z, Wang Z, Wang L and Tian YU. Stereotactic aspiration combined with gamma knife radiosurgery for the treatment of cystic brainstem metastasis originating from lung adenosquamous carcinoma: a case report. Oncol Lett 2015; 9: 1607-1613.

[4] Pell MF, Thomas DG and Krateminos GP. Stereotactic management of intrinsic brain stem lesions. Ann Acad Med Singapore 1993; 22: 447-451.

[5] Shitamichi M, Nakamura J, Sasaki T, Suematsu K and Tokuda S. Computed tomography guided stereotactic aspiration of pontine hemorrhages. Stereotact Funct Neurosurg 1990; 54-55: 453-456.

[6] Song W, Wu YM, Ji Z, Zhu JJ and Pan SY. Guillain-Barre syndrome following sepsis after stereotactic aspiration for spontaneous pontine hemorrhage. Neurol Sci 2012; 33: 657-660.

[7] Guo Z, Wu B, Du C, Cheng M and Tian Y. Stereotactic approach combined with 3D CT reconstruction for difficult-to-access foramen ovale on radiofrequency thermocoagulation of the gasserian ganglion for trigeminal neuralgia. Pain Med 2016; 17: 1704-1716.

[8] Wessels T, Moller-Hartmann W, Noth J and Klotzsch C. CT findings and clinical features as markers for patient outcome in primary pontine hemorrhage. AJNR Am J Neuroradiol 2004; 25: 257-260.

[9] Tao C, Li H, Wang J and You C. Predictors of surgical results in patients with primary pontine hemorrhage. Turk Neurosurg 2016; 26: 77-83.

[10] Dastur CK and Yu W. Current management of spontaneous intracerebral haemorrhage. Stroke Vasc Neurol 2017; 2: 21-29.

[11] Ziai W, Carhuapoma JR, Nyquist P and Hanley DF. Surgical strategies for spontaneous intracerebral hemorrhage. Semin Neurol 2016; 36: 531-541.
[12] Chung SH, Jeong SW and Kim LS. A case of auditory neuropathy caused by pontine hemorrhage in an adult. J Audiol Otol 2017; 21: 107-111.
[13] Liu X, Ogata A, Masuoka J, Inoue K, Nakahara Y, Shimokawa S, Takase Y, Yakushiji Y, Hara H and Abe T. Dural arteriovenous fistula manifesting as pontine hemorrhage at the craniocervical junction. Acta Neurochir (Wien) 2017; 159: 831-834.
[14] Nakajima H, Ishiguro T, Terada A and Komiyama M. Dural arteriovenous fistula of the sinus of the lesser sphenoid wing presenting with pontine hemorrhage. World Neurosurg 2017; 98: 871.e17-871.e21.
[15] Samudra N and Figueroa S. Intractable central hyperthermia in the setting of brainstem hemorrhage. Ther Hypothermia Temp Manag 2016; 6: 98-101.
[16] Massi DG, Nyassinde J and Ndiaye MM. Superior Foville syndrome due to pontine hemorrhage: a case report. Pan Afr Med J 2016; 25: 215.
[17] Polster SP, Dougherty MC, Zeineddine HA, Lee SK and Frim D. A report of 2 cases of brainstem hemorrhage after suboccipital craniectomy for chiari decompression. Oper Neurosurg (Hagerstown) 2018; 14: 598.
[18] Aghajan Y, Levy ML, Mo JQ and Crawford JR. Acute brainstem haemorrhage as a presenting feature of high-grade glioma. BMJ Case Rep 2016; 2016:
[19] Hung YM, Weng KP, Lin CC, Huang JS, Chiou YH and Hsieh KS. Brain stem hemorrhage in a 2-year-10-month-old child with renovascular hypertension related to fibromuscular dysplasia. Acta Cardiol Sin 2015; 31: 564-567.
[20] Huang K, Ji Z, Sun L, Gao X, Lin S, Liu T, Xie S, Zhang Q, Xian W, Zhou S, Gu Y, Wu Y, Wang S, Lin Z and Pan S. Development and validation of a grading scale for primary pontine hemorrhage. Stroke 2017; 48: 63-69.
[21] Hou K, Zhao J, Gao X, Zhu X and Li G. Delayed brainstem hemorrhage secondary to mild traumatic head injury: report of case with good recovery. World Neurosurg 2017; 105: 1035.e11-1035.e13.
[22] Chiu ZK, Bennett IE, Chan P and Rosenfeld JV. Methamphetamine-related brainstem haemorrhage. J Clin Neurosci 2016; 32: 137-139.
[23] Yilmaz D, Karapinar B, Balkan C, Ay Y and Kavakli K. Complete clinical recovery of a central pontine and extrapontine myelinolysis delayed onset in a child with acute myeloblastic leukemia. Minerva Pediatr 2011; 63: 61-65.
[24] Yagura H, Miyai I, Hatakenaka M and Yanagihara T. Inferior olivary hypertrophy is associated with a lower functional state after pontine hemorrhage. Cerebrovasc Dis 2007; 24: 369-374.
[25] Jang SH and Chang MC. Recovery of an injured corticoreticulospinal tract in a patient with pontine hemorrhage. Int J Stroke 2016; 11: NP18-19.
[26] Shin SC, Lim DJ, Kim SD, Cho TH, Park JY and Chung YG. Primary pontine hemorrhage. an analysis of 35 cases and research in prognostic factors. 2007.
[27] Jang JH, Song YG and Kim YZ. Predictors of 30-day mortality and 90-day functional recovery after primary pontine hemorrhage. J Korean Med Sci 2011; 26: 100-107.